CIRJE-F-80

Long Term Loans and Investment in Japan:
An Empirical Analysis Based on the Panel Data of Japanese Firms

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July 2000

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July 12, 2000

Abstract

The purpose of this paper is to investigate whether that the policy-based allocation of long-term funds played an important role in promoting the high economic growth in post-war Japan. Using the panel data functions of Japanese firms, we estimate Tobin's Q investment functions in two different sample periods— 1972-84 and 1985-96. In 1972-84, we find that the long-term loan ratio had an additional positive effect on investment. In particular, the result holds true regardless of the size of corporate cash flows or the type of corporate groupings. However, in 1985-96, we cannot find that a higher ratio of long-term loans increased the Japanese firm's investment. The result indicates that the size of long-term loans had a great influence on the firm's investment only before the financial liberalization in Japan.

JEL #: E22, G21, G28

Key Words: Long-term Loans, Economic Growth, Tobin's Q

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* Previous versions of this paper were presented at Institute for Posts and Communications Policy, Japan Society of Monetary Economics (Tohoku University), Fukushima University, and Hitotsubashi University. We were favored with valuable suggestions from M. Hanazaki, K. Suzuki, and A. Horiuchi as well as comments from attendants at the meetings of those institutes and workshops.

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1. Introduction

In post-war Japan, bank loans had been the major source of external funds for almost all firms. Except for few firms, internal financing was highly limited, and issuing corporate bonds had been strictly regulated until the mid 1980s. The typical Japanese firms relied heavily on bank borrowings to finance their investment funds. The bank based system generally worked well at least before financial liberalization. The "main bank" system was a typical feature of the system that had played an important role in reducing the agency costs of Japanese firms. However, in the Japanese bank based system, some of the firms also benefited from the policy-based allocation of "long-term loans".

Among Japanese policymakers, there was an implicit agreement that the policy-based finance allocated to specific fields of industry was successful in supporting the postwar high-growth. In particular, it was an implicit common sense that long-term funds provided by long-term credit banks and the Japan Development Bank played an important role for high economic growth. From the macroeconomic viewpoint, the policy-based allocation of long-term funds is warranted, if the allocated long-term funds had great external effects in increasing capital stock and production. However, if the financial market is perfect, the arbitrage between short-term and long-term loans works well. In such a case, it is indifferent for the corporations whether their investments are financed with long-term funds or with rolled-over short-term funds (i.e., "the Modigliani-Miller theorem"). It is, thus, not self-evident whether the policy-based allocation of long-term loans could effectively increase capital stock and production of specific corporations or not.

In previous literature, there are several empirical studies that stressed the role of Japan Development Bank's loans (henceforth called "JDB loans") in increasing capital stock and production of specific industries and corporations. For example, Horiuchi and Sui [1993] carried event studies of corporations listed on Tokyo Stock Exchange Second Section, and demonstrated JDB loans were apt to increase capital investment. Calomiris and Himmelberg (1994) carried the similar studies, using company-specific data in the overall machinery industry, and came up with an outcome supporting the pump-priming effect of JDB loans. [1]

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[1] Higano (1986) is one of the earliest studies that reached the same conclusions without rigorous analysis. To the contrary, Horiuchi and Otaki (1987) analyzed related issues by using industry-level macro data, and proved that such effects were scanty in many industries. Beason and Weinstein (1996) also came to a paradoxical

From the macroeconomic viewpoint, however, the weights of JDB loans among total external borrowings were not so high except for a few corporations. This paper, thus, empirically examines whether the total long-term loans — not only JDB loans but also including private long-term loans — had an effect of increasing capital investment of specific corporations in post-war Japan. In previous literature, a series of papers by Teranishi, et al. (e.g., Teranishi (1982), Takei and Teranishi (1991)) are outstanding studies, which proved that the policy-based allocation of the long-term loans contributed to increasing capital stock and production of specific industries during the high-growth period in postwar Japan. However, the analyses by Teranishi and others relied solely on the aggregated time-series data. In contrast, this paper tries to examine the appropriateness of their concept by estimating standard investment functions based on the panel data of individual Japanese firms.

In previous literature, there have been a large number of studies which estimate investment functions, using the panel data of Japanese firms.[2] In particular, Hoshi, Kashyap and Scharfstein (1990, 1991) estimated investment functions taking account of the role of "main banks" and demonstrated that a company belonging to an affiliated business group ("keiretu") was less restricted by the liquidity constraint.[3] Although both the main bank and policy-based allocation of long-term funds were inherent features of Japan's financial market in the high-growth period, the mechanism of affecting investment are intrinsically different from each other. That is, finance by main banks took the form of rolled-over short-term loans, and played the roles of easing short-term liquidity constraints. In contrast, long-term funds are provided in anticipation of mid- and long-term growth of corporations. Therefore, at least when arbitrage did not function well between the short-term and long-term financial markets, the allocation of long-term loans had an effect of lessening credit crunches of long-term investment funds.

In the following analysis, we estimate Tobin's Q investment functions and examine whether the long-term loan ratio has an additional positive effect on investment.

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conclusion that the more dependent an industry was on JDB loans, the lower was its growth rate.

2 For example, Asako, Kuninori, Inoue, and Murase (1989, 1997), Hayashi and Inoue (1991) and Suzuki and Ogawa (1997).

3 The conclusions of Hoshi et al. were confirmed by, for example, Okazaki and Horiuchi (1992) and Ogawa and Suzuki (1997). Hayashi (1997), however, asserts that the conclusions of Hoshi et al. are not robustly supported when excluding some outliners.

The data is based on the corporation-specific financial data from NIKKEI NEEDS in the five industries of iron & steel, nonferrous metals, chemicals, electrical equipment and transportation equipment. Provided that the concept mentioned above is right, restrained long-term loans would have restricted investment before the financial liberalization, even if corporations had a high Tobin's Q and a big size of cash flow. The first purpose of this paper is thus to examine whether the ratio of long-term loans to total loans had an additionally positive effect on investment in the sample period prior to the financial liberalization.

As the financial liberalization progresses, however, arbitrage between long-term and short-term funds began to work in the financial market. As a result, in the recent Japanese economy, it becomes natural to suppose that long-term loans have lost their policy-based roles and that only the fundamental variables have an impact on investment decisions. The second purpose of this paper is thus to examine how well such a diminished role of long-term funds can be confirmed by the estimation of investment function of Japanese firms for two alternative periods of 1972-1984 and 1985-1996.[4]

In the estimated investment functions, we find that even if we allow various fundamental variables such as Tobin's Q, profit, and cash flow, the coefficient of long-term loan ratio is always significantly positive for the sample period 1972-1984. However, for the sample period 1985-1996, the coefficient of long-term loan ratio is never significantly positive. This implies that long-term loans which had important roles for investment before the financial liberalization came to lose their effect on investment during a past two decade.

This paper is organized as follows. Section 2 discusses the roles of long-term funds for investment. Section 3 sets out the investment functions and explains the data which are used to test the theoretical hypotheses. Section 4 explains the construction procedure of capital stock and Tobin's Q. Section 5 presents the estimate results of the investment functions when the long-term fund ratios are added to explanatory variables. Section 6 examines whether long-term funds have any different influences on investment between keiretsu-affiliated and non-affiliated firms. Section 7 investigates the influences the ratio of long-term loans on Tobin's Q. Finally, section 8 puts together the major results of the analysis and discusses remaining issues.

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[4] In this connection, Fukuda, Ji, and Nakamura (1998), using corporation specific data, demonstrated that the structure of corporate demand for long-term funds substantially changed in the mid-1980s.

2 The Roles of Long-Term Funds

If the policy-based allocation of long-term funds can increase capital stock and production, then it may be justified to allocate long-term funds preferentially to those industries and corporations that have large positive external effects for macro economy. However, the Modigliani-Miller theorem implies that if the financial market works perfectly, individual firms are indifferent whether its investment is financed with long-term funds or short-term funds.[5] It is, thus, not clear whether the policy-based allocation of long-term funds could have any contribution to increasing investment of specific industries or firms.

One possible case where the policy-based allocation of long-term funds works well may arise when the financial market is highly regulated at the developing stages of an economy. For example, it is well known that the Japanese government had taken aggressive strategies of allocating long-term funds to specific industries from the postwar rehabilitation period to the high-growth period. Since the government set long-term interest rates much lower than short-term interest rates, the policy-based allocation meant that the borrowers received a kind of subsidy that served their growth. Furthermore, since the policy-based allocation of long-term funds was determined as a series of governmental economic plans, it was combined with other policy measures such as investment tax credit. As a result, the allocation of the long-term funds implied that the government would keep supporting the borrowing firms or industries from various policy measures. In other words, the policy-based allocation of funds could give signals of the government's fostering a specific industry and served to provide information on mid- and long-term growth of the borrowing corporations during the high growth period in Japan.

In addition, to the extent that information asymmetry exists in the financial market, the policy-based allocation of long-term funds may have provided additional information about mid- and long-term growth of the borrowers. In the Japanese financial market, it was pointed out that main banks' monitoring provided information about borrowing companies in terms of short-term financing. However, it would be difficult for the main banks to provide mid-term and long-term information about

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[5] Diamond (1991, 1993) showed that even with no institutional regulation, individual corporations are not indifferent towards whether to borrow long-term funds or to roll over short-term funds for financing capital investment, in the case of market failure occurring due to information asymmetry.

corporate growth, since the main banks, such as city banks and local banks, have traditionally been engaged in providing short-term funds. Particularly, since information has a property of public goods, profit-maximizing private banks could not afford to provide sufficient information about the growth prospect of corporations that are expected to have substantial positive external effects on other corporations. Thus, the policy-based allocation of long-term funds could be evaluated from a different point of view than the provision of short-term information by private financial institutions such as main banks.

3 The Estimated Equation and the Data

Based on the theoretical hypothesis discussed in the preceding section, we shall identify what additional effects the long-term loan ratio had on individual corporations' investments. In identifying the effects, we use individual corporations' financial data and estimate the following Tobin's Q type investment functions.

(1) $I_t/K_t =$ Constant term + $\alpha * X_{t-1} + \beta * \cdot LONG_{t-1}$

where I_t = investment amounts in the period t, K_t = capital stocks in the period t, X_t = fundament variables in the period t, such as Tobin's Q, profit, and cash flow, and $LONG_t$ = the long-term loan ratio in the period t-1. As referred to in the next section, K_t and Tobin's Q are converted into the market values.

In contrast with the standard investment functions, the long-term loan ratio ($LONG_t$) is added to the explanatory variable in eq. (1). This is because in the case that long-term funds impose different restrictions than short-term loans on investment, the size of long-term fund ratio is supposed to affect the size of investment, even if the total amounts of loans are the same. Providing that the concept mentioned in the preceding section holds true, thus, the long-term loan ratio is supposed to have had a significantly positive impact on investments in the period before the financial liberalization. Since the impact of each fundamental variable is also positive, both coefficients α and β are, hence, expected to be significantly positive before the financial liberalization. After the financial liberalization, on the other hand, the fundamental variables have a positive effect on investments, but the long-term loan ratio itself is supposed to have a diminished effect on investments since arbitrage between long-term and short-term funds works. Thus, it is expected that only coefficient α has a statistically significant positive value and that coefficient β becomes less significant.

In the following analysis, bank loans are divided into long-term and short-term ones.

Loans with a maturity exceeding one year are defined as "long-term loans" and the ratio of long-term loans to total loans is defined as "long-term loan ratio". We use this definition because the maturities of bank loans are classified only into those below and above one year in the financial data. As fundamental variables X_t's, we use not only Tobin's Q but also profit and cash flow that are normalized by dividing by the market value of capital stock respectively. In order to avoid the problem of instantaneity bias, all the variables are estimated with a lag of one period.

The investment functions are estimated by an industry-specific panel analysis (the fixed effect model and random effect model) including corporation dummies and time dummies. All the data used for estimation are based on the data set contained in NEEDS-COMPANY by Nihon Keizai Shinbun. Those data are originally based on individual corporations' financial reports listed on the Tokyo Stock Exchange First-Section and Second-Section. The data used cover the period from 1970 through 1996. The estimation period is from 1972 through 1996.[6] The analysis covers corporations belonging to the five industries of iron and steel, nonferrous metals, chemicals, electrical equipment, and transportation equipment (including ship building and automobile manufacturing). As to those corporations whose data were partially missing in the estimation period, their samples are included by using an unbalanced panel analysis.

4 The Estimation of Capital Stock

The data used in our estimation basically depend on each individual corporation's financial data. In calculating the market value of capital stocks, we first apply the perpetual inventory method for four types of capital stocks: (a) buildings and structures, (b) machinery and equipment, (c) vessels and vehicles, and (d) land. We then added up the converted capital stocks to calculate the aggregate capital stocks of individual corporations.[7] Except for land, the values of 1970 were taken as the benchmark, on the assumption that this year's book values of individual capital stocks are equal to their market prices.[8]

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[6] Many companies close their books in March, but not all the companies covered by the analysis did so. Data are, thus, arranged on the basis of calendar year when books were closed.

[7] Tools, apparatus and fixtures are not included in capital stocks, because their values are much smaller than those of other capital stocks.

[8] For example, discrepancies at the time of 1970, if any, would have less substantial

For deflector, we used the wholesale price index (p^{Ii}_t) corresponding to each investment goods i. Specifically, we used the wholesale price index of construction materials for buildings and structures, the wholesale price index of machinery and tools for machinery and equipment, and the wholesale price index of transportation equipment for vessels and vehicles as the deflectors. Each nominal gross investment is calculated by adding the book values of capital depreciation to the increments of each fixed asset.[9] Dividing the nominal gross investment by the investment goods deflector results in the real gross investments ($I_{i,t}$) of each individual tangible fixed asset.

The physical depreciation rate of capital stocks (d^i) is calculated according to Hayashi and Inoue (1991) and Hulten and Wykoff (1981). They estimate the rates of asset depreciation at 0.047 for buildings and adjunctive equipment, at 0.09489 for machinery and equipment, and at 0.1470 for vessels and vehicles and transportation equipment.[10]

Upon obtaining the bench marks for capital stocks, real gross investments, and depreciation rates, we can calculate the real values of each individual capital stocks represented by the index i by the following expression:

$$(2) \quad K_{i,t} = (1-d^i)K_{i,t-1} + I_{i,t}$$

The market value of capital stocks ($p^{Ii}_t K_{i,t}$) can be obtained by multiplying the real stock values by the deflector of capital goods (p^{Ii}_t).

The series of land stock are also calculated using the perpetual inventory method. The benchmark year is 1970, as is the case with other stocks. However, since the discrepancies between the market prices and book values were large, the benchmark for the market prices of land was obtained by multiplying the book values in 1970 by a 5.27. The value of 5.27 is the average ratio of market price to book value in 1970 calculated by Ogawa and Kitasaka (1998). In calculating the ratio, they divided the market prices of the land owned by private non-financial corporations capitalized less than ¥10 million by the book values of the land owned by overall industry, based on

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effect on estimation, since the estimation periods start from 1972.

[9] Data from the NIKKEI NEEDS do not tell the book values of capital stock-specific depreciation, so that the book values of capital stock-specific depreciation were calculated by allocating the total book values of capital stock depreciation (net of land) in proportion to the book values of each individual capital stock.

[10] For the depreciation rate of structures, estimated at 0.0564 by Hulten and Wykoff, we used a 0.047 rate identical to that of buildings and adjunctive equipment.

the Annual Report on National Accounts (the Economic Planning Agency) and the Quarterly Corporations Statistics (the Ministry of Finance).

The increases in the market value of land are calculated by the increases in the book values. However, the decreases in the book value of land, i.e. sold-out land, are converted into market prices based on the LIFO (last-in-first-out) assumption that the sold-out land was purchased at the last purchase point of time. In previous studies, Hoshi and Kashyap (1990), Ogawa (1990) and Ogawa and Suzuki (1997) used the similar assumption. The land price (p^L_t) used for the deflector is the "national index of urban land" (the average price for overall purposes), excluding six major cities, based on the Index of Urban Land Price (Japan Real Estate Institute).

Define the increase in the book value of land by $ILAND_t$ and its decrease by $DLAND_t$. Then, the market value of land investment ($NILAND_t$), the market value of land stock ($LANDY_t = p^L_t L_t$), and the real value of land net investment (IL_t) can respectively be calculated by the following equations:

(3) $NILAND_t = ILAND_t - (p^L_t/p^L_{t-1})*DLAND_{t,}$

(4) $LANDY_t = (p^L_t/p^L_{t-1})*DLAND_{t-1} + NILAND_{t,}$

(5) $IL_t = (ILAND_t/p^L_t) - (DLAND_t/p^L_{t-1}),$

On the other hand, Tobin's average Q is calculated as follows:

(6) $$\text{Tobin's Q} = \frac{V_t + LIB_t - CUR_t - CONSR_t - INTAN_t - OTHER_t - DEF_t}{\sum_i P_t^{Ii} K_{i,t-1}}.$$

where V_t = corporation's market price represented by its share price, LIB_t = total liabilities, CUR_t = current asset, $CONSR_t$ = construction in process, $INTAN_t$ = intangible fixed asset, $OTHER_t$ = financial investment and other assets, and DEF_t = deferred asset. [11]

In the following analysis, we estimate the investment functions based on the market value of capital stock with and without land. Hence, when we use the market value of capital stock without land, we calculate the Tobin's Q by deducting the market value of land ($p^L_t L_t$) from both numerator and denominator in (6).

Table 1 shows average values and standard deviations of estimated Tobin's Qs with

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[11] Except for stock prices, any of the variables is based on the financial data of individual corporations. Share prices are stock prices adjusted for dividend off.

and without land in the five industries of iron and steel (50 companies), nonferrous metals (76 companies), chemicals (125 companies), electrical equipment (186 companies) and transport equipment (79 companies, including shipbuilding and automobile manufacturing). It indicates that Tobin's Q without land has a smaller standard deviation than Tobin's Q with land, which suggests that Tobin's Qs have small dispersions without land in each industry. By contrast, in the electrical equipment industry, the values of Tobin's Q as well as standard deviations are large in general. Regardless of whether land is included in capital stocks, the average value of Tobin's Qs is close to 1 in other four industries (iron and steel, nonferrous metals, chemicals and transportation equipment), which is consistent with the economic theory.

5 The Results of Estimation

This section estimates an investment function represented by eq. (1), using the data series of "capital stock" and "Tobin's Q" prepared in the preceding section. According to Fukuda, Ji, and Nakamura [1998], the financial liberalization in the mid-1980s have caused a substantial structural change in the flow of long-term funds. We thus split the period of estimation into 1972-84 (before the financial liberalization) and 1985-96 (after the financial liberalization). We then attempt a panel analysis of the fixed effect model and the random effect model, including a corporation dummy and time dummy, with respect to each of the five industries (iron and steel, nonferrous metals, chemicals, electrical equipment and transport equipment).[12]

Table 2 shows the results of estimation, using capital stocks including land. The results for the period of 1972-84 are shown in Table 2-1 and those for the period of 1985-96 in Table 2-2. Firstly, the estimates of "α", which is the coefficient of fundamental variables, are positive both before and after the mid-1980s, and supports the standard theoretical results. The results remain the same even when either Tobin's Q, the profit rate, or cash flow is used as a fundamental variable. The t-values are also statistically significant, except for the random effect model for the iron and steel industry.

However, the estimates of "β", which is the coefficient of the long-term loan ratio, are completely different between 1972-84 and 1985-96. That is, the estimates of β are all positive in 1972-84. In particular, t-values are significantly different from zero except for chemicals, and the results have goodness of fit. The result supports the hypothesis

[12] Since shipbuilding is peculiar in the transportation industry, estimations were attempted for both of the cases including and excluding shipbuilding firms.

that even with the total amounts of loans being given, the long-term loans had an additional positive impact on investment before the financial liberalization.

In 1985-96, by contrast, the estimates of β never take a significantly positive value. In the two industries of iron/steel and nonferrous metals, they are positive but are not statistically significant. In the three industries of chemicals, electrical equipment and transportation equipment, they become negative. This means long-term loans have had no significantly positive impact on investment after the mid-1980s when the financial liberalization progressed.

The above results are robust even when we use different explanatory variables. For example, Table 3 indicates the results of estimation when we use capital stocks without land. The comparison between Table 2 and Table 3 show slight differences in the estimates of individual coefficient. However, the estimates in both tables are almost similar in sign and statistical significance, which supports our hypothesis even in the case that capital stocks do not include land.

In Table 4, we set out the results of estimation in the case where both Tobin's Q and profit (or cash flow) are used as explanatory variables to estimate eq. (1).[13] The theory implies that Tobin's Q is a sufficient statistic for investment if the market works perfectly. However, previous empirical studies showed that since corporations face with liquidity constraints, profits and cash flows have an important explanatory power in estimating an investment function even if Tobin's Q is included in the explanatory variable. The results in Table 4 reconfirm this previous result in any industry and any period, suggesting that many Japanese corporations faced with liquidity constraints throughout the periods.

However, as far as we focus our attention to the coefficient of long-term loan ratio, "β", the inclusion of plural fundamental variables has nothing to do with the estimated results. That is, Table 4 shows that as in Table 2, the estimates of "β" are all positive in the 1972-84 period, while those in the 1985-96 period never take significantly positive values. This indicates that although profit or cash flow might ease the short-term liquidity constraints, they could never help reducing the constraints of long-term funds before the financial liberalization. This implies that the long-term constraints should be separated from the short-term liquidity constraints at least before the financial liberalization in Japan.

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[13] Without loss of generality, we reported the case where capital stocks include land in Table 4.

6 The Roles of the Keiretsu Corporate Grouping

In the preceding section, we have demonstrated that up to the mid-1980s, a higher ratio of long-term loans had a positive effect on investment even when we include fundamental variables such as Tobin's Q in the explanatory variables. We have also indicated that the effect of the long-term loan ratio has nothing to do with the size of profit or cash flow, and that the constraints due to a shortage of long-term funds are essentially different from short-term liquidity constraints caused by a shortage of cash flows.

This section examines the robustness of the latter implication by looking at whether the effect of long-term loan ratio on investment is different between keiretsu-affiliated corporations and non-affiliated ones. Some of previous studies proposed that a corporation belonging to a keiretsu corporate grouping faces lesser liquidity constraints. If policy-based allocation of long-term loans is an alternative means to ease liquidity constraints, then the proposition implies that the allocated long-term loans would have had stronger effects on investment for non-affiliated corporations than for affiliated one.

Loans from main banks, however, are basically short-term funds and have the role of easing short-term liquidity constraints such as working funds. By contrast, the policy-based long-term funds are provided in anticipation of mid- and long term prospects of a corporation. Therefore, at least in the period when arbitrage between the short-term and the long-term funds did not function well, the allotment of long-term funds might have served to lessen the constraints of long-term funds.

Splitting corporations belonging to the five industries, covered by our analysis in the previous section, into two groups of keiretsu-affiliated corporations and non-affiliated ones, we shall estimate an investment function represented by eq. (1) with respect to each group. We compare the estimates of "β", a coefficient to indicate the effects of long-term fund ratio on investment, between keiretsu-affiliated corporations and non-affiliated ones. As far as the above conception is correct, no substantial differences are supposed to exist between keiretsu-affiliated corporations and non-affiliated ones concerning the effects of long-term loans on investment

Based on the 1995 version of Keiretsu no Kenkyu by the Economic Research Institute, the corporations belonging to the four corporate groupings or the six corporate groupings are assorted into "keiretsu-affiliated companies" and the others are assorted into "non-affiliated companies". The period of time covered by the following analysis is 1972-84. This is because the preceding section observed that long-term funds had a positive effect on investment in this period. As the result of splitting corporations into two groups, the sample size for each estimation becomes reduced. Thus, in the following estimations, we attempt a panel analysis by way of pooling all the data of corporations belonging to the five industries, rather than make industry-specific estimations.

Table 5 reports the results of estimation when we use capital stock including land. Firstly, the estimates of "α", which is the coefficient of fundamental variables, take positive values regardless of whether corporations belong to keiretsu corporate groupings or not, and their t-values are all significantly different from zero. However, the coefficients of Tobin's Q are bigger for keiretsu-affiliated companies than for non-affiliated companies, which may show keiretsu-affiliated companies have closer relations between Tobin's Q and investment and less effects from liquidity constraints.

The estimates of "β", which is the coefficient of "long-term fund ratio", take positive values regardless of whether corporations belong to keiretsu-affiliated groupings or not. The estimates themselves are almost the same between corporate groups, or, on the contrary, they are a little bit larger for keiretsu-affiliated companies than those for non-affiliated ones. These results clearly do not support the hypothesis that even before the mid-1980s, long-term funds had larger effects on the investments of non-affiliated companies than on the investments of keiretsu-affiliated companies. It is thus evident that long-term funds had not served as an alternative to ease short-term liquidity constraints in non-affiliated companies.

Our findings, however, indicate that long-term funds have a slightly bigger effect on the investments of keiretsu-affiliated companies than on those of non-affiliated ones. This property of long-term funds is not so much significant statistically. However, if that is true, main banks and long-term funds have mutually supplemental effects on easing liquidity constraints. That is, long-term funds had significantly affected investments at least until the mid-1980s, while they had been more effective in the way of corporate groups whose liquidity had been less limited because of the main bank's support. This consequence conforms to the hypothesis attained by Horiuchi and Sui [1993] , and would be worthy of closer scrutiny in our future researches.

7 The Effects of Long-term Funds on Tobin's Q

The results of the estimations in the previous sections have illustrated that even if we added fundamental variables to explanatory variables, a higher ratio of long-term funds has a positive effect on the amounts of investment before the financial liberalization. This implies that before the financial liberalization, investment was substantially restrained even in a corporation with favorable investment opportunities, unless they could borrow as much long-term funds as necessary. In other words, as a corporation had easier access to long-term funds, it could more easily realize favorable opportunities for investment and achieved higher growth before the financial liberalization.

However, throughout these studies, it was not clear how the ratio of long-term funds affects the fundamental value of each corporation. The analysis in this section is thus aimed at identifying how the size of the ratio of long-term loans to total loans affects the fundamental corporate values represented by Tobin's Q. If long-term funds can ease mid- and long-term financial constraints, then a corporation with larger long-term funds will have higher potential to realize their investment opportunities. Thus, a corporation with larger long-term funds can have a larger Tobin's Q in this respect. However, an increase in capital stock due to eased constraints on funds reduces the marginal productivity of capital, which in turn has a negative effect on Tobin's Q. Therefore, the total effects of the long-term fund ratio on Tobin's Q are theoretically ambiguous, even if long-term funds have an effect of easing mid- and long-term limitations on funds.

To identify the total effects of the long-term fund ratio on Tobin's Q, we regress Tobin's Q on both fundamental variables and the long-term fund ratio. Specifically, we estimate the following equation by a panel analysis including constant terms, using the same financial data used in the previous sections.

$$(7) \quad Q_t = \text{constant term} + a{*}P_{t\text{-}1} + b{*}LONG_{t\text{-}1} + \eta_t$$

where Q_t = Tobin's Q in t-period and $P_{t\text{-}1}$ = profit or cash flow in t-1 period.

In eq. (7), all the variables lag at one period in order to avoid the problem of simultaneous bias. In calculating $P_{t\text{-}1}$, both profit and cash flow are normalized by dividing by the market values of tangible fixed assets. As a corporation has a higher profitability, Tobin's Q would become bigger, so that the coefficient "*a*" is supposed to be positive. However, since the total effects of the long-term fund ratio on Tobin's Q are theoretically ambiguous, the sign of "*b*" is not determined a priori.

Table 6 illustrates the estimates in the case where capital stocks including land are used in Equation (7). The estimates for the period of 1972-84 are shown in Table 6-1 and those for the period of 1985-96 in Table 6-2. The estimates of "*a*", which is the coefficient of fundamental variables, are all positive in the estimate periods both before and after the mid.1980s. The result supports the standard hypothesis that the higher is profitability, the larger is Tobin's Q. The t-values are also significantly different from zero for the estimates of "*a*".

The estimates of "*b*", which is the coefficient of "long-term loan ratio", are, on the other hand, much different between 1972-84 and 1985-96. The sign of "*b*" is not definite in the estimations for 1972-84, varying industry by industry. By contrast, it is observed in the estimations for 1985-96 that "*b*" is all negative in the sign. Particularly, in some of the industries of iron and steel, chemicals and electrical equipment, t-values are significantly different from zero. It is evident, thus, that an increase in the long-term loan ratio is apt to significantly decrease Tobin's Q after the financial liberalization.

8 Concluding Remarks

In this paper, we have estimated investment functions of Japanese corporations in order to identify how the allocation of long-term funds contributed to facilitating corporate growth. In the postwar Japan, the government had allocated long-term funds to specific sectors until the introduction of the financial liberalization. As a result, our estimations have demonstrated that before the financial liberaliazation, corporations with a higher ratio of long-term loans made significantly high investments, regardless of fundamental variables such as Tobin's Q. In particular, our estimations have made it clear that the roles played by long-term funds are independent of the sizes of corporate cash flows and of whether a corporation belongs to a keiretsu corporate grouping. This finding suggests that long-term loans had facilitated the potential of corporate growth in a different way than main banks did, before the financial liberalization.

The financial liberalization, however, has remarkably increased the substitutability between long-term and short-term bank loans, as well as that between bank loans and corporate bonds. This implies that after the financial liberalization, the flow of long-term funds began to be determined by market mechanism rather than by the government policy. Our estimations have supported this view and could not find that a higher ratio of long-term loans gave the incentive to make significantly big amounts of investment after the mid 1980s.

In interpreting our estimation results, however, we need to keep in mind several limitations of our analysis. First, because of using corporation-specific data, we cannot identify whether policy-based long-term loans enhanced the potential of industry-wide growth in a target industry. In particular, since our analysis focused on the manufacturing industry, we are not sure that the above conclusions also hold true in non-manufacturing industries. During the high-growth era, significant amounts of long-term funds were allocated to infrastructure-related industries such as power utilities and urban developments, rather than to the manufacturing industry. Thus, it remains for our future researches to see how well the main results in this paper will hold when we include the non-manufacturing industries in our samples.

Second, we need to remember that the policy-based allocation of long-term funds had not necessarily aimed at promoting the growth, but rather had played a role of structural adjustments under some circumstances. For example, in some industries, the policy-based long-term funds were not allocated to several successful corporations because their superior projects were able to be successful without policy-based long-term funds. In other industries, the allocation was targeted at declining sectors because of costly structural adjustments. In those industries, even if the policy-based allocation of long-term funds were successful, a negative inducing effect might be observed from a macroeconomic point of view.

Finally, we need to note that the recent allocation of long-term loans did not aim at fostering specific industries in many cases. In fact, the priority areas for long-term funds in the 1970s were land developments (local and urban developments) and the prevention of public pollution, and those in the 1980s were energy resources-related industries and sectors beyond the conventional industrial framework. The approach of this paper cannot evaluate these inter-industry allocations of long-term funds because it cannot capture repercussion effects of long-term funds beyond the industrial framework.

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Table 1 Descriptive Statistic of Tobin's Q

(1) The case of capital stock including land

	Average	Standard Deviation	Number of Samples
Iron & Steel			
1971-84	1.03603	1.66485	643
1975-84	1.05668	1.90303	471
1985-96	1.35711	1.04978	596
Nonferrous Metals			
1971-84	1.10598	1.09497	877
1975-84	1.06007	0.97028	641
1985-96	1.83458	2.10871	861
Chemicals			
1971-84	1.29397	1.80299	1549
1975-84	1.28881	1.84053	1127
1985-96	1.6025	1.62928	1456
Electrical Equipment			
1971-84	3.67443	8.05434	2004
1975-84	3.83776	8.81992	1466
1985-96	2.9081	4.99273	2088
Transportation Equipment			
1971-84	1.248	1.65817	954
1975-84	1.12298	1.36916	690
1985-96	1.17314	0.99024	896

(2) The case of capital stock not including land

	Average	Standard Deviation	Number of Samples
Iron & Steel			
1971-84	1.00985	2.19623	643
1975-84	1.02183	2.46776	471
1985-96	1.57453	1.69316	596
Nonferrous Metals			
1971-84	1.02067	2.21587	877
1975-84	0.89046	2.12955	641
1985-96	2.48359	4.49438	861
Chemicals			
1971-84	1.42381	2.87749	1549
1975-84	1.37989	2.69617	1127
1985-96	1.94832	2.55941	1456
Electrical Equipment			
1971-84	5.36245	13.80353	2004
1975-84	5.35215	14.39372	1466
1985-96	4.03135	8.50317	2088
Transportation Equipment			
1971-84	1.3346	2.51165	954
1975-84	1.11799	1.92877	690
1985-96	1.36135	1.72395	896

Table 2 Estimation of Investment Function by Industry
- The Case of Capital Stock Including Land

(1) The Period of Estimation : 1972-1984

Iron & Steel	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.01969	3.36905 ***	0.00364	1.21368
Long-term Loan Ratio	0.15852	4.00559 ***	0.08619	3.32876 ***
Hausman Test			0.00060	
Profit Rate	0.23928	5.92602 ***	0.23996	6.60785 ***
Long-term Loan Ratio	0.13412	3.81007 ***	0.07726	3.34671 ***
Hausman Test			0.09110	
Cash Flow	0.48316	6.88681 ***	0.49278	7.82164 ***
Long-term Loan Ratio	0.12517	3.58300 ***	0.07731	3.43371 ***
Hausman Test			0.19270	

Nonferrous Metals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.02929	7.40403 ***	0.02114	6.76576 ***
Long-term Loan Ratio	0.12175	5.49077 ***	0.05204	3.57734 ***
Hausman Test			0.00000	
Profit Rate	0.04544	4.25576 ***	0.06079	6.21874 ***
Long-term Loan Ratio	0.09952	4.52212 ***	0.04533	3.27160 ***
Hausman Test			0.00000	
Cash Flow	0.03248	3.09956 ***	0.04514	4.47638 ***
Long-term Loan Ratio	0.10155	4.59238 ***	0.04896	3.41484 ***
Hausman Test			0.00000	

Chemicals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.01759	6.12598 ***	0.01528	7.74153 ***
Long-term Loan Ratio	0.01348	0.67343	0.00337	0.25623
Hausman Test			0.41570	
Profit Rate	0.23751	6.63199 ***	0.23724	8.61837 ***
Long-term Loan Ratio	0.02587	1.33921	0.02241	1.72260 *
Hausman Test			0.97100	
Cash Flow	0.64533	10.16410 ***	0.60358	12.27330 ***
Long-term Loan Ratio	0.00331	0.17420	0.00193	0.15407
Hausman Test			0.56980	

Electrical Equipment	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.00713	9.09618 ***	0.00311	8.28647 ***
Long-term Loan Ratio	0.05728	4.33098 ***	0.03138	3.68161 ***
Hausman Test			0.00000	
Profit Rate	0.08984	10.17110 ***	0.10536	19.19240 ***
Long-term Loan Ratio	0.03709	2.94382 ***	0.02653	3.24918 ***
Hausman Test			0.05640	
Cash Flow	0.12675	8.78237 ***	0.18321	19.07750 ***
Long-term Loan Ratio	0.04108	3.24313 ***	0.02295	2.86690 ***
Hausman Test			0.00000	

Transportation Equipment (including shipbuilding)	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.01353	5.51411 ***	0.00828	5.22660 ***
Long-term Loan Ratio	0.05994	3.07577 ***	0.01561	1.37328
Hausman Test			0.00020	
Profit Rate	0.50024	11.84460 ***	0.38309	10.88100 ***
Long-term Loan Ratio	0.05288	25.94311 ***	0.02711	2.37180 **
Hausman Test			0.00000	
Cash Flow	0.38470	7.67576 ***	0.35071	8.74403 ***
Long-term Loan Ratio	0.06353	3.39113 ***	0.02816	2.34296 **
Hausman Test			0.02980	

Transportation Equipment (excluding shipbuilding)	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.01332	5.46319 ***	0.00800	5.02923 ***
Long-term Loan Ratio	0.04652	2.38107 **	0.01276	1.10863
Hausman Test			0.00110	
Profit Rate	0.52497	11.07710 ***	0.38382	10.06270 ***
Long-term Loan Ratio	0.04489	2.48040 **	0.02632	2.29220 **
Hausman Test			0.00000	
Cash Flow	0.44113	8.10354 ***	0.38049	8.89105 ***
Long-term Loan Ratio	0.05211	2.78745 ***	0.02337	1.92902 *
Hausman Test			0.03450	

*** significant at a 1% level, ** significant at a 5% level , and * significant at a 10% level

Table 2 Estimation of Investment Function by Industry
- The Case of Capital Stock Including Land

(2) The Period of Estimation : 19785-1996

Iron & Steel	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.02102	4.72586 ***	0.01963	5.30099 ***
Long-term Loan Ratio	0.01261	0.50685	0.01802	1.20266
Hausman Test			0.80200	
Profit Rate	0.33697	6.35166 ***	0.30004	6.89531 ***
Long-term Loan Ratio	0.01606	0.65757	0.01992	1.33725
Hausman Test			0.44880	
Cash Flow	0.41463	4.60787 ***	0.41897	5.54659 ***
Long-term Loan Ratio	0.00776	0.31281	0.01684	1.13713
Hausman Test			0.89930	

Nonferrous Metals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.02340	12.05080 ***	0.01633	13.27620 ***
Long-term Loan Ratio	-0.00571	-0.38356	0.00305	0.30521
Hausman Test			0.00000	
Profit Rate	0.21989	11.38240 ***	0.24469	15.41560 ***
Long-term Loan Ratio	0.00113	0.07496	0.00304	0.30275
Hausman Test			0.07410	
Cash Flow	0.55194	7.03328 ***	0.61720	10.31280 ***
Long-term Loan Ratio	0.00303	0.19062	-0.00225	-0.19997
Hausman Test			0.39370	

Chemicals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.01606	10.62500 ***	0.01465	11.84170 ***
Long-term Loan Ratio	-0.02827	-2.92174 ***	-0.01444	-2.30441 **
Hausman Test			0.02680	
Profit Rate	0.56287	13.99360 ***	0.41394	14.00530 ***
Long-term Loan Ratio	-0.03662	-3.91507 ***	-0.01241	-1.89925 *
Hausman Test			0.00000	
Cash Flow	0.82438	13.21670 ***	0.59493	14.52390 ***
Long-term Loan Ratio	-0.03081	-3.26878 ***	-0.01405	-2.27245 **
Hausman Test			0.00000	

Electrical Equipment	Fixed Effect Model			Random Effect Model		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Tobin's Q	0.00665	16.31400	***	0.00535	15.37660	***
Long-term Loan Ratio	-0.05797	-6.15343	***	-0.03975	-5.68001	***
Hausman Test				0.00000		
Profit Rate	0.01299	3.31561	***	0.03076	9.47366	***
Long-term Loan Ratio	-0.07549	-7.42380	***	-0.04531	-5.99826	***
Hausman Test				0.00000		
Cash Flow	0.03501	4.50396	***	0.07102	10.90000	***
Long-term Loan Ratio	-0.07560	-7.45556	***	-0.04490	-6.04456	***
Hausman Test				0.00000		

Transportation Equipment (including shipbuilding)	Fixed Effect Model			Random Effect Model		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Tobin's Q	0.02641	9.73145	***	0.02272	9.45658	***
Long-term Loan Ratio	-0.07390	-5.58965	***	-0.03386	-3.75077	***
Hausman Test				0.00000		
Profit Rate	0.30828	5.43849	***	0.33144	7.00603	***
Long-term Loan Ratio	-0.09195	-6.91573	***	-0.03874	-4.56754	***
Hausman Test				0.00000		
Cash Flow	0.38173	7.34442	***	0.42873	9.76243	***
Long-term Loan Ratio	-0.09397	-7.18984	***	-0.03667	-4.60130	***
Hausman Test				0.00000		

Transportation Equipment (excluding shipbuilding)	Fixed Effect Model			Random Effect Model		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Tobin's Q	0.02653	9.00998	***	0.02284	8.95300	***
Long-term Loan Ratio	-0.07830	-5.67609	***	-0.03054	-3.32208	***
Hausman Test				0.00000		
Profit Rate	0.47898	6.96148	***	0.45624	8.30453	***
Long-term Loan Ratio	-0.09474	-6.98014	***	-0.03627	-4.22991	***
Hausman Test				0.00000		
Cash Flow	0.41830	7.64527	***	0.45064	9.42059	***
Long-term Loan Ratio	-0.09920	-7.37539	***	-0.03876	-4.64083	***
Hausman Test				0.00000		

*** significant at a 1% level, ** significant at a 5% level, and * significant at a 10% level.

Table 3 Estimation of Investment Function by Industry
- The Case of Capital Stock not Including Land

(1) The Period of Estimation : 1972-1984

Iron & Steel	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.02094	4.00502 ***	0.00293	1.18518
Long-term Loan Ratio	0.18669	3.87254 ***	0.06937	2.51451 **
Hausman Test			0.00000	
Profit Rate	0.19477	6.31057 ***	0.19457	7.12831 ***
Long-term Loan Ratio	0.16264	3.79182 ***	0.08890	3.10400 ***
Hausman Test			0.06620	
Cash Flow	0.37328	6.72610 ***	0.38767	7.86953 ***
Long-term Loan Ratio	0.15095	3.52746 ***	0.08513	3.04626 ***
Hausman Test			0.12660	

Nonferrous Metals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.01275	5.34436 ***	0.01035	5.41164 ***
Long-term Loan Ratio	0.15741	5.64925 ***	0.07985	4.22287 ***
Hausman Test			0.00030	
Profit Rate	0.01896	2.40453 **	0.02660	3.55514 ***
Long-term Loan Ratio	0.12895	4.66814 ***	0.07106	3.65767 ***
Hausman Test			0.00120	
Cash Flow	0.01137	1.52323	0.01637	2.25505 **
Long-term Loan Ratio	0.13129	4.74521 ***	0.07186	3.64948 ***
Hausman Test			0.00160	

Chemicals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.01453	5.90531 ***	0.01296	7.38000 ***
Long-term Loan Ratio	0.02046	0.81826	0.00084	0.04999
Hausman Test			0.34560	
Profit Rate	0.29928	11.74630 ***	0.23447	13.09600 ***
Long-term Loan Ratio	0.04513	1.92745 *	0.03102	2.19584 **
Hausman Test			0.00130	
Cash Flow	0.66355	14.71750 ***	0.61330	16.73010 ***
Long-term Loan Ratio	0.01014	0.44286	0.00428	0.27676
Hausman Test			0.14020	

Electrical Equipment	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.00433	9.02277 ***	0.00203	7.61229 ***
Long-term Loan Ratio	0.06232	3.89284 ***	0.03520	3.33938 ***
Hausman Test			0.00000	
Profit Rate	0.09444	13.22770 ***	0.07363	18.25010 ***
Long-term Loan Ratio	0.04525	2.98386 ***	0.03750	3.64927 ***
Hausman Test			0.00090	
Cash Flow	0.14712	11.78210 ***	0.13994	19.26090 ***
Long-term Loan Ratio	0.05292	3.46623 ***	0.03268	3.36645 ***
Hausman Test			0.15840	

Transportation Equipment (including shipbuilding)	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.01224	6.53538 ***	0.00765	5.81919 ***
Long-term Loan Ratio	0.07303	3.04181 ***	0.02361	1.60600
Hausman Test			0.00010	
Profit Rate	0.37490	14.41180 ***	0.29698	13.07600 ***
Long-term Loan Ratio	0.06036	2.78617 ***	0.04482	2.96741 ***
Hausman Test			0.00000	
Cash Flow	0.34762	9.71679 ***	0.32043	10.81260 ***
Long-term Loan Ratio	0.07297	3.18682 ***	0.03885	2.60487 ***
Hausman Test			0.05400	

Transportation Equipment (excluding shipbuilding)	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.01203	6.50145 ***	0.00745	5.66550 ***
Long-term Loan Ratio	0.05457	2.28150 **	0.01946	1.31304
Hausman Test			0.00030	
Profit Rate	0.37131	13.09160 ***	0.28290	11.71300 ***
Long-term Loan Ratio	0.04868	2.22647 **	0.04157	2.75668 ***
Hausman Test			0.00000	
Cash Flow	0.38667	10.08800 ***	0.34227	10.92760 ***
Long-term Loan Ratio	0.05669	2.49727 **	0.03290	2.19933 **
Hausman Test			0.04980	

*** significant at a 1% level, ** significant at a 5% level , and * significant at a 10% level

Table 3 Estimation of Investment Function by Industry
- The Case of Capital Stock not Including Land

(2) The Period of Estimation : 1985-1996

Iron & Steel	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.01464	3.55132 ***	0.01374	3.86585 ***
Long-term Loan Ratio	0.01177	0.31602	0.01596	0.67648
Hausman Test			0.89130	
Profit Rate	0.23998	5.17110 ***	0.23857	6.18780 ***
Long-term Loan Ratio	0.01059	0.28837	0.01905	0.85964
Hausman Test			0.95590	
Cash Flow	0.28341	3.70388 ***	0.32331	4.76509 ***
Long-term Loan Ratio	0.00610	0.16419	0.01856	0.82218
Hausman Test			0.49890	

Nonferrous Metals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.00895	8.63041 ***	0.00719	9.61816 ***
Long-term Loan Ratio	0.00593	0.30010	-0.00277	-0.22178
Hausman Test			0.03950	
Profit Rate	0.10155	9.04343 ***	0.10733	11.35960 ***
Long-term Loan Ratio	0.01880	0.97655	0.00375	0.29715
Hausman Test			0.38610	
Cash Flow	0.42637	9.42043 ***	0.42380	11.21760 ***
Long-term Loan Ratio	0.02389	1.24507	0.00718	0.55368
Hausman Test			0.49070	

Chemicals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.00913	8.00727 ***	0.00840	8.96572 ***
Long-term Loan Ratio	-0.02082	-1.78836 *	-0.01051	-1.44074
Hausman Test			0.21370	
Profit Rate	0.38000	12.03480 ***	0.28356	12.19400 ***
Long-term Loan Ratio	-0.02793	-2.47049 **	-0.00490	-0.63917
Hausman Test			0.00000	
Cash Flow	0.58952	14.07110 ***	0.52588	15.96340 ***
Long-term Loan Ratio	-0.01926	-1.73509 *	-0.00995	-1.27082
Hausman Test			0.02160	

Electrical Equipment	Fixed Effect Model			Random Effect Model		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Tobin's Q	0.00428	13.79430	***	0.00331	13.15170	***
Long-term Loan Ratio	-0.04080	-3.68057	***	-0.02647	-3.45571	***
Hausman Test				0.00000		
Profit Rate	0.02988	10.64290	***	0.03541	15.36220	***
Long-term Loan Ratio	-0.05524	-4.78488	***	-0.02802	-3.53749	***
Hausman Test				0.00000		
Cash Flow	0.05373	10.93310	***	0.06681	15.94540	***
Long-term Loan Ratio	-0.05616	-4.87231	***	-0.02867	-3.66910	***
Hausman Test				0.00000		

Transportation Equipment (including shipbuilding)	Fixed Effect Model			Random Effect Model		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Tobin's Q	0.01630	8.83862	***	0.01371	8.30269	***
Long-term Loan Ratio	-0.07433	-4.61038	***	-0.03070	-2.86111	***
Hausman Test				0.00000		
Profit Rate	0.30108	7.72921	***	0.28876	8.66557	***
Long-term Loan Ratio	-0.08732	-5.55105	***	-0.03576	-3.56433	***
Hausman Test				0.00010		
Cash Flow	0.32538	8.73387	***	0.37081	11.19690	***
Long-term Loan Ratio	-0.08873	-5.69572	***	-0.03095	-3.40080	***
Hausman Test				0.00000		

Transportation Equipment (excluding shipbuilding)	Fixed Effect Model			Random Effect Model		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Tobin's Q	0.01608	7.96775	***	0.01364	7.76371	***
Long-term Loan Ratio	-0.08316	-5.00217	***	-0.02615	-2.45825	**
Hausman Test				0.00000		
Profit Rate	0.36513	7.44940	***	0.33955	8.54885	***
Long-term Loan Ratio	-0.09220	-5.72916	***	-0.03106	-3.10939	***
Hausman Test				0.00000		
Cash Flow	0.33453	8.49130	***	0.36749	10.29080	***
Long-term Loan Ratio	-0.09770	-6.14336	***	-0.03263	-3.44868	***
Hausman Test				0.00000		

*** significant at a 1% level, ** significant at a 5% level , and * significant at a 10% level

Table 4 Estimation of Investment Function by Industry
- The Case of Tobin's Q and Other Fundamental Variables being Included Together

(1) The Period of Estimation : 1972-1984

Iron & Steel	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.01480	2.52077 **	0.00065	0.22213
Profit Rate	0.18922	4.21582 ***	0.20894	5.19609 ***
Long-term Loan Ratio	0.14874	3.81029 ***	0.08319	3.34127 ***
Hausman Test			0.00990	
Tobin's Q	0.01481	2.55588 **	0.00057	0.19800
Cash Flow	0.39203	5.07253 ***	0.43213	6.19534 ***
Long-term Loan Ratio	0.14067	3.62098 ***	0.08395	3.42740 ***
Hausman Test			0.01480	

Nonferrous Metals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.03011	7.64267 ***	0.02177	7.07101 ***
Profit Rate	0.03447	3.21628 ***	0.04109	3.90366 ***
Long-term Loan Ratio	0.11633	5.26363 ***	0.04726	3.31835 ***
Hausman Test			0.00000	
Tobin's Q	0.03071	7.75473 ***	0.02255	7.26786 ***
Cash Flow	0.03090	3.09070 ***	0.03756	3.79999 ***
Long-term Loan Ratio	0.11666	5.27636 ***	0.04686	3.28804 ***
Hausman Test			0.00000	

Chemicals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.01449	5.00499 ***	0.01087	5.19328 ***
Profit Rate	0.20906	5.49123 ***	0.17388	5.74132 ***
Long-term Loan Ratio	0.02416	1.21442	0.01350	1.03033
Hausman Test			0.11700	
Tobin's Q	0.01258	4.43980 ***	0.00833	4.09145 ***
Cash Flow	0.62760	9.34476 ***	0.53241	9.74646 ***
Long-term Loan Ratio	0.00517	0.26632	-0.00169	-0.13269
Hausman Test			0.01350	

Electrical Equipment	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.00499	6.20054 ***	0.00112	2.75852 ***
Profit Rate	0.14365	8.66795 ***	0.13290	9.93400 ***
Long-term Loan Ratio	0.04863	3.75058 ***	0.02825	3.48865 ***
Hausman Test			0.00000	
Tobin's Q	0.00618	7.78379 ***	0.00178	4.78319 ***
Cash Flow	0.13494	5.73932 ***	0.17673	8.74116 ***
Long-term Loan Ratio	0.05563	4.24743 ***	0.02592	3.29690 ***
Hausman Test			0.00000	

Transportation Equipment (including shipbuilding)	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.00813	3.41988 ***	0.00557	3.17827 ***
Profit Rate	0.45018	10.08320 ***	0.34251	8.86335 ***
Long-term Loan Ratio	0.05694	3.09395 ***	0.02399	1.94783 **
Hausman Test			0.00000	
Tobin's Q	0.01181	4.89983 ***	0.00614	3.93777 ***
Cash Flow	0.32879	6.52650 ***	0.28299	6.90147 ***
Long-term Loan Ratio	0.06181	3.24482 ***	0.01444	1.31014
Hausman Test			0.00010	

Transportation Equipment (excluding shipbuilding)	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.00798	3.34197 ***	0.00534	3.01260 ***
Profit Rate	0.46603	9.15121 ***	0.33818	7.88039 ***
Long-term Loan Ratio	0.04839	2.60845 ***	0.02216	1.77587 *
Hausman Test			0.00000	
Tobin's Q	0.01137	4.76590 ***	0.00605	3.81411 ***
Cash Flow	0.37738	6.86989 ***	0.30458	6.92317 ***
Long-term Loan Ratio	0.04995	2.62884 ***	0.01127	0.99550
Hausman Test			0.00010	

*** significant at a 1% level, ** significant at a 5% level , and * significant at a 10% level

Table 4 Estimation of Investment Function by Industry
- The Case of Tobin's Q and Other Fundamental Variables being Included Together

(2) The Period of Estimation : 1985-1996

Fixed Effect Model Random Effect Model

Iron & Steel	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.00967	1.94240 *	0.00799	1.85110 *
Profit Rate	0.28687	4.73002 ***	0.25580	4.97362 ***
Long-term Loan Ratio	0.01676	0.68704	0.02004	1.36756
Hausman Test			0.54490	
Tobin's Q	0.01552	3.26746 ***	0.01380	3.31166 ***
Cash Flow	0.30192	3.11777 ***	0.31313	3.65285 ***
Long-term Loan Ratio	0.01145	0.46413	0.01577	0.92867
Hausman Test			0.87510	

Nonferrous Metals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.01865	8.66435 ***	0.01270	8.76989 ***
Profit Rate	0.24694	4.79749 ***	0.20313	4.76964 ***
Long-term Loan Ratio	-0.00651	-0.44435	0.00575	0.57338
Hausman Test			0.00000	
Tobin's Q	0.02086	10.22340 ***	0.01377	10.44010 ***
Cash Flow	0.30083	3.75184 ***	0.28540	4.67323 ***
Long-term Loan Ratio	-0.00457	-0.30989	0.00539	0.55378
Hausman Test			0.00000	

Chemicals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Tobin's Q	0.00935	5.99833 ***	0.00946	6.92272 ***
Profit Rate	0.52319	11.16460 ***	0.36061	9.64791 ***
Long-term Loan Ratio	-0.03484	-3.77866 ***	-0.01437	-2.21561 **
Hausman Test			0.00000	
Tobin's Q	0.01174	7.87713 ***	0.01040	8.13495 ***
Cash Flow	0.71534	11.06320 ***	0.50155	10.57830 ***
Long-term Loan Ratio	-0.02855	-3.09983 ***	-0.01677	-2.69702 ***
Hausman Test			0.00000	

Electrical Equipment	Fixed Effect Model			Random Effect Model		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Tobin's Q	0.00405	8.94072	***	0.00288	7.61549	***
Profit Rate	0.20662	11.35420	***	0.20868	13.01600	***
Long-term Loan Ratio	-0.05285	-5.83361	***	-0.03779	-5.70835	***
Hausman Test				0.00000		
Tobin's Q	0.00551	13.30080	***	0.00398	11.62640	***
Cash Flow	0.16312	9.45319	***	0.18928	11.62810	***
Long-term Loan Ratio	-0.05513	-6.01684	***	-0.03801	-5.82528	***
Hausman Test				0.00000		

Transportation Equipment (including shipbuilding)	Fixed Effect Model			Random Effect Model		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Tobin's Q	0.02410	8.52854	***	0.01954	7.73834	***
Profit Rate	0.15858	2.77841	***	0.17407	3.46854	***
Long-term Loan Ratio	-0.07543	-5.72740	***	-0.03387	-3.82674	***
Hausman Test				0.00000		
Tobin's Q	0.02409	9.05577	***	0.01983	8.80039	***
Cash Flow	0.30639	6.06653	***	0.36404	8.32413	***
Long-term Loan Ratio	-0.07690	-5.96946	***	-0.02884	-3.57668	***
Hausman Test				0.00000		

Transportation Equipment (excluding shipbuilding)	Fixed Effect Model			Random Effect Model		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Tobin's Q	0.02189	6.97209	***	0.01750	6.31014	***
Profit Rate	0.28714	3.94302	***	0.27125	4.39341	***
Long-term Loan Ratio	-0.07961	-5.83458	***	-0.03113	-3.46354	***
Hausman Test				0.00000		
Tobin's Q	0.02378	8.27891	***	0.01980	8.21062	***
Cash Flow	0.34230	6.38729	***	0.37822	7.93591	***
Long-term Loan Ratio	-0.08146	-6.09383	***	-0.02888	-3.43701	***
Hausman Test				0.00000		

*** significant at a 1% level, ** significant at a 5% level , and * significant at a 10% level

Table 5 Investment Functions of Keiretsu-Affiliated and Non-Affiliated Groupings

All Industries (Fixed Effect Model)

(i) Four Major Keiretsu Groupings

	Keiretsu-Affiliated Grouping			Non-Affiliated Grouping		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
TobinQ	0.01938	13.24950	***	0.00616	6.84234	***
Long-term Loan Ratio	0.08543	6.95808	***	0.05916	4.64137	***
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Tobin's Q	0.01384	8.62628	***	0.00581	6.47418	***
Profit Rate	0.15511	7.92228	***	0.05800	5.75163	***
Long-term Loan Ratio	0.08359	6.89509	***	0.05464	4.30466	***

(ii) Six Major Keiretsu Groupings

	Keiretsu-Affiliated Grouping			Non-Affiliated Grouping		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
TobinQ	0.01354	12.74650	***	0.00520	4.76569	***
Long-term Loan Ratio	0.07543	7.09282	***	0.06449	3.94865	***
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Tobin's Q	0.01232	11.53070	***	0.00383	3.51576	***
Profit Rate	0.64498	7.14286	***	0.18712	7.20758	***
Long-term Loan Ratio	0.07298	6.90766	***	0.05148	3.18312	***

*** significant at a 1% level, ** significant at a 5% level , and * significant at a 10% level

Table 6 Regression of Tobin's Q by Industry : The Case of Capital Stock Including Land

(1) The Period of Estimation : 1972-1984

Iron & Steel	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Profit Rate	0.66636	2.57041 *	0.72819	1.99957 **
Long-term Loan Ratio	-0.44424	-1.12103	-0.49467	-1.54779
Hausman Test			0.19680	
Cash Flow	1.19480	1.87307 *	1.29168	2.03471 **
Long-term Loan Ratio	-0.46568	-1.39624	-0.51372	-1.60335
Hausman Test			0.24390	

Nonferrous Metals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Profit Rate	1.12559	5.19712 ***	1.43294	6.90110 ***
Long-term Loan Ratio	-0.26248	-1.37428	0.01830	0.11152
Outlier Dummy	14.50160	10.53040 ***	16.70250	12.80260 ***
Hausman Test			0.00000	
Cash Flow	1.16799	5.36422 ***	1.41263	6.70243 ***
Long-term Loan Ratio	-0.25294	-1.32583	0.01056	0.06378
Outlier Dummy	15.38710	10.31200 ***	17.33460	12.14320 ***
Hausman Test			0.00000	

Chemicals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Profit Rate	0.60858	1.31194	1.50064	3.36983 ***
Long-term Loan Ratio	0.23882	0.97331	0.35902	1.57359
Hausman Test			0.00000	
Cash Flow	2.12936	2.54389 **	3.54891	4.39989 ***
Long-term Loan Ratio	0.17722	0.72358	0.23691	1.03858
Hausman Test			0.00000	

Electrical Equipment	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Profit Rate	3.07175	4.13894 ***	5.07767	7.05738 ***
Long-term Loan Ratio	-2.73597	-4.58273 ***	-2.56467	-4.52345 ***
Hausman Test			0.00000	
Cash Flow	2.83706	2.67506 ***	4.74182	4.54363 ***
Long-term Loan Ratio	-2.56550	-4.29825 ***	-2.34111	-4.10974 ***
Hausman Test			0.00000	

Transportation Equipment (including shipbuilding)	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Profit Rate	2.49359	3.77614 ***	2.72279	4.22392 ***
Long-term Loan Ratio	0.57486	2.07195 **	0.55517	2.17551 **
Hausman Test			0.27830	
Cash Flow	2.14695	2.54634 **	2.57138	3.12365 ***
Long-term Loan Ratio	0.62712	2.24903 **	0.59773	2.33351 **
Hausman Test			0.05930	

Transportation Equipment (excluding shipbuilding)	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Profit Rate	3.14647	3.99045 ***	3.43289	4.48961 ***
Long-term Loan Ratio	0.59060	2.01559 **	0.58929	2.19059 **
Hausman Test			0.32860	
Cash Flow	2.97224	2.93825 ***	3.41044	3.47163 ***
Long-term Loan Ratio	0.63344	2.14850 **	0.61472	2.27247 **
Hausman Test			0.17370	

*** significant at a 1% level, ** significant at a 5% level , and * significant at a 10% level

2) The Period of Estimation : 1985-1996

Iron & Steel	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Profit Rate	2.68472	5.12253 ***	3.31841	6.79739 ***
Long-term Loan Ratio	-0.72372	-3.00903 ***	-0.36968	-1.90520 *
Hausman Test			0.00050	
Cash Flow	3.48982	3.94481 ***	4.39637	5.23478 ***
Long-term Loan Ratio	-0.78808	-3.24919 ***	-0.44915	-2.25655 **
Hausman Test			0.00040	

Nonferrous Metals	Fixed Effect Model		Random Effect Model	
Explanatory variables	Estimate	t-Value	Estimate	t-Value
Profit Rate	6.95600	8.73728 ***	8.65087	12.11540 ***
Long-term Loan Ratio	-0.04764	-0.17774	-0.17052	-0.73909
Hausman Test			0.00000	
Cash Flow	6.25660	4.46788 ***	8.79372	6.99766 ***
Long-term Loan Ratio	-0.01032	-0.03709	-0.19987	-0.81557
Hausman Test			0.00010	

Chemicals	Fixed Effect Model			Random Effect Model		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Profit Rate	8.90055	16.12910	***	9.52906	19.12160	***
Long-term Loan Ratio	-0.41917	-3.54577	***	-0.28816	-2.78626	***
Hausman Test				0.00060		
Cash Flow	8.48323	9.97546	***	9.43943	12.36260	***
Long-term Loan Ratio	-0.33661	-2.68380	***	-0.28311	-2.56125	***
Hausman Test				0.02730		

Electrical Equipment	Fixed Effect Model			Random Effect Model		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Profit Rate	8.86995	10.95790	***	9.69041	12.47090	***
Long-term Loan Ratio	-0.68942	-1.46366		-0.62509	-1.49815	
Hausman Test				0.00120		
Cash Flow	5.45317	6.25495	***	5.92085	6.93742	***
Long-term Loan Ratio	-1.00385	-2.08454	**	-0.89558	-2.08236	**
Hausman Test				0.03110		

Transportation Equipment (including shipbuilding)	Fixed Effect Model			Random Effect Model		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Profit Rate	1.51307	2.03430	**	2.26594	3.23566	***
Long-term Loan Ratio	-0.02384	-0.13431		-0.09948	-0.68222	
Hausman Test				0.00880		
Cash Flow	0.39966	0.56800		0.24136	0.35695	
Long-term Loan Ratio	-0.03256	-0.18230		-0.08921	-0.59798	
Hausman Test				0.60460		

Transportation Equipment (excluding shipbuilding)	Fixed Effect Model			Random Effect Model		
Explanatory variables	Estimate	t-Value		Estimate	t-Value	
Profit Rate	4.10997	4.62475	***	4.95631	6.03197	***
Long-term Loan Ratio	-0.02613	-0.14731		-0.11794	-0.81499	
Hausman Test				0.02690		
Cash Flow	0.71700	0.98339		0.68321	0.96630	
Long-term Loan Ratio	-0.05419	-0.29975		-0.11907	-0.78234	
Hausman Test				0.79200		

*** significant at a 1% level, ** significant at a 5% level , and * significant at a 10% level