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Abstract

Corporate investment is the most important factor to explain the long stagnation of Japan during the 1990's. Using the Bank of Japan diffusion indices of 'real profitability' and 'banks' willingness to lend', we estimate investment functions for four groups of firms: large/small and manufacturing/non-manufacturing. Our results suggest that for large firms, financing constraints are not significant whereas the converse is true for small firms. A fall of investment during 1992-94 is largely explained by real factors. However, the credit crunch occurred beginning 1997 and it lowered the growth rate of GDP by 1.6%.

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1. Introduction

It is certain that the long stagnation of the Japanese economy during the 1990's will be remembered as a historical event. Domestically, taking the place of the optimism of the 80's such as 'Japan as Number One', the grave pessimism now prevails. Abroad, Japan turned from menace to mock.

By any standard, the poor performance of the Japanese economy during the 90's stands out. Figure 1 shows the growth rate of real GDP. The average growth rate of real GDP during the high growth period (1956-73) was 10%. The era of high growth ended in the early 1970's[1], but the growth rate during the period beginning the mid 1970's to 1990 still remained as high as 4% on average. In fact, in the late 1980's, when stock and land prices tripled, the Japanese economy enjoyed a domestic demand-led boom; The average growth rate during this period was 5%. The stock price, however, peaked off at the end of 1989, and so did the land price a year later. The economy entered a recession in February 1991. At first, the recession appeared as a normal adjustment after a long boom, but as it turned out, it was the beginning of the stagnated decade. The average growth rate during 1992-98 is merely 1%. During the same period, the U.S. enjoyed the steady 3% growth. The reversal of growth rate between Japan and the U.S. for such a long period is a new phenomenon.

What are the causes of the long stagnation of Japan during the 1990's? Since the bubbles burst, economists have focused on the financial problems. A fall in asset prices allegedly had the negative wealth effect on household consumption. Through deterioration of collateral, it also hurt investment of small firms. And banks suffering from bad loans became reluctant to make new loans (*kashi-shiburi*), and further depressed investment. The views have been expressed many times, but not

[1] For the end of high growth, see chapter 2 of Yoshikawa (1995).

necessarily with substantial evidences. This paper attempts to quantitatively assess the effects of credit crunches or bank's *kashi-shiburi* on investment.

We begin by providing an overview of the Japanese economy in the next section. We can easily find that an extremely poor performance of corporate investment is the most important factor to explain the long stagnation of the Japanese economy during the 90's. An obvious question is then why investment so stagnated. A popular answer is, of course, a credit crunch caused by bad loans banks hold. There is a good consensus that the effect of credit crunch is much more serious on investment of small firms than that of large firms because large firms have better access to capital markets. Given this observation, we estimate investment functions for large and small firms in both manufacturing and non-manufacturing sectors. The explanatory variables are the Bank of Japan Diffusion Indices (DI's) of 'real profitability' and 'banks' willingness to lend.' Taking the latter as an indicator of possible financing constraints, we find that the financing constraints do significantly affect investment of small firms, but not that of large firms. This finding is consistent with the results other researchers have obtained.

On the whole, the effects of the real factor on investment are much more significant than those of the financial factor. In particular, a fall of investment during 1992-94 was basically caused by worsening real profitability; during the same period, financial factor was supportive. However, beginning 1997 amid recession, the credit crunch finally occurred. Based on our investment equations, we make an estimate of the effects of the credit crunch on investment as a whole, and also on GDP. The final section provides some concluding remarks.

2. The Japanese Economy during the 1990's: An Overview

A sensible way to get an overview of the Japanese economy during the 1990's is to look at the demand-decomposition of the growth rate of real GDP. Table 1 presents contribution of demand component such as consumption, investment, and exports to growth rate of GDP. Here, the contribution of X means $\left(\frac{\Delta X}{X}\right)\left(\frac{X}{Y}\right)$ with Y as real GDP.

The table shows that investment is the major factor to account for the 1991-94 recession, the 1995-96 recovery, and also the most recent recession beginning mid 1997. When the growth rate fell from 3.8% to 0.3% during 1991-93, the contribution of investment fell from 1.2% to –1.9% accounting for nearly 90% of a fall in the growth rate. Similarly, when growth accelerated from 0.3% to 5.1% during 1993-96, the contribution of investment rose from –1.9% to 1.8%, again accounting for 80% of the recovery. To the negative growth in 1998, declines in consumption, investment, public expenditures, and exports all contributed. However, Table 1 clearly shows that investment is by far the most significant factor to cause the most recent recession.

Before we turn to investment, we inquire into the following questions; By historical standard, how anomalous a decline or fall in each demand component had been during the 1990's. To study this problem, we first calculate the average, μ and the standard deviation, σ of the growth contribution of each demand component for 1971-90 (quarterly), and then how many σ's the growth rate deviates from μ for 1992. I–98. II. The results are shown in Table 2. By the usual standard, the figures close to two in absolute value would indicate anomaly. The table shows that a fall in investment during the 1992-94 recession was indeed anomalous. So is a decline in investment in 1998.

We notice that a fall in consumption beginning the second quarter of 97 to the present is also anomalous by historical standard. But perhaps more important, we must note persistence in the minus sign for consumption throughout the 1990's. Not the theme of the present paper, but the long stagnation of consumption is a significant factor to have depressed the Japanese economy during the 1990's. Many economists believe that the stagnation of consumption has been in turn caused by job insecurity and uncertain future of the public pension system: See Nakayama (1999).

By and large, corporate investment is the key factor to understand the long stagnation of the Japanese economy during the 1990's although consumption, and a major mistake in fiscal policy also made significant contribution. The most popular explanation of weak investment is credit crunch; Bad loan makes banks unwilling to lend, and it hurts investment. In what follows, we focus on investment, and attempt to estimate the effects of financial distress on investment.

3. Financing Constraints and Investment

Given the popularity of credit crunch as a possible explanation of weak investment, it is natural to turn to financing constraints. Many economists take high correlation between sales/profits/cash flows and investment as an evidence for the significance of financing constraints facing firms. Models of asymmetric information and incentive problems in capital markets imply that the internal resources of a firm influence the shadow cost of external funds and, therefore, that an increase in sales or profits raises investment, holding constant underlying real investment opportunities. In this 'financing constraints' view, cash flows and profits are taken as proxies for changes in net worth or internal funds rather than future profit opportunities. We would expect that financing constraints should be most important for firms likely to face information related capital market imperfections, say small firms as against large firms.

Most empirical works separate the samples of firms likely to face financing constraints from these of firms unlikely to face such constraints in advance. Fazzari, Hubbard, and Petersen (1988), for example, group firms according to whether they pay substantial dividends or not; High-payout firms are taken as unlikely to face financing constraints. Assuming that (1) real profitable investment opportunities can be measured by q, and that (2) cash flow is a reasonable, if imperfect, proxy for the change in net worth, they estimate investment function for each group of firms. Absent financing constraints, the estimated coefficient for cash flow should be zero. They find significantly larger estimated cash flow coefficients for the low-dividend-payout firms than for the high dividend payout firms.

Along similar lines, Hoshi, Kashyap, and Scharfstein (1991) study financing constraints for Japanese firms. Instead of dividend pay-out, they use membership in a large industrial group, or *keiretsu* as a sorting device. Keiretsu firms are supposed to have access to external financing through the group's 'main bank'. As a consequence, cash flow should have a smaller effect on investment for *keiretsu* firms than or non-*keiretsu* firms. They obtain the expected results.

Oliner and Rudebusch (1996) similarly estimate investment equations for small and large firms. Using the panel data taken from the *Financial Report for Manufacturing, Mining and Trade Corporations*, they find that a credit channel based on financing constraints does exist for the transmission of monetary policy and that it operates through small firms. For large firms, they find that there is no significant linkage between cash flows and investment.

The existence of financing constraints, however, is actually not self-evident even for small firms. Figure 2, for example, shows the reasons for cutting investment expenditures which small firms regard as important. It shows that 'real' factors such as a decline in sales or poor profit opportunities are much more important than such 'financial' factors as 'financing constraints' or 'a rise in the cost of capital.' The result shown in Figure 2 is only for 1995, but is typical.

Similarly, the stability of the share of internal funds in the finance of investment of small firms, as shown in Figure 3, is also a bit puzzling from the standpoint of the standard financing constraints story. For example, the simple framework used by Hubbard (1998) to explain financing constraints consists of demand and supply functions of the external funds:

$$S = a + br + W, \tag{1}$$

$$D = c - dr + \Pi. \tag{2}$$

Financing constraints mean that the supply of funds facing firm S depends not only on the interest rate r but also on firm's net worth W which is often proxied by cash flows. The demand for funds D, on the other hand, depends on r and investment opportunities Π. The equality of D and S determines the level of investment I, and the amount of borrowed funds B is equal to the difference between I and cash flows W. From (1) and (2), we obtain

$$\frac{B}{W} = \left[a + \frac{b(c-a)}{b+d}\right]\left(\frac{1}{W}\right) + \left(\frac{b}{b+d}\right)\left(\frac{\Pi}{W} - 1\right). \tag{3}$$

There is no good reason why B/W is so stable as shown in Figure 3. In particular, when b is small (note that large b means no effective financing constraints in the first place), B/W is roughly a/W, and, therefore, we would expect that the share of internal funds rises when cash flows increase, and *vice versa*. Figure 3, however, shows that the share is actually very stable over business cycles. Note that the figure embraces years in both expansion and recession.

What about the case where there are no financing constraints, and cash flows basically transmit prospects for future profits to firms? In this case, the share of internal funds would become stable if the elasticity of the desired investment with respect to cash flows, which are highly correlated with profits, is close to one. And we would expect that this elasticity is indeed close to one under the Cobb/Douglas production function.

Despite some criticisms such as Kaplan and Zingales (1997), and some suggestive evidences we discussed above, the recent researches in this area, by and large, point to the existence of financing constraints for the investment decisions of *some* firms. However, to show the importance of financing constraints for *some* firms is not enough for our purpose to understand the credit crunch explanation of weak investment in Japan during the 1990's. We obviously need to know the impact of credit crunch on *aggregate* investment fluctuations, or for that matter, for aggregate (GDP) fluctuations. Given the popularity of the credit crunch view of the Japanese economy during the 1990's, it is extremely important to estimate the effects of financing constraints on *aggregate* investment.

Investment can decline either when economic conditions facing borrowing firm changed or bank's lending attitude changed. The standard investment equation with cash flows does not help when the credit crunch is caused by a change in bank's lending attitude independent of the position of cash flows on the part of borrowing firm.

The existing literature studies financing constraints mainly in relation to monetary policy. Therefore, the action of the central bank is often taken into account. For example, Oliner and Rudebusch (1996) put a dummy variable that equals unity in the four quarters after a monetary tightening and equals to zero otherwise in their investment equation, and then find that investment of small firms is more closely tied to cash flows during periods of monetary stringency. However, the major problem surrounding the Japanese economy is, of course, *not* tight monetary policy but rather a possible credit crunch caused by banks. We are interested in the magnitude of credit crunch. As noted above, a standard approach which uses cash flows as a regressor in investment equation may show the existence of financing constraints, but does not show us the magnitude of possible credit crunch. For this reason, we use the Bank of Japan Diffusion Index of 'banks' lending attitude' as seen by borrowing firms rather than cash flows in our investment function. We begin by describing our data.

4. Data Description

Our data on investment and capital stock are from *Hojin Kigyo Tokei* (Statistical Survey of Corporations) compiled by the Ministry of Finance. *Hojin Kigyo Tokei* has quarterly data on gross investment and capital stock for four classes of firms grouped by size of capital for both manufacturing and non-manufacturing sectors. This data covers, however, only firms whose capital is greater than ten million yen. We aggregate the bottom three size classes covering firms with capital up to one billion yen to define the 'small firm' group. For the purpose of this study, firms with capital greater than one billion yen are said to belong to the 'large firm' group. We then divide the large and small firm groups into manufacturing and non-manufacturing sectors, respectively. In this way, we obtain four classes of the Japanese firms: small/large and manufacturing/non-manufacturing.

The explanatory variables used in our investment equations are taken from the Bank of Japan *Tankan*. The *BOJ Tankan* (Short-term Economic Survey of Corporations) is based on the quarterly survey conducted by the Bank of Japan about the present and future business conditions facing the Japanese firms. The survey started in 1957 and is considered to be one of the most important information for the Bank of Japan to conduct monetary policy.

The "Judgement Survey" section of the *Tankan* which consists of diffusion indices (DIs), contains the views of firms on the present and future business conditions. In this survey, high rank executives of each firm are asked to select one of the three answers, for example, "good", "not so good", or "bad". They are asked to explicitly take into account seasonality. The *Tankan* DI's are, therefore, conceptually seasonally adjusted. DI represents the percentage of "good" minus the percentage of "bad" in total responses.

As variables to capture the real and financial conditions facing firms, we use the "Forecast on the Next Quarter's Business Conditions" DI and the "Lending Attitude of Financial Institutions" DI, respectively. The former represents the "favorable" minus the "unfavorable" percentage points of entrepreneurs' forecasts of the next quarter's business conditions facing firms with particular emphasis on profits, while the latter represents the "accommodative" minus the "severe" percentage points about the present lending attitude of financial institutions. For the sake of brevity, we call the former the "Real DI" and the latter the "Financial DI".

The BOJ *Tankan* actually has the "Forecast on Capacity in the Next Quarter" DI. The firms are to answer either 'excessive' of 'insufficient.' This DI is plainly more directly related to the desired capital stock or investment than the "Forecast on the Next Quarter's Business Conditions DI." However, it is available only for manufacturing firms. For this reason, we will use the "Forecast on the Next Quarter's Business Conditions" DI in what follows. The two DI's for large manufacturing firms have a significantly negative correlation, namely –0.80, as we would expect.

The BOJ *Tankan* has two parts, one the survey of 'principal' corporations and the other that of 'all' the firms. The former covers 385 manufacturing and 320 non-manufacturing major companies[2]. They are basically non-financial corporations with capital greater than one billion yen,

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[2] 1998. II survey.

and listed on the Tokyo Stock Exchange. The latter survey covers about 4000 manufacturing firms with more than fifty employees and about 5000 non-manufacturing firms with more than twenty employees. They are classified into three categories by the number of employees. For the purpose of this paper we define the 'principal' enterprises of the BOJ *Tankan* as large firms, and 'small' enterprises as small firms.[3] We then have the 'Real' and 'Financial' DI's for four groups of firms, namely large/small and manufacturing/non-manufacturing firms. They are the variable to be used in our investment equation.

Since the 'Real DI' and the 'Financial DI' are our principal explanatory variables, it is important to check the properties of these two DI's in advance of the estimation of investment functions. In particular, one might wonder if they might have considerable overlap. Theoretically, they should be related to each other with possible lags in the economy as a whole. For example, if investment of a firm was cut due to the credit crunch, it would surely adversely affect demand for products and thereby profitability of some firms in the economy. The financial DI, therefore, is meant to capture the impact of specific financial factor, namely banks' lending attitude on borrowing firms. Real profitability perceived by firms may be affected not only real factors but also indirectly by financial factors in the economy. Still, the two DI's are conceptually different.

We pointed out above that *in the economy as a whole* the 'Real DI' and the 'Financial DI' were quite likely related to each other with possible lags. We have four different groups of firms, however. For each group, the relationship between the two DI's is not so obvious. For example, if investment of small firms in the non-manufacturing sector was cut due to

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[3] 'Small enterprises' in the BOJ *Tankan* are manufacturing firms with 50-299 employees, wholesale firms with 20-99 employees, and retail firms with 20-49 employees.

the credit crunch, it is unlikely that demand for products in the same sector declines accordingly. The relationship between the two DI's would be much more indirect for each group of firms than for the economy as a whole.

Given the above consideration, we empirically explore the relation between the *Tankan* Real DI and the Financial DI for four groups of firms: large/small and manufacturing/non-manufacturing. First is the Granger causality test. We regressed one of the two DI's on four lags of the other DI. Table 3 shows the p values under H_0 that the FDI does not Granger cause RDI and H_0 the RDI does not Granger cause FDI, respectively. The table shows that we cannot reject H_0 under conventional significance levels, 5% or 10%. Second is the variance decomposition based on trivariate VAR(4) (Table 4). We observe that fluctuations in each of the two DI's are mostly explained by its own innovations.

Although we will use the "Forecast on the Next Quarter's Business Conditions" DI as an explanatory variable in our investment function, some argue that the "Present Business Conditions" DI might be a more appropriate variable to use in VAR. We ran VAR with the "Present Business Conditions" DI rather than RDI, and obtained basically the same results. On the whole, these results show that the two DI's contain reasonably independent information.

Since diffusion indices are indirect measures, we also explore the relation between RDI/FDI and more conventional variables. Specifically we regressed RDI and FDI on changes in sales deflated by capital stock in the previous period and cash flows, similarly deflated, for four groups of firms. The results are shown in Table 5. On the whole, RDI is more significantly related to changes in sales than cash flows whereas the converse is true for cash flows. In sum, our preliminary investigation suggests that RDI and FDI reasonably capture the constraints as we presume.

The Monthly Report of the Bank of Japan always carries tables and figures of *Tankan* DI's, and refers to them in its analysis of the Japanese economy. Analysts also regard the BOJ DI as one of the most important indicators. However, there are actually few formal analyses which use the Bank of Japan *Tankan* diffusion indices. Kanoh *et. al.* (1991) is a notable exception. They assume different investment behavior for firms which consider their capital stock (1) insufficient, (2) appropriate, and (3) excessive, and using the *Tankan* "Forecast on Capacity in the Next Quarter" DI, estimate aggregate investment function. They make an interesting point that the standard assumption of representative firm could be deceptive, and that heterogeneity of firms is essential to understand aggregate investment.

5. Regression Results

5.1. The Basic Results

In this section, we report the regression results. Before proceeding to our own investment equation, we experimented on investment functions with standard variables. In the literature, Tobin's q, sales and profits are the popular variables to control underlying real investment opportunities, and cash flows are assumed to capture possible financing constraints in investment equation.

It is well known that despite its popularity, q investment function performs poorly: For a recent experiment on the Japanese data, see Kiyotaki and West (1996). We note that q is actually *not* a sufficient statistic for investment when (1) there is a gestation lag, and (2) real profit opportunities and discount factors obey different stochastic processes (see Ueda and Yoshikawa 1986). It is, therefore, not surprising at all to find that q investment function performs poorly. The standard procedure to control real investment opportunities by q is also not so tenable as is commonly thought. For our four groups of firms, stock price is not available any way.

As a preliminary exercise, we estimated following investment equations for each of the four groups of firms (1983.II-1998.II).

$$IK_t = \sum_{i=1}^{4} \alpha_i IK_{t-i} + \sum_{i=1}^{4} \beta_i \Delta YK_{t-i} + \gamma CFK_t + \delta D_t + u_t \tag{4}$$

and

$$IK_t = \sum_{i=1}^{4} \alpha_i IK_{t-i} + \beta RDI_t + \gamma CFK_t + \delta D_t + u_t. \tag{5}$$

Here IK_t denotes gross investment in period t deflated by capital stock at the end of period t-1. ΔYK and CFK are changes in sales and cash flows similarly deflated. Dt are seasonal dummies. In (5), changes in sales ΔYK is replaced by the *Tankan 'real' diffusion index, RDI.* Table 6 shows the results. In both (4) and (5), cash flows turn out to be very significant for all four groups of firms.

As we pointed it out in section 3, the significance of cash flows might suggest the existence of financing constraints but does not provide any information on credit crunch which is caused by a change in bank's lending attitude independent of the position of cash flows on the part of borrowing firm. Therefore, we estimate investment function using RDI and FDI, namely

$$IK_t = \sum_{i=1}^{4} \alpha_i IK_{t-i} + \beta RDI_t + \gamma FDI_t + \delta D_t + u_t. \tag{6}$$

RDI is the "Forecast of Next Quarter's Business Conditions DI" and FDI is the "Lending Attitude of Financial Conditions DI".

As explained in the previous section, the BOJ *Tankan* DI's are defined as the difference between the percentage of firms in the "favourable conditions" and that of firms in the "unfavourable conditions." Suppose that x is a variable which affects the firm's investment decisions such as investment opportunities and available funds, and that x is distributed over firms with density function $f(x)$. Normalize the critical value of x which divides the "favourable" and "unfavourable" conditions as seen by firms to be zero. Then the *Tankan* DI is

$$DI = \int_0^{\infty} f(x)dx - \int_{-\infty}^{0} f(x)dx = 2\int_0^{\infty} f(x)dx - 1. \qquad (7)$$

The i-th firm's investment function is

$$\frac{I_i}{k_i} = \alpha + \beta x_i .$$

α and β are assumed to be common for all the firms. The aggregate investment equation is then

$$\frac{I}{K} = \sum_i \left(\frac{K_i}{K}\right)\left(\frac{I_i}{K_i}\right)$$

$$= \sum_i \left(\frac{K_i}{K}\right)(\alpha + \beta x_i).$$

And, therefore, the expected value of I/K is

$$E\left(\frac{I}{K}\right) = \alpha + \beta \bar{x}, \qquad (8)$$

where $\bar{x}$ is the expected value of x_i. Expectation is taken with respect to

$f(x)$. In general, there is no simple relation between $\bar{x}$ and DI defined by (7). If $f(x)$ is an uniform distribution, we have a simple correspondence. Namely if $f(x) = 1/2a \quad (a > 0)$, then $DI = \bar{x}/a$. Therefore, (8) becomes

$$E\left(\frac{I}{K}\right) = \alpha + a\beta DI. \tag{9}$$

On the premise that this approximation is all right, we estimate (6) using RDI and FDI.

Table 7 provides the OLS and IV estimates of the above investment equation for each of our four groups of firms over the sample period from 1983.II to 1998.II. Some economists believe that financing constraints more significantly affect firm's investment in recessions than in booms. Given this observation, we also estimated our investment equation for 1983.II-90.IV and 1991.I-98.II, separately. The FDI turn out to be insignificant for three groups of firms, and have a wrong sign for one group. This result is the same for two subsample periods.

An estimated coefficients on DIs indicates a percentage change in *I/K* corresponding to one percent changes in DIs. Heteroskedasticity consistent standard errors are in parentheses. Since the lagged dependent variables are on the right-hand side, the absence of serial correlation is essential to obtain the consistent OLS estimates. To test the absence of serial correlation, we regressed the residual e_t on e_{t-1}, e_{t-2}, e_{t-3}, e_{t-4}, and other regressors. We report the p values under H_0 that the coefficients on the lagged e_t's are zero, namely that there is no serial correlation in (6).

The error term in investment equation (6) is possibly correlated with RDI and as a result the coefficient for RDI may be overestimated. We also take into account a possibility that both DI's may suffer from measurement errors, and estimate (6) using lagged RDI's as FDI's instruments. Table 7 also provides IV estimates. It turns out that the OLS estimates and the IV estimates are reasonably similar to each other. For simplicity, we use the OLS estimates in subsequent discussions. We call (1) the large manufacturing firms, (2) large non-manufacturing firms, (3) small manufacturing firms, and (4) small non-manufacturing firms as type I firms, type II firms, type III firms, and type IV firms, respectively.

For type I firms, RDI has the significantly positive effects on *I/K*, while the coefficient of FDI is insignificant and also has wrong sign. The result is basically the same for type II firms, but the coefficient of RDI is smaller for type II firms than for type I firms. For type III firms, the estimated coefficient for both RDI an FDI are significant and of correct sign. The estimated coefficient for RDI is larger than the corresponding estimates for type I and type II firms. Also, for type III firms, the impact of RDI is twice as large as that of FDI.

Both RDI and FDI have significant effects on *I/K* for type IV firms. The coefficient for RDI is smaller for type IV firms than that for type III firms, however. In contrast, the coefficient of FDI is larger for type IV firms than for type III firms. In other words, small non-manufacturing firms are more strongly affected by financial factors than by real factors whereas the other way round is true for small manufacturing firms.

To sum, the estimated coefficients of RDI are all positive and highly significant. The coefficients are larger for small firms than for large firms, and also they are larger for manufacturing firms than for non-manufacturing firms. On the other hand, the coefficients of FDI are insignificant and of wrong sign for large firms. However, they are significant and of correct sign for small firms. These results are broadly consistent with those of Fazzari, Hubbard, and Petersen (1988) and Oliner and Rudebusch (1996). They use cash flows as the proxy for financing constraints, however.

We also obtain VAR(4) estimates for the three variables, FDI, RDI, and *I/K* for each of our four groups of firms. Table 8 reports the variance decompositions of *I/K*. For type I firms, FDI explains only 8% of the fluctuations in *I/K*, while RDI explains about 79%. For type II firms, the contributions of RDI and FDI are 40% and 19%, respectively. Similarly, the corresponding figures are 38% and 43%, respectively for type III firms. Finally, for type IV firms, RDI accounts for about 34% of the variance of *I/K*, whereas the contribution of FDI is merely 51%. On the whole, the relative contribution of financial factor is larger for small firms than for large firms. It is the largest for small non-manufacturing firms. These results are broadly consistent with our OLS estimates; The Real DI is a more important determinant of investment for large firms whereas the converse is true for small firms.

5.2 Machinery and Construction

We have seen investment for four groups of firms thus far. It is often pointed out that the pattern of fluctuations differs for machinery and construction. Specifically, during the 1990's, construction investment dropped more severely than machinery investment. In the light of this argument, in what follows, we disaggregate investment into machinery and investment, and study the differences in their determinants.

The *Hojin Kigyo Tokei* has data on 'construction in process', which is approximately equal to construction investment. Using this data, we can disaggregate investment into machinery investment and construction investment. Construction shares about two-third of the investment of large firms whereas it shares only about one-third of the investment of small firms. Until the beginning of the 1990's, investment of large firms had lagged behind that of small firms over business cycles in a quite regular manner. This 'stylized fact' may have reflected the difference in the shares of machinery and construction of investment in small and large firms.

We estimate the machinery and construction equations for each of our four groups of firms for the same sample period as in our basic regressions, i.e., 1983.II to 1998.II. Table 9 shows the estimated coefficients for machinery investment and for construction investment. On the whole, the coefficients of the RDI and the FDI tend to be much larger in the construction equations than in the corresponding machinery equations. The estimated coefficients of the FDI in construction equations for small firms are more than 10 times as large as the corresponding coefficients in machinery equations. The coefficients of the RDI in the construction equation is about 3 times as large as those in machinery equations, with the exception of small non-manufacturing firms. Construction investment is more sensitive to changes in both real and financial factors than machinery investment.

In both machinery and construction equations, FDI is significant for small firms, but not for large firms. On the other hand, RDI is significant and has correct sign, except for construction investment of small firms.

6. Effects of Credit Crunch on Aggregate Investment and GDP

Our OLS estimates imply that the effects of real and financial factors on investment differ for our four groups of firms. In what follows, by aggregating four investment equations, we estimate the effects of real and financial factors on *aggregate* investment.

First, given the estimated equation, we set the values of one of the two DIs to be zero, and simulate the hypothetical movements of I/K for each one of the four groups of firms to see the relative importance of the 'Real' and 'Financial' DIs. In this way, we have the contribution of RDI and FDI on I/K for each of the four groups of firms.

Then we convert the time-series of I/K into the rate of change in investment for each group of firm. Specifically, we use the following relationship for this conversion.

$$\frac{I_t - I_{t-1}}{I_{t-1}} \approx \frac{(I/K)_t - (I/K)_{t-1}}{(I/K)_{t-1}} + \left(\frac{I - DP}{K}\right)_{t-1} + \delta, \tag{10}$$

where *DP* denotes depreciation. Under the assumption that δ is constant, we can transform the time series of *I/K* into the time series of the growth rate of investment for each of our four groups of firms. The results are shown in Figures 4(a) – 4(d).

Figure 4(a) shows the effects of real and financial factors on the growth of investment for large manufacturing (type I) firms. The effects of financial factor are very small relative to that of real factors. The effects of real factor range from –25% to 30%, while those of financial factor are from –2% to 2%. The quantitatively same result is obtained for large non-manufacturing (type II) firm, as shown in Figure 4(b). However, the effects of real factor is much smaller (less than a half in magnitude) for large non-manufacturing firms than for large manufacturing firms. This is not surprising because the estimated coefficient for RDI is almost twice as large for large manufacturing firms as for large non-manufacturing firms (0.0169 versus 0.0095 in Table 7).

The effects of real and financial factors for small firms are presented in Figures 4(c) and 4(d). They are entirely different from those for large firms shown in Figures 4(a) and 4(b). The financial factor plays a much larger role for small firms than for large firms. In particular, for small non-manufacturing firms (Type IV firms), the effects of FDI often become larger in magnitude than those of RDI. Again, this should not be surprising given the estimated coefficients for RDI and FDI shown in Table 7.

The financial factor sustains growth of investment of small firms for most of our sample period except for 1997-98. For 1998, investment of type IV firms is lowered by nearly 7% only by financial factors.

Next, to see the effects on the macroeconomy as a whole, by way of aggregation based on four equations, we estimate the effects of real and financial factors on growth of the *aggregate* investment. The shares of investment of type I-IV firms in 1990.I are 16%, 10%, 22%, and 23%, respectively. We assume that firms that our data does not cover are all "Small Non-manufacturing firms," namely type IV. Many of the firms that our data does not cover are, in fact, small retail stores; The assumption we make is, therefore, reasonable.

The result is shown in Figure 5. This figure clearly shows that on the whole the effects of real factor dominate those of financial factors. We observed in Table 2 unusually large declines in investment during 1992-94 and 1998. Figure 5 shows that a significant fall of investment during 1992-94 was basically caused by worsening real factors rather than financial distress; The financial factor during this period was basically supportive. This result is consistent with the results obtained by Gibson (1995). He finds that although a firm's investment is sensitive to the financial health of its main bank, the effect of the problems in the banking sector on aggregate investment during 1991-92 is small.

However, beginning 1997 the financial factor abruptly turned from supportive to distressing factor. Since there was absolutely no intention to tighten money on the part of the Bank of Japan during the period, we must interpret this negative effect of the abrupt change in the FDI as the credit crunch caused by actions taken by banks. We note that historically the FDI basically reflects the stance of monetary policy, and that deterioration of the FDI amid easy money is unprecedented. For 1998, the negative impacts of financial distress on the aggregate investment growth are estimated to be at most 3.8%, while those of real factors are 15.5%.

To evaluate the effects of the credit crunch during 1997-98, we simulate growth of investment under alternative financial conditions. For this purpose, we take up the period of 1995.III-96.II as the benchmark period; This is the period of recovery leading up to the 5% growth for 1996. We calculate the average FDI for this benchmark period, and then simulate growth of the aggregate investment for 1996.II-98.II under the hypothesis that the FDI had kept unchanged at this 1995.III-96.II average level. Figure 6 shows the difference between the estimated growth of aggregate investment based on actual RDI and FDI, and the simulated growth based on the hypothetical values of FDI as explained above.

The figure shows that the annual growth rate of investment would have risen by nearly 10% for 1998 if the credit crunch had not occurred and FDI had kept unchanged at the 1995.III-96.II average level. Given the fact that investment shares one sixth of real GDP, this implies that the absence of credit crunch would have raised the growth rate of GDP by 1.6%.

7. Concluding Remarks

The most important factor to explain the long stagnation of the Japanese economy during the 1990's is extremely weak investment. Many economists argue that weak investment is, in turn, explained by credit crunch.

To test this popular argument, we estimated investment equations using the BOJ Diffusion Indices for 'real' and 'financial factors.' Taking the financial DI as a variable to indicate the significance of possible financing constraints, and also to measure the seriousness of credit crunch facing borrowing firms, we found that financing constraints existed for small firms, but not for large firms. This result is consistent with those obtained in the standard literature.

However, on the whole, the real DI (RDI) is a much more important determinant of investment than the 'banks' lending attitude' DI (FDI). In particular, a fall of investment during 1992-94 was basically caused by worsening profit opportunities. FDI had been supportive throughout the period up to 97.

Many economists refer to bubbles and burst of stock /land prices and tend to interpret them as a *causal* factor to explain investment (See, for example, Fisher 1996). However, asset prices are not exogenous variables. Expectations about future profitability and growth had driven the large fluctuations in both investment and asset prices. Our finding that RDI is a dominant factor to explain investment is, therefore, not inconsistent with the fact that asset prices and investment moved in tandem.

Beginning 1997, the FDI abruptly turned from supportive to distressing factor. As we argued above, we cannot help but interpret it as a credit crunch. Based on our estimated investment equations, we assessed the magnitude of this credit crunch. Our estimate is that the credit crunch lowers the growth rate of real GDP by 1.6 % for 1998. In conclusion, the credit crunch does not really explain the long stagnation of investment throughout the 1990's, but it had the major negative effect on aggregate investment during 1997-98. It is an important remaining issue to explain exactly what are the *real* causes to depress investment so long.

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Table 1 Contribution of Demand Components

(%)

	Consumption	Housing Investment	Fixed Investment	Inventory Investment	Public Consumption	Public Investment	Exports	Imports	GDP Growth
1980	0.6	-0.6	1.0	-0.0	0.3	-0.5	1.4	0.7	2.8
1981	0.9	-0.1	0.5	0.0	0.5	0.3	1.2	-0.0	3.2
1982	2.6	-0.0	0.2	-0.0	0.3	-0.2	0.1	0.2	3.1
1983	2.0	-0.3	0.2	-0.3	0.3	-0.2	0.5	0.2	2.3
1984	1.6	-0.1	1.5	0.0	0.2	-0.3	1.5	-0.8	3.9
1985	2.0	0.1	1.7	0.3	0.0	-0.5	0.6	0.1	4.4
1986	2.0	0.4	0.7	-0.2	0.5	0.2	-0.7	-0.1	2.9
1987	2.5	1.1	0.9	-0.1	0.2	0.5	-0.1	-0.7	4.2
1988	3.1	0.7	2.3	0.6	0.2	0.3	0.6	-1.6	6.2
1989	2.8	0.1	2.4	0.1	0.2	-0.0	0.9	-1.6	4.8
1990	2.6	0.3	2.0	-0.2	0.1	0.3	0.7	-0.8	5.1
1991	1.5	-0.5	1.2	0.3	0.2	0.3	0.6	0.3	3.8
1992	1.2	-0.3	-1.1	-0.5	0.2	1.0	0.5	0.1	1.0
1993	0.7	0.1	-1.9	-0.1	0.2	1.2	0.2	0.0	0.3
1994	1.1	0.4	-0.9	-0.3	0.2	0.2	0.5	-0.8	0.6
1995	1.2	-0.3	0.8	0.2	0.3	0.1	0.6	-1.4	1.5
1996	1.7	0.7	1.8	0.4	0.2	0.8	0.8	-1.3	5.1
1997	0.6	-0.9	1.2	-0.1	0.1	-0.9	1.4	-0.1	1.4
1998	-0.6	-0.6	-2.1	-0.1	0.1	-0.0	-0.3	0.9	-2.8

Table 2 Growth Rate Deviations

		Consumption	Housing Investment	Fixed Investment	Inventory Investment	Government expenditures	Exports	Imports	GDP Growth (%)
1971-1990									
AVERAGE		0.025	0.002	0.008	-0.001	0.006	0.006	-0.005	
STD		0.014	0.007	0.011	0.007	0.010	0.007	0.008	
1992	I	-0.20	-1.46	-1.27	0.27	0.26	0.14	0.36	2.41
	II	-0.84	-0.86	-1.63	-0.72	0.42	0.05	0.40	1.03
	III	-1.07	-0.54	-1.87	-1.15	0.47	-0.17	0.87	0.67
	IV	-1.55	-0.37	-2.32	-0.68	0.77	-0.40	0.94	0.16
1993	I	-1.71	-0.48	-2.45	-0.91	0.99	-0.22	0.77	-0.25
	II	-1.60	-0.58	-2.48	0.70	0.54	-0.55	0.80	0.25
	III	-1.08	0.10	-2.60	-0.19	0.88	-0.73	0.52	0.71
	IV	-0.87	0.31	-2.58	-0.09	0.58	-1.26	0.36	0.46
1994	I	-0.77	0.21	-2.39	-0.04	0.25	-0.82	-0.01	0.43
	II	-1.04	0.75	-1.63	-1.26	0.21	-0.19	-0.42	0.45
	III	-0.84	0.45	-1.42	0.19	-0.44	-0.13	-0.54	1.02
	IV	-1.26	-0.20	-0.96	0.30	-0.72	0.49	-0.57	0.66
1995	I	-1.44	0.00	-0.51	0.51	-0.97	0.13	-0.81	0.45
	II	-0.72	-1.05	-0.09	0.42	-0.64	0.43	-0.99	1.50
	III	-0.76	-1.57	0.14	0.38	-0.13	-0.09	-1.19	1.29
	IV	-0.74	-0.59	0.47	0.20	0.46	-0.27	-1.39	2.53
1996	I	0.39	-0.09	0.84	0.56	1.46	-0.40	-1.50	5.92
	II	-0.73	0.80	0.36	0.32	1.02	-0.96	-1.36	3.59
	III	-1.03	1.12	0.80	0.04	-0.46	-0.33	-0.73	3.15
	IV	-0.78	0.77	0.80	-0.18	-1.28	0.46	-0.33	3.17
1997	I	0.13	-0.12	0.64	-0.49	-2.34	0.75	-0.11	2.80
	II	-1.94	-1.30	0.04	0.16	-2.38	1.88	0.54	0.10
	III	-1.31	-2.16	-0.17	0.34	-1.20	1.04	0.72	1.03
	IV	-2.14	-2.33	-0.65	0.30	-0.94	0.61	1.18	-0.43
1998	I	-3.60	-1.82	-1.73	0.36	-0.73	-0.44	1.47	-3.50
	II	-1.72	-1.32	-2.21	-0.21	-0.74	-1.66	2.16	-1.63

Table 3 Granger Causality Test

	I	II	III	IV
Dependent	Large firms		Small firms	
Variable	Manufacturing	Non-manufacturing	Manufacturing	Non-manufacturing
RDI	0.742	0.445	0.270	0.233
FDI	0.386	0.250	0.351	0.342

Table 4 (a) Variance Decomposition
Dependent Variable: RDI

	I	II	III	IV
	Large firms		Small firms	
	Manufacturing	Non-manufacturing	Manufacturing	Non-manufacturing
Call Rate	5.66	4.11	2.06	0.46
RDI	89.30	90.73	63.34	84.60
FDI	5.04	5.16	34.61	14.94

Note: After 12 quarters.

Table 4 (b) Variance Decomposition
Dependent Variable: FDI

	I	II	III	IV
Call Rate	19.68	22.69	3.93	3.73
RDI	26.91	30.21	14.51	35.37
FDI	53.41	47.10	81.56	60.90

Note: After 12 quarters.

Table 5 (a) Preliminary Regressions for RDI

	I	II	III	IV
	Large firms		Small firms	
	Manufacturing	Non-manufacturing	Manufacturing	Non-manufacturing
(Δ Y/K)-1	0.0033	0.0020	0.0010	0.0004
	(0.0005)	(0.0005)	(0.0003)	(0.0003)
(Δ Y/K)-2	0.0034	0.0022	0.0011	0.0005
	(0.0005)	(0.0005)	(0.0003)	(0.0004)
(Δ Y/K)-3	0.0034	0.0023	0.0013	0.0006
	(0.0005)	(0.0005)	(0.0003)	(0.0004)
(Δ Y/K)-4	0.0035	0.0021	0.0012	0.0005
	(0.0005)	(0.0005)	(0.0003)	(0.0003)
p-value*	0.0000	0.0001	0.0003	0.3889
CF/K	-0.0013	-0.0001	-0.0011	-0.0003
	(0.0003)	(0.0007)	(0.0003)	(0.0008)
Adjusted R-squared	0.6545	0.3505	0.2347	0.0632

Notes: Results derived from regressions over 1983.II to 1998.II. Standard errors in parentheses. Number of Observations: 61.

* under H0 that the coefficients on the lagged (Δ Y/K)'s are equal to zero.

Table 5 (b) Preliminary Regressions for FDI

	I	II	III	IV
	Large firms		Small firms	
	Manufacturing	Non-manufacturing	Manufacturing	Non-manufacturing
(Δ Y/K)-1	-0.0005	-0.0003	0.0003	0.0003
	(0.0007)	(0.0006)	(0.0002)	(0.0002)
(Δ Y/K)-2	-0.0003	0.0000	0.0001	0.0003
	(0.0007)	(0.0006)	(0.0002)	(0.0002)
(Δ Y/K)-3	-0.0002	0.0000	0.0005	0.0005
	(0.0008)	(0.0007)	(0.0002)	(0.0002)
(Δ Y/K)-4	-0.0007	-0.0004	0.0005	0.0005
	(0.0008)	(0.0008)	(0.0002)	(0.0002)
p-value*	0.9156	0.9767	0.1635	0.0296
CF/K	0.0024	0.0034	0.0023	0.0022
	(0.0004)	(0.0008)	(0.0002)	(0.0003)
Adjusted R-squared	0.0628	-0.0593	0.2164	0.3997

Notes: Results derived from regressions over 1983.II to 1998.II. Standard errors in parentheses. Number of Observations: 61.

* under H0 that the coefficients on the lagged (Δ Y/K)'s are equal to zero.

Table 6 (a) Investment Equations with Cash Flows

	I	II	III	IV
	Large firms		Small firms	
	Manufacturing	Non-manufacturing	Manufacturing	Non-manufacturing
(Δ Y/K)-1	0.0033	0.0005	0.0002	-0.0012
	(0.0013)	(0.0011)	(0.0012)	(0.0008)
(Δ Y/K)-2	-0.0017	-0.0006	-0.0004	-0.0019
	(0.0014)	(0.0009)	(0.0014)	(0.0005)
(Δ Y/K)-3	0.0004	0.0006	0.0000	-0.0009
	(0.0019)	(0.0011)	(0.0011)	(0.0007)
(Δ Y/K)-4	0.0056	0.0012	0.0023	-0.0003
	(0.0015)	(0.0009)	(0.0010)	(0.0008)
CF/K	0.0165	0.0323	0.0224	0.0297
	(0.0033)	(0.0064)	(0.0049)	(0.0042)
Adjusted R-squared	0.9511	0.9029	0.9236	0.9369
p-value*	0.1148	0.1710	0.5540	0.1005

Notes: Results derived from regressions over 1983.II to 1998.II. Standard errors in parentheses. Number of Observations: 61.

* See the main text.

Table 6 (b) Investment Equations with Cash Flows

	I	II	III	IV
	Large firms		Small firms	
	Manufacturing	Non-manufacturing	Manufacturing	Non-manufacturing
RDI	0.0092	0.0046	0.0146	0.0075
	(0.0036)	(0.0025)	(0.0046)	(0.0046)
CF/K	0.0115	0.0233	0.0188	0.0258
	(0.0044)	(0.0095)	(0.0045)	(0.0047)
Adjusted R-squared	0.9459	0.9094	0.9324	0.9327
p-value	0.0291	0.0473	0.9269	0.4348

Notes: Results derived from regressions over 1983.II to 1998.II. Standard errors in parentheses. Number of Observations: 61.

Table 7 Baseline Investment Equations

		I	II	III	IV
		Large firms		Small firms	
		Manufacturing	Non-manufacturing	Manufacturing	Non-manufacturing
OLS	RDI	0.0169	0.0095	0.0195	0.0135
		(0.0028)	(0.0019)	(0.0050)	(0.0057)
	FDI	-0.0011	-0.0004	0.0144	0.0173
		(0.0022)	(0.0015)	(0.0077)	(0.0052)
Adjusted R-squared		0.9421	0.9250	0.9177	0.9087
p-value		0.1287	0.0872	0.1374	0.0686

IV	RDI	0.0201	0.0093	0.0205	0.0161
		(0.0031)	(0.0020)	(0.0052)	(0.0051)
	FDI	-0.0004	0.0000	0.0128	0.0172
		(0.0019)	(0.0016)	(0.0089)	(0.0054)
Adjusted R-squared		0.9406	0.8988	0.9176	0.9137

Notes: Results derived from regressions over 1983.II to 1998.II.
Standard errors in parentheses.
Number of Observations: 61.

Table 8 Variance Decomposition

Dependent Variable: I/K

	I	II	III	IV
	Large firms		Small firms	
	Manufacturing	Non-manufacturing	Manufacturing	Non-manufacturing
RDI	79.42	39.58	37.55	33.71
FDI	7.73	18.67	42.59	51.20
I/K	12.85	41.75	19.86	15.09

Notes: Results derived from VAR over 1984.II to 1998.II. After 12 quarters.

Table 9 Machinery and Construction

	I	II	III	IV
	Large firms		Small firms	
Machinery Investment	Manufacturing	Non-manufacturing	Manufacturing	Non-manufacturing
RDI	0.0044	0.0051	0.0118	0.0091
	(0.0008)	(0.0009)	(0.0031)	(0.0040)
FDI	-0.0001	-0.0001	0.0119	0.0149
	(0.0008)	(0.0009)	(0.0061)	(0.0041)
Adjusetd R-squared	0.8288	0.8896	0.8877	0.8876
p-value	0.5580	0.8278	0.8969	0.6691
Construction Investment				
RDI	0.1044	0.0179	0.0349	0.0046
	(0.0302)	(0.0089)	(0.0327)	(0.0692)
FDI	0.0766	0.0002	0.2683	0.1885
	(0.0206)	(0.0110)	(0.0938)	(0.0770)
Adjusetd R-squared	0.8811	0.8280	0.6542	0.3792
p-value	0.5756	0.9815	0.8937	0.0022

Notes: Results derived from OLS regressions over 1983.II to 1998.II.
Standard errors in parentheses. Number of Observations: 61.

Figure 1 GDP Growth 1956.I-1998.II

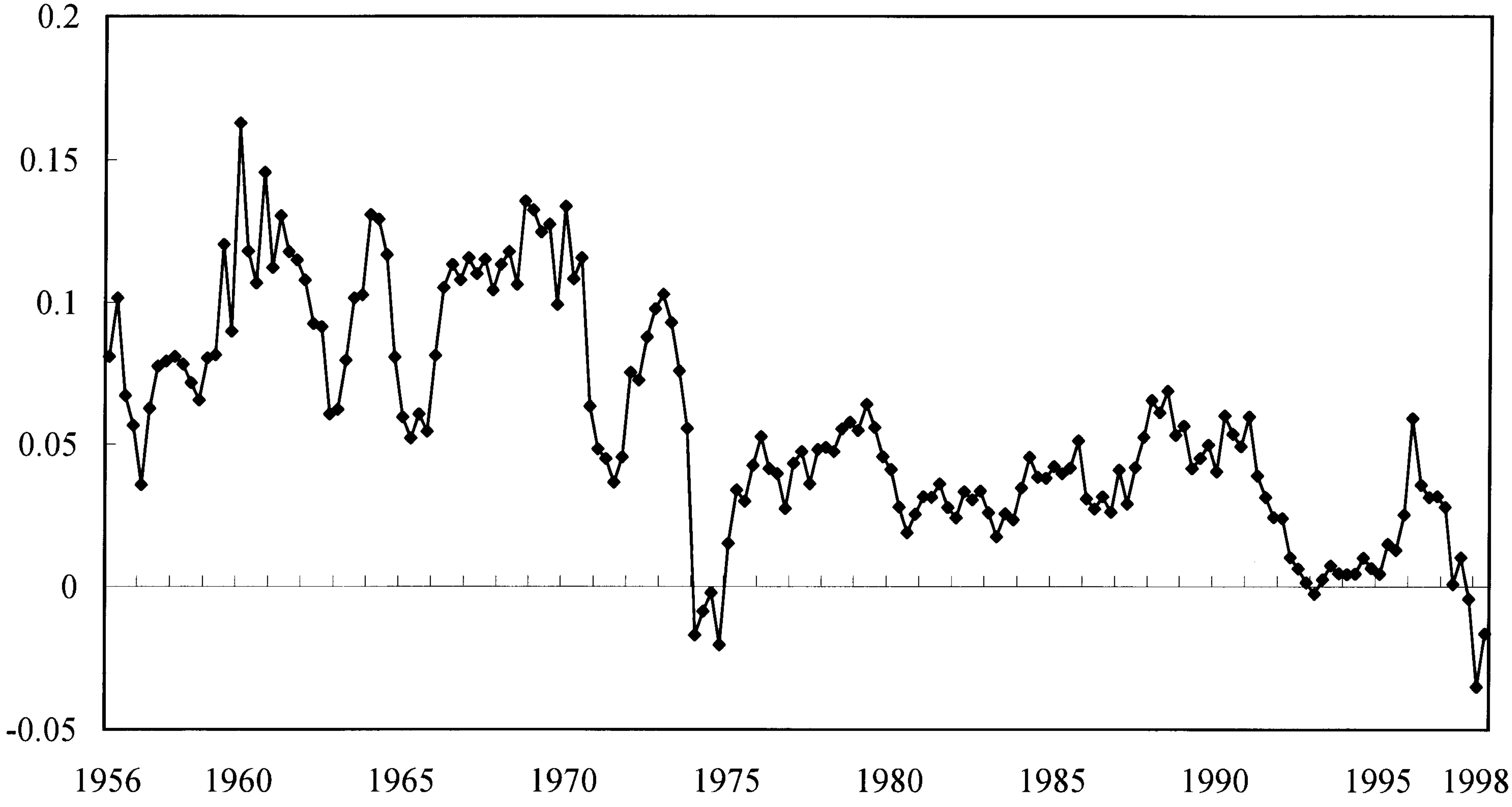

Figure 2: Reasons for Cutting Investment Expenditures: 1995

(Source) The Finance Corporation for Small Firms, "Survey of Investment of Small Firms"

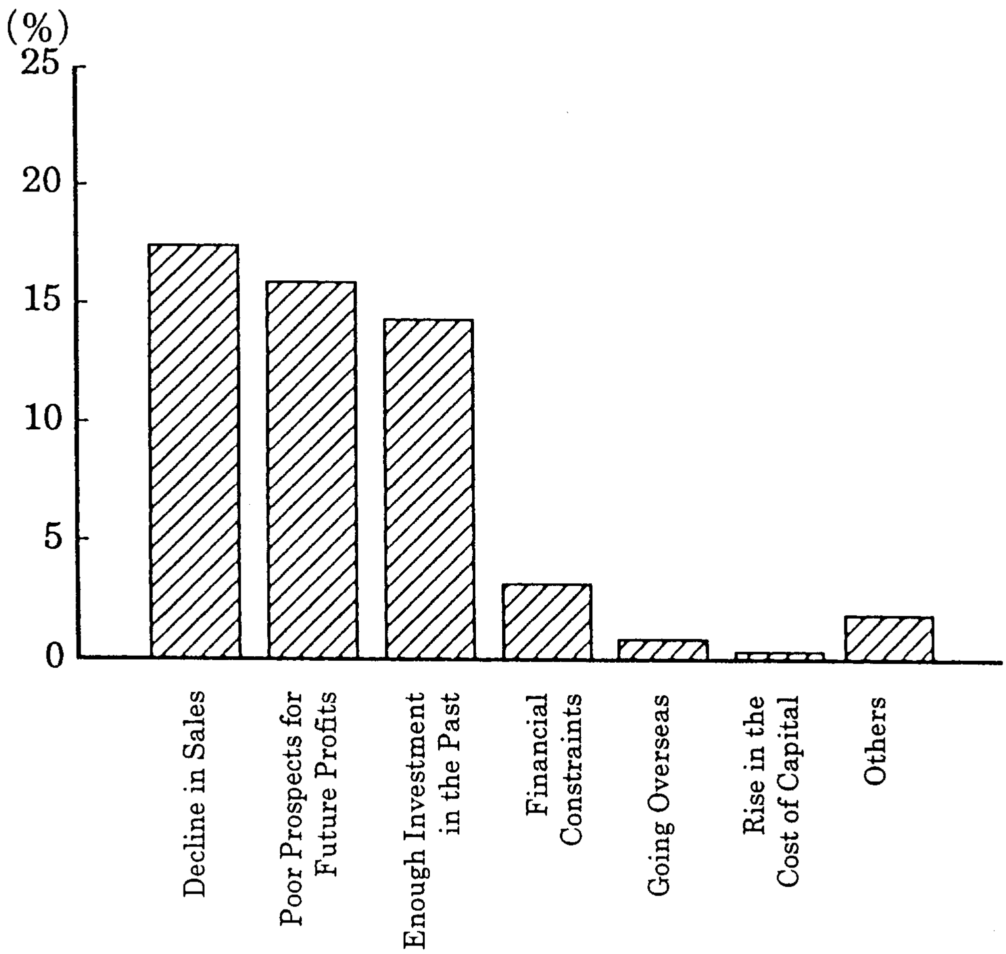

Figure 3: The Finance of Investment of Small Firms

(Source) The Finance Corporation for Small Firms, "Survey of Investment of Small Firms"

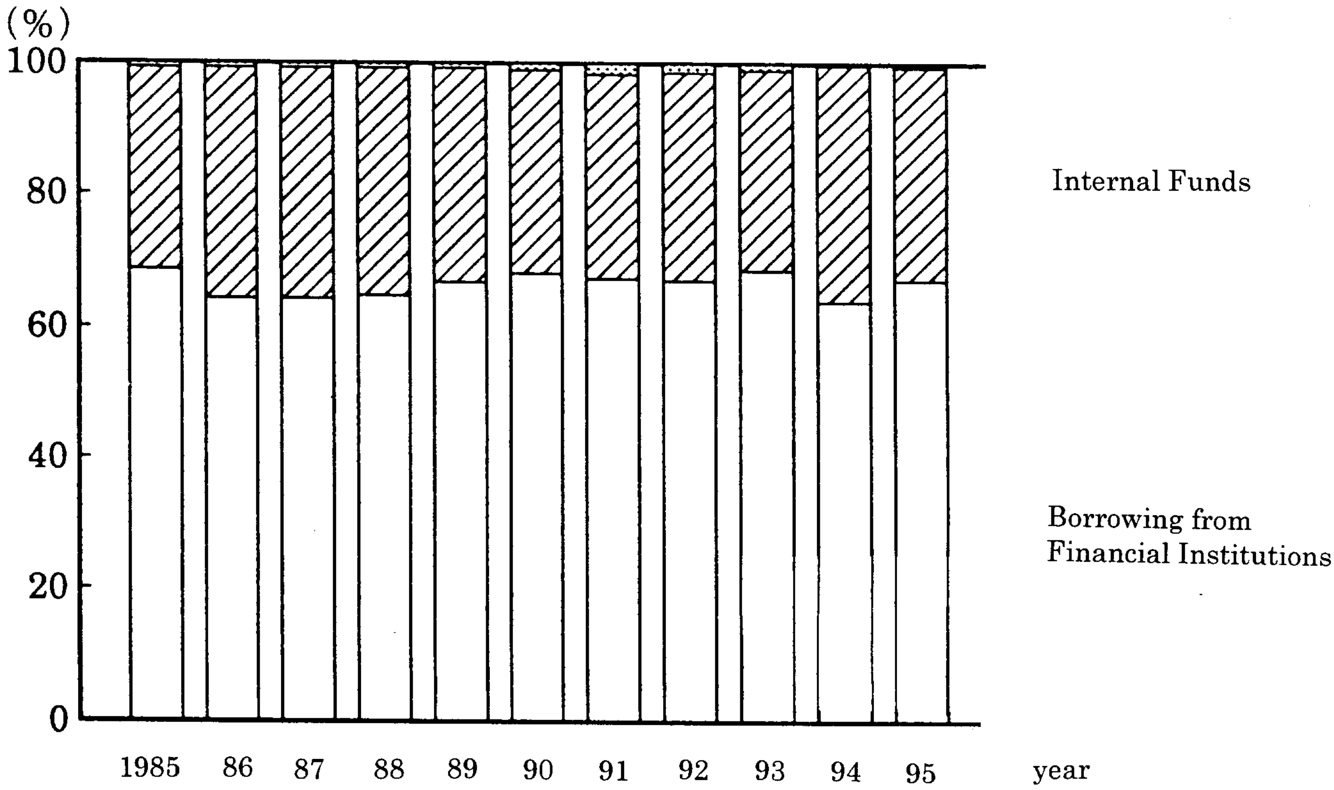

Figure 4 (a) Large firms/ Manufacturing (type I)

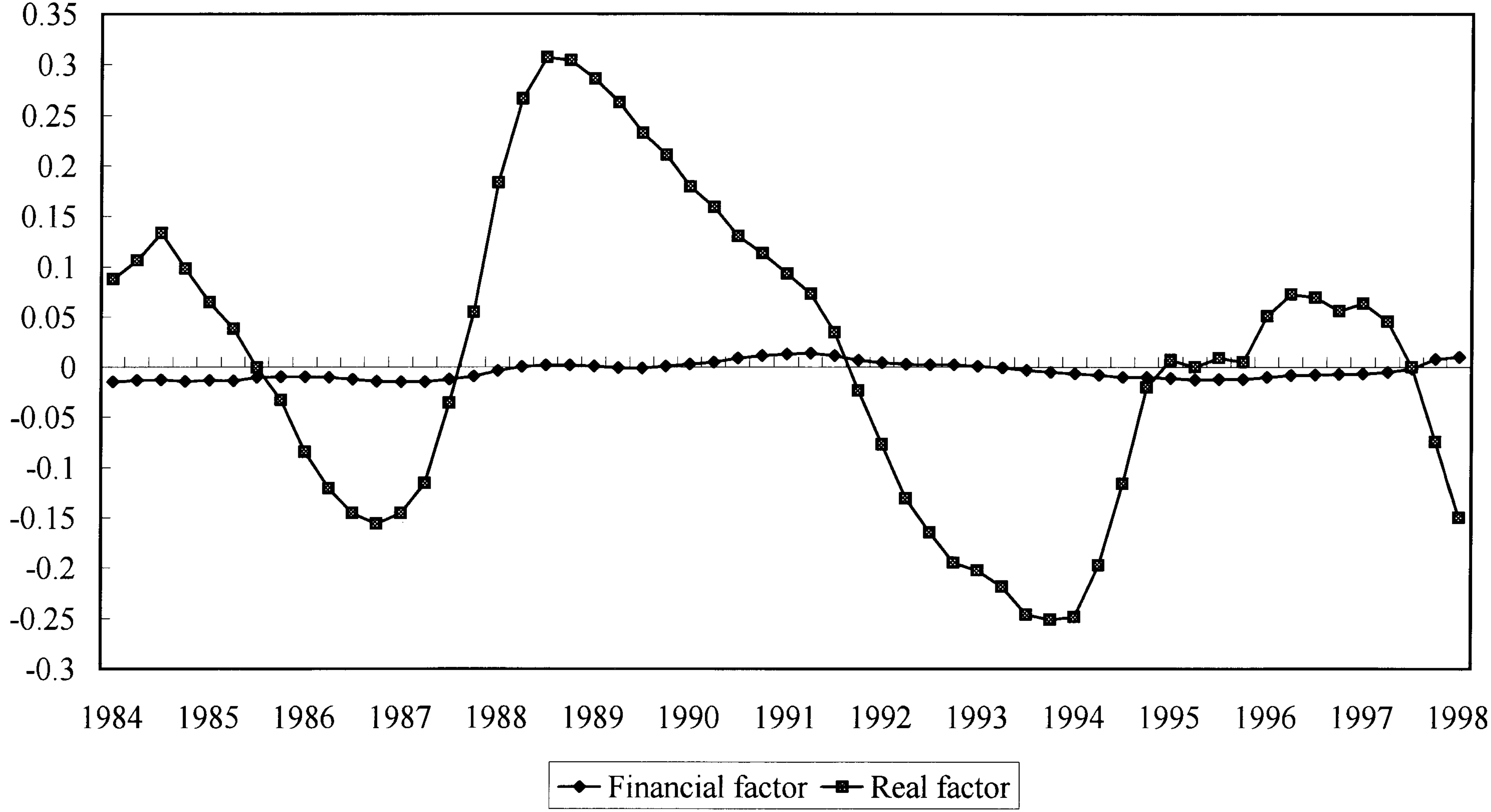

Figure 4 (b) Large firms/ Nonmanufacturing (type II)

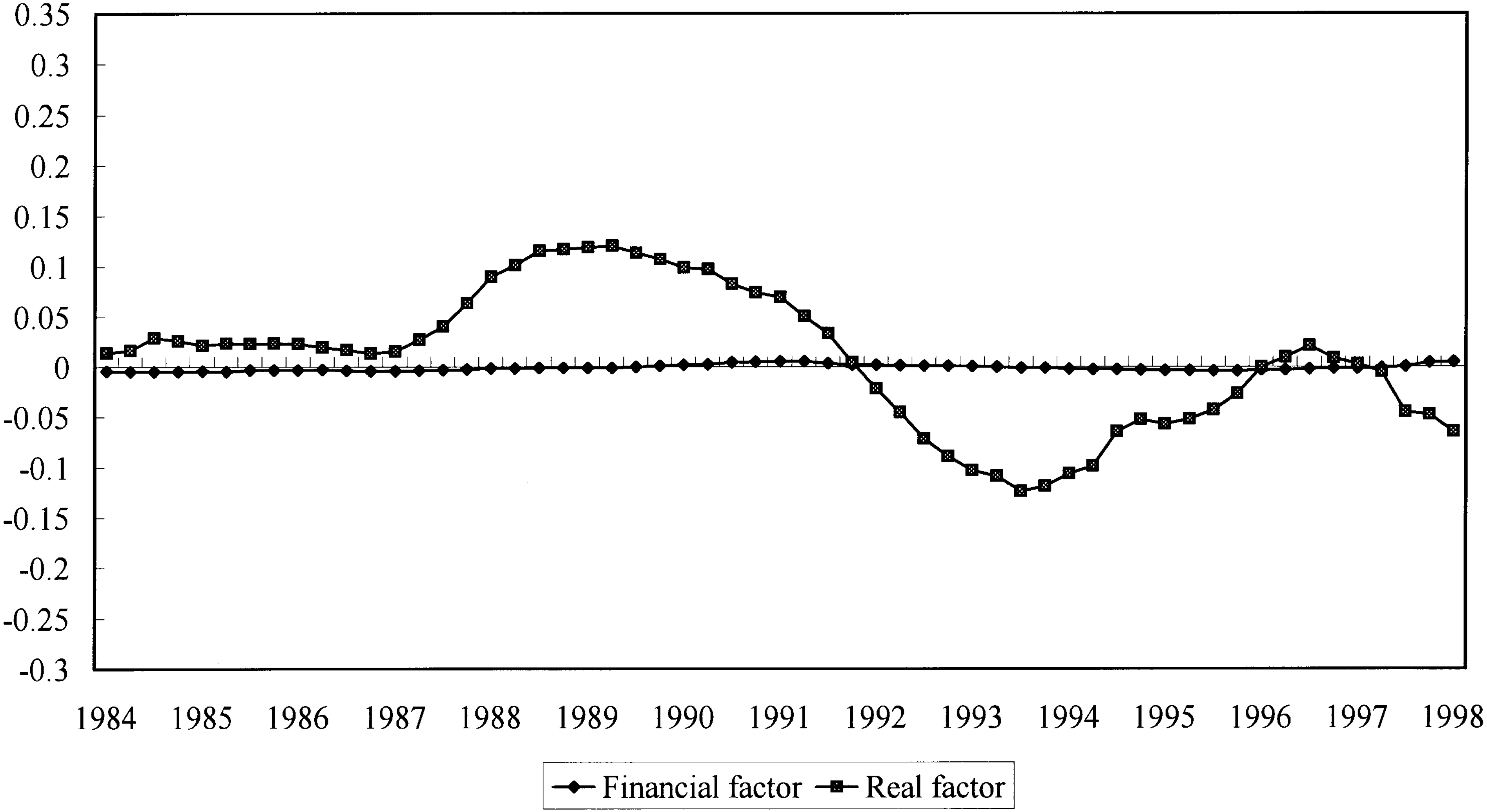

Figure 4 (c) Small firms/ Manufacturing (type III)

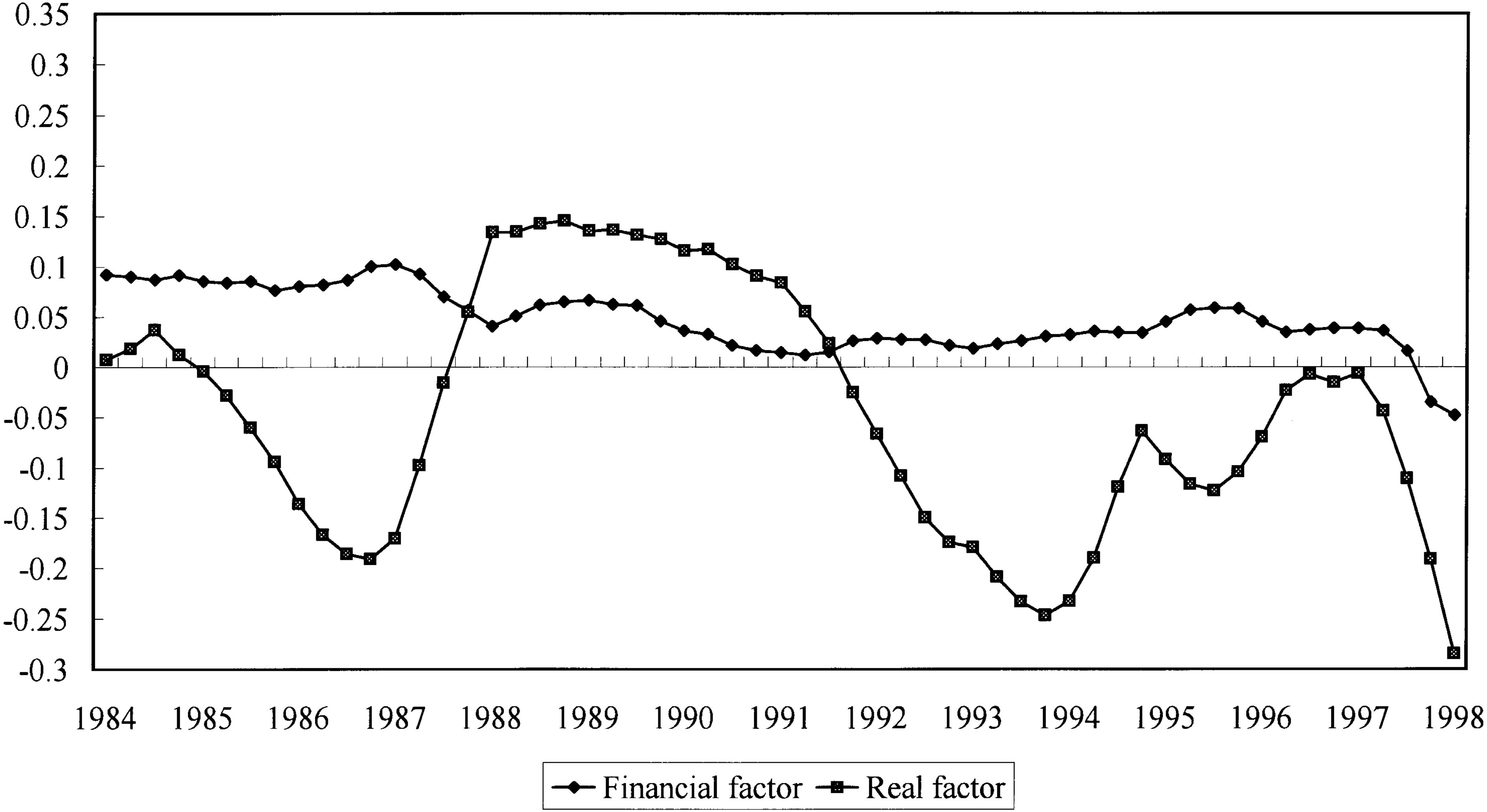

Figure 4 (d) Small firms/ Nonmanufacturing (type IV)

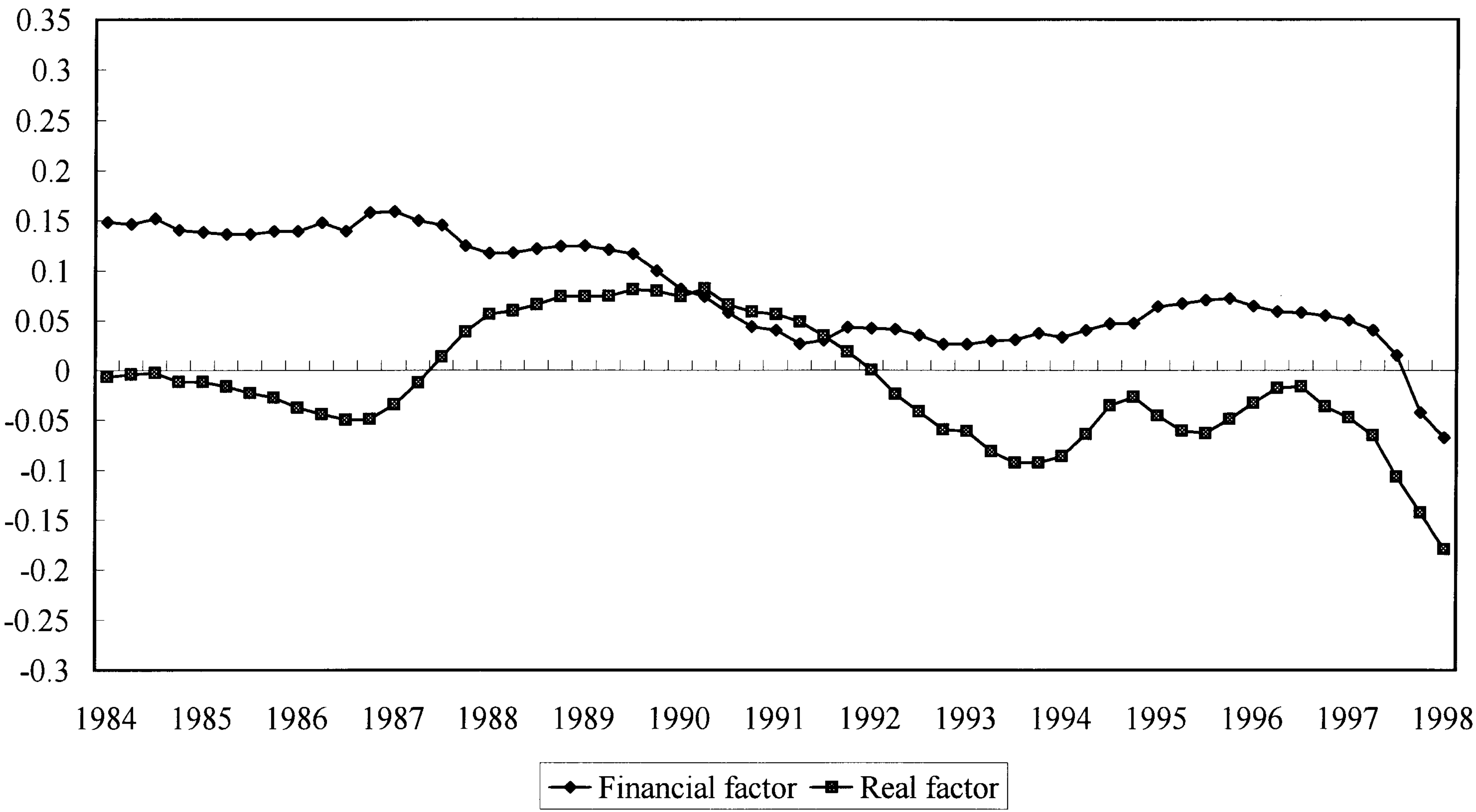

Figure 5 The Impact of Real and Financial Factors on the Aggregate Investment Growth

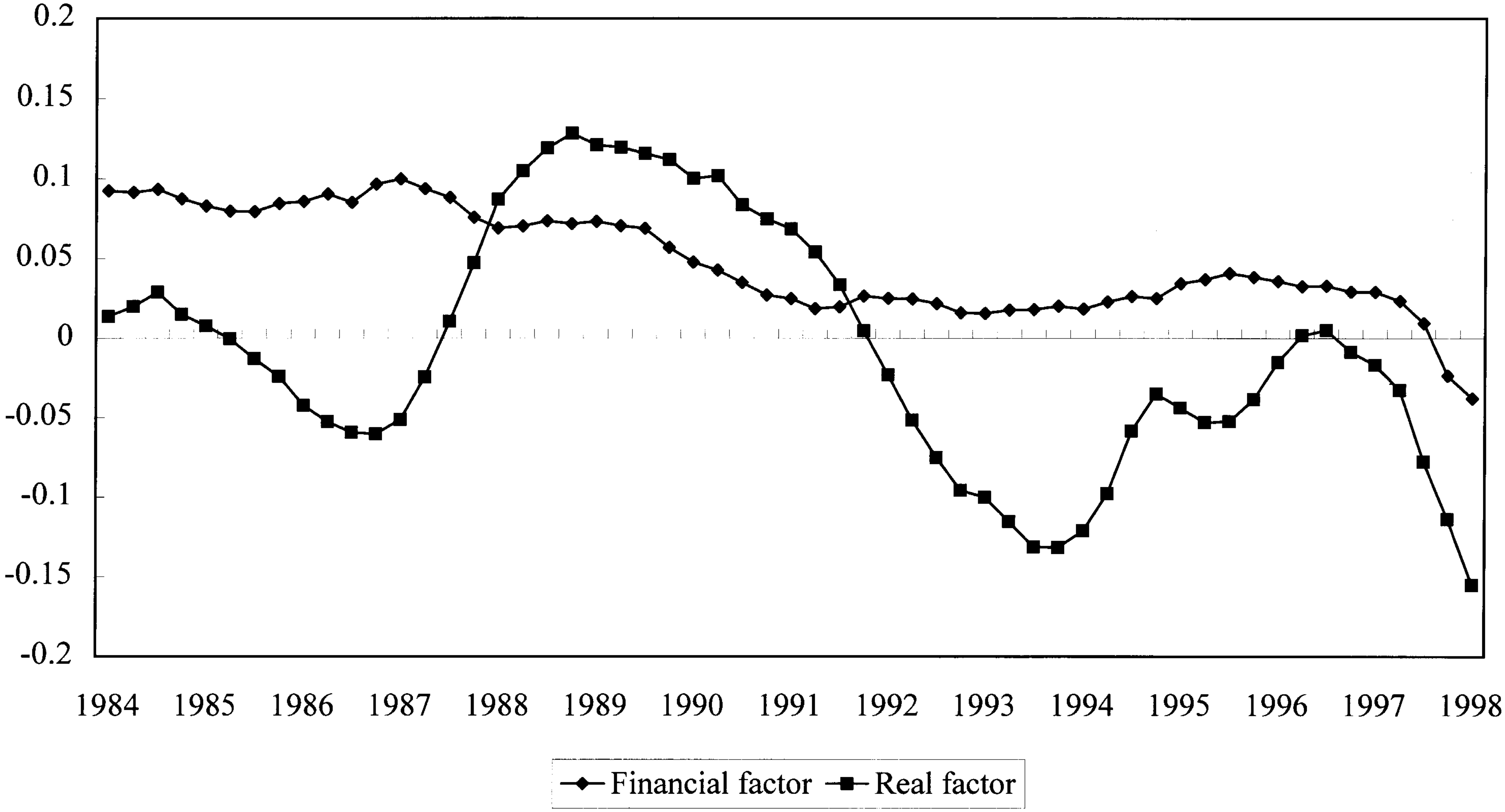

Figure 6 Simulation Result: The Impact of Credit Crunch on Growth of Aggregate Investment