Discussion Paper No. 681

INFORMATION, INVESTMENT, AND THE STOCK MARKET: A STUDY OF INVESTMENT REVISION DATA OF JAPANESE MANUFACTURING INDUSTRIES

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Abstract

We examined investment behavior in the Japanese manufacturing industry using investment revision data to analyze investment behavior from a fresh angle. We tested the martingale investment hypothesis and then the q-theory of investment by looking at the response of stock return and investment to news arriving at firms. The martingale hypothesis was generally accepted, and we also found evidence for the validity of the q-theory hypothesis. Investment was responsive to profit rate revision and sales revision, but stock return responded only to profit rate revision. Further investigation revealed that investment was also motivated by expansion of market share for sales, especially for industries with rapid technological progress.

JEL Classification Number: E-22, E-44

Keywords: Investment revision, martingale, stock return, q theory, market share, flexible accelerator theory

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1. Introduction

Current fixed investment, added to capital stock, contributes to future production activities. Thus future prospects of output markets as well as production factor markers are of paramount importance in determining investment. Although the importance of expectations with respect to investment activities has been well recognized, there have been very few studies that have tackled directly how incoming information makes firms change their expectations and thus revise their investment plans. This is mainly because expectation is intrinsically unobservable and researchers have to somehow specify the stochastic process driving the basic factors of investment. Under the assumption that the firm's optimal investment plan is determined by maximizing its firm value, one ingenious bypass to avoid handling expectations is the use of stock market information for conveying all of the information that is relevant for investment. That is, the future profitability of the investment is summarized into one variable, Tobin's q.[1] Appealing as this theory is, empirical work is not necessarily supportive of the positive relationship between investment and the stock market.[2]

In this study we examined how new information is utilized in revising investment plans in Japanese manufacturing industries. A new feature of our study is the use of investment revision data in the Short-term Economic Survey of Enterprises in Japan (Tankan), compiled by the Bank of Japan, without imposing any assumptions on a prior expectation formation by firms. By regressing investment revision based on incoming information, we may discover how firms revise their investment in response to incoming information. Moreover, under the rational expectation hypothesis, investment reflects all of the information available to the firm that is relevant to the future prospects of output markets as well as input factor markets. It implies that investment revision is a martingale, as is shown below. The martingale property of investment is in line with that of consumption originally derived by Hall (1978) from the permanent income hypothesis. We can test this martingale hypothesis using investment revision data.

Our approach has another advantage in that we can test the well-celebrated q-theory of investment by examining simultaneously the response of stock price, as well as investment, to incoming information.

Our main findings are as follows: First, on the whole, firms make their investment plans by fully exploiting all available information, in the sense that the information available before the revision date has no explanatory power in predicting investment revision. Second, investment revision and stock return are significantly affected by a revision of the profit rate. This might explain the positive correlation between investment and stock return. Third, once sales revision is taken into consideration, investment revision is more responsive to sales revision than is profit revision. However, stock return does not respond to sales revision, which implies that the relationship between investment and stock return is not stable. Rather, our evidence suggests that attention should also be paid to the market share aspect of the investment decision, as investment is partly driven by the firm's desire to expand its market share for sales.

This paper is organized as follows: In Section 2, after a brief explanation of a theoretical idea underlying our empirical work, we specify equations to be estimated that associate investment revision with incoming news. We also set up a framework to test the q-theory of investment. Section 3 describes our data on investment revision. Section 4 shows empirical results and discusses their implications. Section 5 concludes this study.

2. Investment Revision and Incoming News: Theory and Empirical Strategy

Investment revision and martingale

It is a general principle that the optimal investment of a firm is determined by intertemporal optimization. The objective function of the firm and the constraints are not specified at this time. The optimal investment in the period t (I_t) is written as a function of the information available to the firm in the period t, denoted by Ω_t.

$$I_t = f(\Omega_t) \qquad (1)$$

Suppose that a firm makes its first investment plan for period t in the period t sub-period, t_1. For example, the period corresponds to the year and the sub-period corresponds to a quarter. We assume that the investment plan is revised in the subsequent sub-periods $t_2, t_3, \cdots, t_k$ of period t. That is, the investment is revised k-1 times in period t before the investment plan is finally materialized. Figure 1 shows the process of investment revision in period t until a final determination of the plan is made. We denoted the investment plan for period t in sub-period t_j by $I_{t_j,t}$. Under a rational expectation assumption, the investment plan reported by the firm is a mathematical expectation that is conditional on the information set (Ω_{t_j}) available to the firm in sub-period t_j, or

$$I_{t_j,t} = E\left[I_t \middle| \Omega_{t_j}\right] \qquad (2)$$

The expected growth rate of investment for period t based on Ω_{t_j} is given by

$$G_{t_j,t} \equiv \frac{I_{t_j,t}}{I_{t-1}} = E\left[\frac{I_t}{I_{t-1}} \middle| \Omega_{t_j}\right] \qquad (3)$$

The investment plan is revised by incoming information, so that the revision of the investment growth rate between t_j and t_l $(t_l > t_j)$, denoted by RG_{t_j,t_l}, is written as

$$RG_{t_j,t_l} \equiv \frac{I_{t_l,t}}{I_{t-1}} - \frac{I_{t_j,t}}{I_{t-1}} = E\left[\frac{I_t}{I_{t-1}} \middle| \Omega_{t_l}\right] - E\left[\frac{I_t}{I_{t-1}} \middle| \Omega_{t_j}\right] \qquad (4)$$

Because no information is lost, or $\Omega_{t_j} \subset \Omega_{t_l}$,

$$E\left[RG_{t_j,t_l} \middle| \Omega_{t_j}\right] = 0 \qquad (5)$$

Equation (5) implies that the revision of the investment growth rate between t_j and t_l is a martingale.[3] The revision of the investment growth rate between t_j and t_l is driven by the information arriving between the sub-period t_j and t_l, but no variable in the information set Ω_{t_j} can predict the revision of the investment growth rate between t_j and t_l.

Specifically, we assumed that the revision of the investment growth rate between t_j and

t_l is a linear function of the information arriving between the sub-period t_j and t_l.

$$RG_{t_j,t_l} = \sum_{i=1}^{m} \alpha_i x_{i,t_j,t_l} \qquad (6)$$

where x_{i,t_j,t_l} : i-th information arriving between the sub-period t_j and t_l

$$x_{i,t_j,t_l} \in \Omega_{t_l} - \Omega_{t_j}$$

When the variables in the information set Ω_{t_j} were added to the explanatory variables in Equation (6), the corresponding coefficient estimates should be jointly zero. That is,

$$RG_{t_j,t_l} = \sum_{i=1}^{m} \alpha_i x_{i,t_j,t_l} + \sum_{i=1}^{n} \beta_i y_{i,t_j} \qquad (7)$$

where $y_{i,t_j} \in \Omega_{t_j}$

The test of martingale hypothesis is reduced to the test of the null hypothesis, that $\beta_1 = \beta_2 = \cdots \beta_n = 0$, in Equation (7).

Investment and stock return

Now, we will be more specific about the objective function of the firm. The standard assumption in the investment literature is that of value maximization. It is well known that Tobin's q, ratio of firm value to the replacement value of capital stock, is a sufficient investment statistic. The implications for the relationship between investment revision and stock price are straightforward. The firm revises the investment plan in response to any information that affects its firm value. Accordingly, the stock price also responds to the same information. Let z_{t_j,t_l} be information arriving between the sub-period t_j and t_l that affects the investment plan. Excess stock return between the sub-period t_j and t_l (R_{t_j,t_l}) is also affected by z_{t_j,t_l}.[4]

From the above discussion we can derive an investment function that has stock return as an explanatory variable. Both investment revision and stock return constitute a function of common information, z_{t_j,t_l}, or

$$RG_{t_j,t_l} = a_0 + a_1 z_{t_j,t_l} + v_{t_j,t_l} \quad (8)$$

$$R_{t_j,t_l} = b_0 + b_1 z_{t_j,t_l} + \varepsilon_{t_j,t_l} \quad (9)$$

where v_{t_j,t_l} : measurement error of investment growth rate uncorrelated with z_{t_j,t_l}

ε_{t_j,t_l} : other factors, uncorrelated with z_{t_j,t_l} and investment revision, that affect stock return

$a_1 > 0, b_1 > 0$

Eliminating z_{t_j,t_l} from Equations (8) and (9), we obtain

$$RG_{t_j,t_l} = a_0 - \frac{a_1}{b_1} + \frac{a_1}{b_1} R_{t_j,t_l} - \frac{a_1}{b_1} \varepsilon_{t_j,t_l} + v_{t_j,t_l} \quad (10)$$

Equation (10) states that the revision of investment growth rate is positively correlated with stock return. However, an estimation of Equation (10) by ordinary least squares (OLS) yields a biased estimate of the stock return coefficient because stock return is correlated with the composite error term. Because stock return is negatively correlated with the error term, we will have a downward biased estimate. The above argument illustrates why we often obtain a weak positive or sometimes a negative relationship between stock return and investment in empirical studies.[5] [6] We will show that this is exactly the case for our data set in Section 4.

3. Data Description of Investment Revision

The Short-term Economic Survey of Enterprises, called TANKAN, is a quarterly survey of enterprises conducted by the Bank of Japan to provide an accurate picture of business trends in Japan. In the survey, responding enterprises are asked to provide annual forecasts for several items that include fixed investment.[7] Sample aggregates by industry and firm size are released as a projected year-to-year percentage change in investment.

The survey is conducted quarterly in March, June, September, and December. The survey results are released at the beginning of April, July, October, and in mid-December. The annual investment projection for a certain fiscal year is first released in March of the previous fiscal year, and is revised five times, in June, September, December, March, and June of the following fiscal year, when the final figure is settled. Therefore, we can calculate the revision of the projected investment growth rate five times. There is, however, a caveat. In the first survey conducted in March of the previous fiscal year, the denominator in calculating growth rate is not a final one, and thus the investment revision from March to June reflects not only the change in projected annual investment (numerator) but also a change in the denominator. Thus, the investment revision from March of the previous fiscal year to June is not comparable to other revisions. Furthermore, the revision from March to June of the following fiscal year is a kind of ex-post revision and differs in nature from other revisions. Therefore, we used three of the revision series of annual investment growth rate: those from June to September, from September to December, and from December to Match.

The sample period covers from 1975 FY to 2002 FY.[8] We used only investment revision data from large enterprises because most of the medium-sized and small enterprises are not listed. Note that an examination of the relationship between investment and stock return is valid as long as the enterprises are listed.[9] In regression analysis, we pooled time series data across industries to increase observations. We used 12 manufacturing industries: textiles; pulp and paper; petroleum and coal products; ceramics, stone, and clay; iron and steel; non-ferrous metals; food and beverages; processed metals; industrial machinery; electrical machinery; and transportation machinery and precision machinery.

Figure 2 shows the annual projection of the investment growth rate of manufacturing as a whole for 1975 FY– 2000 FY, every five years. The five figures are annual projections made in June, September, December, March, and June in the following fiscal year, respectively. It appears that the annual projection is revised upward in September and December and then slightly revised downward after December, except for 1975 FY and 1985 FY. The Bank of Japan explains this pattern as follows: In the early stage of investment planning new plans become concrete and the plans that were unfinished in the previous fiscal year are added. This leads to an upward revision of investment plan. However, delays in construction and the postponement of plans are observed at the late stage of investment planning, which leads to downward revision of plans. If this is the case, then the investment revision might not be a martingale in the rigorous sense. We will examine this in detail in the next section.

4. Estimation Results and Their Implications

Incoming information and investment revision

We examined how the projection of annual investment growth rate is revised by incoming news. We regressed a revision of the projected annual investment growth rate (REVINV) on the variables that represent incoming news. The TANKAN survey also collects useful information on incoming news. This information consists of a projection of the profit rate, measured by the ratio of current profit to sales, and the sales growth rate. Thus a revision of profit rate (REVPROFIT) and of the sales growth rate (REVSALE) are readily calculated. Note that REVPROFIT and REVSALE are a revision of the projected annual profit rate and sales growth rate, respectively, similar to the definition of the REVINV variable.

Regression analysis was conducted separately for three revision dates (June–September, September–December, and December–March), because the response of investment to arriving news will depend on the stage of investment planning. The response might be weaker at the early stage of the investment plan because firms can easily change an investment plan at a later stage. As the investment plan gets materialized, the firms might be more responsive to incoming news.

By pooling time-series data across the 12 industries, we estimated the investment revision equation by OLS. The industry effects were taken into consideration by means of industry dummies. For the regression of the September–December and December–March revision data, we added the lagged revision to examine the persistency of the investment projection. When a martingale is held rigorously, we expect that the current revision is not affected by the lagged revision.[10] Estimation results of regressing REVINV on REVPROFIT and REVSALE are shown in Table 1.[11] A revision of both the profit rate and the sales growth rate had significantly positive effects on the revision of the investment growth rate for all of the revision dates, if used alone. An upward revision of the profit rate by 1% raises the revision of the investment growth rate by 3–4% points, while an upward revision of the sales growth rate leads to an approximate 0.6%-point upward revision of the investment growth rate. However, when a revision of both the profit rate and the sales growth rate are taken into consideration simultaneously, the revision of the profit rate is no longer significant for the December–March revision, while the revision of the sales growth rate remains significant at the 1% level for all of the revision dates. Surprisingly, a lagged investment revision had a significant effect on current investment revision. In the September–December revision, lagged investment had positive effects, while in the December–March revision it had negative effects. This result confirmed statistically the persistence of the projection of the annual investment growth rate, as seen in Figure 2. This suggests that the martingale hypothesis was not held rigorously.

We extended our analysis by adding more variables representing arriving news to the two basic revision variables used above. We constructed variables representing incoming news by VAR. Specifically, we estimated the following six-variable VAR system on quarterly data for 1975 FY–2002 FY. The variables we used were the rate of change in the corporate goods price index relative to the investment goods price and sales. In addition, we used stock returns and the change in the average variable cost, measured by sales cost divided by sales, the borrowing interest rate and diffusion index of lending attitude of financial institutions.[12] Note that all of the variables used in the VAR analysis are quarterly realized values, not revisions of annual projections. They are seasonally unadjusted, so we also added seasonal dummies. A six-variable VAR is estimated for each industry and we defined the incoming news variable as a one-period-ahead forecast error. In regression analysis, we used four variables of incoming news. They were forecast errors of the rate of change in corporate goods price relative to investment goods price (REVPRICE), the change in the average variable cost (REVAVECOST), the borrowing interest rate (REVINT), and the diffusion index of lending attitude of financial institutions (REVLEND). The regression results are shown in Table 2. The REVAVECOST variable was significant. Shock of the rate of change in the average variable cost exerted significant positive effects on the June–September and

December–March investment revision. The average variable cost reflects the capacity utilization rate, so it is quite legitimate to suggest that investment is revised upward when the rate of change in the average variable cost increases. Note that the revision of the profit rate ceases to be significant for the September–December and the December–March revision date, while the revision of the sales growth rate remains significantly positive for every revision date. This suggests that the revision of the sales growth rate is more important than that of the profit rate in revising the investment growth rate.

Next, we conducted the martingale test by adding variables available for the firm when the initial projection of the investment growth rate is made. Because we already knew that the lagged investment revision was a significant explanatory variable, our test was conditional on the persistence of the investment revision. We added the following five variables and tested the null hypothesis that the corresponding coefficients were jointly zero. The variables we considered were the first lag of the rate of change in the corporate goods price index relative to the investment goods price and the change in average variable cost, the borrowing interest rate and diffusion index of the lending attitude, and the stock return. The test statistics are shown in Table 3. The null hypothesis was not rejected at the conventional significance level for the June–September and the December–March revision and it was not rejected at the 1% significance level for the September–December revision.[13] It would be fair to say that the martingale hypothesis was conditional on the persistence of the investment revision.

Stock market and investment revision

As was discussed in Section 2, we expected to observe co-movement of investment revision and stock return in value-maximizing firms when they are driven by the same factors. In this section we examine the relationship between the revision of the investment growth rate and the stock return. First we regressed the quarterly stock return on the two basic variables used in the investment revision regression: the revision of the profit rate and the sales growth rate. The quarterly stock return was calculated as follows: the stock price index quoted in the Tokyo Stock Exchange, available monthly by industry. We first calculated the quarterly average of the stock price index, and then we calculated the quarterly stock return for each industry as the rate of change in the quarterly stock price.[14]

Table 4 shows the regression results of the quarterly stock return on the two revision variables.[15] Revision of both the profit rate and the sales growth rate had significantly positive effects on stock return, except in the December–March period, when it was used alone. The explanatory power of the sales growth revision was much lower than that of the profit rate. The adjusted R-squared ranged from -0.01 to 0.04 for the sales growth revision, while it ranged from -0.01 to 0.14 for the profit rate revision. When both revision variables were taken into consideration at the same time, the revision of the profit rate remained significant but that of the sales growth rate lost its significance. It appeared that the stock return was driven by new information associated with the profit rate.[16] This evidence is in accord with the q-type investment theory.

In section 2 we stated that the OLS estimation of the relationship between investment revision and stock return should lead to a downward biased estimate. Table 5 shows the regression results of investment revision on stock return.[17] The first column of each revision date shows the estimation results by OLS. Stock return had a significantly positive coefficient only in the June–September revision period. The second column of each revision date shows the estimation results from the instrumental variable (IV) method, to correct possible correlation between stock return and the error term. We used the lagged stock return as the instrument. In this case, the stock return had significantly positive coefficients in all of the revision dates. Furthermore, the coefficient estimates from the IV method were much larger than those from OLS. This is exactly the case discussed in Section 2, and it indicates that both the investment revision and stock return were driven by the same factor: revision of the profit factor. However, the stock return was also affected by other factors uncorrelated with investment revision.

We extended this analysis by adding more explanatory variables. First, we added a revision of the sales growth rate in the investment revision equation. The third column of each revision date in Table 5 shows the estimation results from the IV method. A lagged stock return was used for the instrument for the current stock return. The coefficient estimate of stock return got smaller, and they were barely significant for the

June–September and December–March revision dates. However, the coefficient estimate of the stock return was no longer significant for the September–December revision date.

In the second extension we added four one-period forecast errors calculated from the VAR analysis above, as well as the sales growth revision, as explanatory variables. Estimation results by the IV method are shown in Table 6. Stock return still exerted a positive effect on the investment revision, but it was significant only for the June–September revision date. However, the effects of sales growth revision on investment revision remained significantly positive for all of the revision dates.

In summary, a revision of the profit rate affected both the investment revision and stock return, but once the revision of the sales growth rate was taken into account, the profit rate revision variable lost its significance in the investment revision equation, although it remained significant in the stock return equation. The q-theory predicts that the stock return will respond in the same direction to the information that affects investment revision, which is not necessarily supported by our estimation results. There are several interpretations of our results. First, it is possible that the q-theory will keep its validity in explaining investment behavior once the perfect competitive assumption of product market underlying the q-theory is relaxed. When a firm faces a downward demand curve, the average q contains not only the marginal profitability of the investment (marginal q) but also the monopoly rent of the firm, which, in turn, is affected by sales growth. Schiantarelli and Geogoutsos (1990) and Galeotti and Schiantarelli (1991) formally demonstrated that the output variable enters q-type investment functions with a negative sign. Contrary to the theoretical prediction, we observed a positive correlation between current investment revision and current sales growth revision.[18]

Secondly, our evidence was also consistent with a flexible accelerator model of investment, where sales are the most important factor in determining investment. Abel and Blanchard (1988) rebuilt the traditional flexible accelerator model in an intertemporal context. Taking future sales as a given, they derived an optimal investment rule by minimizing the production cost in combination with the adjustment cost of investment. Investment narrowed the gap between optimal capital stock and the initial existing capital stock. Optimal capital stock is defined as the present discounted value of expected future sales. When the firm obtains information that is useful for revising future sales growth, the firm will exploit that information and revise the optimal capital stock accordingly. Thus, the investment plan will also be revised. As appealing as this theory is, more empirical work is needed to support it. Specifically, we need to conduct a direct test by estimating the Euler equation of the investment derived from intertemporal cost minimization.

Thirdly, it has been frequently asserted that the investment of Japanese firms is motivated by growth considerations, in addition to profit maximization. The Development Bank of Japan conducted an interesting survey on investment in 1999, released as the Corporate Investment Attitude Survey in The Development Bank of Japan (1999). This survey covered 3302 companies whose equity capital is one billion yen or more and was designed to elucidate the present condition of, and change in, investment behavior. The survey asked the following question to the firms involved: Has the maintenance and expansion of market share for sales been a driving force of investment acceleration in the 80s, and in the 90s? Eighty-two percent of the respondents in manufacturing industries answered "yes" for investment acceleration in the 80s and 64% for investment acceleration in the 90s. This illustrates the importance of market share considerations in understanding the investment behavior of Japanese firms.[19] This will be especially true for firms in industries with rapid technological progress, because investment in these industries will embody new technology; therefore, those firms that do not increase investment in response to increasing demand will not benefit from new technology and will eventually lose their competitive edge.[20] If this interpretation is valid, investment revision in industries with rapid technological progress will be more responsive to sales revision. To test this conjecture, we compared the response of investment revision to sales growth revision in industries with high and low technological progress. Specifically, we constructed the industry dummy for machinery industries that are expected to have high technological progress and added the cross term of the industry dummy with sales growth revision in the investment revision equations.[21]

Table 7 shows the estimation results. The cross term was significantly positive for all of the revision dates, irrespective of the specification of the investment equations.[22] It implies that the investment revision is much more responsive to the revision of sales growth for industries with rapid technological progress. This lends empirical support to our third interpretation, that maintenance or expansion of market share for sales is a major concern informing the investment decisions of firms .

5. Concluding Remarks

This study examined the investment behavior of Japanese manufacturing industries based on investment revision data. Use of investment revision data enabled us to shed light on investment behavior from different angles. First, we tested the martingale hypothesis of investment, which says that information is utilized efficiently in planning investments. Second, we examined the q-theory of investment by looking simultaneously at the response of stock return and investment to incoming news.

We found that the martingale hypothesis is generally accepted, in the sense that the information available to a firm prior to their investment revision does not affect the investment revision, although we observed some persistence of investment revision. We also found evidence favorable to the q-theory. That is, both stock return and investment revision respond in the same direction to a revision of the profit rate. However, once the revision of sales growth rate is taken into consideration, investment is responsive to sales revision, but stock return is not. Our evidence hints that the q-theory alone is not sufficient to explain the investment behavior of Japanese manufacturing firms. One possible approach, then, would be to take account of the market share aspect in investment decisions. This is especially useful in explaining the investment behavior of machinery industries characterized by rapid technological progress. More investigation into a firm’s investment motivation, consistent with observed investment activities, would constitute a promising avenue for future research.

Footnotes

[1] For seminal work on Tobin's q, see Tobin (1969) and Hayashi (1982).
[2] There are numerous studies on the relationship between the stock market and investment. For example, see Barro (1990), Morck et al. (1990), Blanchard et al. (1993), and Lamont (2000).
[3] Schankerman (2002) was the first to demonstrate that investment revision is a martingale.
[4] For formal discussion see Pakes (1985) and Schankerman (2002).
[5] See Lamont (2000) for another reason why we observe a negative correlation between stock return and investment.
[6] It is straightforward to extend the one variable case above to a multiple variables case, to obtain the relationship between stock return and investment.
[7] Fixed investment is defined as the amount of newly listed tangible fixed assets including new land purchase expenses. Note that it includes the amount newly appropriated in ongoing construction, but excludes the amount transferred from in-progress construction to property, plants, and equipment.
[8] TANKAN survey has been revised from the March 2004 survey, so that our sample period covers up to 2002 FY to maintain continuity of the data series. .
[9] Large enterprises are defined as those with 1000 employees or more.
[10] For the June–September revision regression we do not add the lagged revision because the March–June revision is contaminated by the final investment update in the previous year, as noted in Section 3.
[11] The projection of the profit rate in the June survey is only available after 1984, so the number of observations in the June–September investment revision regression is less than in the other regressions.
[12] The variables of sales, sales cost, and borrowing interest rate were taken from *Financial Statement Statistics of Corporations* by the Ministry of Finance. They are available by industry and by firm size, and measured by equity capital. Our figures are those of large corporations whose equity capital is more than one billion yen. The Bank of Japan compiles data on corporate goods price and the diffusion index of lending attitude of financial institutions, which is taken from the *Short-term Economic Survey of Enterprises*.
[13] The martingale test was also conducted for the case without lagged investment revisions as explanatory variables. The test statistics were 2.26 and 1.23 for the September–December and the December–March revision, respectively, and the test results in the text remained unaltered.
[14] It would be ideal to use excess stock return rather than stock return per se. However, quarterly return of the appropriate safe asset to be subtracted from the stock return was not available, so we used stock returns. Our approach is justified as long as the return of riskless asset is constant over time.
[15] Industry dummies are also used as regressors.
[16] Our evidence, that profit rate revision is more useful in predicting stock return, remained unaltered even when we added residual variables constructed from the VAR analysis above as explanatory variables.

[17] Industry dummies as well as lagged investment revision are also explanatory variables.
[18] See also Lindenberg and Ross (1981) and Ogawa and Kitasaka (1999) for the association of monopoly rent with average q and investment.
[19] Development Bank of Japan (2001) estimated investment equations with qualitative survey results as an explanatory variable, using a panel data set. They found that the investment rate of the firms that linked maintenance and expansion of market share for sales with investment acceleration was significantly higher.
[20] It has also been argued, from the standpoint of R&D investment, that the fraction of R&D expenditure, considered as a fixed cost, is high for machinery industries and, as sales increase, the cost burden of R&D expenditure decreases, which induces the firms in machinery industries to expand market share.
[21] Machinery industries cover the machinery, electrical machinery, transportation equipment, and precision instruments industries.
[22] We tried the case where the cross term of the industry dummy with profit rate revision is also added as an explanatory variable. It was insignificant for all of the revision dates, while the cross term of the industry dummy with sales growth rate remained significantly positive, irrespective of the revision date.

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Figure 1

Process of Investment Revision in Period t

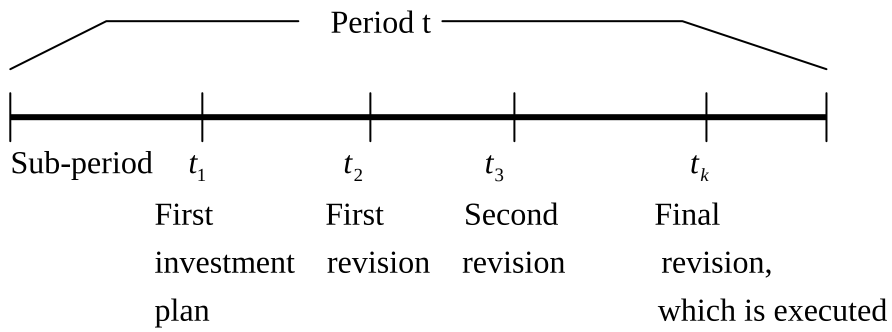
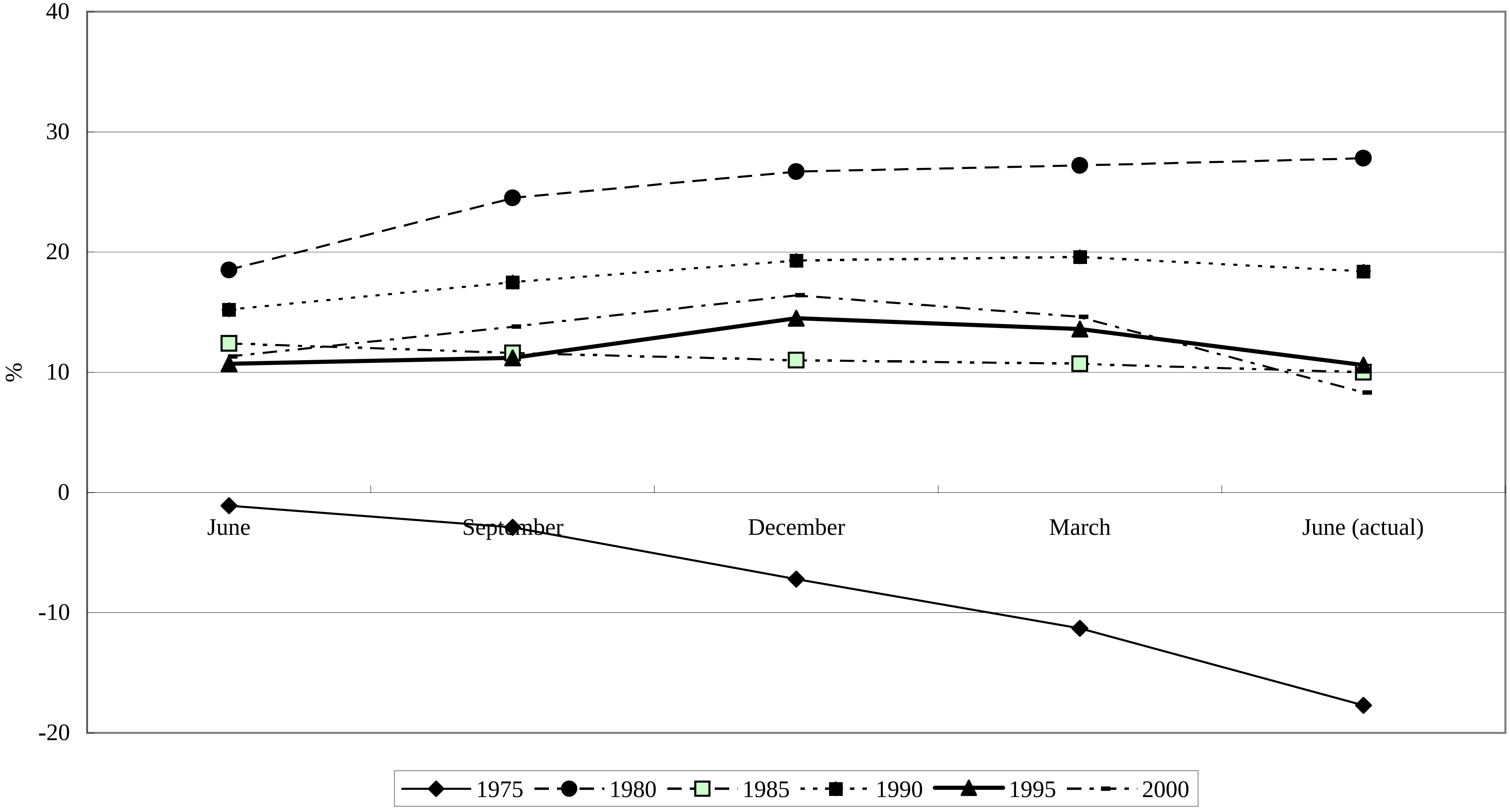


Figure 2
Annual Projection of Investment Growth Rate



Source: The Bank of Japan, Short-term Economic Survey of Enterprises.

Table 1

Revision of Projected Annual Investment Growth Rate and Arriving News: Basic Case

Explanatory variables	June to September			Investment Revision September to December			December to March		
REVPROFIT	3.8694***		2.6748***	3.0258***		1.8453*	4.0507***		1.1311
	(5.92)		(3.59)	(3.26)		(1.80)	(3.50)		(0.88)
REVSALE		0.6394***	0.4028***		0.6536***	0.4994***		0.6744****	0.6176***
		(6.73)	(3.15)		(3.77)	(2.59)		(5.86)	(4.68)
Lagged investment revision				0.3099***	0.2808***	0.2532**	-0.5374***	-0.5481***	-0.5502***
				(2.94)	(2.65)	(2.37)	(-11.52)	(-12.15)	(-12.18)
Adjusted R^2	0.1544	0.1419	0.1864	0.0863	0.0967	0.1034	0.2960	0.3427	0.3422
S.E.	0.0367	0.0381	0.0360	0.0719	0.0715	0.0712	0.0601	0.0581	0.0581

Notes: The values in parentheses are t-values.

Estimates of constant and industry dummies are suppressed.

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

Table 2
Revision of Projected Annual Investment Growth Rate and Arriving News:
Extended Case

Explanatory variables	June to September	Investment Revision September to December	December to March
REVPROFIT	2.6224***	1.5428	1.4110
	(3.50)	(1.44)	(1.09)
REVSALE	0.4889***	0.5795***	0.6506***
	(3.76)	(2.80)	(4.93)
REVPRICE	-0.3433	-0.1058	-0.3631
	(-1.39)	(-0.33)	(-1.43)
REVAVECOST	0.6500**	0.0115	1.1653***
	(2.15)	(0.02)	(3.07)
REVINT	0.8944	-0.8938	0.6899
	(1.27)	(-0.77)	(0.84)
REVLEND	-0.0298	0.0663	0.0125
	(-0.97)	(1.42)	(0.42)
Lagged investment revision		0.2575**	-0.5564***
		(2.39)	(-12.40)
Adjusted R^2	0.2031	0.1006	0.3578
S.E.	0.0356	0.0713	0.0574

Notes: See the notes in Table 1.

Table 3

Test Statistics of Martingale Hypothesis

Investment revision		
June to September	September to December	December to March
Test Statistics		
F(5,217)	F(5,288)	F(5,288)
0.6059 (0.70)	2.3721 (0.04)	1.3442 (0.25)

Notes: Values in parenthesis are p-values.

Table 4

Stock Return and Arriving News

Explanatory variables	Stock Return June to September			September to December			December to March		
REVPROFIT	10.5092***		10.6400***	6.3515***		6.8639***	2.2060		1.6129
	(6.87)		(5.97)	(5.36)		(5.05)	(1.43)		(0.91)
REVSALE		0.9671***	-0.0441		0.4294*	-0.1948		0.2059	0.1242
		(4.47)	(-0.14)		(1.87)	(-0.77)		(1.29)	(0.68)
Adjusted R^2	0.1420	0.0424	0.1382	0.0731	-0.0042	0.0719	-0.0135	-0.0147	-0.0153
S.E.	0.0859	0.0868	0.0861	0.0952	0.0991	0.0953	0.0808	0.0808	0.0809

Notes: See the notes in Table 1.

Table 5

Stock Return and Revision of Projected Annual Investment Growth Rate: Basic Case

Explanatory variables	Investment Revision								
	June to September			September to December			December to March		
	OLS	IV	IV	OLS	IV	IV	OLS	IV	IV
Stock return	0.0869***	0.2622**	0.2312*	0.0328	0.3651**	0.2654	0.0196	0.7756**	0.5643*
	(3.36)	(2.21)	(1.90)	(0.77)	(2.22)	(1.64)	(0.45)	(2.09)	(1.65)
REVSALE			0.4158***			0.5560***			0.5463***
			(2.66)			(2.88)			(3.29)
Lagged investment revision				0.3956***	0.3316***	0.2477**	-0.5205***	-0.4641***	-0.5010***
				(3.81)	(2.81)	(2.17)	(-10.96)	(-6.41)	(-7.82)
Adjusted R^2	0.0478			0.0556			0.2675		
S.E.	0.0401	0.0431	0.0411	0.0731	0.0802	0.0756	0.0613	0.0867	0.0740

Notes: See the notes in Table 1.

Table 6

Stock Return and Revision of Projected Annual Investment Growth Rate: Extended Case

Explanatory variables	June to September IV	Investment Revision September to December IV	December to March IV
Stock return	0.2181*	0.2664	0.3989
	(1.90)	(1.43)	(1.50)
REVSALE	0.5184***	0.5358**	0.6489***
	(3.66)	(2.30)	(4.64)
REVPRICE	-0.1135	0.0825	-0.5186*
	(-0.56)	(0.22)	(-1.76)
REVAVECOST	0.9249***	-0.0130	1.3607***
	(2.85)	(-0.02)	(2.96)
REVINT	0.8194	0.4443	1.3359
	(1.32)	(0.29)	(1.28)
REVLEND	0.0259	0.0098	0.0372
	(0.97)	(0.14)	(1.02)
Lagged investment revision		0.2493**	-0.5216***
		(2.15)	(-9.40)
S.E.	0.0401	0.0761	0.0654

Notes: See the notes in Table 1.

Table 7

Revision of Projected Annual Investment Growth Rate and Market Share Hypothesis

Explanatory variables	June to September		Investment Revision September to December		December to March	
REVPROFIT	2.4094***	2.4000***	1.5409	1.2257	0.0724	0.3485
	(3.22)	(3.20)	(1.49)	(1.14)	(0.05)	(0.25)
REVSALE	0.2690*	0.3525**	0.3871*	0.4468**	0.6194***	0.6517***
	(1.91)	(2.46)	(1.92)	(2.05)	(4.72)	(4.96)
REVSALE× Industry dummy	0.5368**	0.5349**	0.7492*	0.7940*	1.2614**	1.2812**
	(2.21)	(2.20)	(1.80)	(1.87)	(2.07)	(2.13)
REVPRICE		-0.3185		-0.0132		-0.3558
		(-1.30)		(-0.04)		(-1.41)
REVAVECOST		0.7092**		0.0584		1.1784***
		(2.36)		(0.11)		(3.12)
REVINT		0.7777		-0.8364		0.6989
		(1.11)		(-0.72)		(0.85)
REVLEND		-0.0241		0.0739		0.0120
		(-0.79)		(1.58)		(0.41)
Lagged investment revision			0.2186**	0.2224**	-0.5590***	-0.5652***
			(2.02)	(2.04)	(-12.38)	(-12.62)
Adjusted R^2	0.2002	0.2166	0.1101	0.1082	0.3493	0.3654
S.E.	0.0357	0.0353	0.0709	0.0710	0.0578	0.0571

Notes: See the notes in Table 1.