Entrepreneurship and capital investment: another explanation for the slump in capital investment under deflation*

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Abstract

This study investigates the factors behind the slump in capital investment by listed companies in the deflationary Japanese economy. We estimate the investment function using information on the attributes of top managers as well as corporate financial data. We find that in addition to Tobin's q and cash flow, several manager-attributes significantly affect each listed company's capital investment. These attributes are the president's career and age, whether or not he/she is an owner president, and the ratio of director bonuses to the distribution of profits. Compared to small- and medium-sized companies, listed companies have various financing methods. Thus, even during a financial crisis, the financial restrictions on their capital investment would be relatively moderate. Our results suggest that after the collapse of the bubble economy, in addition to the deterioration of companies' fundamentals, the changes in the stance of top managers in listed companies may have caused a reduction in capital investment in Japan.

Keywords: capital investment, deflation, entrepreneurship
JEL Classification: G31, G32

I. Introduction

After the collapse of the bubble economy, the Japanese economy experienced "the lost two decades" from the 1990s to the first half of the 2000s. During the lost two decades, the slump in companies' capital investment was one of the most serious macro-economic symptoms. In the decade that began from fiscal year 1991, the average annual increase rate in private capital investment fell to -1.11% in nominal terms and 0.25% in real terms. In the 10 years from fiscal year 2001, it slumped to -1.31% in nominal terms and 0.16% in actual

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terms. These unfavorable results are in marked contrast to those in the decade from fiscal year 1981, when private capital investment rose by an average annual amount of 8.98% in nominal terms and 8.21% in real terms.

In small- and medium-sized companies, the changes in financial institutions' lending attitudes brought about the slump in capital investment from the second half of the 1990s to the first half of the 2000s. However, compared to such companies, listed companies have various financing methods; even during a financial crisis, the financial restrictions on their capital investment should be relatively moderate. Therefore, it is difficult to explain the slump in listed companies' capital investment from the 1990s onwards from the viewpoint of borrowing constraints.

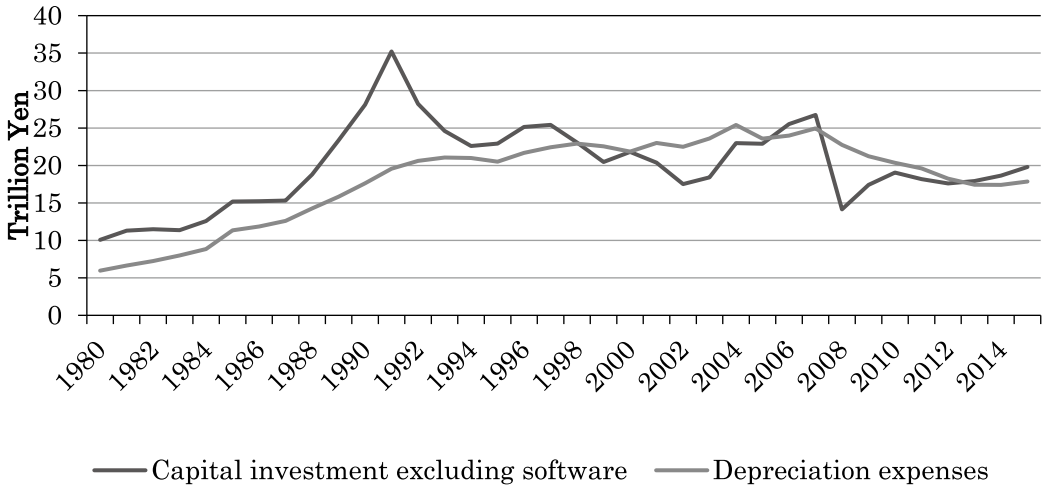
Using the data from the annual Financial Statements Statistics of Corporations by Industry (Ministry of Finance), Figure 1 shows the trends in "capital investment excluding software" and "depreciation expenses" among major companies with capital of 1 billion yen or more. Up to the first half of the 1990s, capital investment trended at a rate of around 1.5 times the depreciation expenses. However, capital investment rarely exceeded depreciation expenses after the second half of the 1990s. In particular, after 1999, capital investment was frequently below depreciation expenses.

The same trend is established even when expanding the scope to companies with little capital. It can be inferred that the slump in capital investment has been a general trend for all companies since the second half of the 1990s. On the other hand, since the mid-1990s, the vintage of capital stocks (the average age of facilities) rose rapidly, mainly in the manufacturing industry, and the elapsed number of years (age), which was 10.2 years in 1994, had jumped to 12.0 years by 2002. This significant rise in the vintage of capital stocks in the manufacturing industry in Japan was in marked contrast with that in other major countries, such as Germany and the United States. The stagnated capital investment led to the aging and obsolescence of facilities.

One of the reasons why companies have become conservative about capital investment since the middle 1990s is the deterioration of the macro fundamentals and the increase in uncertainty. The deterioration of fundamentals caused corporate profit forecasts to decline, and as a result, it reduced companies' motivation to conduct capital investment. The increase in uncertainty made companies more conservative about their activities. In addition, when the financial crisis became serious around 1998, the slump in bank lending caused cash flow conditions to worsen, particularly for small- and medium-sized companies, which had negative impacts on capital investment.

However, particularly with regards to the capital investment of listed companies, these traditional factors are not enough to explain all of the persistent capital investment stagnation that occurred from the second half of the 1990s to the 2000s. The objective of this study is to consider alternative factors behind the slump in listed companies' capital investment in the deflationary Japanese economy by estimating the investment function. In particular, we use information on the manager-attributes as well as corporate financial data to estimate the investment function.

Figure 1. Capital investment and depreciation expenses



(Source) Prepared by the authors from annual Financial Statements Statistics of Corporations by Industry (Ministry of Finance).

In the following analysis, we establish the hypothesis that in the uncertain economic environment, the change in the stance of top managers towards capital investment is useful in explaining the slump in capital investment at that time. We investigate the validity of this hypothesis by using firm-level data. In the analysis, we estimate Tobin's q-type capital investment function. We find that the presidents' (CEOs') attributes (including careers, whether or not he/she was an owner president, and age) as well as the ratio of director bonuses to the distribution of profits had significant effects on entrepreneurship in Japanese companies during the deflationary period (1997 to 2005). To the extent that the proxy variables relating to the extent of managers' risk aversion are useful in explaining the trend in capital investment at that time, we can conclude that the change in the managers' stance was related to the capital investment stagnation.

In previous literature, numerous studies estimated Japanese companies' capital investment function (for examples, refer to the surveys of Miyagawa (1997) and Suzuki (2001)). In particular, several studies showed that companies' borrowing constraints have restricted their capital investment. Asako, Kuninori, Inoue, and Murase (1997), Hayashi and Inoue (1991), Hoshi, Kashyap, and Scharfstein (1991), are seminal examples. With regards to capital investment since the 1990s, Nagahata and Sekine (2005), Fukuda (2003), Hori, Saito, and Ando (2006), and Masuda (2015) analyzed the effect of borrowing constraints for listed companies, while Fukuda, Kasuya, and Nakajima (2007) analyzed for unlisted companies. There have also been many studies on the relationship between uncertainty and capital investment, including Ogawa and Suzuki (2000), Kasuya (2003), Tanaka (2004), and Nishioka and Ikeda (2006). However, because it is not easy to acquire the data, there have been hardly any studies that focused on the attributes of company's top managers and that analyzed the effects that changes to these attributes have on capital investment.

In literature, Bertrand and Schoar (2003) is one of exceptional studies that considers the effects of manager-attributes on corporate performance in the United States[1]. Using individual questionnaire data on U.S. companies, they showed that managers' specific characteristics greatly affect the differences in corporate performance, including capital investment. Regarding Japanese companies, several studies, including Kaplan (1994), Kato (1997), and Xu (1997), analyzed the effects of financial incentives for mangers on corporate performance. However, in these previous studies, the main focus was on explaining the variations in performance between companies. Our study is in marked contrast to these studies in that we focus on the effect of company's manager-attributes on capital investment in Japan. In particular, we analyze what effects the changed manager-attributes have had on capital investment in the deflationary Japanese economy.

From the analysis in this study, we find that in addition to Tobin's q and cash flow, presidents' (CEOs') attributes (careers, whether or not he/she is an owner president, and age) and the size of director bonuses significantly affect capital investment. We also find that because these manager-attributes changed greatly during the 1990s, the number of managers with the attributes of increasing investment tended to decline in the following periods. These results suggest that in the deflationary Japanese economy, in addition to the stagnated macro fundamentals, changes in manager attributes have hindered capital investment.

As noted by Schumpeter, managers' entrepreneurship is the most important driver of economic growth. "Entrepreneurship," in which companies have the "ability" to innovate by dynamically changing not only "technologies," but also aspects such as "methods," "markets," and organizations," is important in order to achieve sustainable economic growth. The results of this study show that the attitude of taking on challenges among top managers is necessary for the Japanese economy to fully escape from deflation and to achieve sustainable economic growth.

The structure of this paper is as follows. First, after examining a simple theoretical hypothesis in Section II, the investment function that will serve as the basic model is formulated in Section III. After explaining the data on manager attributes in Section IV, the results of the estimations using these data are presented in Section V. The effects of director bonuses are estimated in Section VI. Finally, the issues remaining in this study are examined in Section VII.

II. Considerations from a simple, two-period model

The objective of this paper is to verify how changes in top managers' attributes have increased their risk aversion and have had a negative effect on capital investment in Japan. Before moving into empirical studies, this section constructs a simple, two-period model to confirm theoretically that a rise in the extent of managers' risk aversion has a negative effect

[1] Even other than these, several recent studies analyzed the effects of manager attributes on corporate performance. These studies include Bennedsen, Pérez-González, and Wolfenzon (2006), Pérez-González (2006), Cho, Halford, et al. (2016). Laine (2017) clarified that various factors, including manager attributes, affect the 'animal spirit' to conduct investment.

on capital investment.

Below, we will consider the company managers' decision making on whether or not to conduct risky capital investment. When capital investment is conducted, the enterprise value becomes $\tilde{V}$. However, when capital investment is conducted, what enterprise value is realized will depend on the subsequent state of the economy. At the stage of making the investment decision, the realized enterprise value $\tilde{V}$ is uncertain. In contrast, when investment is not conducted, the enterprise value does not depend on the subsequent state of the economy. Without investment, the enterprise value V_0 will always be realized. Under such a situation, as long as managers are risk averse, the presence of uncertainty will greatly affect their investment decision making.

In the following analysis, we denote the utility of company managers by $u(V)$ which is monotonically increasing in the enterprise value V and strictly concave in V. The managers, who maximize the expected utility, will conduct investment if and only if the following condition is satisfied.

$$Eu(\tilde{V})>u(V_0) \tag{1}$$

Here, $u'(V)>0$ and $u''(V)<0$. Furthermore, operator E represents the conditional expected value based on the managers' information at the time they decide on capital investment.

As long as the managers are risk averse, even if investment increases the expected enterprise value (that is, $E\tilde{V}>V_0$), the inequality in (1) will not necessarily be satisfied. In particular, $Eu(\tilde{V})$ becomes smaller not only as the uncertainty of $\tilde{V}$ becomes larger but also as the manager becomes more risk averse. Therefore, capital investment amounts tend to be kept low both by uncertainty and increases in the extent of the manager's risk aversion.

Generally speaking, the uncertainty of corporate value fluctuates depending on economic conditions. Therefore, there are many studies on the relationship between uncertainty and capital investment (see, for example, Dixit and Pindyck; 1994). On the other hand, less consideration has been given to the influence of manager's risk aversion on capital investment. This is because many researchers thought that the degree of risk aversion of managers would not change significantly in the short-run. Also, in a neoclassical economic model in which market discipline works efficiently, managers who lack entrepreneurship are obliged to leave the market. Therefore, prior research does not discuss explicitly changing of the managers' degree of risk aversion. However, after the collapse of the Japanese bubble economy, it is likely that the extent of managers' risk aversion greatly increased in Japan. Thus, it is meaningful to conduct an empirical analysis that explicitly addresses the degree of managers' risk aversion in the estimations.

There are contrasting positions on how to understand managers' behavior in the bubble economy and after its collapse. During the bubble economy, it is likely that the active stances of managers resulted in excessive investment. In contrast, after the collapse of the bubble, many of these managers took responsibility for the worsening performance and stepped down. At the same time, under the stagnant economy, the performance of companies that acted in a risk averse manner improved. There are quite a few examples of companies that had missed business opportunities during the bubble period but became the healthiest com-

panies after the collapse of the bubble. As a result, the extent of managers' risk aversion increased greatly in the 1990s and the early 2000s. After the collapse of the bubble, the trend of welcoming relatively risk-averse managers increased in the Japanese economy.

The increase in the degree of managers' risk aversion has an important implication for investment because risk averse managers do not invest excessively. However, at the same time, the increase in the degree of risk aversion may lead to a decline in entrepreneurship. If entrepreneurship declines and the degree of managers' risk aversion increases, investment will not be conducted even when it would increase the expected enterprise value, and the sustainable growth of the economy will be impeded.

III. Estimations of the capital investment function

III-1. The basic model

Based on the discussion in the previous section, the following sections will examine whether manager-attribute information has an additional effect on capital investment. In the estimation, we will use the financial data on each listed company *i* and their top managers' information. Allowing fixed effects of company *i* and time *t*, we will estimate the non-balanced panel investment function, including fundamental variables such as Tobin's q, cash flow, and the ratio of debt to total capital as control variables.

$$I_{i,t}/K_{i,t} = \alpha_i + \beta_t + \gamma\, Q_{i,t-1} + \delta\, CF_{i,t-1} + \varepsilon D_{i,t-1} + \varphi\, M_{i,t-1}, \quad (2)$$

Here, $I_{i,t}$ is the capital investment amount in period t, $K_{i,t}$ is capital stock at the beginning of period t, $Q_{i,t-1}$ is Tobin's q in period t-1, $CF_{i,t-1}$ is cash flow in period t-1, $D_{i,t-1}$ is ratio of debt to total capital at the end of period t-1, and $M_{i,t-1}$ is manager-attribute information in period t-1. The subscripts $_i$ and $_t$ represent the company and time index, respectively.

Here, Tobin's q is a standard variable that captures the inherent effects of a company's own fundamentals on capital investment. In addition to Tobin's q, we also include cash flow and the ratio of debt to total capital as the explanatory variables in equation (2). We include cash flow to reconfirm the existence of liquidity constraints. As cash flow is a variable that is highly correlated with Tobin's q, we need some reservations when interpreting the results of the estimations. However, if there exist liquidity constraints, it is expected that in addition to Tobin's q, cash flow will have a significantly positive effect on investment. We include the ratio of debt to total capital to verify the existence of a debt overhang problem. Given the other conditions, a debt overhang problem will greatly restrict capital investment in companies that have large amounts of borrowings. If there exists a debt overhang problem, even when controlling for the effects of Tobin's q and cash flow, the ratio of debt to total capital is expected to have a negative effect on capital investment.

A key feature of equation (2) is that in addition to these companies' standard financial variables, manager-attribute information, $M_{i,t-1}$, is added to the explanatory variables. If the top manager's attributes such as risk aversion are different, his or her investment behavior will also be different. Hence, by adding the explanatory variable $M_{i,t-1}$, we can examine

whether top managers' entrepreneurship, including their risk aversion, will have any effects on capital investment. Strictly speaking, a company's attributes themselves also change endogenously, depending on the company's performance. However, by controlling for the effects of financial variables such as Tobin's q, the problem of endogenous changes can be avoided to a certain extent. Further, to avoid the problem of simultaneity bias, the estimations were conducted with a lag of one period, not only for the financial variables but also for all the company attributes-related explanatory variables. The estimations were always carried out with the time dummy variable β_t included. This variable captures the effects of annual changes in macro fundamentals on each company's capital investment.

III-2. The selection of the financial variables

The data used in the following analysis were those of the companies listed in the 1st and 2nd sections of the Tokyo Stock Exchange. We download financial data from the financial statements database of the Development Bank of Japan for fiscal years 1996 to 2005. When the financial data could be obtained twice a year, companies with many monthly financial statements were used. We also collected the manager-attribute information as described in the next section. In the analysis, capital investment amounts from fiscal years 1996 to 2005 are estimated using both lagged financial data and lagged president-attribute information.

To obtain real capital investment amount ($I_{i,t}$), we calculated

"the book value of tangible fixed assets at the end of the fiscal period under review
− the book value of tangible fixed assets at the end of the previous fiscal period
+ the depreciation amount in the fiscal period under review"

and deflated it by the investment-goods deflator. Real capital stocks ($K_{i,t}$) are tangible fixed assets excluding land, for which the book-value series from fiscal year 1969 onwards was converted into a market-value series using the perpetual inventory method employed in Hayashi and Inoue (1991) (see the Appendix for more details).

Tobin's q was calculated as follows:

Tobin's q = (the company's market value + the total debt amount - the market valuation of land - the book values of other assets) / the re-acquisition value of capital stock

Here the company's market value was obtained from the stock price. The market valuation of land was calculated from the book value assuming the first-in, first-out method. For the re-acquisition price of capital stock, which is the denominator of Tobin's q, we used the end of the previous fiscal period's portion of real capital stock (excluding land), converted into a market-value series.

Regarding the financial variables, "cash flow" was depreciation expenses + ordinary income. To normalize it by the company's size, we divided it by the sum of depreciation ex-

Table 1. Descriptive statistics

	Investment	Tobin's q	Cash flow	Total borrowing ammount
Average	0.073	0.804	0.045	0.162
Median	0.057	0.469	0.039	0.120
Standard deviation	0.084	2.862	0.044	0.159
Skewness	1.373	1.514	1.290	1.002
Kurtosis	7.967	14.307	20.485	3.418
No. of observations	18664	18778	19105	19074

Note: Investment is normalized by capital stock. Cash flow and total borrowing ammount are normalized by total asset.
(Source) Prepared by the authors.

penses in sales and current assets. Additionally, "the ratio of debt to total capital" was obtained by dividing the total amount of short-term borrowing and long-term borrowing by the total assets in the previous fiscal year's financial statements.

To exclude outliers, we removed observations when each variable satisfied the following conditions: $I_{i,t}$ / $K_{i,t}$ less than -0.3 or greater than 0.5, "cash flow" less than -0.3 or greater than 0.8, "the ratio of debt to total capital" greater than 0.8, and the absolute value of $Q_{i,t}$ exceeds 20. From the remaining sample observations, 1,694 companies were used as subjects for the analysis. Table 1 shows the basic statistics of each financial variable for all the sampled companies. The results were not greatly different to those in prior studies, but each variable takes heterogeneous value across the companies. In particular, the standard deviation of Tobin's q was large. Furthermore, the average of Tobin's q was 0.804, which to a certain extent is a value close to 1; however, reflecting stock prices and economic recessions, the median of Tobin's q was a smaller value, 0.469.

IV. Information on the attributes of top managers

The objective of this paper is to verify whether or not a listed company's capital investment is affected not only by financial variables, but also by that company's attributes, especially the attributes of its top managers. In estimating the investment function (2), we included several proxies for company's attributes as explanatory variables. These proxies are the "company age" (the logarithm of the number of years since the year of establishment) and four dummy variables regarding the attributes of the president: the "president major shareholder dummy," "president replacement dummy," "external president dummy," and "president age dummy." The information on the attributes of the listed companies was collected from the various issues of "CD Eyes" by Tokyo Shoko Research and "Company Employee Records: All Listed Companies Edition" by Diamond, Inc.

The "president major shareholder dummy" is a dummy variable taking the value 1 when the name of the president was listed as the major shareholder in "CD Eyes" for each fiscal

year. When the president is the major shareholder, external monitoring would be difficult and self-righteous management may be conducted. However, because the agency costs associated with coordinating the interests of the stakeholders are small, it is possible to actively conduct capital investment. In companies in which ownership and management have been separated, it is not easy for the owners to monitor the top managers' behaviors, and performance may slump because the top managers may take actions that are against the interests of the owners. In contrast to this, in companies where the president is the major shareholder, the top managers are less likely to act against the interests of the owners, and there is little reduction in capital investment due to the agency costs.

The "president replacement dummy" is a dummy variable taking the value 1 in a year in which the president was replaced. To the extent that a president resigns or is dismissed due to poor performance, the newly chosen president will tend to be a more conservative top manager than his/her predecessor. This is because replacements do not want to repeat the same mistakes of the past. Therefore, it is likely that the degree of risk aversion of the replacement president will increase significantly compared to that of the replaced president. Of course, in addition to a resignation or dismissal due to poor performance, a president may be replaced because he/she has completed his/her term of office, or for other such reasons. In these cases, the replacement president might not make major changes to the company's management policy. However, even in such cases, as it will take some time for the new president to become accustomed to his/her new work duties, he/she will naturally tend to be more conservative.

The "external president dummy" is a dummy variable that takes the value 1 when the president was invited from a different company. It was difficult to directly obtain information on whether or not the president was invited from a different company. Therefore, the year the president joined the company and the year in which he/she graduated in their academic careers were compared. Then, if the year of joining the company was more than 15 years, or more than 10 years, from the graduation year, he/she was judged as an "external president." Depending on the number of years, we defined the president as either "external president 15" or "external president 10." When the president is invited from a different company, it is likely that he/she can conduct innovative management that is not constrained by his/her company's customers and traditions up to that time, so it is considered that he/she will also become active with regards to capital investment.

The "president age dummy" is a dummy that takes the value 1 when the president is aged 50 or under. In a typical large Japanese company, it is rare for a president to be aged 50 years or under. In owner companies, the president who is appointed as the successor is often comparatively young. However, even among the same group of owner-company presidents, their behavior patterns will differ depending on whether or not they are young[2]. The "president age dummy" can be thought of as capturing the less conservative capital investment

[2] In order to show that creative innovation is conducted by companies and societies in which young managers can take managerial positions, Acemoglu et al. (2014) used the number of patents cited and other variables for the quality of innovation and showed that high quality innovation is more easily realized by younger managers.

behaviors of young presidents. Since elderly presidents may have different behavior patterns, an "elderly president dummy," which takes the value 1 when the president is aged 70 years or older, was also included during the estimates.

Figures 2-1 to 2-4 summarize how the percentages of companies taking the value 1 for the dummy variables that relate to the manager-attribute information changed during the sample period. The largest change across the sample period was the percentage of compa-

Figure 2-1. Major shareholder managers in listed companies

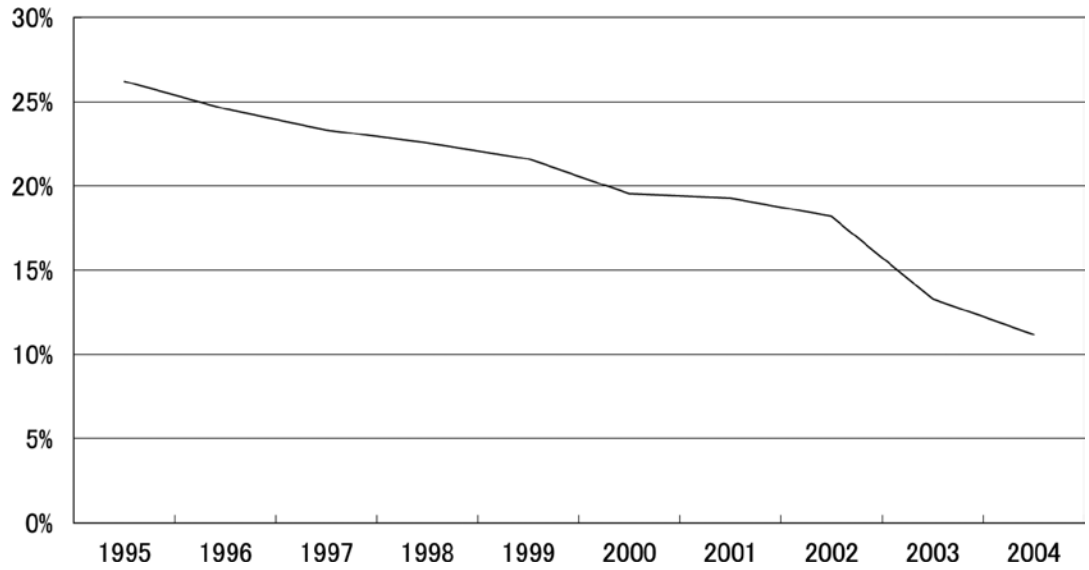
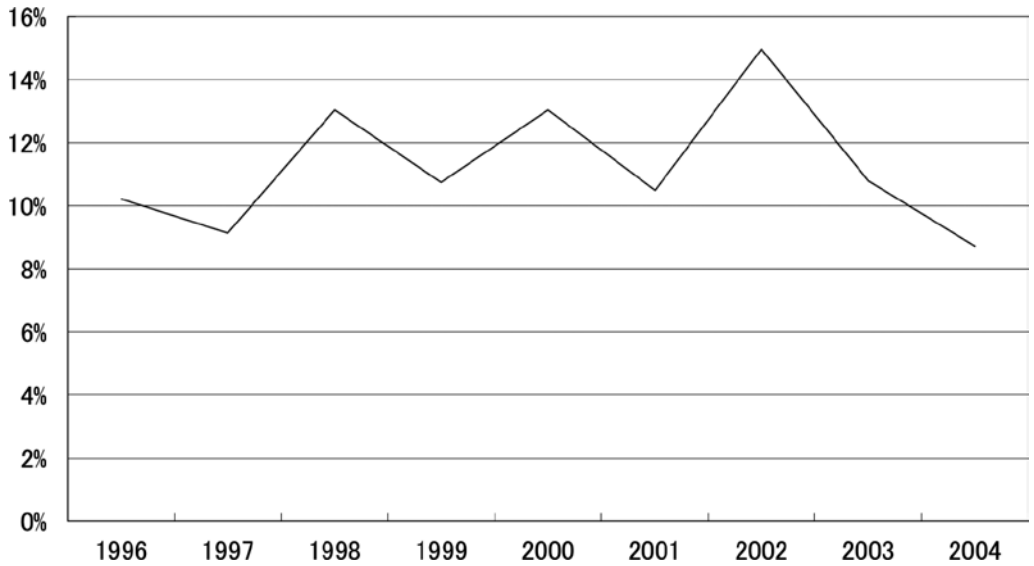


Figure 2-2. Top manager replacements in listed companies



nies taking the value 1 for the "president major shareholder dummy." This was 26% of the entire sample during fiscal year 1995, but by fiscal year 2004, it had fallen as far as 11%, showing that the number of owner presidents declined greatly during this period. Furthermore, a trend-like decline in "external president 15" can also be observed: while it exceeded 30% during fiscal year 1996, by fiscal year 2004 it had declined to 25%. It can be said that during this period, there was a decline in the number of external presidents who were re-

Figure 2-3. Trends in the percentage of presidents who are an external president ("external president 15")

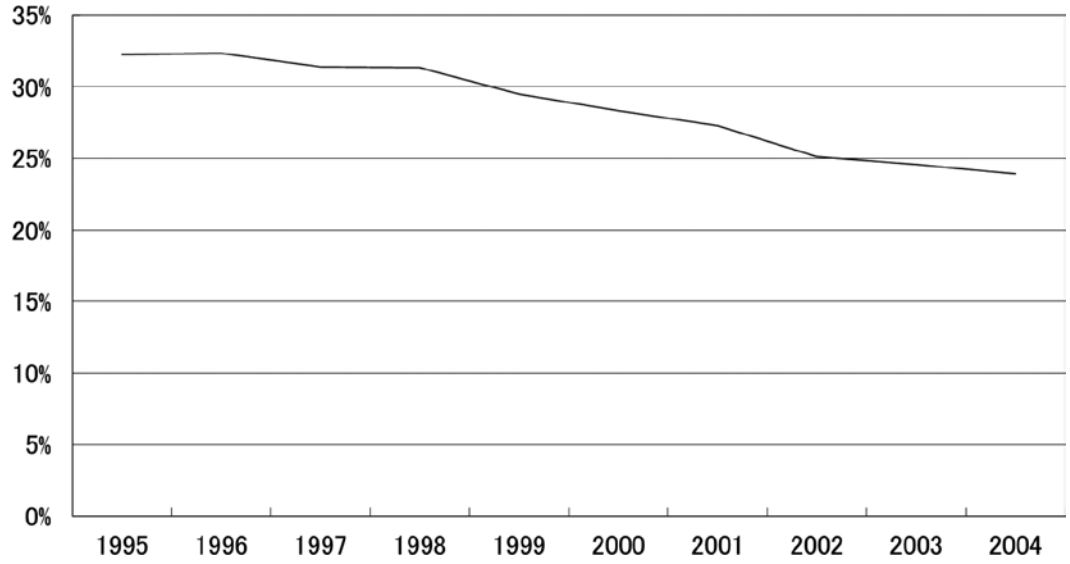
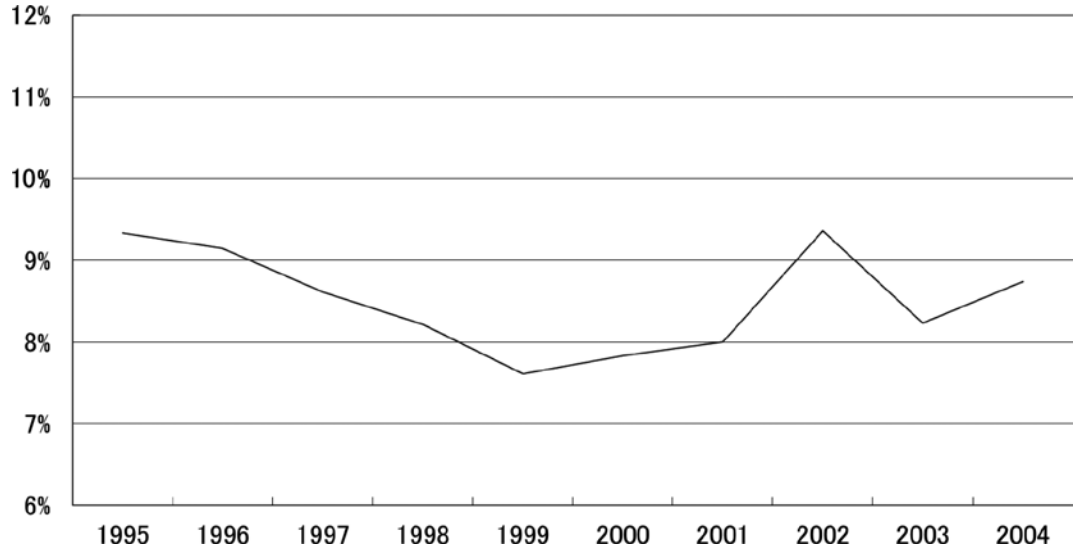


Figure 2-4. Trends in the "president age dummy"



cruited from outside the company in question.

On the other hand, from fiscal year 1996 onwards, there were no trend-like changes in the percentages of companies taking the value 1 for the "president replacement dummy" and the "president age dummy." However, the number of companies with the "president replacement dummy" taking the value 1 increased between fiscal years 1998 to 2002. This was a period in which, as a whole, the capital investment amount was below depreciation expenses, suggesting that presidents were replaced in many listed companies during this period, likely due to resignations and dismissals because of poor performance.

V. Results of the basic model's estimations

The result of our basic model's estimations on capital investment from fiscal years 1996 to 2005 are summarized in Tables 2-1, 2-2, and 2-3. Regarding the results of fundamental variables such as Tobin's q, cash flow, and the ratio of debt to total capital, all of the estimated parameters satisfied the expected sign condition; all also had statistically significant effects at the 1% level in each of the specifications. As in many previous studies, the signs of both "Tobin's q" and "cash flow" were positive. In particular, the significantly positive effects of "cash flow" suggest the possibility of the existence of liquidity constraints even in the listed companies. On the other hand, "the ratio of debt to total capital" took a significantly negative sign. Given the other conditions, the excessive-debt problem greatly restricts the capital investment of companies that have a large amount of borrowing. Therefore, our results support the hypothesis that an excessive-debt problem negatively affects capital investment.

However, it is worthwhile to note that even on controlling for these financial variables, all of the indicators of manager-attributes satisfy the expected sign conditions, and most of them are also statistically significant. In other words, the "president major shareholder dummy," "external president dummy," and "president age dummy" had positive effects on capital investment, whereas the "president replacement dummy" and "the company age dummy" had negative effects on capital investment. These results suggest that, in addition to the financial variables, manager-attributes are extremely useful in explaining listed companies' capital investment.

For example, the estimated coefficient of the "president major shareholder dummy" implies that when the president ceases to be the major shareholder, the capital investment ratio decreases from approximately 0.005 to 0.008. Since the entire sample's capital investment ratio average was approximately 0.073 and the median was about 0.058, a decrease from 0.007 to 0.008 is definitely not a small one.

As can be seen in Figure 2-1, in Japan, since the second half of the 1990s, the number of companies taking the value 1 for the "president major shareholder dummy" has been greatly decreasing. The reasons for the decrease in the number of presidents who are the major shareholder can be broadly arranged into the following three cases: (1) they remain the major shareholder but cease to be the president (2) they remain the president but cease to be the

major shareholder, and (3) they cease to be both the major shareholder and the president. However, in each case, the agency costs rise between the shareholders and the top managers, which is likely to make the company management more conservative.

The coefficient of the "external president dummy" variables also take significantly positive values: approximately 0.006 for "external president 15" and approximately 0.005 for "external president 10." This means that when the president is an external president, the capital investment ratio increases. As seen in Figure 2-3, in Japan, since the second half of the 1990s, there has been a relative decline in the number of external presidents, suggesting that this result also led to the slump in capital investment since the second half of the 1990s.

On the other hand, the "president replacement dummy" coefficient was negative. This implies that in the event that a president is replaced, even when the other indicators are unchanged, the capital investment ratio decreases by approximately 0.005, which is far from

Table 2-1. Estimation results of the basic model

	(A)			(B)		
	coefficient	Standard deviation	t-statistics	coefficient	Standard deviation	t-statistics
Constant term	0.228	0.038	5.9974 ***	0.228	0.038	5.9893 ***
Tobin's q	0.002	0.000	6.4561 ***	0.002	0.000	6.4548 ***
Cash flow	0.253	0.033	7.6620 ***	0.252	0.033	7.6027 ***
Total borrowing amount	−0.081	0.011	−7.4974 ***	−0.081	0.011	−7.4946 ***
President major shareholder dummy	0.006	0.003	1.8001 *	0.005	0.003	1.6484 *
President replacement dummy				−0.003	0.002	−1.8359 *
External president 15						
President age dummy						
Company age (logarithm)	−0.033	0.010	−3.4355 ***	−0.033	0.010	−3.4217 ***
1997 dummy	−0.005	0.002	−1.9623 **	−0.004	0.002	−1.7973 *
1998 dummy	−0.013	0.002	−5.4032 ***	−0.013	0.002	−5.2553 ***
1999 dummy	−0.030	0.003	−11.7897 ***	−0.029	0.003	−11.5491 ***
2000 dummy	−0.025	0.003	−9.5808 ***	−0.024	0.003	−9.4072 ***
2001 dummy	−0.030	0.003	−11.0635 ***	−0.029	0.003	−10.8541 ***
2002 dummy	−0.037	0.003	−13.1234 ***	−0.036	0.003	−12.9772 ***
2003 dummy	−0.036	0.003	−12.3769 ***	−0.035	0.003	−12.1466 ***
2004 dummy	−0.032	0.003	−10.6712 ***	−0.032	0.003	−10.5492 ***
2005 dummy	−0.023	0.073	−0.3205	−0.023	0.073	−0.3160

	(C)			(D)		
	coefficient	Standard deviation	t-statistics	coefficient	Standard deviation	t-statistics
Constant term	0.219	0.044	4.9779 ***	0.223	0.040	5.5315 ***
Tobin's q	0.002	0.000	5.8184 ***	0.002	0.000	5.9314 ***
Cash flow	0.256	0.037	6.8560 ***	0.239	0.034	6.9846 ***
Total borrowing amount	−0.086	0.012	−7.1026 ***	−0.077	0.011	−7.0090 ***
President major shareholder dummy	0.008	0.003	2.1514 **	0.006	0.003	1.8257 *
President replacement dummy						
External president 15	0.006	0.003	2.0044 **			
President age dummy				0.005	0.003	1.3372
Company age (logarithm)	−0.032	0.011	−2.8605 ***	−0.033	0.010	−3.1777 ***
1997 dummy	−0.003	0.002	−1.1732	−0.003	0.002	−1.0576
1998 dummy	−0.012	0.003	−4.7810 ***	−0.012	0.002	−4.8937 ***
1999 dummy	−0.027	0.003	−10.3899 ***	−0.028	0.003	−10.7809 ***
2000 dummy	−0.023	0.003	−8.7065 ***	−0.023	0.003	−8.9247 ***
2001 dummy	−0.028	0.003	−9.8166 ***	−0.028	0.003	−10.2565 ***
2002 dummy	−0.038	0.003	−12.5647 ***	−0.037	0.003	−12.8923 ***
2003 dummy	−0.036	0.003	−11.0268 ***	−0.036	0.003	−12.0225 ***
2004 dummy	−0.030	0.003	−8.9872 ***	−0.031	0.003	−10.2030 ***
2005 dummy	−0.022	0.071	−0.3115	−0.019	0.071	−0.2606

***Significant at the 1% level, **Significant at the 5% level, *Significant at the 10% level

Table 2-2. Estimation results of the basic model

	(E)				(F)			
	coefficient	Standard deviation	t-statistics		coefficient	Standard deviation	t-statistics	
Constant term	0.219	0.044	4.9791	***	0.222	0.040	5.5164	***
Tobin's q	0.002	0.000	5.8226	***	0.002	0.000	5.9267	***
Cash flow	0.253	0.037	6.7622	***	0.237	0.034	6.9172	***
Total borrowing amount	−0.086	0.012	−7.1215	***	−0.077	0.011	−7.0008	***
President major shareholder dummy	0.007	0.003	1.9729	**	0.005	0.003	1.6606	*
President replacement dummy	−0.004	0.002	−2.1088	**	−0.004	0.002	−2.0823	**
External president 15	0.006	0.003	1.9271	*				
President age dummy					0.005	0.003	1.4918	
Company age (logarithm)	−0.032	0.011	−2.8527	***	−0.032	0.010	−3.1584	***
1997 dummy	−0.002	0.002	−0.9585		−0.002	0.002	−0.8655	
1998 dummy	−0.012	0.003	−4.5884	***	−0.012	0.002	−4.7193	***
1999 dummy	−0.027	0.003	−10.0846	***	−0.027	0.003	−10.5067	***
2000 dummy	−0.023	0.003	−8.5128	***	−0.023	0.003	−8.7196	***
2001 dummy	−0.027	0.003	−9.5620	***	−0.027	0.003	−10.0126	***
2002 dummy	−0.037	0.003	−12.3989	***	−0.036	0.003	−12.7184	***
2003 dummy	−0.035	0.003	−10.7953	***	−0.035	0.003	−11.7558	***
2004 dummy	−0.030	0.003	−8.8595	***	−0.031	0.003	−10.0545	***
2005 dummy	−0.022	0.071	−0.3052		−0.018	0.0714	−0.2485	

	(G)				(H)			
	coefficient	Standard deviation	t-statistics		coefficient	Standard deviation	t-statistics	
Constant term	0.216	0.044	4.9073	***	0.216	0.044	4.9032	***
Tobin's q	0.002	0.000	5.8167	***	0.002	0.000	5.8223	***
Cash flow	0.257	0.037	6.8899	***	0.254	0.037	6.7944	***
Total borrowing amount	−0.085	0.012	−7.0294	***	−0.085	0.012	−7.0438	***
President major shareholder dummy	0.008	0.004	2.3266	**	0.008	0.004	2.1564	**
President replacement dummy					−0.005	0.002	−2.2433	**
External president 15	0.007	0.003	2.1388	**	0.006	0.003	2.0688	**
President age dummy	0.007	0.004	1.8358	*	0.007	0.004	1.9963	**
Company age (logarithm)	−0.032	0.011	−2.8169	***	−0.031	0.011	−2.8054	***
1997 dummy	−0.003	0.002	−1.1672		−0.002	0.002	−0.9384	
1998 dummy	−0.012	0.003	−4.7643	***	−0.012	0.003	−4.5576	***
1999 dummy	−0.027	0.003	−10.3643	***	−0.026	0.003	−10.0388	***
2000 dummy	−0.023	0.003	−8.6512	***	−0.023	0.003	−8.4413	***
2001 dummy	−0.028	0.003	−9.7675	***	−0.027	0.003	−9.4935	***
2002 dummy	−0.038	0.003	−12.5327	***	−0.037	0.003	−12.3523	***
2003 dummy	−0.035	0.003	−11.0085	***	−0.035	0.003	−10.7615	***
2004 dummy	−0.030	0.003	−8.9870	***	−0.030	0.003	−8.8460	***
2005 dummy	−0.016	0.071	−0.2290		−0.015	0.071	−0.2147	

***Significant at the 1% level, **Significant at the 5% level, *Significant at the 10% level

negligible in terms of the samples' average and median capital investment ratio. As was discussed in the previous section, there are times when the president is replaced smoothly, such as when he/she has completed his/her term of office. However, in the listed companies in Japan from the end of the 1990s, the replacement of presidents increased compared to such replacements before that time. This is likely to reflect the rise in cases of a president being replaced following his/her resignation or dismissal due to poor performance, which led to more conservative capital investment in the deflationary Japanese economy.

The "president age dummy" was not significant in (D) and (F) but significant in (G), (H), (I), and (J) in the tables. It tends to be significant only when it is jointly estimated with the "external president dummy." Young presidents aged 50 or under, indicated by the "president age dummy," actively conducted capital investment activities only when we control the effect of whether an external president also actively engaged in capital investment activities.

Table 2-3. Estimation results of the basic model

	(I)			(J)		
	coefficient	Standard deviation	t-statistics	coefficient	Standard deviation	t-statistics
Constant term	0.215	0.044	4.8755 ***	0.216	0.044	4.8932 ***
Tobin's q	0.002	0.000	5.8341 ***	0.002	0.000	5.8314 ***
Cash flow	0.254	0.037	6.7996 ***	0.254	0.037	6.7896 ***
Total borrowing amount	−0.085	0.012	−7.0433 ***	−0.085	0.012	−7.0269 ***
President major shareholder dummy	0.008	0.004	2.2768 **	0.008	0.004	2.1946 **
President replacement dummy	−0.005	0.002	−2.3293 **	−0.005	0.002	−2.3324 **
External president 15	0.006	0.003	2.0737 **			
External president 10				0.005	0.003	1.8140 *
President age dummy	0.007	0.004	1.8946 *	0.007	0.004	1.8541 *
Elderly president dummy	−0.004	0.003	−1.1571	−0.004	0.003	−1.1805
Company age (logarithm)	−0.031	0.011	−2.7730 ***	−0.031	0.011	−2.7881 ***
1997 dummy	−0.002	0.002	−0.9309	−0.002	0.002	−0.9252
1998 dummy	−0.012	0.003	−4.5550 ***	−0.011	0.003	−4.5401 ***
1999 dummy	−0.026	0.003	−10.0566 ***	−0.026	0.003	−10.0347 ***
2000 dummy	−0.023	0.003	−8.4573 ***	−0.023	0.003	−8.4343 ***
2001 dummy	−0.027	0.003	−9.5065 ***	−0.027	0.003	−9.4801 ***
2002 dummy	−0.037	0.003	−12.3554 ***	−0.037	0.003	−12.3282 ***
2003 dummy	−0.035	0.003	−10.7754 ***	−0.035	0.003	−10.7555 ***
2004 dummy	−0.030	0.003	−8.8532 ***	−0.030	0.003	−8.8401 ***
2005 dummy	−0.016	0.071	−0.2199	−0.016	0.071	−0.2209

***Significant at the 1% level, **Significant at the 5% level, *Significant at the 10% level

Unfortunately, the "elderly president dummy" was not significant, but its sign was negative. This result is in marked contrast with the fact that young presidents are less conservative. It is likely that young presidents will conduct innovative management whereas old presidents will not.

"Company age" (logarithm of the number of years since the year of establishment) was consistently negative and significant. This result reflects that capital investment is conducted more actively in venture companies that were recently established, while more companies that have been established for many years are more conservative.

VI. The effects from director bonuses

In the previous section, we estimated the investment function of listed companies in the deflationary Japanese economy and found that in addition to standard financial variables, such as Tobin's q and cash flow, the manager-attributes of the president's career and age, as well as whether or not he/she is an owner president, significantly affect capital investment. In this section, in addition to these inherent attributes of top managers, we will investigate whether the size of "director bonuses" affects capital investment. "Director bonuses" is different from the manager-attributes that were used in the previous section in the sense that it is determined endogenously according to the economic conditions. However, even companies with the same profits pay different director bonuses. Thus, director bonuses can be a proxy that may affect attributes of the managers.

Unlike "director remuneration" that is one part of SG&A expenses, director bonuses are not corporate income tax deductibles. "Director bonuses" are also in the trade-off relationship with dividends and retained earnings in the distribution of profits. Even with these

costs, many companies pay director bonuses because a high ratio of director bonuses can provide incentives to directors through these additional salary payments. Therefore, "director bonuses" can be a proxy variable that changes unobservable manager-attributes.

Below, we will add an on-period lagged value of "director bonuses," which is normalized by "undistributed profit in the fiscal period," to the explanatory variables and examine how the directors changed their capital investment behavior when they received a bonus. However, it is not the case that all companies pay director bonuses. Therefore, the estimations are carried out with the "director bonuses zero dummy," which takes the value 1 for companies that paid zero director bonuses in the one-before period in the database of the Development Bank of Japan[3].

Companies with negative undistributed profit during the fiscal period will always have zero director bonuses. However, despite having negative undistributed profit in the fiscal period, there are some companies, if only a few, that still pay director bonuses. Therefore, the estimations were carried out by respectively adding the "deficit companies dummy," which takes the value 1 for companies whose undistributed profit in the fiscal period for one period before was negative, and the "deficit companies director bonuses dummy," which takes the value 1 for companies whose undistributed profit in the fiscal period for one period before was negative, but whose director bonuses were positive.

The results of the estimations are summarized in Table 3. Given limited data availability, the estimations period was for the fiscal years between 1996 to 2002, which is three years fewer than the analysis in the previous section. First, the estimation results for the financial variables and the president-attribute information are essentially the same as those in the previous section. This suggests that the results in the previous section are robust, as they are practically unaffected by the estimations period and by the effects of director bonuses. On the other hand, "director bonuses," which is normalized by "undistributed profit in the fiscal period," takes a positive sign. In contrast, the "director bonuses zero dummy" takes a significantly negative sign. "Director bonuses" was not statistically significant when the "director bonuses zero dummy" was added to the explanatory variables. However, when the "director bonuses zero dummy" is not added, it was statistically significantly positive, even when adding the "deficit companies dummy" and the "deficit companies director bonuses dummy." These results show that companies with large director bonuses actively conduct capital investment, but in contrast, companies with no director bonuses reduce capital investment.

"Director bonuses" is an endogenous variable that reflects a company's financial condition. However, it is worthwhile to note that even when controlling for the financial variables that affect capital investment, such as Tobin's q, the "director bonuses" variable still affects investment. This means that even if we control for the fact that "director bonuses" reflects a company's financial condition, it is an important proxy variable that reflects the attributes of

[3] In the Development Bank of Japan database, in addition to companies whose director bonuses were zero, companies whose director bonuses are unknown are also input as zero; therefore, it is necessary to be aware of this when interpreting the results of the dummy variables.

Table 3. The effects from directors' bonuses

	coefficient	Standard deviation	t-Statistic		coefficient	Standard deviation	t-Statistic	
Constant term	0.199	0.057	3.485	***	0.201	0.057	3.518	***
Tobin's q	0.003	0.000	5.781	***	0.003	0.000	5.621	***
Cash flow	0.243	0.045	5.421	***	0.195	0.046	4.221	***
Total borrowing amount	−0.072	0.015	−4.846	***	−0.064	0.015	−4.292	***
President major shareholder dummy	0.010	0.005	2.155	**	0.010	0.005	2.239	**
President replacement dummy	−0.004	0.002	−1.791	*	−0.004	0.002	−1.874	*
External president 15	0.007	0.004	1.881	*	0.007	0.004	1.917	*
President age dummy	0.010	0.004	2.256	**	0.010	0.004	2.308	**
Company age (logarithm)	−0.028	0.015	−1.943	*	−0.027	0.015	−1.883	*
Directors' bonuses/undistributed profit	0.066	0.030	2.227	**	0.015	0.032	0.478	
Deficit companies directors' bonuses dummy	0.009	0.008	1.019		0.002	0.009	0.187	
Directors bonuses zero dummy					−0.012	0.003	−4.287	***
1997 dummy	−0.002	0.003	−0.933		−0.002	0.003	−0.949	
1998 dummy	−0.011	0.003	−4.338	***	−0.011	0.003	−4.202	***
1999 dummy	−0.026	0.003	−9.532	***	−0.025	0.003	−9.072	***
2000 dummy	−0.023	0.003	−7.838	***	−0.021	0.003	−7.446	***
2001 dummy	−0.027	0.003	−8.644	***	−0.026	0.003	−8.138	***
2002 dummy	−0.037	0.003	−10.946	***	−0.034	0.003	−10.183	***

	coefficient	Standard deviation	t-Statistic		coefficient	Standard deviation	t-Statistic	
Constant term	0.200	0.057	3.500	***	0.201	0.057	3.523	***
Tobin's q	0.003	0.000	5.902	***	0.003	0.000	5.712	***
Cash flow	0.209	0.046	4.522	***	0.180	0.047	3.849	***
Total borrowing amount	−0.064	0.015	−4.273	***	−0.060	0.015	−4.011	***
President major shareholder dummy	0.010	0.005	2.184	**	0.010	0.005	2.245	**
President replacement dummy	−0.004	0.002	−1.722	*	−0.004	0.002	−1.819	*
External president 15	0.007	0.004	1.940	*	0.007	0.004	1.948	*
President age dummy	0.010	0.004	2.292	**	0.010	0.004	2.323	**
Company age (logarithm)	−0.028	0.015	−1.933	*	−0.027	0.015	−1.885	*
Directors' bonuses/undistributed profit	0.052	0.030	1.741	*	0.014	0.032	0.431	
Deficit companies directors' bonuses dummy	0.014	0.009	1.663	*	0.006	0.009	0.689	
Directors bonuses zero dummy					−0.010	0.003	−3.501	***
Deficit companies dummy	−0.008	0.003	−3.063	***	−0.005	0.003	−1.807	
1997 dummy	−0.002	0.003	−0.949		−0.002	0.003	−0.957	
1998 dummy	−0.011	0.003	−4.261	***	−0.011	0.003	−4.173	***
1999 dummy	−0.026	0.003	−9.359	***	−0.025	0.003	−9.028	***
2000 dummy	−0.022	0.003	−7.693	***	−0.021	0.003	−7.410	***
2001 dummy	−0.026	0.003	−8.362	***	−0.025	0.003	−8.035	***
2002 dummy	−0.035	0.003	−10.524	***	−0.034	0.003	−10.030	***

***Significant at the 1% level, **Significant at the 5% level, *Significant at the 10% level

that company's directors which increases capital investment. Companies with a high ratio of director bonuses to profits are companies that are also highly confident in the active decision making of their top managers. In such companies, it is likely that there is a strong tendency to conduct aggressive management, and as a result, capital investment is conducted more actively. In contrast, companies with zero director bonuses include cases where the undistributed profit in the fiscal period was negative (when they did not pay director's bonuses) as well as cases where "director bonuses" was zero even when the undistributed profit in the fiscal period was positive (when directors took responsibility for poor performance). In such companies, it is likely that the top managers are afraid of failing again, and as a result, capi-

tal investment slumps.

Figures 3-1 to 3-3 show the average of "director bonuses" divided by "undistributed profit in the fiscal period" from 1995 to 2001 for all the sample companies, for companies with a positive director bonuses ratio, and for companies with a zero director bonuses ratio. In terms of the quality of the Development Bank of Japan database, the zero director bonuses group of companies includes not only companies with zero director bonuses, but also

Figure 3-1. Bonuses/undistributed profit (in the case of all sampled companies)

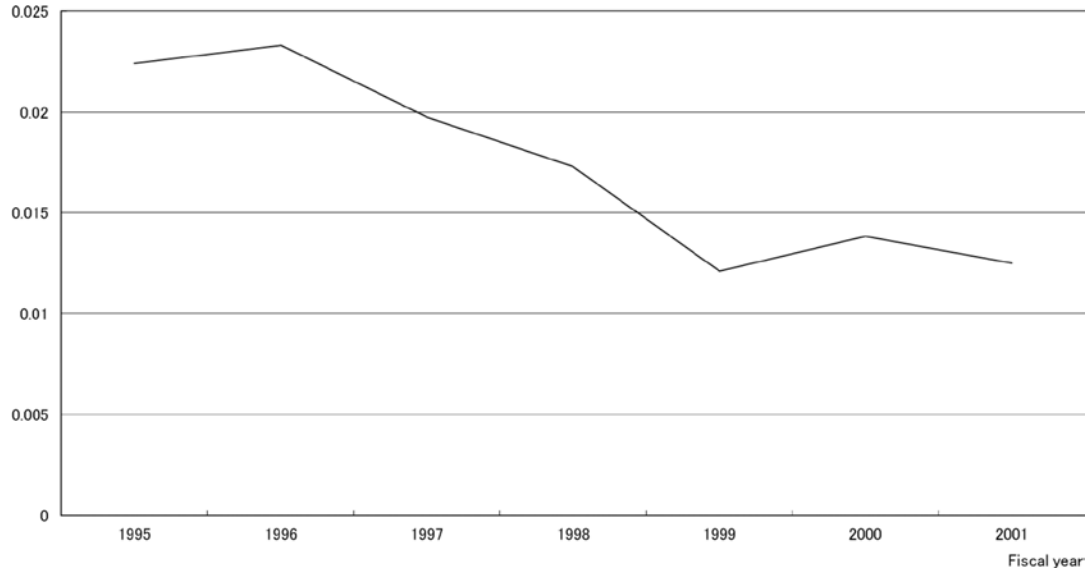


Figure 3-2. Bonuses/undistributed profit (in the case of companies paying bonuses)

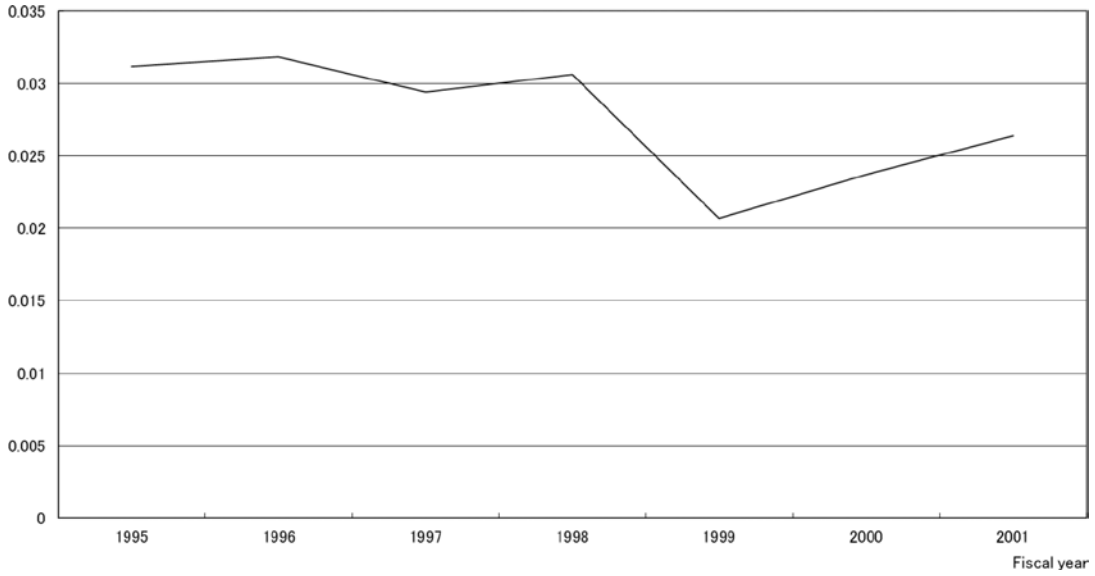
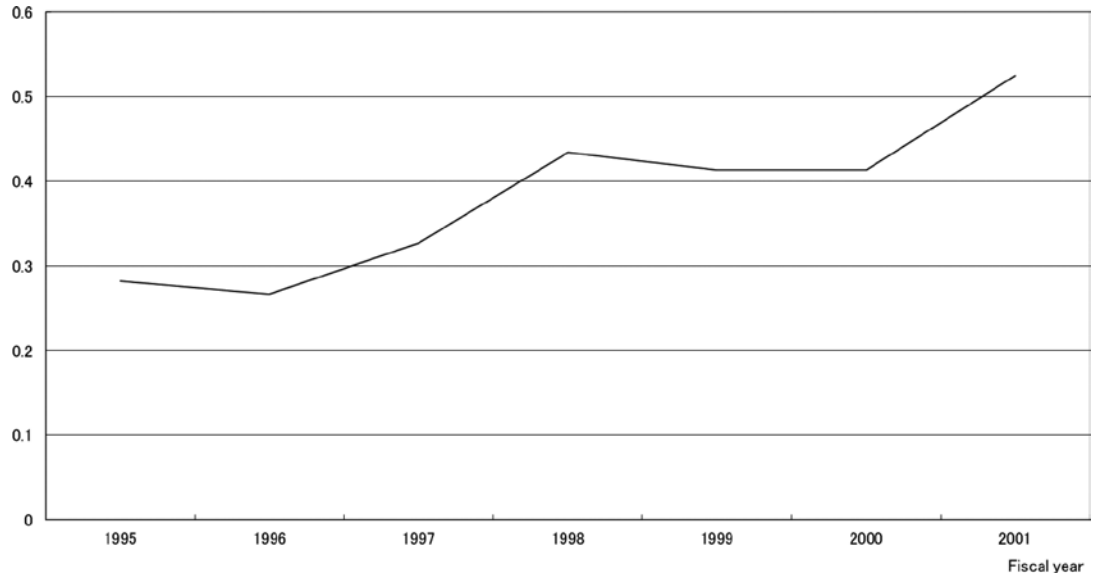


Figure 3-3. The ratio of companies with zero directors' bonuses



companies for which the director bonus was unknown. Therefore, we need some reservations when interpreting the results. However, on looking at the trend in director bonuses from the second half of the 1990s to the start of the 2000s, we see that, on the one hand, "director bonuses," which was normalized by "undistributed profit in the fiscal period," trended downward; on the other hand, the number of companies with zero director bonuses greatly increased during the same time period. It is likely that these trends in director bonuses were a factor behind the slump in capital investment at that time.

VII. Conclusion

In this paper, based on financial data and manager-attribute information, we analyzed the determinants of listed companies' capital investment in the deflationary Japanese economy. As in previous literature, we found that financial variables such as Tobin's q and cash flow have significant explanatory power for capital investment. However, even after controlling for the effects of these fundamental variables, the manager-attributes of the president's career and age and whether he/she is an owner president have significant effects on capital investment. We also found that the ratio of director bonuses to the distribution of profits has a significant effect on capital investment.

In Japan, the number of top managers whose attributes have significantly positive effects on capital investment, such as manager entrepreneurship, has been declining since the second half of the 1990s. In contrast, the number of top managers whose attributes have negative effects on capital investment has been increasing, such as managers' risk aversion. As a result, not only the deterioration of macro fundamentals, but also the increase in managers'

risk aversion and the decline in managers' entrepreneurship have had the effect of keeping down capital investment in listed companies under deflationary conditions.

In general, it is not easy to quantitate proxies for top managers' qualitative aspects. The manager-attributes addressed by this study constitute only a small part of these aspects. It is likely that the effects on capital investment of the decline in entrepreneurship in the deflationary Japanese economy were more diverse than that which we were ascertained quantitatively in this study. When changes in entrepreneurship have a monetary externality, the increase in the extent of managers' risk aversion may reduce Tobin's q for the macro economy as a whole and may bring about a new slump in capital investment. In this study, the analysis did not explicitly incorporate these additional effects. Further studies are important in considering the factors behind the slump in capital investment in the deflationary Japanese economy.

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Appendix: The calculation of real capital stock (the re-acquisition price)

In this paper, we used financial data from fiscal year 1969 onwards in the database of the Development Bank of Japan (when it was not possible to use fiscal 1969 data, the data from the earliest fiscal year after that year was used). Using the perpetual inventory method, we calculated the re-acquisition value of capital stock for individual tangible fixed assets and summed them up to obtain the total re-acquisition value of tangible fixed assets. The calculation method follows Hayashi and Inoue (1991). The specific calculation steps were as follows:

First, the nominal capital investment amount by each tangible fixed asset was calculated as follows

The nominal capital investment amount in the fiscal period

= the book value of tangible fixed assets at the end of the fiscal period - the book value of tangible fixed assets at the end of the previous fiscal period + the depreciation amount in the fiscal period

We then deflated this by the deflator of the investment good price to obtain the real capital investment amount for the tangible fixed assets. The deflator of the investment good was the construction materials price index for buildings and structures, and the capital goods price index for machinery and equipment, vehicles and transportation equipment, and tools and fixtures. Both of the price indexes were from the Bank of Japan's Corporate Goods Price Index (CGPI).

Following previous studies, we calculated the real amounts of capital stock for individual tangible fixed assets (excluding land) based on the perpetual inventory method, using the real capital investment amounts and capital stock's physical depreciation rate. For capital stocks physical depreciation rates (δ), we used the values in Hayashi and Inoue (1991) (Buildings: 4.7%; Construction: 5.64%; Mechanical equipment: 9.489%; Ships, Vehicles, and Transportation Equipment: 14.70%; Tools and Fixtures: 8.838%).