RIETI Discussion Paper Series 19-E-009

Why Is Investment So Weak Despite High Profitability? A panel study of Japanese manufacturing firms

OGAWA Kazuo
Kansai Gaidai University

Elmer STERKEN
University of Groningen

TOKUTSU Ichiro
Kobe University

RIETI
Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
https://www.rieti.go.jp/en/

RIETI Discussion Paper Series 19-E-009
February 2019

Why Is Investment So Weak Despite High Profitability? A panel study of Japanese manufacturing firms *

OGAWA Kazuo
College of Foreign Studies, Kansai Gaidai University
Elmer STERKEN
University of Groningen
TOKUTSU Ichiro
Graduate School of Business Administration, Kobe University

Abstract

We examine the investment behavior of Japanese manufacturing firms, using firm-level panel data for the period of 1970 to 2014. We find that the profitability of investment, measured by marginal q, has increased over time, while the investment rate has declined. We shed light on the perceived gap between investment and marginal q by estimating a marginal q-type investment function. We find that the investment sensitivity to profitability has declined steadily, which is partly explained by a decrease in the proportion of growth firms that have strong investment sensitivity to marginal q, and an increase in the proportion of restructuring firms that have weak investment sensitivity to marginal q.

Keywords: Investment, Marginal q, Investment gap, Growth firms, Restructuring firms
JEL classification: E22, E44

* This study is conducted as a part of the project "Study Group on Corporate Finance and Firm Dynamics" undertaken at the Research Institute of Economy, Trade and Industry (RIETI). The authors are grateful for helpful comments and suggestions by Takashi Hatakeda, Yuji Honjyo, Masayuki Morikawa, Ryuzo Miyao, Hiroshi Ohashi, Arito Ono, Etsuro Shioji, Hiroshi Uchida, Iichiro Uesugu, Makoto Yano and seminar participants at Kobe University and RIETI Discussion Paper seminar. This research was financially supported by KAKENHI Grant-in-Aid for Scientific Research (B) #16H03604. The usual caveat applies.

1. Introduction

The decline in investment after the Global Financial Crisis, despite an increase in investment profitability, has been observed all over the world, which has revived interest in investment models and sparked a debate on the main causes of weak investment. The decline in investment in the U.S. has been discussed by Hall (2015), Alexander and Eberly (2016), Fernald et al. (2017) and Gutierrez and Philippon (2017). The weak investment in advanced economies as well as developing economies has been examined by Bussiere et al. (2015), Buca and Vermeulen (2015), Dottling et al. (2017), Lewis et al. (2014), Kose et al. (2017), Brufman et al. (2013), Gruber and Kamin (2015) and Banerjee et al. (2015).

Japan is no exception. Figure 1 shows the investment rate and the marginal q of the Japanese non-financial corporations constructed from the annual time series of national accounts over the past half century. Marginal q, measure of profitability of investment, is calculated as the expected present discounted value of future profit rates under the static expectations for the profit rate and the interest rate. The marginal q precipitated in the aftermath of the first oil crisis. However, marginal q has exhibited an increasing trend since then, although it fell temporarily in the early 1990s soon after the bubble burst and in 2008 and 2009 after the Global Financial Crisis. Contrasted with an increasing trend of marginal q, the investment rate has exhibited a decreasing trend and has fallen sharply in the aftermath of the first oil crisis. In the 1980s, the investment rate was relatively stable, but it has fallen steadily since the bubble burst.

The purpose of this study is to examine why corporate investment has been weak in spite of a rising trend of profitability, using panel data of Japanese manufacturing firms over the past four decades. This research is in line with Nakamura (2017) and Tanaka (2018) who examined the causes of stagnant corporate investment in Japan. Nakamura (2017) demonstrates that conservative investment behavior before the Global Financial Crisis was driven by two motivations: managerial entrenchment and precautionary saving, while investment after the Global Financial Crisis was weakened by a precautionary saving motivation which was reinforced by the experience of sudden downturn and temporary liquidity shortage after the crisis. Tanaka (2018) first shows that the sensitivity of capital investment to Tobin's q has been declining since 1990 and then demonstrates that failure to obtain expected earnings from investments might have a negative impact on subsequent investment behavior after the Global Financial Crisis.

Our study differs from theirs by three points. First, they mainly focus on investment behavior of the Japanese firms in the 2000s, but our sample period dates back nearly a half-century and covers a long range of period from 1970 to 2014. Second, in formulating the investment equation, we take account of market power which affects a firm's incentives to invest. Consideration of market power is important since many argue that market structure has drastically changed over nearly a half-century. Third, we shed light on the distributional aspect of firms. Specifically we categorize our sample firms into four groups by the magnitude of sales and cost growth. The proportion of firms with positive sales growth and positive cost growth, termed as *growing firms*, has decreased since the 1990s, while the proportion of firms with negative sales growth and negative cost growth, termed as *restructuring firms*, has increased at the same time. We argue that the firm characteristics of growing firms are quite different from restructuring firms, which leads to the difference in adjustment cost of investment and thus generates the differential response of investment to marginal q.

Let us preview our main findings. The sensitivity of investment to marginal q has declined since the end of the high growth era. Weak sensitivity of investment to marginal q is quite robust, irrespective of the specification of the investment function. Our finding that the sensitivity of investment to marginal q has become weaker is still supported even after incorporating market power. It turns out that weak sensitivity of investment to marginal q is partly due to an increasing proportion of the restructuring firms that have lower sensitivity of investment to marginal q.

The remainder of the paper is organized as follows. We develop a basic marginal q-type investment model in section 2. In section 3 we explain the construction procedures of variables of investment function and present some descriptive statistics of major variables. In section 4 we show the estimation results of the marginal q-type investment functions. We examine why the sensitivity of investment to marginal q has declined over time in Section 5. The last section concludes.

2. A basic model of investment

Consider a perfectly competitive firm that chooses a sequence of investment to maximize its value. The firm pays the investment goods price, p_t^I per unit of investment I_t and incurs convex adjustment cost of investment $G(I_t, K_{t-1})$, where K_{t-1} is capital stock at the end of period *t*-1. The production function is linearly homogenous, $F(K_{t-1}, N_t)$ where N_t is labor input in period *t*.

The firm solves the following problem to obtain the optimal sequence of investment.

$$\begin{aligned} V_t(K_{t-1}) = p_t\big(F(K_{t-1}, N_t) - G(I_t, K_{t-1})\big) - w_t N_t - p_t^I I_t \\ + E_t[(1 + R_{t+1})^{-1} V_{t+1}(K_t)] \end{aligned} \tag{1}$$

subject to the capital accumulation equation

$$K_t = (1 - \delta)K_{t-1} + I_t$$

$E_t[\cdot]$: the expectation operator conditional on the information in period *t.*

where p_t is the output price in period *t*, w_t is wage rate in period *t*, R_{t+1} is the one period interest rate and δ is the depreciation rate.

The first order condition of I_t is written as

$$\frac{\partial G}{\partial I_t} = [Mq_t - 1]\frac{p_t^I}{p_t} \tag{2}$$

where Mq_t is the marginal q, which is defined as the expected present value of future marginal product of capital divided by the investment goods price.

Marginal q is written as

$$Mq_t = \frac{1}{p_t^I} E_t\left[\sum_{j=1}^{\infty} \mu_{t+j}\,(1-\delta)^{j-1} p_{t+j}\left(\frac{\partial F}{\partial K_{t+j-1}} - \frac{\partial G}{\partial K_{t+j-1}}\right)\right] \tag{3}$$

where

$$\mu_{t+j} = \prod_{i=1}^{j}(1+R_{t+i})^{-1} \quad (j = 1,2,\cdots).$$

If we assume that the adjustment cost of investment is quadratic or

$$G(I_t, K_{t-1}) = \frac{\alpha_1}{2}\left(\frac{I_t}{K_{t-1}} - \theta\right)^2 K_{t-1} \tag{4}$$

Then we can derive a basic investment function to be estimated as

$$\frac{I_t}{K_{t-1}} = \theta + \frac{1}{\alpha_1}[Mq_t - 1]\frac{p_t^I}{p_t} \tag{5}$$

Equation (5) shows that marginal q is a sufficient statistics of investment. The basic investment function can be extended to incorporate two hypotheses. The first hypothesis is frictions in financial markets. It is well known that the balance sheet conditions of a debtor affect the cost of raising external funds when financial markets are imperfect. When there exists asymmetric information between debtors and creditors, it will drive a wedge between the cost of external finance and internal finance, called *the external finance premium*. The cost of external finance is higher than that of internal fund by the external finance premium and thus investment is influenced by the availability of internal fund.[1] Furthermore, the external finance premium is inversely associated with the borrower's collateralizable net worth relative to the debt. An adverse shock to the borrower's net worth raises the external finance premium and reduces borrowings as well as investment. To account for external finance constrains, we add the ratio of cash flow to

[1] There is a large of literature on this issue, following Fazzari et al. (1987). See Hubbard (1998) for a survey of investment behavior under financial market imperfections.

capital stock and the debt-asset ratio to the explanatory variables.

The second hypothesis is the effect of uncertainty on investment. It is well known that in the presence of irreversibility under uncertainty there exists nonnegligible opportunity cost of investing today rather than keeping the option of waiting to invest until new information arrives at the firm.[2] Therefore increasing uncertainty raises this opportunity cost and decreases investment. We add the standard deviation of the sales growth rate as a measure of uncertainty to the explanatory variables.

The extended investment function is written as

$$\frac{I_t}{K_{t-1}} = \beta_0 + \beta_1[Mq_t - 1]\frac{p_t^I}{p_t} + \beta_2\frac{CF_t}{K_{t-1}} + \beta_3(DEBT)_{t-1} + \beta_4(STDGRW)_t \quad (6)$$

where CF_t is cash flow, $DEBT_t$ is the debt-asset ratio and $STDGRW_t$ is the standard deviation of the sales growth rate.

3. Data construction and basic descriptive statistics

We describe the procedures to construct the variables used for estimating the investment function derived in the previous section and then depict the characteristics of the constructed variables. In particular we make a detailed explanation on how the marginal q is constructed, since marginal q is a key determinant of investment. The basic data come from the *Corporate Financial Database of Development Bank of Japan*. The database provides the time series of financial statements about 3000 listed firms from 1957 to 2015 and total number of observation is more than 100,000, but we only use the data for manufacturing firms for the period from 1970 to 2014. The data on prices are complemented by the System of National Accounts of Japan.

We follow Abel and Blanchard (1986) in constructing marginal q. Marginal q is defined as the expected present value of a stream of future marginal product of capital including marginal adjustment cost of investment, divided by the investment price deflator. The basic idea is to formulate the stochastic process underlying the discount factor $r_t = \frac{1-\delta}{1+R_t}$ and the profit rate π_t, defined as the ratio of gross profit to capital stock, and then calculate the expected present value of the profit rate.

Suppose that the change in discount factor, Δr_t and the change in profit rate, $\Delta\pi_t$ are characterized by the VAR model of lag order 2 or

[2] See McDonald and Siegel (1986) Dixit and Pindyck (1994) for an excellent exposition of the effect of uncertainty on investment. For empirical evidence, see Pindyck and Solimano (1993), Leahy and Whited (1996), Guiso and Parigi (1999), Ogawa and Suzuki (2000), Bulan (2005) and Arslam et al. (2015).

$$\begin{aligned}\Delta\pi_t &= a_1\Delta\pi_{t-1} + a_2\Delta\pi_{t-2} + a_3\Delta r_{t-1} + a_4\Delta r_{t-2} + \epsilon_{1t} \\ \Delta r_t &= b_1\Delta\pi_{t-1} + b_2\Delta\pi_{t-2} + b_3\Delta r_{t-1} + b_4\Delta r_{t-2} + \epsilon_{2t},\end{aligned} \tag{7}$$

where ϵ_{1t} and ϵ_{2t} are disturbance terms.

In a matrix form eq. (7) is rewritten as

$$\Delta\mathbf{Z}_t = \mathbf{A}\Delta\mathbf{Z}_{\mathrm{t}-1} + \begin{pmatrix}\epsilon_{1t}\\0\\\epsilon_{2t}\\0\end{pmatrix}, \tag{8}$$

where

$$\Delta\mathbf{Z}_t = \begin{pmatrix}\Delta\pi_t\\\Delta\pi_{t-1}\\\Delta r_t\\\Delta t_{t-1}\end{pmatrix} \text{ and } \mathbf{A} = \begin{pmatrix}a_1 & a_2 & a_3 & a_4\\1 & 0 & 0 & 0\\b_1 & b_2 & b_3 & b_4\\0 & 0 & 1 & 0\end{pmatrix}.$$

Then it can be shown that marginal q, defined as eq. (3), is written as[3]

$$Mq_t = \frac{\pi_t}{1-r_t} + \frac{\pi_t}{(1-r_t)^2}\mathbf{b}'(\mathbf{I}-r_t\mathbf{A})^{-1}\mathbf{A}\Delta\mathbf{Z}_{\mathrm{t}} + \frac{r_t}{1-r_t}\mathbf{a}'(\mathbf{I}-r_t\mathbf{A})^{-1}\mathbf{A}\Delta\mathbf{Z}_{\mathrm{t}} \tag{9}$$

where

$$\mathbf{a} = \begin{pmatrix}1\\0\\0\\0\end{pmatrix} \text{ and } \mathbf{b} = \begin{pmatrix}0\\0\\1\\0\end{pmatrix}.$$

We estimate the VAR model of Δr_t and $\Delta\pi_t$ with lag order 2 for thirteen industries, respectively and then use the coefficient estimates of the VAR model of each industry to construct the marginal q series of the firms in the industry.[4] The sample mean and median of the marginal q for each industry is shown in Table 1. Marginal q is high in precision instruments, electrical machinery, equipment and supplies and machinery and is low in basic metal, pulp, paper and paper products and petroleum and coal products. The mean of marginal q of the manufacturing sector over the sample period is depicted in Figure 2. The marginal q series estimated under the assumption that the VAR model is of lag order 1 is also shown. It turns out that the marginal q series is robust in terms of the lag order of the VAR model. The firm-level mean of marginal q exhibits a similar movement to the aggregate marginal q series. Marginal q plummeted after the

[3] In calculating marginal q we include the current profit rate since we use annual data and small-scale investment realized in the short-term might depend on the current profit rate.
[4] We omit the observations less than 2.5 percentile and more than 97.5 percentile in each sector for profit rate and the discount factor in estimating the VAR model.

first oil crisis, but it exhibits an increasing trend since then except for several years in the early 1990s, after the bubble burst and 2008 and 2009 after the Global Financial Crisis.

The investment rate is the ratio of real investment to the capital stock at the end of the previous year. Real investment is obtained by dividing the nominal investment expenditure by the deflator of gross fixed capital formation in the system of national accounts. The real capital stocks are calculated by the perpetual inventory (PI) method. The sample mean and median of the investment rate for each industry is shown in Table 2. The investment rate is high in precision instruments, electrical machinery, equipment and supplies and food products and beverages and low in basic metal, textiles and machinery. The mean of the investment rate over the sample period is depicted in Figure 3. The investment rate fell sharply after the first oil crisis and rebounded in the 1980s. After the investment rate hit a peak in 1991, it has declined steadily since then.

Figure 4 shows the mean of the ratio of real cash flow to the capital stock at the end of the previous year over the sample period. It fell sharply in 1974 soon after the first oil crisis, but it exhibits an increasing trend since then, although it fluctuates a lot around the trend. Figure 5 shows the mean of the standard deviation of the sales growth rate as a measure of uncertainty of the firms over the sample period. The standard deviation was rather stable in the 1980s through the 1990s, although it increased after the first oil crisis, in the early 2000s and after 2009. Table 3 shows the descriptive statistics of the major variables used in estimating the investment function for the seven sub-samples as well as the whole sample period. The debt-asset ratio has decreased steadily over the sample period.[5]

4. Estimation Results of Basic Investment Model

We estimate the investment function derived in section 2 for whole sample and the seven sub-sample periods. The seven sub-sample periods are the high growth period (1972-1973), the stable-growth period after the first oil crisis (1974-1986), the bubble period (1987-1990), the lost decade (1991-2002), the way out period from the lost decade (2003-2007), the global financial crisis (2008-2012) and the Abenomics era (2013-2014). The seven sub-sample periods are all characterized by the big events that affected the firm's behavior and it justifies our empirical strategy to estimate the investment function separately for each period.

Table 4 shows the estimation results of the basic investment function where the marginal q is the only explanatory variable. The investment function is estimated by the fixed-effects model with year dummies. Marginal q has a significantly positive effect on the investment rate except for the period of 2013-2014. Note that the coefficient estimate of the marginal q has a tendency to decline over time. The coefficient estimate of the marginal q is 0.0393 in the high growth period but it falls to 0.0127 in the Abenomics period.

[5] See the Data Appendix for more details on the construction procedure of the major variables.

Table 5 shows the estimation results of the investment function where two variables representing the financial frictions, cash flow ratio and debt-asset ratio, are added as explanatory variables. We still observe the declining tendency of the coefficient estimate of the marginal q. The cash flow variable has a significantly positive effect on investment only for the period of 1974-1986 and 2003-2007. The debt-asset ratio has a significantly negative effect on investment in all the sub-sample periods but 1972-1973 and 1987-1990. Note that the effect of debt-asset ratio on investment is the largest in the Abenomics era, which is consistent with the 2016 special survey, conducted by the DBJ, that askes the reasons why the firms hold down investment expenditures. Nearly 40 % of the firms replied that strengthening the balance-sheet has higher priority than investment.

Table 6 shows the estimation results of the investment function where the uncertainty measure is added as an explanatory variable to the marginal q and the financial frictions variables. Uncertainty has a significantly negative effect on investment except for the bubble period and the Abenomics era. The coefficient estimate of marginal q has decreased over time. To sum up, the declining trend of the sensitivity of investment to the marginal q is robust with respect to the specification of the investment function.

5. Why has the sensitivity of investment to profitability declined?

We find that the sensitivity of investment to marginal q has declined since the early 1970s. In this section we examine why the sensitivity of investment to marginal q has fallen. We consider two hypotheses for explaining low investment despite high marginal q.

The first hypothesis is a rise in market power. Aghion et al. (2014) argue that firms in industries that do not face the threat of investment might have weak incentives to invest. Gutierrez and Philippon (2017) also argue that under-investment relative to Tobin's Q in the U.S. business sector since the early 2000s is partly due to declining competition.

We modify the firm's investment behavior under the assumption that the firm faces a downward sloping demand curve in the product market, which is given by

$$p_t = h\big(F(K_{t-1}, N_t) - G(I_t, K_{t-1})\big) \tag{10}$$

Then it can be shown that the investment function is derived as

$$\frac{I_t}{K_{t-1}} = \theta + \frac{1}{\alpha_1}[Mq_t - 1]\frac{p_t^I}{p_t\left(1 - \frac{1}{\varepsilon}\right)} \tag{11}$$

where marginal q is written as

$$Mq_t = \frac{1}{p_t^I} E_t \left[\sum_{j=1}^{\infty} \mu_{t+j} \, (1-\delta)^{j-1} p_{t+j} \left(1 - \frac{1}{\varepsilon}\right) \left(\frac{\partial F}{\partial K_{t+j-1}} - \frac{\partial G}{\partial K_{t+j-1}} \right) \right] \tag{12}$$

and ε is elasticity of demand with respect to price or $\varepsilon = -\frac{p_t}{(F-G)_t} \cdot \frac{d(F-G)_t}{dp_t}$.

It is easy to show that $\left(1 - \frac{1}{\varepsilon}\right)$ is the inverse of the price-cost ratio when the production technology is linearly homogeneous. The price-cost ratio, defined as the ratio of price to the unit cost, is positively related with the price-cost margin, which measures a firm's ability to extract rents from the market and can be a proxy of market power. Figure 6 shows the mean and median of the price-cost margin of the firms in our sample. We observe that the price-cost margin has been stable since the 1980s, although it declined sharply in the 1970s.[6] We multiply the marginal q calculated in section 3 and the output price in eq. (11) by the inverse of the price-cost ratio and then estimate the investment function that takes account of imperfect competition in the output market.

Table 7 shows the estimation results of the basic investment function where the marginal q is the only explanatory variable. Marginal q has again significantly positive effect on the investment rate except for the period of 2013-2014. We confirm that the coefficient estimate of the marginal q has declined over time. Table 8 shows the estimation results of the basic investment function where two variables, cash flow ratio and debt-asset ratio, are added as the explanatory variables. We still observe the declining tendency of the coefficient estimate of the marginal q. Table 9 shows the estimation results of the investment function where the uncertainty measure is added as an explanatory variable to the marginal q and the financial frictions variables. We find that the coefficient estimate of marginal q has decreased over time. To sum up, declining trend of the sensitivity of investment to the marginal q is still supported even if we take the imperfect competition in the output market into consideration in the firm's investment behavior.[7]

Now we turn to the second hypothesis. The firm can raise profits from investment by increasing sales and/or cutting cost. Exogenous demand growth contributes to the sales growth, while a fall of input prices or an increase in productivity leads to a cut-down of cost. We estimate an effect of a change in marginal q on the sales growth and the cost growth to quantify the effects

[6] Relatively stable movement of the price-cost margin of individual firms since the 1980s is contrasted with an increase of industry-level concentration measure, such as sales concentration ratio or Herfindahl-Hirschman Index, which suggests that our first hypothesis might be examined, using alternative measure of market power.

[7] Gutiérrez and Philippon (2017) show that the Herfindahl index has significantly negative effect on fixed investment of U.S, firms, but the price-cost margin does not.

of sales and cost on profitability (Table 10). The sales (cost) growth rate has a significantly positive (negative) effect on a change in marginal q for all the sub-sample periods. The effects of sales growth rate and cost growth rate on marginal q are largest in the period of 2003-2007 when the firms were struggling to get out of the lost decade.

Given the evidence above on the effects of sales growth and cost growth on the marginal q, we categorize the firms into four groups, depending the sign of the sales growth rate and the cost growth rate. The firms with positive sales growth and positive cost growth are termed as *growing firms*. The firms with positive sales growth but with negative cost growth are termed as *blue-chip firms*. The firms with negative sales growth and negative cost growth are termed as *restructuring firms*. The firms with negative sales growth and positive cost growth are termed as *declining firms*. The firms in each group might have different adjustment costs of investment, reflecting the business environments surrounding them. A growing firm might be expanding the scale of operations to keep pace with an increase in demand. For the growing firms the adjustment cost of investment will not be so large because the firms have designed their organizational system so that the firms might be able to accommodate large size of investment. Therefore investment responds actively to an increase in marginal q. On the other hand, the restructuring firms are struggling to cut production cost to cope with a decrease in demand. They might regroup their existing business into fewer business units, downsize the business's workforce, go for decentralization and do outsourcing. The restructuring firms devote most of their managerial resources to restructuring activities, so that they cannot afford to allocate their managerial resources to undertaking large-scale investment. Therefore the adjustment cost of investment is large for restructuring firms and thus the response of investment to marginal q will be weak.

Given the different nature of adjustment cost of investment depending on the type of firms, we can show that the sensitivity of investment to marginal q has weakened as the proportion of restructuring firms gets larger over time. Figure 7 shows the proportion of firms in the four groups defined above. Figure 8 shows the proportion of firms in the four groups among the firms with *increasing* marginal q. Note that the firms with *increasing* marginal q play a vital role in increasing investment. The proportion of blue-chip firms and declining firms are small relative to that of growing firms and restructuring firms. The proportion of restructuring firms has increased since the lost decade. The proportion of restructuring firms exceeds that of growing firms in nine years out of 24 years after the 1991. Paying our attention to the firms with increasing q, the proportion of restructuring firms exceeds that of growing firms in 1993, 1994, 1999, 2002 and 2010 each of which corresponds to the years of severe downturn.

We compare the firm's major characteristics between the growing firms and the restructuring firms with increasing q.[8] Table 11 compares the mean of the investment rate, the ratio of cash

[8] The comparison between the growing firms and the restructuring firms without any constraints on

flow to capital stock, the debt-asset ratio, the TFP growth rate, price-cost ratio and the proportion of the non-regular workers for the six sub-sample periods as well as the whole sample period. The investment rate of growing firms is significantly higher for all the sub-sample periods but the Abenomics era, which is consistent with our conjecture that the growing firms have lower adjustment cost of investment. The growing firms have significantly higher TFP growth rate for all the sub-sample periods and have significantly lower debt-asset ratio for all the sub-sample periods but the Abenomics era. The proportion of the non-regular workers is higher for the restructuring firms in the 1990s and the early 2000s. We can see that the restructuring firms manage to turn profits by hiring non-regular workers, but their debt-asset ratio remained high and they fail to raise the TFP growth rate. The growing firms have more market power in terms of the price-cost ratio for all the sub-sample periods.

Given the evidence above that growing firms have different firm characteristics from restructuring firms, we compare the adjustment cost of investment between the growing firms and the restructuring firms by estimating the investment function separately for four groups of firms. Note that the parameter of the adjustment cost of investment is the inverse of the coefficient estimate of marginal q. Table 12 shows the estimation results of investment function for four groups of firms. The coefficient estimate of marginal q is the largest for growing firms and the smallest for the restructuring firms, irrespective of the specification of the investment function. It suggests that growing firms have lower adjustment cost of investment and respond more actively to marginal q than the restructuring firms.

Lastly we calculate the weighted average of the coefficient estimates of marginal q across the four groups of firms. We use the coefficient estimates of marginal q when all the explanatory variables are taken into consideration. The weights are the proportion of firms in each group. Figure 9 shows the calculated sensitivity of investment to marginal q for each year as well as the five-year moving average. It is clear from Figure 9 that an increase in the proportion of restructuring firms is partly responsible for the declining trend of the sensitivity of investment to marginal q.

6. Concluding Remarks

By examining panel data of Japanese manufacturing firms over nearly a half century, we find that the profitability of investment, measured by marginal q, has increased steadily after a temporarily sharp fall after the first oil crisis., while the investment rate has a declining trend since the bubble burst. We shed light on this gap between weak investment and high marginal q. Our tentative conclusion is that this gap is partly due to a decrease in the number of growing firms

marginal q remains unaltered except for the proportion of non-regular workers. The growing firms have higher proportion of non-regular workers in the 1990s.

that have low adjustment cost of investment and an increase in the restructuring firm that have high adjustment cost of investment. Moreover, we find that a decrease in the sensitivity of investment to profitability is not caused by a change in market power of the firms.

Given the fact that the profitability of investment has improved over time, we expect the aggregate investment rate to increase if the restructuring firms switch to the growing ones. Increasing the long-term growth potentials does help the restructuring firms more active in investment. The 2017 Annual Survey of Corporate Behavior, conducted by the Cabinet Office, shows that the manufacturing firms still have a poor long-term growth prospect of the Japanese economy. The expected average growth rate of the economy is barely above unity, 1.08%. We argue in other paper that a steady rise in consumption growth can raise the long-term growth prospect of the firms.[9]

[9] See Ogawa (2018) for more detailed discussions.

References

Abel, A. B. and O. Blanchard (1986). "The Present Value of Profits and Cyclical Movements in Investment," *Econometrica*, Vol.54, pp. 239-273.

Aghion, P., Bechtold, S., Cassar, L. and H. Herz (2014). "The Causal Effects of Competition on Innovation: Experimental Evidence," NBER Working Paper No.19987.

Alexander, L. and J. Eberly (2018). "Investment Hollowing Out," *IMF Economic Review*, Vol.66, No.1.

Banerjee R., J. Kearns and M. Lombardi (2015). "(Why) Is Investment Weak?" *BIS Quarterly Review* (Mar.).

Brufman. L., Martinez, L., and R. P. Artica (2013). "What Are the Causes of the Growing Trend of Excess Savings of the Corporate Sector in Developed Countries", *Policy Research Working Paper* No.6571, World Bank Group.

Buca, A. and P. Vermeulen (2015). "Corporate Investment and Bank-dependent Borrowers during the Recent Financial crisis," European Central Bank Working Paper No.1859.

Bulan, L. T. (2005). "Real Options, Irreversible Investment and Firm Uncertainty: New Evidence from U.S. Firms," *Review of Financial Economics*, Vol.14 (3–4), pp.255-279.

Bussiere, M., Ferrara, L. and J. Milovich (2015). "Explaining the Recent Slump in Investment: the Role of Expected Demand and Uncertainty," Banque de France Working Papers 571.

Dixit, A. K. and R. S. Pindyck (1994). *Investment and Uncertainty*, Princeton, New Jersey: Princeton University Press.

Dottling, R., Gutiérrez, G. and T. Philippon (2017). "Is There an Investment Gap in Advanced Economies? If so, Why?" mimeographed.

Fazzari, S., Hubbard, R.G. and B. C. Petersen (1988). "Financing Constraints and Corporate Investment," *Brookings Papers on Economic Activity*, No.1, pp.141-206.

Fernald, J. G., Hall, R. E., Stock, J. H. and M. W. Watson (2017). "The Disappointing Recovery of Output after 2009," *Brookings Papers on Economic Activity*, No.1, pp.1-58.

Gruber J. W. and S.B. Kamin (2015). "The Corporate Saving Glut in the Aftermath of the Global Financial Crisis", *International Financial Discussion Papers*, 1150, Board of Governors of the Federal Reserve System.

Guiso, L. and G. Parigi (1999). "Investment and Demand Uncertainty," *Quarterly Journal of Economics*, Vol.114, Issue 1, pp.185-227.

Gutiérrez, G. and T. Philippon (2017). “Declining Competition and Investment in the U.S.” NBER Working Paper No.23583.

Hall, R.E. (2004). “Measuring Factor Adjustment Costs,” *Quarterly Journal of Economics*, Vo.119, No.3 pp.899-927.

Hubbard, R.G. (1998). “Capital-Market Imperfections and Investment,” *Journal of Economic Literature* Vol.36, pp.193-225.

Kose A., Ohnsorge, F. L., Ye, L. S., and E. Islamaj (2017). “Weakness in Investment Growth: Causes, Implications and Policy Responses,” Policy Research Working Paper No. 7990, World Bank Group.

Leahy, J. V. and T. M. Whited (1996). “The Effect of Uncertainty on Investment: Some Stylized Facts,” *Journal of Money, Credit and Banking*, Vol.28, No.1, pp.64-83.

Lewis C., Pain, N., Strasky, J. and F. Menkyna (2014). “Investment Gaps after the Crisis,” OECD Economics Department Working Papers, No. 1168.

McDonald, R. and D. Siegel (1986). “The Value of Waiting to Invest,” *Quarterly Journal of Economics*, Vol.101, No.4, pp.707-728.

Tanaka, K. (2018). “The Puzzle of the Gap between Strong Corporate Profits and Weak Capital Investment,” mimeographed (in Japanese).

Nakamura, J. (2017). “Why Does Capital Investment by Japanese Firms Remain Sluggish? :A Reexamination from Secular Stagnation Perspective,” *Economic Analysis (Keizai Bunseki)*, The Cabinet Office No.193, pp.51-82. (in Japanese)

Ogawa, K. (2018). “Expected Growth Rate of the Japanese Economy and Abenomics,” *Shoko Kinyu*, Jan., pp.6-27. (in Japanese)

Ogawa, K. and K. Suzuki (2000). “Uncertainty and Investment: Some Evidence from the Panel Data of Japanese Manufacturing Firms,” *The Japanese Economic Review*, Vol.51, No.2, June 2000, pp.170-192.

Pindyck, R.S. and A. Solimano (1993). “Economic Instability and Aggregate Investment,” *NBER Macroeconomics Annual* 8, Cambridge, Massachusetts: MIT Press, pp.259-303.

Yavuz, A., Atabek, A., Hulagu, T.and S. Sahinoz (2015). “Expectation Errors, Uncertainty, and Economic Activity,” *Oxford Economic Papers*, Vol. 67, No. 3, pp.634–660.

Data appendix

In this appendix we explain the sources and the methods of constructing the variables used in this study. As we stated in the text, the data are mainly from the *Corporate Financial Database of Development Bank of Japan* (DBJ). The data on prices are in principle complemented by the System of National Accounts of Japan (SNA).

[1] The variables used in the calculation of Tobin's marginal q

π_t: gross profit rate of period *t*, the ratio of the sum of 'net operating profit' and 'depreciation expense' to the beginning of period real gross capital stock in period *t*,

δ: depreciation rate of gross capital stock, assumed to be constant, is calculated as the sample average for the sample period of the corresponding firm. We estimate the depreciation rate of 'gross' capital stock as the ratio of 'retirement in tangible fixed asset (except for land)' to 'gross fixed tangible asset (except for land)' including 'accumulated depreciation' in fixed tangible asset schedule. In estimating this constant ratio, denominator, gross fixed tangible asset, is the average of the beginning and end of period and

R_t: interest rate in period *t* calculated as the ratio of 'interest and discount expense' to the sum of 'interest bearing debt' and 'note receivable discounted.' 'Interest bearing debt' is the sum of 'short- and long-term bank loan', 'corporate bond' and 'employee's deposit.' In estimating this ratio, 'interest bearing debt' is defined as the average of the beginning and end of period.

[2] Variables related to investment and capital stock

Nominal investment expenditure is available in the schedule of tangible fixed assets schedule. We convert nominal investment expenditures to those in real term (in 2005 constant prices) by the deflator of gross fixed capital formation, p_t^I, in SNA.

By using the real investment expenditure, the real gross capital stocks are calculated based on the perpetual inventory method as

$$K_t = I_t \ + (1-\delta)K_{t-1}, \tag{A-1}$$

where

K_t: real capital stock (in 2005 constant prices) at the end of period *t* and

I_t: real investment in period *t*. The investment rate in this study is defined as I_t/K_{t-1}.

The benchmark real gross capital stock at the beginning of the sample period is obtained by

$$K_0 = \frac{I_1}{\delta+g}, \tag{A-2}$$

where δ is the same as that in the estimation of marginal q.

g: the average growth rate of real investment expenditure in the sample period for each firm as

$$g = \frac{(\ln I_T - \ln I_1)}{T - 1}. \tag{A-3}$$

[3] Other variables in the econometric analysis.

CF_t: Cash-flow in period *t*. We define cash flow as the sum of 'profit after tax', 'depreciation expense' and net increase of 'notes and account payable' minus net increase in 'inventory' and 'notes and account receivable'. In estimating cash flow ratio, CF_t/K_{t-1}, CF_t is also deflated by the output deflator, p_t, in SNA.

A_t: 'Total asset' at the end of period *t*.

D_t: 'Total debt' at the end of period *t*. In the regression model debt-asset ratio, DEBT, is defined as the lagged value, D_{t-1}/A_{t-1}.

S_t: 'Sales amount' in DBJ and

$STDGRW_t$: The standard deviation of the rate of change in real sales amount of the past three years. In calculating $STDGRW_t$, S_t is deflated by the output deflator of the corresponding sector in SNA.

[4] Variables related to cost and total factor productivity

Total cost, C_t, is the sum of 'cost of sales' and 'selling, general and administrative expenses' in DBJ. Since we define the profit in gross term including depreciation, total cost in this study is net of depreciation. Price cost margin is defined as

$$PCM_t = \frac{S_t - C_t}{S_t}, \tag{A-4}$$

The growth rate of the total factor productivity, $\Delta \ln TFP_t$, is defined as

$$\Delta \ln TFP_t = \Delta \ln X_t - s_t^K \Delta \ln K_{t-1} - s_t^L \Delta \ln L_t - s_t^M \Delta \ln M_t. \tag{A-5}$$

where

VX_t: Total output of period *t*. 'Sales amount' + net of 'inventory stock' in DBJ. X_t is obtained by deflating VX_t by output deflator of the corresponding sector, p_t, in SNA.

VM_t: Intermediate input of period t. 'Material cost' in factory cost and selling, general and administrative expenses in DBJ. Since we cannot divide the selling, general and administrative expenses into material, labor and capital cost, we divide selling, general and administrative expenses proportionately to the corresponding shares in factory cost. M_t is obtained by deflating VM_t by intermediate input deflator of the corresponding sector, p_t^M, in SNA.

L_t: Labor input of period *t*. 'number of persons engaged' in DBJ adjusted by the yearly working hour of the corresponding sector in SNA.

VL_t: Labor cost of period t. 'Labor cost' in factory cost and selling, general and administrative expenses in DBJ. For the same reason and method as in material cost, we estimate the labor cost in selling, general and administrative expenses.

VK_t: Capital cost of period t defined as $VX_t - VM_t - VL_t$.

s_t^K: the average of the relative cost share of capital, VK/VX, in period t and t-1.

s_t^L: the average of the relative cost share of labor, VL/VX, in period t and t-1 and

s_t^M: the average of the relative cost share of material, VM/VX, in period t and t-1.

Table 1 The mean and median of marginal q by industry

		(1) 1972-1973	(2) 1974-1986	(3) 1987-1990	(4) 1991-2002	(5) 2003-2007	(6) 2008-2012	(7) 2013-2014	(8) Whole period
					mean				
(1)	Food products and beverages	1.245	1.007	1.126	1.138	1.422	1.632	1.333	1.205
(2)	Textiles	1.740	0.857	1.414	0.841	1.062	1.065	1.214	0.992
(3)	Pulp, paper and paper products	0.983	0.747	0.972	0.839	1.041	0.992	0.846	0.862
(4)	Chemicals	1.264	0.929	1.268	1.339	1.686	1.636	1.702	1.292
(5)	Petroleum and coal products	0.713	0.637	0.795	0.771	1.350	1.357	1.364	0.867
(6)	Non-metallic mineral products	1.076	0.721	0.993	0.893	1.059	1.118	1.078	0.903
(7)	Basic metal	1.005	0.619	0.939	0.727	1.172	0.919	0.932	0.795
(8)	Fabricated metal product	1.329	0.978	1.766	1.275	1.470	1.464	1.869	1.302
(9)	Machinery	1.614	1.131	1.624	1.360	2.307	1.916	2.060	1.497
(10)	Electrical machinery	1.725	1.383	1.713	1.442	1.787	1.478	1.928	1.517
(11)	Transport equipment	1.068	0.833	0.968	0.861	1.215	1.079	1.129	0.941
(12)	Precision instruments	1.905	1.676	1.842	1.785	2.549	1.788	2.543	1.900
(13)	Miscellaneous mfg.	1.706	1.063	1.486	1.309	1.715	1.686	1.911	1.388
	Total	1.386	0.997	1.356	1.188	1.625	1.484	1.644	1.248
					median				
(1)	Food products and beverages	1.200	0.885	0.867	0.894	1.138	1.317	1.056	0.964
(2)	Textiles	1.368	0.630	0.891	0.581	0.786	0.838	0.861	0.678
(3)	Pulp, paper and paper products	1.021	0.625	0.845	0.683	0.819	0.857	0.728	0.716
(4)	Chemicals	0.952	0.671	0.954	0.932	1.207	1.130	1.317	0.909
(5)	Petroleum and coal products	0.549	0.542	0.569	0.622	0.923	1.073	0.919	0.663
(6)	Non-metallic mineral products	0.994	0.654	0.873	0.721	0.879	0.915	0.970	0.762
(7)	Basic metal	0.828	0.562	0.852	0.630	0.946	0.728	0.784	0.665
(8)	Fabricated metal product	1.177	0.880	1.510	1.073	1.128	1.037	1.509	1.070
(9)	Machinery	1.184	0.905	1.334	1.027	1.604	1.197	1.452	1.091
(10)	Electrical machinery	1.326	1.107	1.354	1.027	1.305	1.030	1.051	1.113
(11)	Transport equipment	0.905	0.781	0.856	0.764	1.118	0.907	0.959	0.832
(12)	Precision instruments	1.648	1.442	1.457	1.161	1.741	1.531	1.993	1.439
(13)	Miscellaneous mfg.	1.163	0.852	1.156	0.957	1.123	1.002	1.315	0.983
	Total	1.076	0.783	1.028	0.869	1.148	1.040	1.133	0.913

Table 2 The mean and median of the investment rate by industry

		(1) 1972-1973	(2) 1974-1986	(3) 1987-1990	(4) 1991-2002	(5) 2003-2007	(6) 2008-2012	(7) 2013-2014	(8) Whole period
					mean				
(1)	Food products and beverages	0.248	0.138	0.162	0.127	0.108	0.099	0.097	0.131
(2)	Textiles	0.214	0.108	0.164	0.098	0.082	0.079	0.089	0.109
(3)	Pulp, paper and paper products	0.188	0.133	0.184	0.097	0.094	0.087	0.083	0.121
(4)	Chemicals	0.159	0.125	0.161	0.123	0.115	0.111	0.108	0.126
(5)	Petroleum and coal products	0.227	0.107	0.167	0.114	0.127	0.110	0.085	0.123
(6)	Non-metallic mineral products	0.170	0.118	0.163	0.106	0.094	0.088	0.074	0.115
(7)	Basic metal	0.172	0.115	0.141	0.105	0.104	0.085	0.090	0.112
(8)	Fabricated metal product	0.225	0.121	0.185	0.123	0.092	0.074	0.098	0.121
(9)	Machinery	0.174	0.122	0.158	0.106	0.110	0.096	0.086	0.117
(10)	Electrical machinery	0.177	0.161	0.187	0.120	0.118	0.098	0.107	0.135
(11)	Transport equipment	0.180	0.140	0.172	0.116	0.128	0.096	0.105	0.129
(12)	Precision instruments	0.206	0.145	0.185	0.122	0.130	0.104	0.122	0.135
(13)	Miscellaneous mfg.	0.214	0.134	0.192	0.125	0.110	0.095	0.096	0.128
	Total	0.187	0.130	0.169	0.116	0.110	0.096	0.098	0.124
					median				
(1)	Food products and beverages	0.215	0.111	0.121	0.098	0.078	0.067	0.072	0.098
(2)	Textiles	0.166	0.074	0.116	0.056	0.054	0.045	0.051	0.068
(3)	Pulp, paper and paper products	0.151	0.102	0.159	0.073	0.059	0.064	0.054	0.089
(4)	Chemicals	0.135	0.103	0.140	0.098	0.093	0.087	0.093	0.102
(5)	Petroleum and coal products	0.180	0.073	0.143	0.084	0.090	0.076	0.076	0.088
(6)	Non-metallic mineral products	0.147	0.094	0.135	0.078	0.067	0.065	0.067	0.085
(7)	Basic metal	0.137	0.087	0.122	0.080	0.076	0.066	0.062	0.086
(8)	Fabricated metal product	0.212	0.090	0.145	0.088	0.066	0.046	0.074	0.086
(9)	Machinery	0.134	0.088	0.123	0.074	0.077	0.067	0.062	0.083
(10)	Electrical machinery	0.150	0.130	0.159	0.091	0.087	0.070	0.071	0.104
(11)	Transport equipment	0.160	0.125	0.165	0.101	0.116	0.079	0.089	0.113
(12)	Precision instruments	0.166	0.114	0.138	0.081	0.096	0.083	0.083	0.098
(13)	Miscellaneous mfg.	0.206	0.115	0.169	0.094	0.084	0.068	0.075	0.099
	Total	0.155	0.102	0.141	0.087	0.083	0.071	0.073	0.095

Table 3 Descriptive statistics of the major variables

	(1) I/K_{-1}	(2) Mq	(3) CF/K_{-1}	(4) $DEBT$	(5) $STDGRW$	(6) PCM
			mean			
1972-1973	0.187	1.386	0.073	0.732		0.120
1974-1986	0.130	0.997	0.075	0.704	0.111	0.083
1987-1990	0.169	1.356	0.090	0.616	0.090	0.092
1991-2002	0.116	1.188	0.095	0.552	0.083	0.080
2003-2007	0.110	1.625	0.118	0.498	0.089	0.096
2008-2012	0.096	1.484	0.107	0.479	0.121	0.086
2013-2014	0.098	1.644	0.130	0.462	0.113	0.092
Whole period	0.124	1.248	0.093	0.588	0.098	0.087
			median			
1972-1973	0.155	1.076	0.060	0.758		0.113
1974-1986	0.102	0.783	0.062	0.743	0.087	0.079
1987-1990	0.141	1.028	0.077	0.628	0.070	0.085
1991-2002	0.087	0.869	0.082	0.557	0.063	0.072
2003-2007	0.083	1.148	0.097	0.500	0.061	0.079
2008-2012	0.071	1.040	0.086	0.473	0.095	0.070
2013-2014	0.073	1.133	0.098	0.448	0.083	0.076
Whole period	0.095	0.913	0.078	0.603	0.074	0.077
			standard deviation			
1972-1973	0.126	1.084	0.134	0.131		0.067
1974-1986	0.103	0.806	0.119	0.164	0.083	0.062
1987-1990	0.116	1.046	0.127	0.177	0.072	0.059
1991-2002	0.101	1.129	0.126	0.186	0.067	0.074
2003-2007	0.096	1.646	0.136	0.187	0.081	0.107
2008-2012	0.088	1.546	0.140	0.186	0.093	0.162
2013-2014	0.087	1.675	0.144	0.184	0.096	0.216
Whole period	0.104	1.198	0.129	0.199	0.080	0.096

Table 4 Estimation results of the investment function with marginal q: Basic case

	(1) 1972-1973	(2) 1974-1986	(3) 1987-1990	(4) 1991-2002	(5) 2003-2007	(6) 2008-2012	(7) 2013-2014	(8) whole period:
$(Mq - 1)\, p^I / p$	0.0393	0.0543	0.0446	0.0307	0.0192	0.0165	0.0127	0.0281
	(4.75)	(30.55)	(11.49)	(24.86)	(10.05)	(9.12)	(1.11)	(50.74)
Constant term	0.1458	0.1578	0.1180	0.1741	0.0744	0.1131	0.0884	0.1462
	(30.89)	(54.83)	(38.68)	(75.40)	(29.62)	(43.56)	(11.57)	(38.36)
R^2	0.1270	0.1109	0.0614	0.0889	0.0375	0.0356	0.0114	0.1147
No. of observations	1,275	10,878	3,897	12,854	4,245	3,865	843	37,857

Table 5 Estimation results of the investment function with marginal q and financial frictions: Basic case

	(1) 1972-1973	(2) 1974-1986	(3) 1987-1990	(4) 1991-2002	(5) 2003-2007	(6) 2008-2012	(7) 2013-2014	(8) whole period:
$(Mq - 1)\, p^I / p$	0.0450	0.0566	0.0484	0.0320	0.0203	0.0195	0.0031	0.0294
	(4.86)	(30.23)	(11.83)	(24.57)	(9.34)	(9.81)	(0.18)	(48.33)
CF / K_{-1}	0.0588	0.0201	0.0071	0.0092	0.0394	0.0054	0.0658	0.0107
	(1.51)	(2.35)	(0.40)	(1.22)	(3.01)	(0.43)	(0.83)	(2.44)
DEBT	-0.0770	-0.1357	-0.0563	-0.0318	-0.1104	-0.1622	-0.6557	-0.0313
	(-0.53)	(-9.44)	(-1.51)	(-2.55)	(-3.49)	(-4.81)	(-2.05)	(-6.24)
Constant term	0.1956	0.2579	0.1528	0.1928	0.1322	0.1963	0.4158	0.1657
	(1.80)	(22.93)	(6.32)	(24.81)	(7.34)	(11.26)	(2.52)	(31.20)
R^2	0.1331	0.1021	0.0613	0.0890	0.0369	0.0284	0.0030	0.1163
No. of observations	1,202	10,264	3,736	12,385	4,080	3,688	811	36,166

Table 6 Estimation results of the investment function with marginal q, financial frictions and uncertainty: Basic case

	(1) 1972-1973	(2) 1974-1986	(3) 1987-1990	(4) 1991-2002	(5) 2003-2007	(6) 2008-2012	(7) 2013-2014	(8) whole period:
$(Mq - 1)\, p^I / p$		0.0528	0.0460	0.0318	0.0170	0.0202	0.0090	0.0272
		(26.25)	(10.65)	(23.60)	(7.49)	(9.79)	(0.48)	(42.59)
CF / K_{-1}		0.0284	0.0045	0.0061	0.0420	0.0036	0.0520	0.0093
		(3.25)	(0.25)	(0.80)	(3.10)	(0.28)	(0.59)	(2.04)
DEBT		-0.1371	-0.0650	-0.0268	-0.0964	-0.1757	-0.7953	-0.0333
		(-9.23)	(-1.70)	(-2.11)	(-2.89)	(-4.96)	(-2.20)	(-6.42)
STDGRW		-0.0516	0.0566	-0.0465	-0.0991	-0.0696	-0.1412	-0.0454
		(-3.57)	(1.32)	(-2.99)	(-3.74)	(-2.95)	(-0.97)	(-5.77)
Constant term		0.2535	0.1541	0.1931	0.1351	0.2083	0.5005	0.1684
		(21.07)	(6.10)	(24.16)	(7.07)	(11.34)	(2.68)	(30.67)
R^2		0.0924	0.0583	0.0893	0.0382	0.0259	0.0036	0.1050
No. of observations		9,608	3,570	11,843	3,803	3,466	782	33,072

Table 7 Estimation results of the investment function with marginal q: Imperfect competition case

	(1) 1972-1973	(2) 1974-1986	(3) 1987-1990	(4) 1991-2002	(5) 2003-2007	(6) 2008-2012	(7) 2013-2014	(8) whole period:
$(Mq - 1)\, p^I / p$	0.0415	0.0580	0.0470	0.0339	0.0207	0.0184	0.0151	0.0296
	(4.43)	(30.62)	(11.57)	(25.14)	(10.21)	(9.55)	(1.24)	(50.50)
Constant term	0.1511	0.1647	0.1227	0.1771	0.0758	0.1129	0.0889	0.1507
	(34.55)	(56.54)	(41.45)	(77.16)	(30.53)	(43.37)	(12.55)	(39.05)
R^2	0.1204	0.1065	0.0631	0.0825	0.0372	0.0312	0.0117	0.1116
No. of observations	1,233	10,764	3,855	12,673	4,148	3,734	817	37,224

Table 8 Estimation results of the investment function with marginal q and financial frictions: Imperfect competition case

	(1) 1972-1973	(2) 1974-1986	(3) 1987-1990	(4) 1991-2002	(5) 2003-2007	(6) 2008-2012	(7) 2013-2014	(8) whole period:
$(Mq - 1)\, p^I / p$	0.0475	0.0602	0.0508	0.0340	0.0222	0.0216	0.0100	0.0307
	(4.64)	(30.22)	(11.85)	(24.29)	(9.70)	(10.22)	(0.54)	(48.04)
CF / K_{-1}	0.0691	0.0192	0.0050	0.0093	0.0373	0.0038	0.0760	0.0115
	(1.77)	(2.25)	(0.28)	(1.23)	(2.81)	(0.30)	(0.94)	(2.60)
DEBT	-0.1530	-0.1352	-0.0560	-0.0315	-0.1083	-0.1589	-0.7140	-0.0333
	(-1.00)	(-9.33)	(-1.49)	(-2.50)	(-3.36)	(-4.62)	(-2.06)	(-6.58)
Constant term	0.2578	0.2649	0.1580	0.1961	0.1329	0.1955	0.4429	0.1718
	(2.25)	(23.36)	(6.44)	(24.88)	(7.21)	(10.96)	(2.49)	(31.97)
R^2	0.1130	0.0989	0.0627	0.0842	0.0367	0.0271	0.0068	0.1136
No. of observations	1,162	10,163	3,698	12,226	4,000	3,561	786	35,596

Table 9 Estimation results of the investment function with marginal q, financial frictions and uncertainty: Imperfect competition case

	(1) 1972-1973	(2) 1974-1986	(3) 1987-1990	(4) 1991-2002	(5) 2003-2007	(6) 2008-2012	(7) 2013-2014	(8) whole period:
$(Mq - 1)\, p^I / p$		0.0562	0.0482	0.0339	0.0186	0.0219	0.0116	0.0285
		(26.22)	(10.63)	(23.38)	(7.81)	(10.06)	(0.59)	(42.44)
CF / K_{-1}		0.0281	0.0019	0.0054	0.0407	-0.0003	0.0489	0.0096
		(3.20)	(0.10)	(0.71)	(2.97)	(-0.02)	(0.55)	(2.09)
DEBT		-0.1364	-0.0656	-0.0260	-0.0979	-0.1696	-0.7702	-0.0351
		(-9.13)	(-1.70)	(-2.02)	(-2.92)	(-4.70)	(-2.00)	(-6.70)
STDGRW		-0.0543	0.0637	-0.0432	-0.0977	-0.0665	-0.1473	-0.0437
		(-3.74)	(1.47)	(-2.76)	(-3.58)	(-2.80)	(-1.00)	(-5.49)
Constant term		0.2600	0.1590	0.1960	0.1369	0.2060	0.4901	0.1723
		(21.44)	(6.23)	(24.23)	(7.11)	(10.99)	(2.47)	(31.10)
R^2		0.0893	0.0589	0.0840	0.0370	0.0245	0.0072	0.1023
No. of observations		9,521	3,535	11,697	3,752	3,372	762	32,639

Table 10 The effects of sales growth and cost growth on marginal q: Quantitative evaluation

	(1) 1972-1973	(2) 1974-1986	(3) 1987-1990	(4) 1991-2002	(5) 2003-2007	(6) 2008-2012	(7) 2013-2014	(8) whole period:
Δ ln$S$		7.768	10.852	11.071	13.829	10.043	8.595	9.998
		(78.0)	(39.0)	(90.1)	(50.2)	(35.8)	(4.8)	(138.6)
Δ ln$C$		-6.774	-9.472	-9.951	-12.433	-8.186	-6.057	-8.811
		(-61.1)	(-31.9)	(-73.0)	(-42.4)	(-25.6)	(-3.0)	(-110.7)
Constant term		-0.522	0.018	-0.117	-0.023	-0.086	-0.001	-0.490
		(-36.8)	(1.5)	(-10.9)	(-1.5)	(-3.8)	(0.0)	(-20.9)
R^2		0.518	0.441	0.467	0.374	0.398	0.301	0.427
No. of observations		10,078	3,758	12,514	4,116	3,442	818	35,029

Table 11 Comparison of growing firms and restructuring firms by major firm characteristics

	(1) 1972-1973			(2) 1974-1986			(3) 1987-1990			(4) 1991-2002		
	(1) dS > 0, dC >0	(4) dS > 0, dC < 0	(1)-(4)	(1) dS > 0, dC > 0	(4) dS > 0, dC < 0	(1)-(4)	(1) dS > 0, dC > 0	(4) dS > 0, dC < 0	(1)-(4)	(1) dS > 0, dC > 0	(4) dS > 0, dC < 0	(1)-(4)
NRW				0.109	0.092	0.017	0.125	0.115	0.010	0.137	0.150	-0.014
						(2.39)			(0.77)			(-2.49)
I/K_{-1}				0.130	0.092	0.037	0.159	0.102	0.057	0.115	0.087	0.028
						(9.75)			(7.60)			(12.11)
DEBT				0.720	0.765	-0.045	0.651	0.688	-0.037	0.560	0.603	-0.043
						(-7.29)			(-2.99)			(-8.90)
$\Delta \ln TFP$				0.045	0.002	0.043	0.044	0.013	0.031	0.040	0.006	0.034
						(19.19)			(8.13)			(25.41)
CF/K_{-1}				0.069	0.059	0.010	0.077	0.094	-0.017	0.089	0.080	0.009
						(2.59)			(-2.03)			(3.09)
STDGRW				0.106	0.096	0.010	0.088	0.099	-0.011	0.080	0.077	0.002
						(3.21)			(-2.27)			(1.38)
PCM				0.091	0.075	0.016	0.093	0.076	0.017	0.091	0.073	0.018
						(9.34)			(5.26)			(14.55)

	(5) 2003-2007			(6) 2008-2012			(7) 2013-2014			(8) 1974-2014		
	(1) dS > 0, dC > 0	(4) dS > 0, dC < 0	(1)-(4)	(1) dS > 0, dC > 0	(4) dS > 0, dC < 0	(1)-(4)	(1) dS > 0, dC > 0	(4) dS > 0, dC < 0	(1)-(4)	(1) dS > 0, dC > 0	(4) dS > 0, dC < 0	(1)-(4)
NRW	0.180	0.208	-0.028	0.187	0.193	-0.006	0.181	0.178	0.003	0.143	0.156	-0.014
			(-2.51)			(-0.61)			(0.11)			(-3.77)
I/K_{-1}	0.108	0.076	0.031	0.086	0.080	0.007	0.097	0.096	0.002	0.122	0.086	0.036
			(7.14)			(1.81)			(0.13)			(21.94)
DEBT	0.548	0.566	-0.018	0.512	0.549	-0.037	0.506	0.512	-0.006	0.616	0.620	-0.003
			(-2.06)			(-4.04)			(-0.25)			(-1.00)
$\Delta \ln TFP$	0.046	0.017	0.029	0.052	0.005	0.047	0.039	-0.004	0.043	0.044	0.007	0.037
			(11.41)			(16.08)			(4.20)			(39.89)
CF/K_{-1}	0.110	0.100	0.010	0.106	0.113	-0.007	0.135	0.114	0.021	0.087	0.085	0.002
			(1.65)			(-1.10)			(1.10)			(1.10)
STDGRW	0.083	0.079	0.004	0.118	0.103	0.015	0.105	0.107	-0.002	0.094	0.086	0.008
			(1.08)			(3.48)			(-0.18)			(5.82)
PCM	0.094	0.077	0.017	0.091	0.077	0.014	0.090	0.077	0.013	0.092	0.075	0.017
			(6.60)			(5.50)			(1.90)			(21.21)

Notes: *NRW* is the proportion of non-regular workers.

Table 12 Estimation results of the investment functions by firm group

	(1) dS>0, dC>0			(2) dS>0, dC<0		
$(Mq - 1)\ p^I / p$	0.0326	0.0339	0.0316	0.0289	0.0276	0.0267
	(39.44)	(38.33)	(33.73)	(3.56)	(3.19)	(2.44)
CF / K_{-1}		0.0023	-0.0026		0.0456	0.0723
		(0.36)	(-0.39)		(0.69)	(1.07)
$DEBT$		-0.0355	-0.0362		-0.0502	-0.0593
		(-5.01)	(-4.92)		(-0.83)	(-0.94)
$STDGRW$			-0.0568			-0.0161
			(-5.06)			(-0.17)
Constant term	0.1499	0.1732	0.1811	0.1370	0.1732	0.2720
	(34.66)	(25.65)	(24.22)	(2.91)	(2.66)	(2.88)
R^2	0.1080	0.1097	0.1036	0.1147	0.1296	0.1243
No. of observations	21,546	20,757	18,818	1,111	1,044	998

	(3) dS<0, dC>0			(4) dS<0, dC<0		
$(Mq - 1)p^I / p$	0.0262	0.0316	0.0283	0.0208	0.0200	0.0193
	(4.86)	(4.56)	(3.90)	(18.31)	(15.57)	(14.54)
CF / K_{-1}		0.0060	-0.0073		0.0320	0.0346
		(0.14)	(-0.16)		(4.27)	(4.51)
$DEBT$		0.0396	0.0394		-0.0330	-0.0346
		(1.01)	(0.95)		(-3.80)	(-3.90)
$STDGRW$			-0.0594			-0.0144
			(-0.91)			(-1.06)
Constant term	0.1248	0.0974	0.0948	0.1590	0.1741	0.1393
	(4.59)	(2.52)	(2.53)	(12.20)	(11.82)	(12.08)
R^2	0.0695	0.0564	0.0547	0.0528	0.0564	0.0558
No. of observations	1,274	1,223	1,146	11,820	11,281	10,754

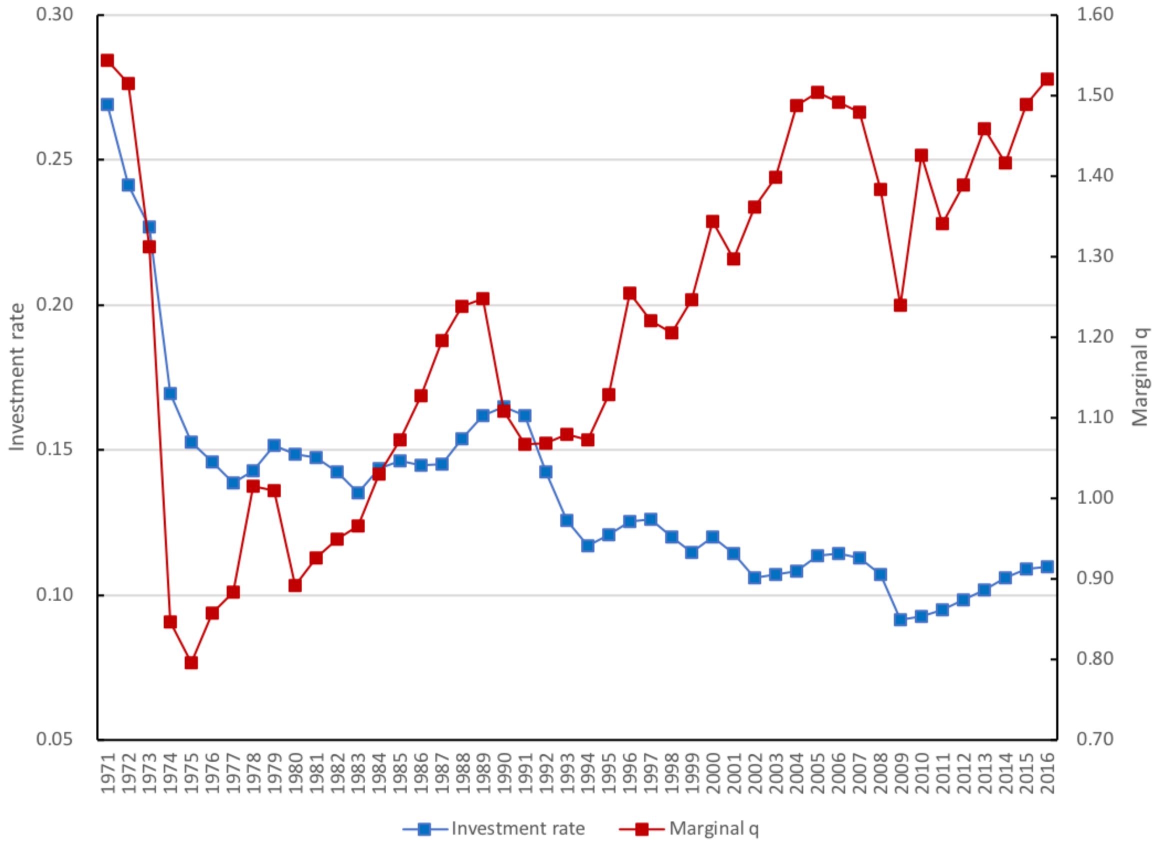

Figure 1 The investment rate and marginal q of the Japanese non-financial corporations: 1971-2016

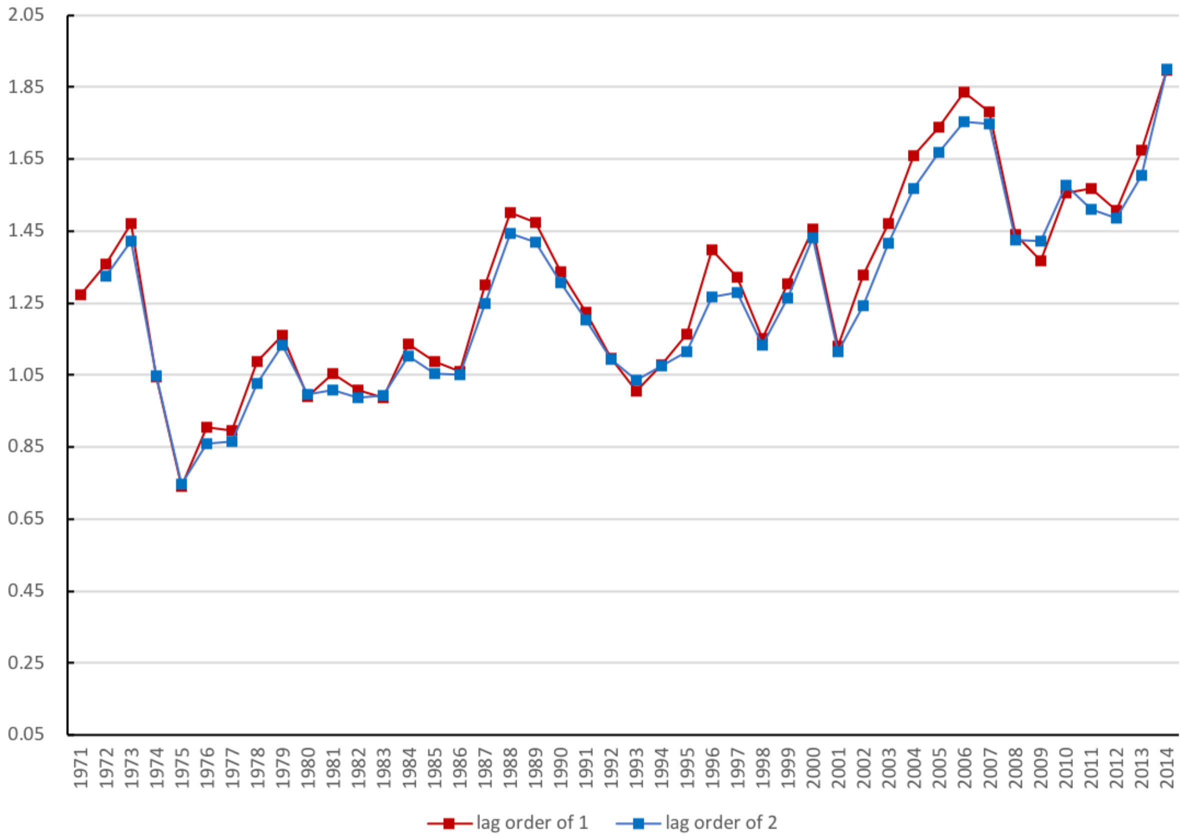

Figure 2 The mean of marginal q of the manufacturing firms: 1971-2014

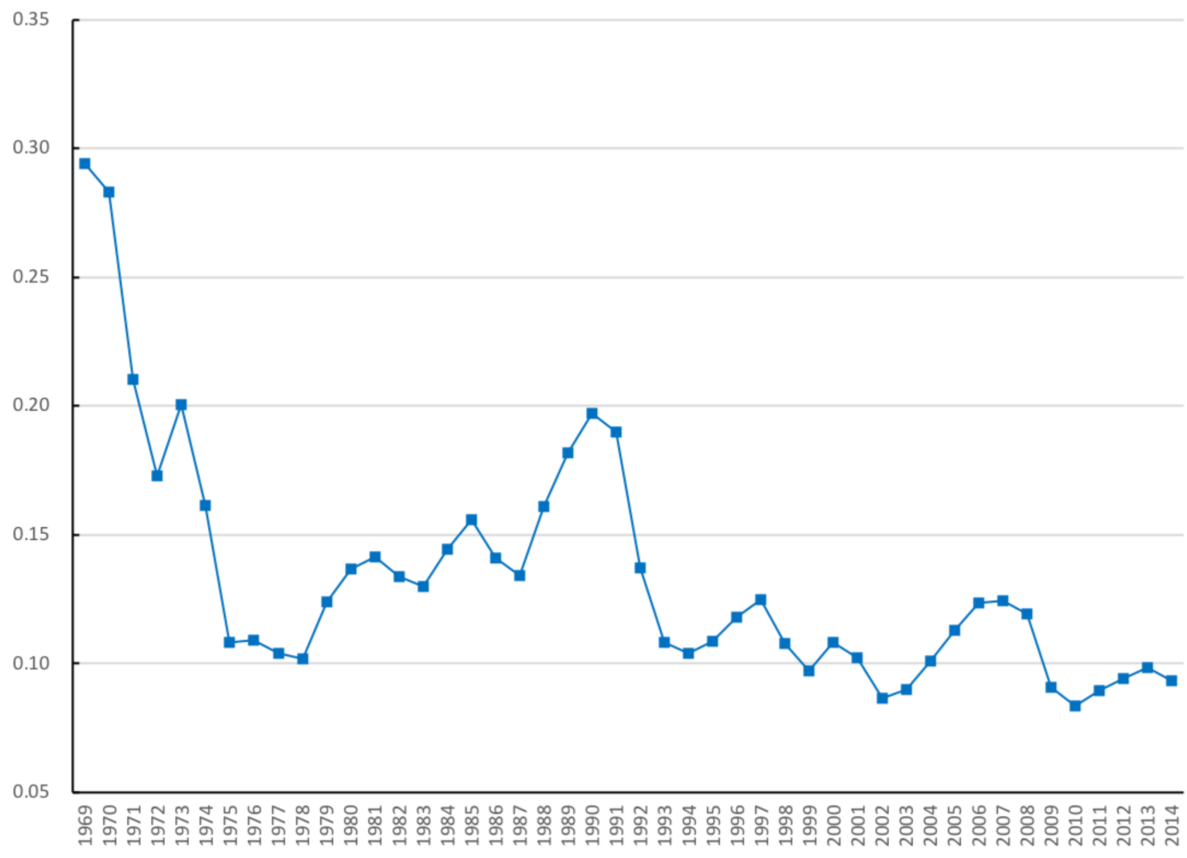

Figure 3 The mean of the investment rate of the manufacturing firms: 1969-2014

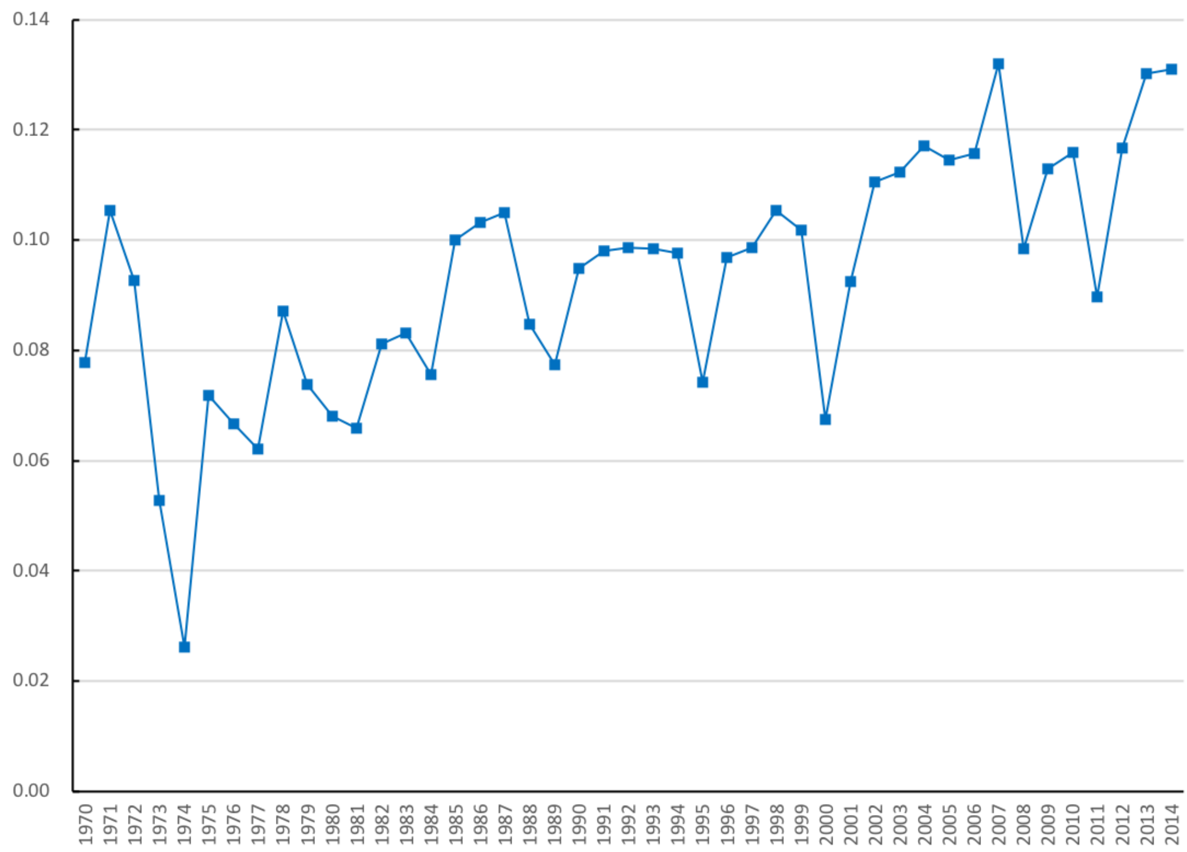

Figure 4 The mean of the cash flow ratio of the manufacturing firms: 1970-2014

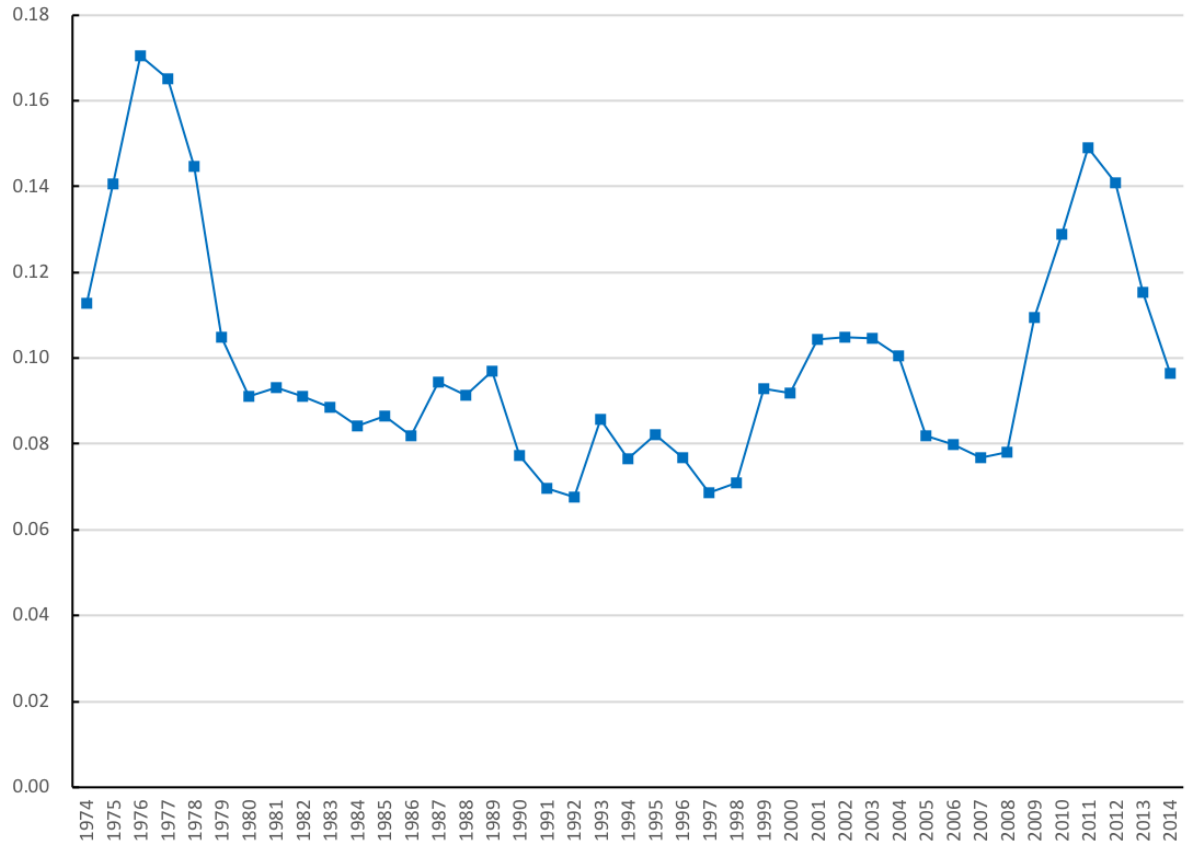

Figure 5 The mean of the standard deviation of sales growth rate of the manufacturing firms: 1974-2014

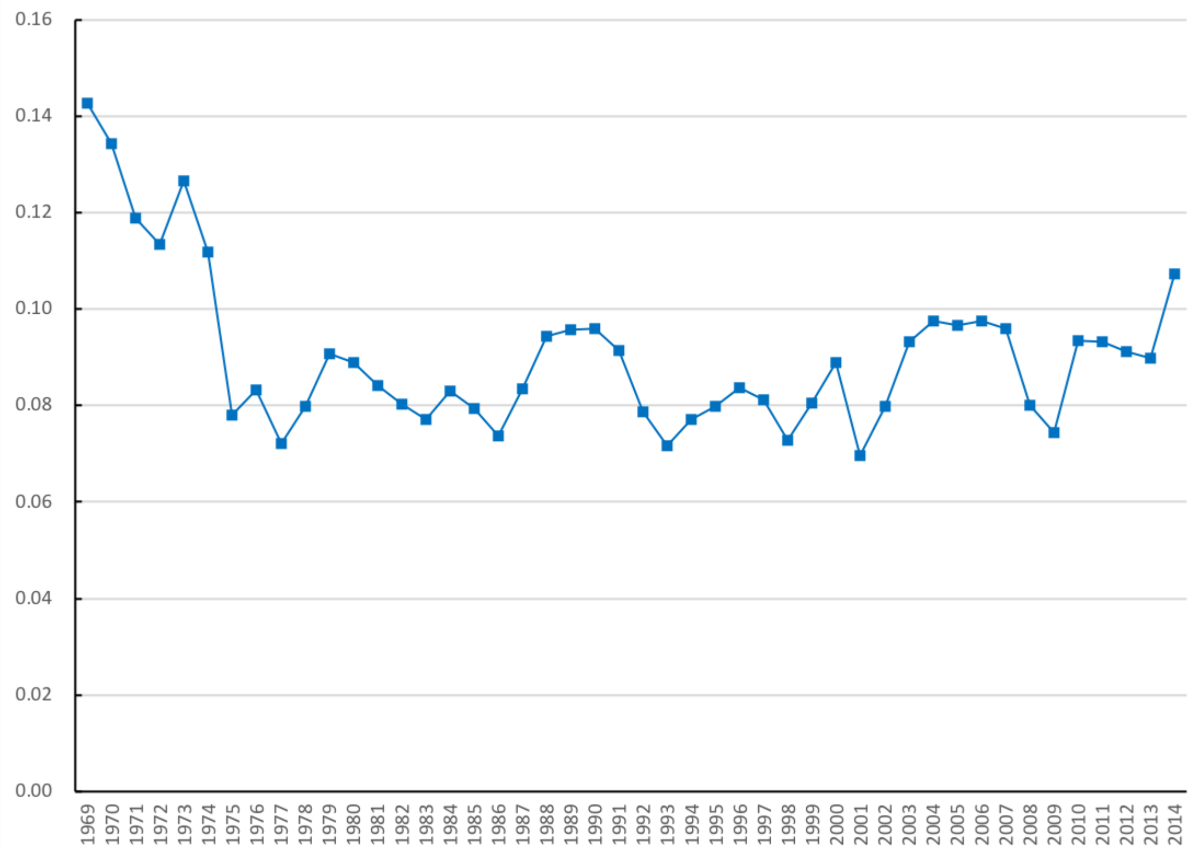

Figure 6 The mean of the price cost margin of the manufacturing firms: 1969-2014

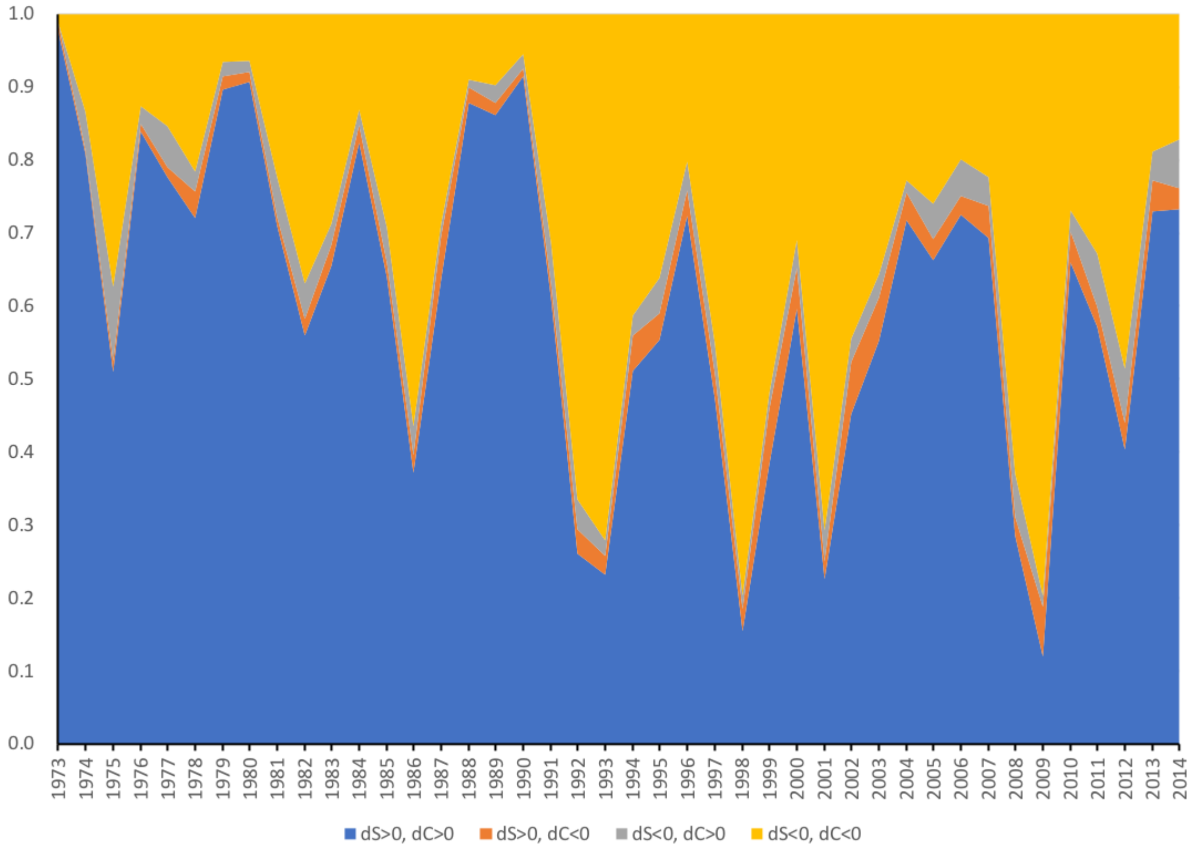

Figure 7 The proportion of firms in the four groups classified by sales growth and cost growth

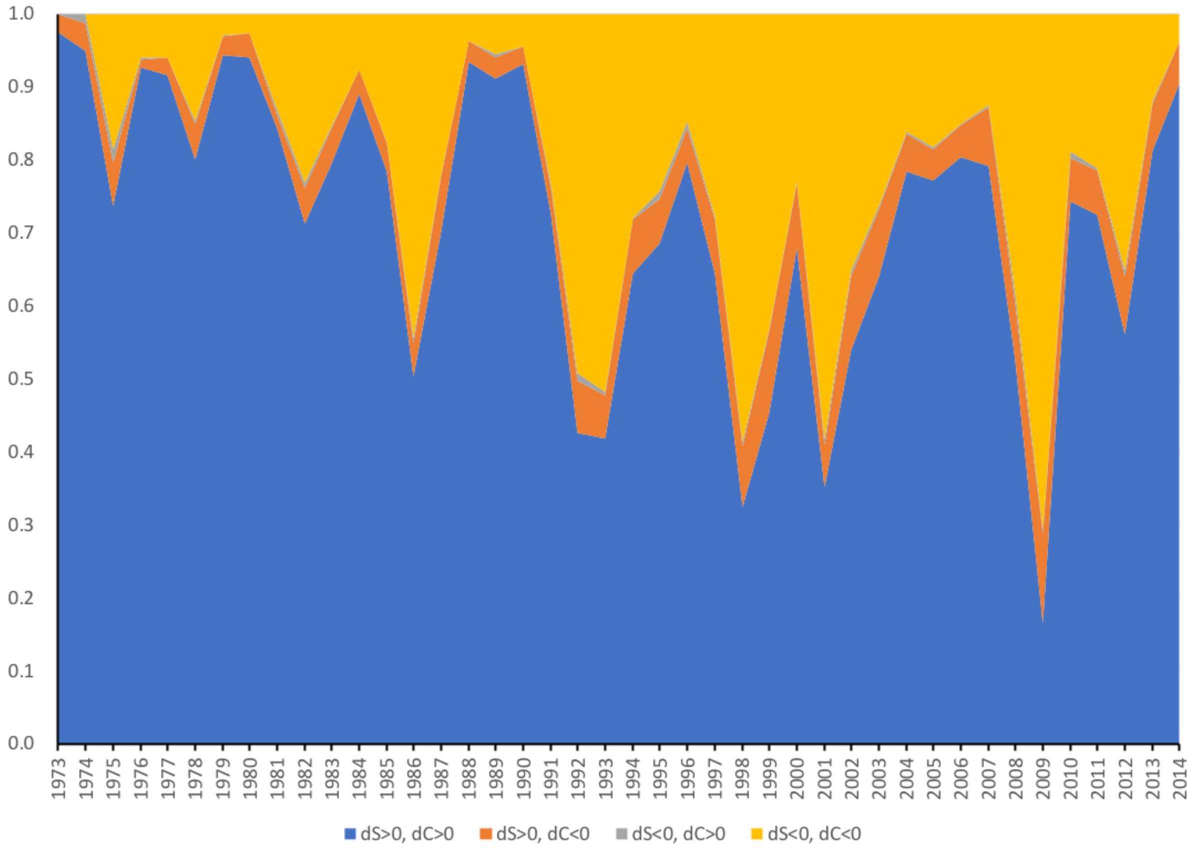

Figure 8 The proportion of firms with increasing marginal q in the four groups classified by sales growth and cost growth

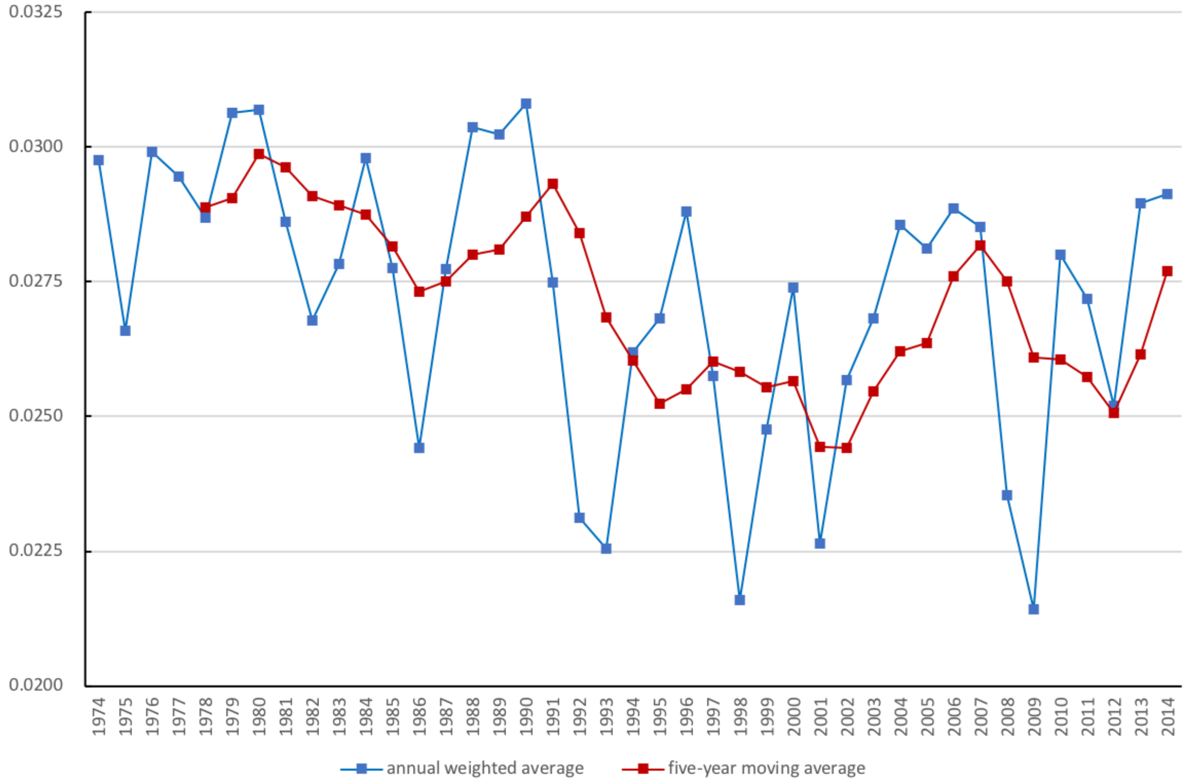

Figure 9 The sensitivity of investment to marginal q over the sample period