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Abstract

This paper uses Japanese firm-level data to analyze empirically the financial constraints in intangible investments. We estimate investment functions in which cash flow is used as a key explanatory variable. We then observe differences in the sensitivity of investments to cash flow by the type of assets, industry, firm size, and firm age. According to the estimation results, investments in intangible assets are more sensitive to internal capital compared with investments in tangible assets, suggesting the existence of market failure in the financial markets. This market failure is more serious for small- and medium-sized enterprises (SMEs) and young firms. However, policies to promote investments are concentrated on tangible assets, with the exception of research and development (R&D) investment. This paper suggests that investment tax credits and financial support for SMEs and young firms should focus more on intangible investments.

Keywords: Intangible investments, Credit constraint, Cash flow, Investment function
JEL Classifications: E22; G31

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Financial Constraints in Intangible Investments: Evidence from Japanese firms

1. Introduction

This paper uses Japanese firm-level panel data to analyze empirically the financial constraints in intangible investments.

Studies on the role of intangible assets on economic growth are progressing rapidly (see, for example, Miyagawa and Kim (2010) for a survey). Recent studies, based upon a framework proposed by Corrado et al. (2009), classify 1) software and other computerized information, 2) innovative property (scientific R&D, non-scientific R&D), and 3) economic competencies (brand equity, firm-specific resources) as "intangible assets." The coverage of this definition is wider than the accounting measure of fixed intangible assets.

In many advanced countries, studies have been conducted based on this framework, such as Marrano et al. (2009) for the UK, Belhocine (2009) for Canada, and Edquist (2011) for Sweden. These studies have identified the quantitative contribution of intangible assets on macroeconomic growth and productivity. In Japan, Fukao et al. (2009) is the representative study in this line of literature. These authors estimated that the ratio of intangible assets to GDP was 11.1% (2000-2005 average), of which computerized information, innovative property, and economic competencies represented 2.2%, 6.0%, and 2.9%, respectively. The ratio of intangible assets was lower than that of the U.S., and the recent growth rate of intangible assets in Japan was stagnant. Furthermore, Chun et al. (2012) estimated intangible investments by industry for Japan and Korea and found that the intangible investments of the service industry were far lower than those of the manufacturing industry in Japan.

Empirical studies on the effects of intangible assets on firm performance are also developing rapidly. In a pioneering study in this area, Bloom and Van Reenen (2007) collected information on firm-level management practices and found that managerial practices were strongly associated with firm-level productivity. In Japan, Miyagawa et al. (2010) conducted a similar survey and provided suggestive evidence on the positive relation between management practices and productivity at the firm level. Although these studies do not cover all intangible investments and their focus is organizational innovation and human resources management, they indicate that some types of intangible investments make positive contributions to firm-level productivity performance.

To summarize, these studies have shown that intangible assets play an important role in economic performance, but investments in intangible assets may be lower than the optimal level. The motivation of this study is to investigate why firms underinvest in intangible assets, even though these assets are effective for enhancing firm performance, and to examine the policy measures that are desirable for promoting intangible investments. In other words, the basic question of this paper is whether there is a market failure in intangible investments.

Among intangible investments, numerous studies have been conducted on R&D investments. These studies have indicated that the private rate of return to R&D investments is generally lower than the social rate of return, which includes benefits from knowledge spillover. Underinvestment in R&D emerges as a result of the profit-maximizing behavior of firms (see, for example, Griliches (1998) as a survey). In addition, capital market imperfection stemming from information asymmetry has been shown to be serious for R&D investments (see Hall (2002) and Hall and Lerner (2009)). However, for intangible investments other than R&D investments, the existence or nonexistence of market failure has not been identified empirically.

Regarding policy measures by types of investments in practice, tax incentives for investments are concentrated only on equipment investments and R&D investments (see Figure 1). There are tax incentives for software and human capital investments in Japan, but the size of these measures is very small. If intangible investments are lower than the socially optimal level, it is desirable to introduce policy measures to stimulate such investments. However, it is difficult to plan appropriate policy tools without information on the nature and magnitude of the market failure.

Against these backgrounds, this paper uses firm-level panel data from the Basic Survey of Japanese Business Structure and Activities to empirically analyze financial constraints in intangible investments. Specifically, we estimate investment functions in which cash flow is used as a key explanatory variable to determine the sensitivity of intangible investments to internal cash. We then observe differences in the sensitivity of investments to cash flow by the type of assets, industry, firm size, and firm age. If there is a market failure in intangible investments caused by information asymmetry or agency problems, the sensitivity of intangible investments to cash flow is expected to be higher than tangible (equipment) investments. In addition, we expect the sensitivity to cash flow to be larger among small- and medium-sized enterprises (SMEs) and young firms, whose financial constraints are generally more severe than large, mature firms.

It should be noted that the intangible investments in this paper are confined to those covered by the Basic Survey of Japanese Business Structure and Activities, which involves the acquisition of intangible assets defined by the current accounting standard.[1] In other words, the analysis in this paper does not completely cover the intangible assets defined by Corrado et al. (2009). However, several recent studies use accounting measures of intangible assets in firm-level empirical analysis. For example, Marrocu et al. (2012) use accounting measures of intangible assets to investigate their role on productivity among European firms. Dischinger and Riedel (2011) and Becker and Riedel (2012) are examples of the use of accounting measures of intangible assets to analyze the investment behavior of multinational firms.

According to the estimation results, investments in intangible assets are more sensitive to internal cash flows compared with investments in tangible assets. By the type of firm, the sensitivity of intangible investments to cash flow is stronger for SMEs and young firms, which face severe constraints in external financial markets, than for large, mature firms. These results suggest the existence of a market failure in intangible investments caused by information asymmetry or by a lack of resale markets for intangible assets. One policy implication of these results is that policies to remove market failure, such as improvements in financial intermediaries' ability to evaluate intangibles and the expansion of transaction markets for intellectual property rights, are desirable. Another implication is that investment tax credits and financial support for SMEs or young firms should focus on their intangible investments.

The rest of this paper is structured as follows. Section 2 briefly surveys past literature on empirical studies of liquidity constraints. Section 3 describes the data used and the method of analysis. Section 4 presents and interprets the results, and Section 5 concludes with policy implications.

2. Literature Review

Since the influential paper by Fazzari et al. (1988), numerous studies have analyzed the effect of capital market imperfections on firm investment by estimating investment functions using internal cash flow as key explanatory variable (see Hubbard (1998) and Bond and Van Reenen (2007) for a survey of the literature). Investment-cash flow sensitivity has been

[1] According to the Japanese Corporate Accounting Principles, fixed intangible assets include goodwill, patents, superficies, trademarks and software. Except for software, only purchased fixed intangible assets can be appropriated in the balance sheet.

interpreted as evidence of a credit market imperfection caused by information asymmetry. A large number of empirical studies confirm the significance of capital market imperfections, at least for firms such as SMEs or young firms.[2]

A large number of studies estimate Q-type investment functions using Tobin's Q as an explanatory variable representing firms' investment opportunities (see Blundell et al. (1992), Whited (1992), Schaller (1993), Hubbard et al. (1995), Gilchrist and Himmelberg (1995, 1998), Lamont (1997), Bierlen and Featherstone (1998), Hu and Schiantarelli (1998), Hadlock (1998), Gan (2007), Hadlock and Pierce (2010), among others). However, the traditional sales accelerator investment demand model, the Error-Correction investment model, and the Euler equation model are also frequently used in empirical studies.[3] For Japanese firms, Hoshi et al. (1991) is a representative study in this area. These authors estimated Q-type investment functions for Japanese manufacturing firms by distinguishing group (*keiretsu*) firms and independent firms. They found that investment by firms with a close relationship to a bank is less sensitive to internal cash flow than investment by independent firms. Ogawa et al. (1996) estimated Euler-type investment functions and presented evidence that SMEs are more likely to be liquidity constrained.

A relatively small number of studies has investigated financial market imperfection for R&D investment. Hall (1992), Hao and Jaffe (1993), Himmelberg and Petersen (1994), Bhagat and Welch (1995), Bond et al. (1999), Brown et al. (2009), Brown and Petersen (2009), Czarnitzki et al. (2011), and Aghion et al. (2012) are examples. Generally speaking, as Hall (2002) shows, SMEs and start-up firms face a higher cost of capital for financing R&D investment. These studies suggest that investments in intangible assets other than R&D may be constrained by financial market imperfection.

3. Data and Methodology

The analysis in this paper uses panel data from the Basic Survey of Japanese Business

[2] Several studies cast doubt on the interpretation of investment-cash flow sensitivity as evidence of capital market imperfection (Kaplan and Zingales (1997, 2000), Gilchrist and Himmelberg (1998), Erickson and Whited (2000), Bond et al. (2004), Cummins et al. (2006), Chen and Chen (2012)).

[3] Bond and Meghir (1994) is an example of the use of an Euler equation model of investment. Bond et al. (2003) use both an Error-Correction model and an Euler equation model.

Structure and Activities conducted by METI. This annual survey, begun in 1991, accumulates representative statistics on Japanese firms with 50 or more regular employees, including firms engaged in mining, manufacturing, electricity and gas, wholesale, retail, and several service industries. Approximately 30,000 firms are surveyed every year. The purpose of this survey is to produce a comprehensive picture of Japanese firms, including their basic financial information, composition of businesses, R&D activities, IT usage, and foreign direct investments. Because the sample firms are coded by using perpetual numbers, we can easily construct a firm-level longitudinal data set. The Survey began collecting information on "intangible fixed assets" (stock value) from fiscal year 2003 and added a survey item on "intangible fixed asset investments" (flow value) from fiscal year 2006. As mentioned earlier, this survey item indicates the acquisition of intangible fixed assets defined by the current accounting standard. Patents produced from internal R&D and expenditures for employee training are generally not included in intangible investments because only purchased fixed intangible assets can be appropriated on the balance sheet, with the exception of software.

According to the Survey, the ratio of intangible investments to total fixed asset investments (sum of the tangible asset and intangible asset investments) is 15.2% at the sample mean (average for 2006 to 2009).[4] By industry, the ratio is higher for information and communication (I&C) firms and service firms: the ratios are 8.1% (manufacturing), 20.4% (wholesale), 10.9% (retail), 44.5% (I&C), and 19.2% (service) (see Figure 2). The major reason for the very high figure for the I&C industry is that software investment is large for this industry, and internally produced software is included in the fixed intangible investments.[5] In contrast, the low ratio for manufacturing firms is due to the relatively high equipment investment in this industry. These industry figures indicate that intangible assets are important factors in production for firms operating in the non-manufacturing sector.

As described in the previous section, a large number of previous studies have used Q-type investment functions, where Tobin's Q is interpreted as a variable of firms' investment opportunities. However, because most of the sample firms of this paper are not listed

[4] In the Basic Survey of Japanese Business Structure and Activities, tangible fixed assets include land.

[5] Although the composition of fixed intangible investments (flow value) is not identified in the Basic Survey of Japanese Business Structure and Activities, the value of software assets (stock value) is surveyed as part of intangible assets. According to these data, 74% of fixed intangible assets are software assets in the I&C industry.

(public) firms, the market value to calculate Q is not available. For this reason, we use an accelerator-type investment model as a baseline estimation, where the growth of firm sales is included as an independent variable. Among representative past studies, Fazzari et al. (1988) showed the estimation results of both the Q model and the accelerator-type investment model, and the size of the coefficients for cash flow is quite similar in both specifications. Himmelberg and Petersen (1994) analyzed R&D investment and cash flow sensitivity and reported results replacing Tobin's Q with sales growth. The estimated coefficients for cash flow are similar in size. To check the robustness of the results, we also estimate an Error-Correction investment model.

The baseline equation to be estimated is expressed below. Equation (1) shows a pooled OLS estimation, and equation (2) shows a fixed-effects (FE) estimation. The reason for using OLS as well as FE is that the time-series observation period is relatively short, and the cross-sectional variation contains useful information.[6]

$$I_{it}/K_{it-1} = a + ß_1\, CF_{it}/K_{it-1} + ß_2 \Delta S_{it} + ß_k \Sigma_k\, industry\ dummies + \lambda_t + \varepsilon_{it} \qquad (1)$$

$$I_{it}/K_{it-1} = a + ß_1\, CF_{it}/K_{it-1} + ß_2 \Delta S_{it} + ß_k \Sigma_k\, industry\ dummies + \lambda_t + \eta_i + \varepsilon_{it} \qquad (2)$$

In these equations, I_{it}, CF_{it}, and ΔS_{it} denote internal cash flows (net profit after tax plus depreciation), fixed tangible/intangible investments, and sales growth (average of past two years), respectively. Investments and cash flows are normalized by the beginning-of-period total capital stock (K_{it-1}: tangible fixed assets plus intangible fixed assets). In addition, three-digit industry dummies are used to control for industry effects. λ_t denotes year dummies, η_i denotes firm fixed effects, and ε_{it} is an i.i.d. error term. Because the data for intangible investments are available only from the year 2006, the period of analysis is four years, from 2006 to 2009.[7] To avoid bias caused by outliers, we eliminate firms where the absolute value of cash flow or tangible/intangible investments exceeds ten times the value of total fixed assets.

Our interest is the different sensitivity to internal cash flow of tangible investments and intangible investments. We expect the sensitivity to be larger for intangible investments.

[6] In estimating investment functions, recent studies often employ a GMM estimator to control for the endogeneity of regressors. However, when using a GMM estimator, lagged variables of more than three periods are necessary. Because we have only four years of observations, we use pooled OLS and FE estimators.

[7] Data on lagged total fixed assets from 2005 and data for sales from 2004 are used for the estimations.

However, it should be noted that we cannot simply compare the size of the coefficients ($ß_1$), because the value of tangible investments is approximately four times larger than the value of intangible investments (see Table 1). Thus, we calculate the effect of one standard deviation of cash flow on each type of investment and compare the percentage change in tangible/intangible investments.

Then, we divide the sample by firm size and firm age to identify the different effects of internal cash flow on intangible investments. The threshold to determine SMEs is paid-up capital of 100 million yen.[8] We define "young firms" as those whose age after establishment is less than the sample average (approximately 41 years). We expect the sensitivity to cash flow to be larger among SMEs and young firms because these firms are generally more financially constrained than large, mature firms.

Finally, the equation of the Error-Correction model is shown below, based on the specification of Bond et al. (2003). The notations are basically the same as equations (1) and (2), but ΔS_{it} is the sales growth from the previous year. S_{it-2} is the 2-year lagged sales, and $(lnI_{it-2} - lnS_{it-2})$ is the error-correction term for which the sign of the coefficient is expected to be negative. That is, when the capital stock exceeds the optimal level, investments will decrease, and the shortage of capital stock will increase investments. The list of the major variables and their summary statistics are shown in Table 1.

$$I_{it}/K_{it-1} = a + ß_1 I_{it-1}/K_{it-2} + ß_2 CF_{it}/K_{it-1} + ß_3 CF_{it-1}/K_{it-2} + ß_4 \Delta S_{it} + ß_5 \Delta S_{it-1} + ß_6 (lnI_{it-2} - lnS_{it-2}) + ß_k \Sigma_k \text{ industry dummies} + \lambda_t + \eta_i + \varepsilon_{it} \quad (3)$$

4. Results

The estimation results of investment functions (1) and (2) are shown in Table 2. The coefficients of cash flow ($ß_1$) are positive and highly significant in both OLS and FE estimations, and the size of the coefficients is similar in magnitude for both specifications. According to the FE estimation results, the coefficients are 0.047 and 0.024 for tangible and

[8] In the Small and Medium-sized Enterprise Basic Act, "SMEs" are defined both the number of employees and the value of the paid-up capital, and the thresholds differ by industry. However, in the corporate tax policy, "SMEs" are firms for which paid-up capital is equal to or less than 100 million yen, irrespective of the industry.

intangible investments, respectively. However, as mentioned, the value of tangible investments is approximately four times larger than the value of intangible investments. That is, the effect of one unit of cash flow on the percentage change in investments is larger for intangible investments than for tangible investments. Figure 3 indicates the magnitude of a one-standard-deviation change of cash flow (relative to total fixed assets) on the percentage changes of tangible/intangible investments. [9] A one-standard-deviation larger cash flow is associated with approximately 30% greater tangible investments and approximately 55% greater intangible investments. It is clear that intangible investments depend on internal cash flow more than tangible investments do.

The following are possible reasons for the higher sensitivity of intangible investments to internal finance: 1) information asymmetry between the borrowing firms and financial intermediaries is severe for intangible investments due to the limited ability of financial intermediaries to evaluate the profitability of investment, and 2) the collateral value of intangible assets is relatively low because of the lack of resale markets for intangible assets compared with real estate or equipment and machinery. The above result suggests the existence of capital market imperfections in intangible investments.

Table 3 and Figure 4 show results by splitting the sample firms into manufacturing and non-manufacturing firms. The sensitivity to cash flow is higher in non-manufacturing firms for both tangible and intangible investments. In particular, in the FE estimation result, the sensitivity of intangible investments to internal cash flow has a large positive value for non-manufacturing firms, but the sign of the coefficient is not positive for manufacturing firms. This result suggests that the financial market imperfection is likely to be related to the service sector productivity issue.

Table 4 shows the results for the separate estimations for SMEs and large firms. As explained in section 3, “SMEs” are defined as firms with paid-up capital of 100 million yen or less. According to the FE estimation results, the sensitivity to cash flow is higher among SMEs than among large firms for both tangible and intangible investments, but the difference in the cash flow sensitivity between firm size classes is remarkable for intangible investments. A one-standard-deviation larger cash flow is associated with approximately 42%

[9] In calculating the effects of a one-standard-deviation change in cash flow on investments, the average value of investments and the standard deviation of cash flow are calculated from the samples used for the estimations (not the figures for the total sample).

greater intangible investments among large firms, but this figure is approximately 75% among SMEs (see Figure 5). This result suggests that the degree of capital market imperfection is stronger for SMEs.

We divide the sample into younger firms and mature firms to estimate investment functions. The mean age of sample firms (approximately 41 years) is used as the threshold value to divide the sample. The results are presented in Table 5. It is clear that intangible investments among young firms are more sensitive to cash flow than among mature firms. According to the FE estimation results, a one-standard-deviation larger cash flow is associated with approximately 30% greater intangible investments among mature firms, but this figure is approximately 50% among young firms (see Figure 6). By the type of investment, the effects of cash flow among young firms are approximately 32% and 50% for tangible investments and intangible investments, respectively. This result indicates that young firms face severe constraint in the external capital market to finance intangible investments. Policy measures should target young SMEs to stimulate intangible investments.

Finally, we estimate the Error-Correction model of investment (equation (3)) to check the robustness of the above results. The results of the FE estimations are presented in Table 6. The coefficients for the error-correction term ($lnKI_{it-2}$ - lnS_{it-2}) are negative and significant, consistent with the sign condition of the model. It is difficult to compare the estimated coefficients with those from the accelerator-type investment model because the Error-Correction model has lagged cash flow as an explanatory variable. However, the coefficients for the current cash flow are not much different from the results of the accelerator-type investment model.

The estimation results by industry (manufacturing/non-manufacturing firms), by firm size (SMEs/large firms), and by firm age (young/matured firms) are presented in Table 7. All of the results are generally similar to those using the accelerator-type investment model. Irrespective of the functional forms, the conclusion remains that investment-cash flow sensitivity is stronger for intangible investments than for tangible investments and that the effect of internal cash flow is prominent among SMEs and young firms.

5. Conclusion

Recent studies show that intangible assets play an important role in economic performance, and investments in intangible assets might be lower than the optimal level.

This paper uses panel data from the Basic Survey of Japanese Business Structure and Activities to empirically analyze the financial constraints of intangible investments.

The results of the analysis can be summarized as follows:

1) Investments in intangible assets are more sensitive to internal cash flow compared with investments in tangible assets, which suggests the existence of market failure in financial markets caused by the information asymmetry between lenders and borrowers or by the lack of a resale market for intangible assets.

2) The sensitivity of intangible investments to cash flow is stronger for SMEs and young firms than for large, mature firms, indicating severe constraints of financing from external markets among SMEs and young firms.

This paper suggests that investment tax credits and financial support for intangible investments to prevent underinvestment should be considered. In particular, such policies are necessary for SMEs and young firms. However, actual policies to promote investments are concentrated on tangible assets, with the exception of R&D tax credits. In practice, intangibility itself may be an obstacle to establishing concrete policy measures. Therefore, one possible solution is to reduce the corporate tax rate, on the one hand, and to scrap existing tax expenditure for tangible investments, on the other hand. In addition, direct policy measures to correct market failure are desirable. The improvement of financial intermediaries' capability to evaluate intangibles and the expansion of transaction markets for intellectual property rights are examples of these policies.

This study is subject to some limitations. The data on intangible investments in this paper are confined to the acquisition of intangible assets defined by the current accounting standard. As a result, the analysis of this paper does not cover some intangible investments, such as intellectual property developed inside the firm, employee training expenses, and organizational innovations. We use simple OLS and FE to estimate investment functions because the sample period is limited to the four years between 2006 and 2009. However, the analysis is not free from endogeneity concerns. More rigorous analysis is expected when longer time-series data become available.

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Table 1 Summary statistics

Variables		Obs	Mean	Std. Dev.	Min	Max
ln(value added)	lnva	239,984	7.094	1.203	0.000	14.751
ln(labor input)	lnlabor	213,447	10.284	0.991	8.345	16.473
ln(tangible assets)	lntasset	251,433	6.669	1.923	0.000	16.293
ln(intangible assets)	lniasset	180,131	2.736	2.009	0.000	13.148
Tangible investments/Total assets	tinv_k	76,105	0.169	0.369	0.000	9.871
Intangible investments/Total assets	iinv_k	53,692	0.047	0.237	0.000	9.457
Cash Flow/Total assets	cflow_k	92,749	0.329	1.064	-9.933	9.974
Number of employees	emp	92,749	479	1,865	50	132,006
Sales	sale	92,749	26,803	182,497	8	12,300,000
Sales growth (2 years' average)	avgsale	84,303	1.017	0.744	0.209	193.544

(Notes) ln(value added), ln(labor input), ln(tangible assets), and ln(intangible assets) are for the years from 2003 to 2009. Other variables are for the years from 2006 to 2009.

Table 2 Estimation results of investment functions

	(1)		(2)		(3)		(4)	
	tinv_k		iinv_k		tinv_k		iinv_k	
	OLS		OLS		FE		FE	
cflow_k	0.0566	***	0.0245	***	0.0472	***	0.0240	***
	(0.0014)		(0.0010)		(0.0023)		(0.0017)	
avgsale	0.0175	***	0.0059	***	0.0068	***	0.0002	
	(0.0017)		(0.0010)		(0.0022)		(0.0064)	
year dummies	yes		yes		yes		yes	
industry dummies	yes		yes		yes		yes	
Number of obs	69,759		49,119		69,759		49,119	
R-squared	0.0459		0.0956		0.0187		0.0159	

(Notes) Estimation period is from 2006 to 2009. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Adjusted R-squared for OLS estimates, R-squared (within) for FE estimates. tinv_k, iinv_k, cflow_k, and avgsale denote tangible investments divided by total fixed assets, intangible investments divided by total fixed assets, cash flows divided by total fixed assets, and sales growth (2 years' average)..

Table 3 Estimation results by industry

	(1)		(2)		(3)		(4)	
OLS	Manufacturing		Non-manufacturing		Manufacturing		Non-manufacturing	
	tinv_k		tinv_k		iinv_k		iinv_k	
cflow_k	0.0790	***	0.0486	***	0.0070	***	0.0279	***
	(0.0026)		(0.0018)		(0.0008)		(0.0015)	
avgsale	0.0029	*	0.1207	***	−0.0001		0.0481	***
	(0.0015)		(0.0054)		(0.0004)		(0.0039)	
year dummies	yes		yes		yes		yes	
industry dummies	yes		yes		yes		yes	
Number of obs	35,667		34,092		24,713		24,406	
Adj R-squared	0.0429		0.0606		0.0163		0.0884	
	(5)		(6)		(7)		(8)	
FE	Manufacturing		Non-manufacturing		Manufacturing		Non-manufacturing	
	tinv_k		tinv_k		iinv_k		iinv_k	
cflow_k	0.0429	***	0.0470	***	−0.0041	***	0.0320	***
	(0.0042)		(0.0030)		(0.0013)		(0.0027)	
avgsale	0.0021		0.1077	***	−0.0060		0.0128	
	(0.0019)		(0.0121)		(0.0039)		(0.0112)	
year dummies	yes		yes		yes		yes	
industry dummies	yes		yes		yes		yes	
Number of obs	35,667		34,092		24,713		24,406	
R-squared: within	0.0187		0.0235		0.0059		0.0199	

(Notes) Estimation period is from 2006 to 2009. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4 Estimation results by firm size

	(1)		(2)		(3)		(4)	
OLS	SMEs		Large firms		SMEs		Large firms	
	tinv_k		tinv_k		iinv_k		iinv_k	
cflow_k	0.0646	***	0.0457	***	0.0248	***	0.0240	***
	(0.0020)		(0.0020)		(0.0013)		(0.0014)	
avgsale	0.0720	***	0.0147	***	0.0150	**	0.0056	***
	(0.0075)		(0.0016)		(0.0062)		(0.0011)	
year dummies	yes		yes		yes		yes	
industry dummies	yes		yes		yes		yes	
Number of obs	39452		30307		25005		24114	
Adj R-squared	0.0545		0.0415		0.0977		0.1013	
	(5)		(6)		(7)		(8)	
FE	SMEs		Large firms		SMEs		Large firms	
	tinv_k		tinv_k		iinv_k		iinv_k	
cflow_k	0.0592	***	0.0344	***	0.0275	***	0.0215	***
	(0.0034)		(0.0033)		(0.0023)		(0.0025)	
avgsale	0.0436	***	0.0044	**	0.0092		−0.0056	
	(0.0097)		(0.0021)		(0.0099)		(0.0086)	
year dummies	yes		yes		yes		yes	
industry dummies	yes		yes		yes		yes	
Number of obs	39,452		30,307		25,005		24,114	
R-squared: within	0.0269		0.0211		0.0506		0.0159	

(Notes) Estimation period is from 2006 to 2009. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5 Estimation results by firm age

	(1)		(2)		(3)		(4)	
OLS	Young frims		Matured firms		Young frims		Matured firms	
	tinv_k		tinv_k		iinv_k		iinv_k	
cflow_k	0.0522	***	0.0590	***	0.0234	***	0.0163	***
	(0.0019)		(0.0025)		(0.0015)		(0.0008)	
avgsale	0.0155	***	0.0492	***	0.0058	***	0.0036	*
	(0.0021)		(0.0052)		(0.0014)		(0.0021)	
year dummies	yes		yes		yes		yes	
industry dummies	yes		yes		yes		yes	
Number of obs	32826		36933		23674		25445	
Adj R-squared	0.0391		0.043		0.0843		0.064	
	(5)		(6)		(7)		(8)	
FE	Young frims		Matured firms		Young frims		Matured firms	
	tinv_k		tinv_k		iinv_k		iinv_k	
cflow_k	0.0518	***	0.0220	***	0.0287	***	0.0080	***
	(0.0033)		(0.0040)		(0.0027)		(0.0011)	
avgsale	0.0046		0.0499	***	−0.0033		0.0151	***
	(0.0028)		(0.0074)		(0.0108)		(0.0033)	
year dummies	yes		yes		yes		yes	
industry dummies	yes		yes		yes		yes	
Number of obs	32826		36933		23674		25445	
R-squared: within	0.0248		0.024		0.0248		0.0158	

(Notes) Estimation period is from 2006 to 2009. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6 Estimations using Error-Correction model of investment

	(1)		(2)	
FE	tinv_k		iinv_k	
tinv_k_1, iinv_k_1	−0.0358	***	−0.1311	***
	(0.0018)		(0.0050)	
cflow_k	0.0476	***	0.0207	***
	(0.0030)		(0.0023)	
cflow_k_1	−0.0008		0.0078	***
	(0.0014)		(0.0012)	
gsale	0.0027	**	0.0057	
	(0.0011)		(0.0045)	
gsale_1	0.0437	***	0.0167	**
	(0.0080)		(0.0069)	
lnkt_lnsale_2, lnki_lnsale_2	−0.1563	***	−0.0379	***
	(0.0082)		(0.0030)	
year dummies	yes		yes	
industry dummies	yes		yes	
Number of obs	47,181		27,404	
R-sq: within	0.0447		0.0706	

(Notes) Fixed-effects estimates for the years from 2006 to 2009 with standard errors in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%. gsale denotes sales growth from the previous year and gsale_1 denotes lagged sales growth. Lnkt_lnsale_2 and lnki_lnsale_2 are error-correction terms.

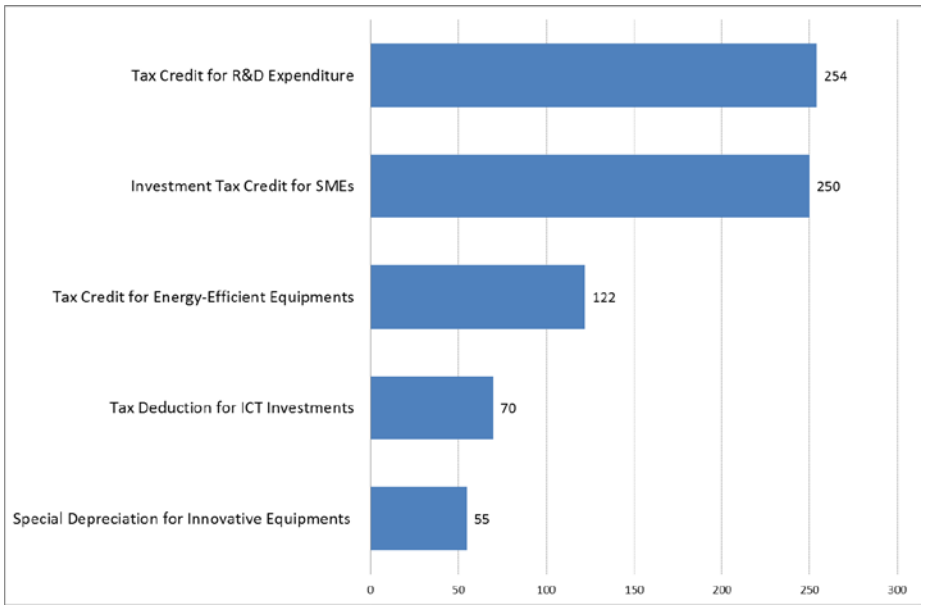
Table 7 Estimations using Error-Correction model of investment (by industry, by firm size, and by firm age)

1. By industry	(1)		(2)		(3)		(4)	
FE	Manufacturing		Non-manufacturing		Manufacturing		Non-manufacturing	
	tinv_k		tinv_k		iinv_k		iinv_k	
cflow_k	0.0403	***	0.0460	***	0.0021		0.0243	***
	(0.0054)		(0.0038)		(0.0016)		(0.0036)	
cflow_k_1	0.0212	***	−0.0021		0.0029	**	0.0058	***
	(0.0042)		(0.0016)		(0.0013)		(0.0017)	
2. By firm size	(1)		(2)		(3)		(4)	
FE	SMEs		Large firms		SMEs		Large firms	
	tinv_k		tinv_k		iinv_k		iinv_k	
cflow_k	0.0508	***	0.0426	***	0.0210	***	0.0206	***
	(0.0045)		(0.0041)		(0.0033)		(0.0031)	
cflow_k_1	0.0016		−0.0029	*	0.0137	***	0.0022	***
	(0.0025)		(0.0016)		(0.0017)		(0.0016)	
3. By firm age	(1)		(2)		(3)		(4)	
FE	Young frims		Matured firms		Young frims		Matured firms	
	tinv_k		tinv_k		iinv_k		iinv_k	
cflow_k	0.0534	***	0.0181	***	0.0233	***	0.0072	***
	(0.0043)		(0.0048)		(0.0036)		(0.0016)	
cflow_k_1	−0.0025		0.0039		0.0067	***	0.0098	***
	(0.0019)		(0.0033)		(0.0018)		(0.0012)	

(Notes) Fixed-effects estimates for the years from 2006 to 2009 with standard errors in parentheses.

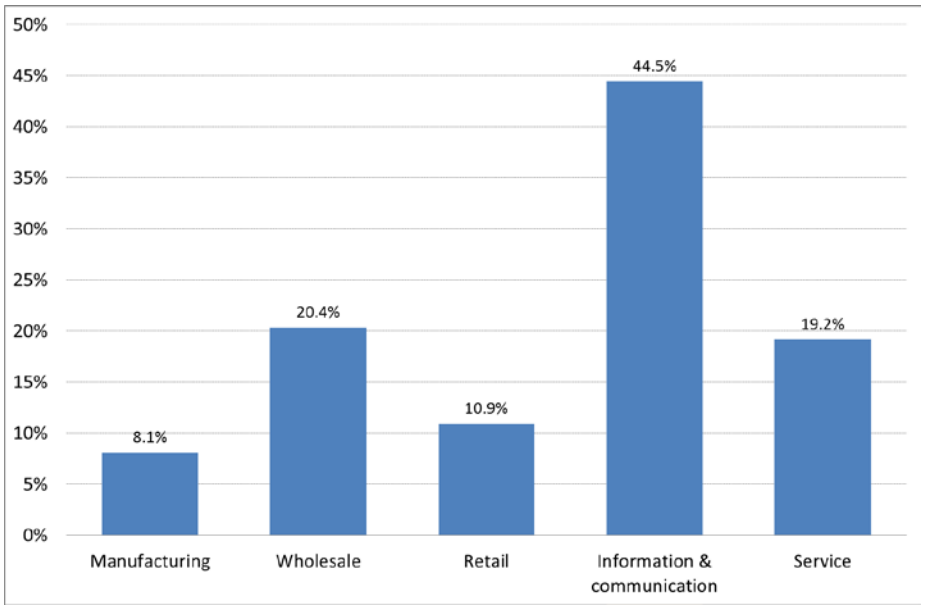
* significant at 10%; ** significant at 5%; *** significant at 1%. Independent variables are the same with table 6, but only the coefficients for cash flow are expressed in the table.

Figure 1 Major special tax measures (corporate tax, billion yen / year)



(Note) The values are for the fiscal year 2010.

Figure 2 Ratio of intangible investment to total fixed asset investment by industry



(Notes) Total fixed asset investments are the sum of the tangible and intangible investments. The figures are the mean value of the firms in each industry calculated from the pooled years from 2006 to 2009.

Figure 3 Effects of one standard deviation change of cash flow on percentage change of tangible/intangible investments

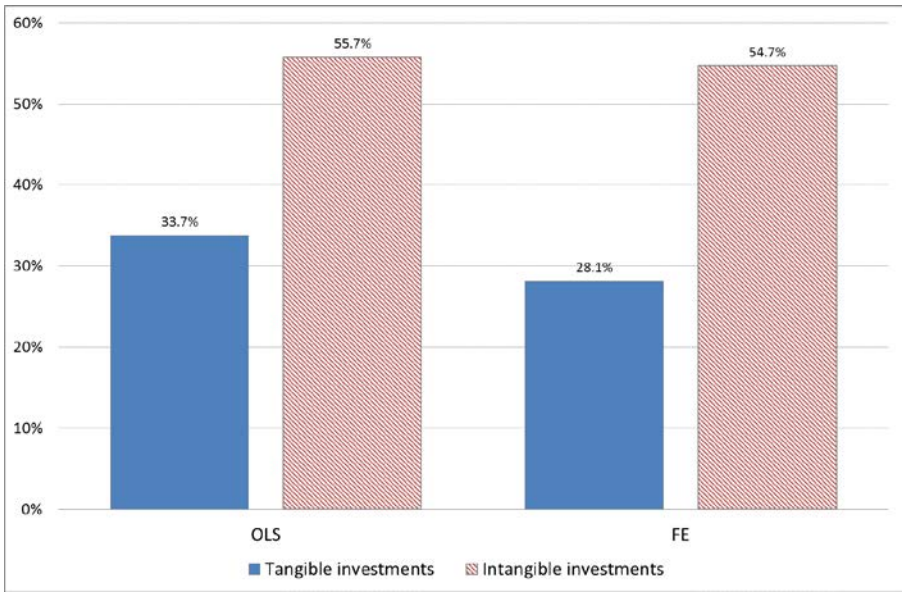


Figure 4 Effects of one standard deviation change of cash flow on percentage change of tangible/intangible investments (by industry)

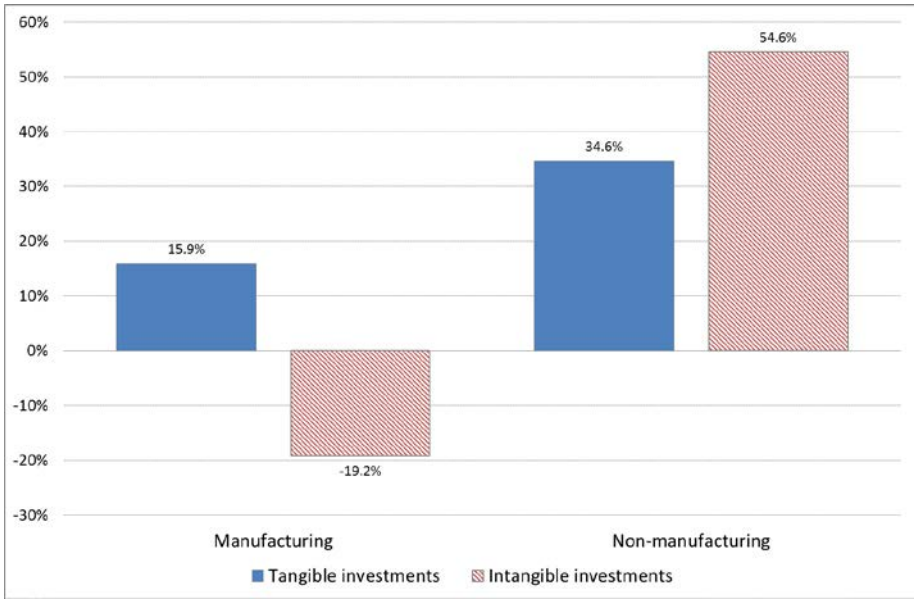


Figure 5 Effects of one standard deviation change of cash flow on percentage change of tangible/intangible investments (by firm size)

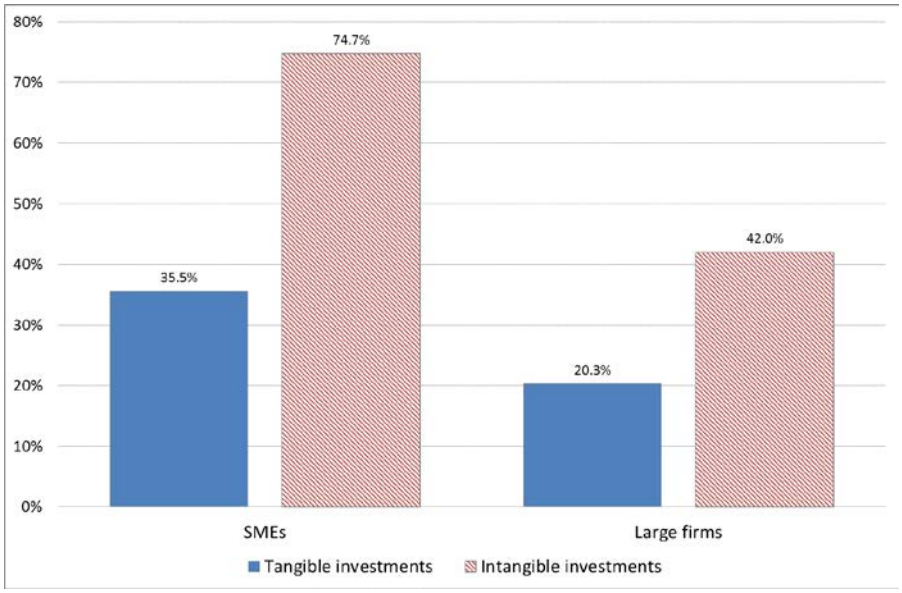


Figure 6 Effects of one standard deviation change of cash flow on percentage change of tangible/intangible investments (by firm age)