Investment Spikes and Adjustment toward Target Leverage: Evidence from Japan

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Abstract

This study presents an empirical investigation whether lumpy investment behaviors by firms affect their readjustment toward target leverage ratios. Using a data sample of Japanese listed firms from 1978–2008, it is found that firm investment spikes have a larger effect on debt than equity issuances. The positive effect of investments on debt issue is greater for firms with below-target debt than for those with above-target debt. The results imply that firms with below-target debt might move toward the target whereas those with above-target debt move away from it during large investments. It is also found that financially constrained firms, with above-target debt, are more responsive to investment spikes than their financially unconstrained counterparts.

Keywords: Information asymmetry, lumpy investment, financial constraint

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1 Introduction

How firms determine their capital structure and when and how they change it are one of the most important topics in corporate finance. According to the trade-off theory, firms determine their optimal capital structure to balance the marginal benefits and costs of debt. Many empirical studies support the trade-off theory that firms adjust their capital structure toward the target debt ratio. Moreover, recent studies have concluded that the speed of this adjustment differs depending on whether firms have a financial deficit or surplus, suggesting the influence on the target behavior by other factors, such as the asymmetric information costs of external financing (Byoun 2008; Faulkender *et al.* 2012). A faster adjustment is enabled among firms in case of a financial deficit (surplus) because the adjustment costs are lower when shared with other transaction costs.

Earlier studies employ a partial adjustment model, which assumes a constant and continuous adjustment.[1] However, if an adjustment cost function is non-convex and has a fixed cost, then adjustment is expected to be infrequent and lumpy. Moreover, previous studies also assume that investment is continuous. However, recent studies on investment have found that firm investment behavior is lumpy,[2] not continuous; therefore, a firm's capital structure adjustment is expected mostly during investment spikes.

1 See Shyam-Sunder and Myers (1999), Fama and French (2002), Flannery and Rangan (2006), and Kayhan and Titman (2007).

2 See Caballero *et al.* (1995).

This study investigates how firms' investment activities influence their debt and equity issuance decisions and their corresponding rebalancing behavior toward a target debt level. We test whether firms move toward or away from their debt target during large investments. We also analyze whether the impact of large investments differ among firms with heterogeneous characteristics.

This study differs from previous studies in two ways. First, we investigate the effects of large investments on financial decisions of debt and equity issues. Using financing decisions as dependent variables, we avoid the mechanical mean reversion problems associated with the use of the debt ratio as the dependent variable (Chen and Zhao 2007; Chang and Dasgupta 2009). Second, we focus on the influence of firms' lumpy investment behaviors instead of continuous investment behaviors.

Using the data on Japanese listed firms, we find that lumpy investments positively affect debt and equity issuances; however, this effect varies depending on a firm's debt position and firm characteristics. Firms with below-target debt are more likely to issue debt to move toward the target; however, firms with above-target debt also issue debt to move away from the target. On the other hand, the effects of spikes on equity issues are consistent with the target behavior that firms with below-target debt are less likely to issue equity. The effects of spikes on debt issues are found to vary with firm characteristics. Financially constrained firms are more sensitive to spikes, suggesting greater benefits of adjustment during spikes. Mature firms with blow-target debt issue debt more, while those with above-target debt issue less than growing firms. In contrast, the effects of spikes on equity do not vary with firm

characteristics.

The remainder of the paper is organized as follows. Section 2 reviews previous empirical studies on changes in capital structure and highlight their shortcomings. Section 3 describes our sample data and the basic estimation strategy. Section 4 presents the estimation results of the effect of lumpy investments on debt (equity) issuance and firm target behavior. Section 5 discusses the results and presents the study conclusions.

2 Capital structure adjustments toward the target: theory and evidence

This section reviews previous theoretical and empirical studies on capital structure adjustments. Many studies have tested the dynamic trade-off theory, which predicts that firms adjust their capital structure toward their debt target, and have found supporting evidence by estimation, using the partial adjustment model. However, since the estimated adjustment speed is very slow (Fama and French 2002), some recent studies have explored its reasons. One of the impediments for adjustment toward the debt target is the high transaction cost. Leary and Roberts (2005) found that the adjustment speed of firms is slow when the non-convex adjustment cost functions are assumed. With fixed costs for adjustments, firms do not adjust their capital structure continuously, but periodically; therefore, the observed adjustments are lumpy over time.

Some other studies have explored the possibility of asymmetric adjustment cost. With informational asymmetry costs, the issue of equity is

more costly than debt due to adverse selection (Majluf and Myers 1984). Therefore, to minimize these transaction costs, firms find it optimal to adjust their capital structure at the time of investments. Byoun (2008) found that adjustment is faster for over-leveraged (under-leveraged) firms with financial surplus (deficit) compared to over-leveraged firms (under -leveraged) with financial deficit (surplus). Faulkender *et al.* (2012) found that firms with larger cash flows adjust faster than those with smaller cash flows. They argue that adjustment costs are low during investments because transaction costs are shared between the benefits of approaching the target and funding investments. Dudley (2012) also found evidence that firms move toward the target when they invest. On the other hand, DeAngelo *et al.* (2011) argue that firms temporarily move away from their target when the investment benefits are greater than the costs of deviation from the target. Using data from Japanese listed firms, Shikimi (2014) findings are consistent with those of DeAngelo *et al.* (2011).

Together, these findings imply that the functional form of adjustment costs and asymmetry in adjustment costs result in slower adjustments, on average. However, studies exploring real investment effects estimate the partial adjustment model and do not consider the possibility that lumpy real investment patterns result in lumpy capital structure adjustments. Given this disparity in the literature, this present study investigates the effect of lumpy investments on firms' financing decisions regarding the issuance of debt and equity.

3 Data and empirical specification

3.1 Empirical specification

We assume that firms' financing decisions can be described as follows :

$$Y_{it}^{*} = \alpha(Debt_{it-1} - Target_{it}^{*}) + \beta S_{it} + \mathbf{X}_{it}\boldsymbol{\gamma} + m_i + u_{it}, \quad (1)$$
$$Y_{it} = 1 \ if \ Y_{it}^{*} > 0,$$
$$Y_{it} = 0 \ otherwize,$$

where Y_{it} is the financing decision of firm i in year t. $Debt_{it-1}$ is the firm's debt ratio, defined as the sum of short-term and long-term debts divided by the sum of short-term debt, long-term debt, and capital. $Target_{it}^{*}$ is the firm's target debt ratio, S_{it} is an investment spike, $\mathbf{X}_{it}$ is a vector of control variables, and m_i is a measure of the firm's heterogeneity. We assume that the firm's heterogeneity is correlated with the firm's average of observable characteristic variables, and employ the Mundlak probit model to obtain estimators (Wooldridge 2010). The expected sign of α is negative for the issue of debt and is positive for that of equity. β is expected to be positive. We regard an investment spike as an exogeneous variable since the Durbin-Wu- Hausman test rejects the endogenenity.

3.2 Data

Our sample comprises non-financial firms listed on the first or second sections of Japanese stock markets from 1978 to 2008. We restrict our sample to those firms that have been listed for at least five consecutive years, and obtain accounting and stock price data from *Firm Financial Statement Data Bank*, supplied by the Development Bank of Japan. We

exclude the electricity, gas, and water supply industries because they tend to be heavily regulated. Firms whose book debt-asset ratio exceed one or take a negative value and those with missing stock price information are eliminated from the sample. Firms whose growth rate of total assets is more than 100% or less than −100% are also eliminated, since their involvement in a merger, acquisition, or large asset sale is likely. The lower and upper 0.5% tails of the distribution of financial variables are trimmed to eliminate outliers. Variables are deflated by the consumer price index. Summary statistics are presented in Table 1.

Table 1. Summary statistics

	Total sample		Firms who issue debt		Firms who issue equity	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Debt / total assets	0.592	(0.211)	0.616	(0.195)	0.577	(0.188)
Debt / total assets – Target debt ratio	0.005	(0.058)	-0.014	(0.060)	0.038	(0.063)
ln (sales)	17.641	(1.401)	17.618	(1.381)	17.586	(1.254)
Market / book assets	1.426	(0.714)	1.546	(0.807)	1.643	(0.692)
EBITDA / total assets	0.052	(0.038)	0.055	(0.036)	0.066	(0.036)
Tangible fixed assets / total assets	0.266	(0.160)	0.254	(0.161)	0.260	(0.144)
(Cash + marketable securities) / total assets	0.168	(0.113)	0.167	(0.108)	0.188	(0.115)
Price earnings ratio	18.619	(69.406)	22.764	(53.889)	29.600	(52.500)
Shareholdings by top 10	0.447	(0.204)	0.445	(0.213)	0.413	(0.219)
Shareholdings by banks	0.273	(0.152)	0.269	(0.152)	0.288	(0.148)
Shareholdings by foreigners	0.054	(0.086)	0.052	(0.085)	0.064	(0.086)
Fraction of observations that issue debt	0.213	(0.410)				
Fraction of observations that issue equity	0.029	(0.167)				
Fraction of observations that hit investment spikes	0.078	(0.268)	0.148	(0.355)	0.131	(0.338)
N	58138		12402		1668	

Financing decisions

Debt and equity issuances are the two types of financial decisions to be

considered here. Debt issuance includes public debt and bank loan debt. Following Chang and Dasgupta (2009), net debt issue and net equity issue are defined as follows: Net equity issue is a change in book capital minus a change in retained earnings, whereas net debt issue is a change in total assets minus a change in retained earnings and net equity issue. Net debt (equity) issues are divided by total assets at the beginning of the year. Following Hovakimin *et al.* (2001), Hovakimin (2004), and Leary and Roberts (2005), a firm that has a net debt (equity) issuance exceeds 5% of total assets at the beginning of the year is defined to issue debt (equity).

Investment spikes

Following Caballero *et al.*(1995), an investment spike is defined as follows:

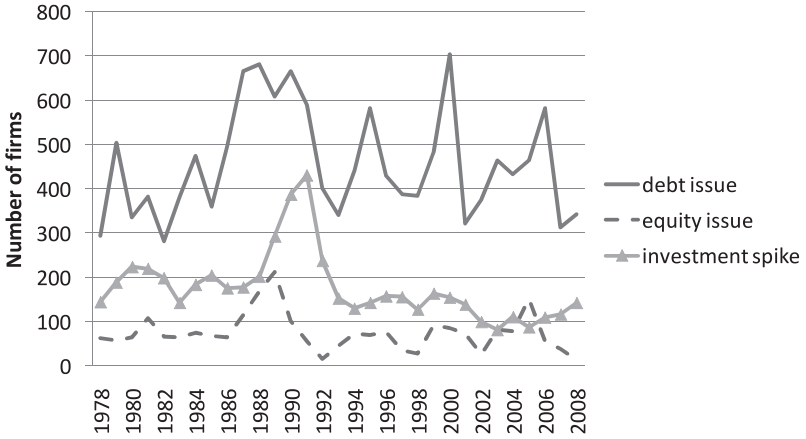
$$Spike = 1 \ \ if \ \ ((I_{it} - I_i)/\sigma_i^I) > 1.5,$$

where I_{it} is firm i's investment rate at time t, I_i is the firm's mean of investment rate, and σ_i^I is the firm-level standard deviation. Following Shima (2005), the investment rate is defined as an increase in fixed tangible assets minus depreciation divided by capital stock at the beginning of the year. Figure 1 plots the number of firms that have issued debt (equity) and have experienced investment spikes during the period from 1978 to 2008.

Determinants of target capital structure

Target capital structure is described as follows:

Figure 1. Financing choice and investment spikes



This figure plots the number of firms that have issued debt (equity) and have experienced investment spikes during the period from 1978 to 2008.

$$Target_{it}^{*} = \mathbf{W}_{it-1}\ \boldsymbol{\delta} + f_i + \delta_t + \varepsilon_{it},$$

where $\mathbf{W}_{it-1}$ is a vector of firm characteristics, such as firm size, growth, profitability, and collateral (Rajan and Zingales 1995; Hovakimian *et al.* 2001; Frank and Goyal 2008; Lemmon *et al.* 2008). f_i is firm fixed effects, δ_t denotes the year dummy to control for macroeconomic shocks such as the inflation rate. For firm size, we use the ln (sales) as a proxy. For firm growth, we use the market-to-book ratio as a proxy. EBITDA / total assets and tangible fixed assets / total assets, respectively, are used as proxies for profitability and collateral. Industry median debt ratios are also included to control for variations across industries. We regress firm observable debt ratio on those determinants, and obtain fitted values as target debt ratio. The firm fixed effects are also included in the fitted values (Flannery and Rangan 2006; Lemmon *et*

Table 2. Estimation results of target capital structure

	1976-1986	1987-1995	1996-2008
ln (sales)	-0.024 ***	0.023 ***	0.027 ***
	(0.002)	(0.003)	(0.001)
Market / book assets	-0.017 ***	-0.004 ***	0.004 ***
	(0.002)	(0.001)	(0.001)
EBITDA/ total assets	-0.521 ***	-0.394 ***	-0.381 ***
	(0.013)	(0.017)	(0.010)
Tangible fixed assets / total assets	0.018 **	0.046 ***	0.091 ***
	(0.009)	(0.010)	(0.007)
Industry median of debt / total assets	0.390 ***	0.321 ***	0.194 ***
	(0.018)	(0.024)	(0.042)
Constant	0.778 ***	0.211 ***	0.161 ***
	(0.027)	(0.034)	(0.024)
Year dummy	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Hausman test : χ^2	1583.55 ***	491.32 ***	533.58 ***
Adjusted R^2	0.8733	0.9215	0.9091
N	23311	17587	30812
N of firms	1700	2321	3058

Note : The dependent variable is firm debt ratio, defined as the sum of short-term plus long-term debts divided by sum of the shot-term debt, long-term debt, and capital. Robust standard errors are in parentheses. Significance at the 10%, 5%, and 1% level is denoted by *, **, and ***, respectively.

al. 2008). We divide the time frame into three financial periods : 1976–1986, 1987–1995, and 1996–2008 to consider the possibility that a firm's decisions regarding its target capital structure might be affected by financial regulations.[3] Table 2 tabulates the estimation results.

3 Regulations on bond issuances were gradually relaxed after 1987. Equity issue at market price was banned during 1990–1995.

Other variables

To control for other factors explained by the pecking-order hypothesis and market timing hypothesis, cash plus marketable securities divided by total assets and the price-to-earnings ratio are included. We expect the cash ratio to have negative effects for both issues. The price-to-earnings ratio is expected to have a positive effect on the issue of equity. The shareholdings ratio for the top 10 shareholders, banks, and foreigners is also included to control for the effect of the agency problem. To control for industry variation and macroeconomic shocks, industry and year dummies are included, respectively.

4 Debt (equity) issue and real investments

4.1 Base model

Estimation results for Equation (1) are presented in Table 3. The coefficients of deviation from the target have the expected signs and have highly significant effects on debt (equity) issue, suggesting that firms are more likely to adjust their capital structure in case of higher deviation. Although the investment spikes have a positive effect at the 1% level for both debt and equity, their effect is greater for debt than for equity. When firms make large investments, firms' probabilities of debt issuance increases by 15.6%; whereas, equity issuance increases by 1.1%. Cash divided by total assets have a negative effect on debt (equity) issue, suggesting that firms with more internal funds are less likely to use external financing; this is consistent with the pecking-order hypothesis. The coefficients of the price-to-earnings ratio are positive and significant at the 1% level for both debt and equity issuance. None of shareholding

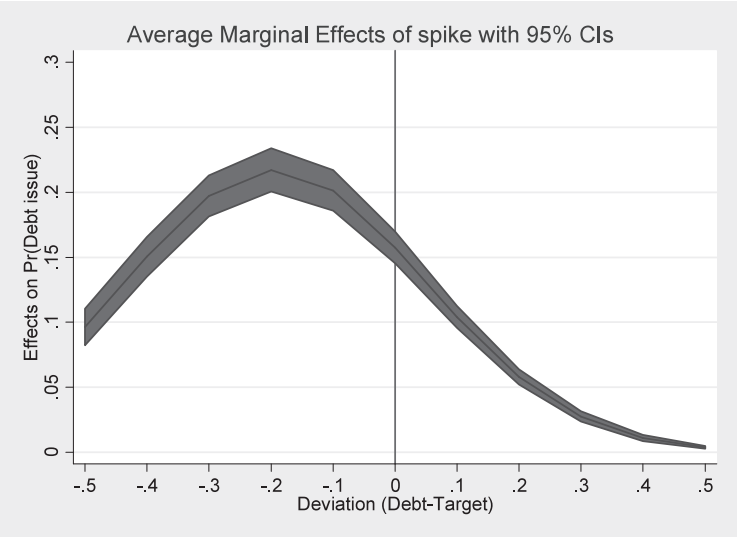
Table 3. Estimation results of debt (equity) issue and investment spikes

	Debt issue		Equity issue		Test of equal coefficients
	Coef.	Average marginal effect (dy/dx)	Coef.	Average marginal effect (dy/dx)	Test of equal coefficients
Debt – target (%)	-4.389 ***	-1.167 ***	4.232 ***	0.252 ***	1146.9 ***
	(0.126)	(0.032)	(0.233)	(0.015)	
Investment spikes	0.588 ***	0.156 ***	0.192 ***	0.011 ***	73.79 ***
	(0.023)	(0.006)	(0.035)	(0.002)	
Cash/total assets	-0.974 ***	-0.259 ***	-0.254 *	-0.015	11.87 ***
	(0.089)	(0.024)	(0.154)	(0.010)	
Price earnigs ratio	0.0006 ***	0.0002 ***	0.0010 ***	0.0001 ***	1.7
	(0.0001)	(0.0000)	(0.0002)	(0.0000)	
Shareholdings by top 10	0.031	0.008	-0.213 **	-0.013 **	2.98 *
	(0.051)	(0.014)	(0.107)	(0.006)	
Shareholdings by banks	-0.01	-0.003	-0.209	-0.012	0.63
	(0.113)	(0.030)	(0.192)	(0.014)	
Shareholdings by foreigners	0.023	0.006	0.797 ***	0.048 ***	8.42 ***
	(0.135)	(0.036)	(0.176)	(0.013)	
Average of debt – target	-1.419 ***	-0.377 ***	-3.61 ***	-0.215 ***	3.44 *
	(0.528)	(0.140)	(1.226)	(0.071)	
Average of investment spikes	-0.597 ***	-0.159 ***	0.223	0.013	2.57
	(0.175)	(0.046)	(0.270)	(0.022)	
Average of Cash/total assets	0.14	0.037	0.572 **	0.034 **	0.01
	(0.127)	(0.034)	(0.235)	(0.014)	
Average of price earnings ratio	0.0005	0.0001	0.0006	0.0000	0.04
	(0.0003)	(0.0001)	(0.0005)	(0.0000)	
Average of shareholdings by top 10	-0.018	-0.005	0.076	0.005	8.61 ***
	(0.076)	(0.020)	(0.179)	(0.009)	
Average of shareholdings by banks	-0.371 ***	-0.099 ***	0.45 **	0.027 *	0.1
	(0.133)	(0.035)	(0.190)	(0.014)	
Average of shareholdings by foreigners	0.221	0.059	0.117	0.007	
	(0.164)	(0.044)	(0.236)	(0.017)	
Constant	-1.142 ***		-2.552 ***		
	(0.057)		(0.135)		
N	57350		57146		
Log likelihood	-27239.1		-6656.99		
Test of all the coefficients of average indendent variables is zero	34.93 ***		22.58 ***		
Industry dummy	Yes		Yes		
Year dummy	Yes		Yes		

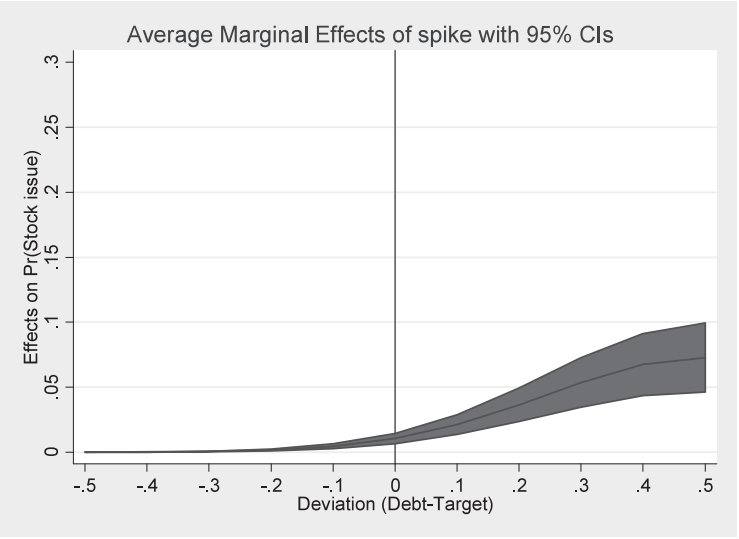
Bootstrap standard errors for estimated coefficients and Delta-method standard errors for average marginal effects (AME) are in parentheses. Significance at the 10%, 5%, and 1% level is denoted by *, **, and ***, respectively.

Figure 2. The average marginal effect of spikes

Panel A. The effect of spikes on debt issue



Panel B. The effect of spikes on equity issue



ratio variables are significant for debt issue. On the other hand, shareholding by the top 10 (foreigners) has a negative (positive) effect on equity (debt) issue at the 5% (1%) significance level, suggesting that cross-shareholding weakens shareholder discipline; however, the presence of foreign shareholders lowers the agency costs.

To further evaluate the effects of investment spikes on financing decisions, Figure 2 plots the average marginal effects of investment spikes at the firm's debt position. Firms are more likely to issue debt when actual debt is below-target (Panel A); however, they are also observed to do so when it is above-target. On the other hand, firms are likely to issue equity when their debt is above-target, but not when it is below-target (Panel B).

4.2 Target behavior and investment by firm characteristics

In this section, we examine whether the effect of investment spikes vary with firm characteristics and market conditions. We split the sample according to firm characteristics, such as financial constraints, investment opportunities, earnings volatility, profitability, and their market-to-book ratio, and compare their target behaviors and the effects of spikes in those samples.

A. Financial constraints

Financially constrained firms have greater difficulty in issuing debt or equity compared with financially unconstrained firms, due to high transaction costs. Therefore, we expect financially constrained firms to be less likely to issue debt (equity) and adjust their capital structure compared with unconstrained firms (Korajczyk and Levy 2003). On the

other hand, financially constrained firms are expected to make less frequent, but lumpy adjustments since the opportunity costs of forgoing investments and the timing of adjustment are higher compared with financially unconstrained firms. Thus, they are expected to be more responsive to investment spikes. Samples are divided into financially con-

Table 4. Estimation results of debt (equity) issue by firm characteristics

Panel A: Financial constraints

	Debt issue				
	Financially constrained firms		Financially unconstrained firms		
	Coef.	dy/dx	Coef.	dy/dx	Test
Debt – Target	-3.965 ***	-1.031 ***	-5.16 ***	-1.357 ***	12.56 ***
	(0.224)	(0.057)	(0.233)	(0.059)	
Investment spikes	0.688 ***	0.176 ***	0.518 ***	0.136 ***	8.08 ***
	(0.044)	(0.010)	(0.036)	(0.012)	

	Equity issue				
	Financially constrained firms		Financially unconstrained firms		
	Coef.	dy/dx	Coef.	dy/dx	Test
Debt – Target	3.456 ***	0.175 ***	4.528 ***	0.251 ***	3.43 *
	(0.442)	(0.017)	(0.515)	(0.026)	
Investment spikes	0.279 ***	0.013 ***	0.082	0.006	2.33
	(0.057)	(0.004)	(0.073)	(0.005)	

Panel B: Investment opportunities

	Debt issue				
	MB ratio ≥ 1		MB ratio < 1		
	Coef.	dy/dx	Coef.	dy/dx	Test
Debt – Target	-4.331 ***	-1.224 ***	-5.873 ***	-1.179 ***	18.6 ***
	-0.111	(0.037)	(0.346)	(0.086)	
Investment spikes	0.558 ***	0.156 ***	0.775 ***	0.151 ***	9.31 ***
	-0.021	(0.006)	(0.077)	(0.013)	

	Equity issue				
	MB ratio ≥ 1		MB ratio < 1		
	Coef.	dy/dx	Coef.	dy/dx	Test
Debt – Target	4.266 ***	0.295 ***	2.679 ***	0.077 ***	4.18 **
	(0.213)	(0.014)	(0.594)	(0.015)	
Investment spikes	0.154 ***	0.011 ***	0.571 ***	0.016 ***	10.42 ***
	(0.033)	(0.003)	(0.077)	(0.004)	

Panel C: Earnings volatility

	Debt issue				
	High volatility		Low volatility		
	Coef.	dy/dx	Coef.	dy/dx	Test
Debt – Target	-4.041 ***	-1.101 ***	-4.525 ***	-1.159 ***	2.37
	(0.205)	(0.052)	(0.321)	(0.076)	
Investment spikes	0.456 ***	0.124 ***	0.665 ***	0.170 ***	12.33 ***
	(0.042)	(0.011)	(0.040)	(0.010)	
	Equity issue				
	High volatility		Low volatility		
	Coef.	dy/dx	Coef.	dy/dx	Test
Debt – Target	3.596 ***	0.206 ***	4.699 ***	0.307 ***	4.29 ***
	(0.353)	(0.025)	(0.404)	(0.026)	
Investment spikes	0.247 ***	0.014 ***	0.176 **	0.012 ***	1.1
	(0.079)	(0.004)	(0.086)	(0.006)	

Panel D: Profitability

	Debt issue				
	High profitable firms		Low profitable firms		
	Coef.	dy/dx	Coef.	dy/dx	Test
Debt – Target	-4.342 ***	-1.182 ***	-4.04 ***	-1.017 ***	0.9
	(0.202)	(0.056)	(0.222)	(0.054)	
Investment spikes	0.597 ***	0.162 ***	0.566 ***	0.142 ***	0.35
	(0.028)	(0.008)	(0.052)	(0.013)	
	Equity issue				
	High profitable firms		Low profitable firms		
	Coef.	dy/dx	Coef.	dy/dx	Test
Debt – Target	4.618 ***	0.383 ***	2.72 ***	0.090 ***	11.85 ***
	(0.335)	(0.033)	(0.464)	(0.018)	
Investment spikes	0.165 ***	0.013 ***	0.337 ***	0.011 ***	5.02 **
	(0.051)	(0.004)	(0.096)	(0.004)	

strained and financially unconstrained firms. Firms whose annual total assets are less (greater) than the 30th (70th) percentile are defined as financially constrained (unconstrained) firms.

The estimation results are presented in Panel A of Table 4. Other

Panel E: Market timing

	Debt issue				
	MB ratio ≥ industry median		MB ratio < industry median MB ratio		
	Coef.	dy/dx	Coef.	dy/dx	Test
Debt – Target	-4.299 ***	-1.278 ***	-4.573 ***	-1.131 ***	1.26
	(0.159)	(0.048)	(0.182)	(0.048)	
Investment spikes	0.484 ***	0.143 ***	0.676 ***	0.163 ***	18.02 ***
	(0.031)	(0.007)	(0.033)	(0.007)	

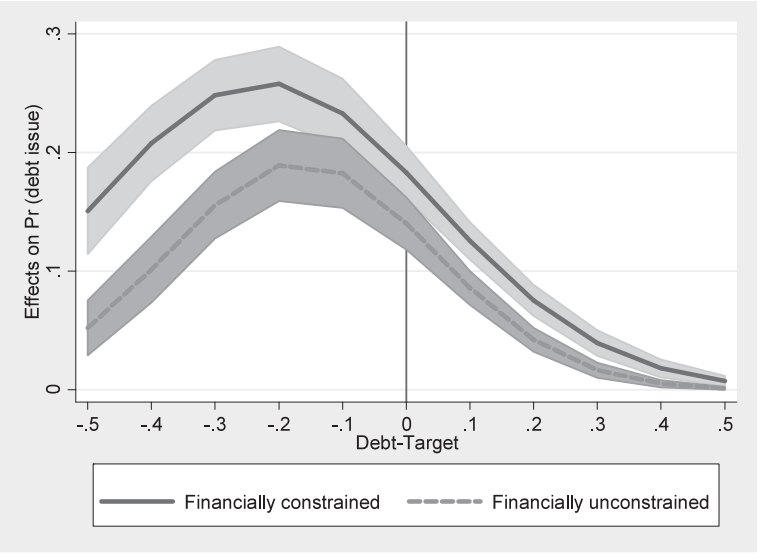
	Equity issue				
	MB ratio ≥ industry median		MB ratio < industry median MB ratio		
	Coef.	dy/dx	Coef.	dy/dx	Test
Debt – Target	4.061 ***	0.402 ***	3.881 ***	0.140 ***	0.16
	(0.314)	(0.024)	(0.338)	(0.015)	
Investment spikes	0.067 *	0.007	0.319 ***	0.012 ***	10.99 ***
	(0.038)	(0.006)	(0.063)	(0.002)	

All the equations include all the other variables in Table 3. In Panel A, firms whose annual total assets are less (greater) than the 30th (70th) percentile are defined as financially constrained (unconstrained) firms. Firms whose market-to-book ratio is greater (less) than one are classified as firms with high (low) investment opportunities in Panel B. If the coefficient of variation of firms' EBITDA to assets is greater (less) than 70th (30th) percentile, they are classified as high (low) volatile in Panel C. High (low) profitability firms are defined as firms with an EBITDA-to-assets ratio greater (less) than the 70th (30th) percentile in Panel D. Samples are divided into two groups based on whether a firm's market-to book-ratio is greater than the industry median or not in Panel E. Bootstrap standard errors for estimated coefficients and Delta-method standard errors for average marginal effects (AME) are in parentheses. * p<0.1, ** p<0.05, *** p<0.01

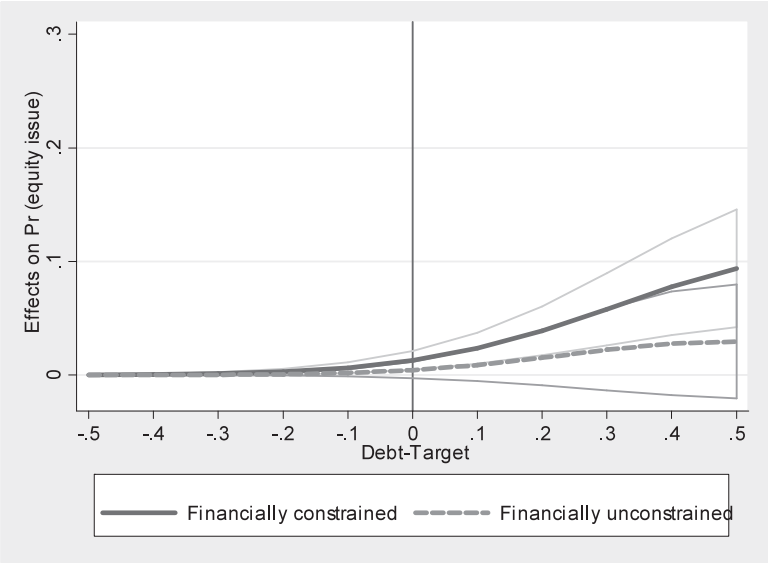
variables used in Table 3 are also included (not reported due to space constraints). Deviations from target and investment spikes have the expected sign, demonstrating highly significant effects on debt issuance by financially constrained and unconstrained firms. It is also noteworthy that those effects differ between the two groups. On the other hand, al-

Figure 3. The average marginal effect of spike by financial constraints

Panel A. Average marginal effects of spikes on debt issue by financial constraints



Panel B. Average marginal effects of spikes on equity issue by financial constraints



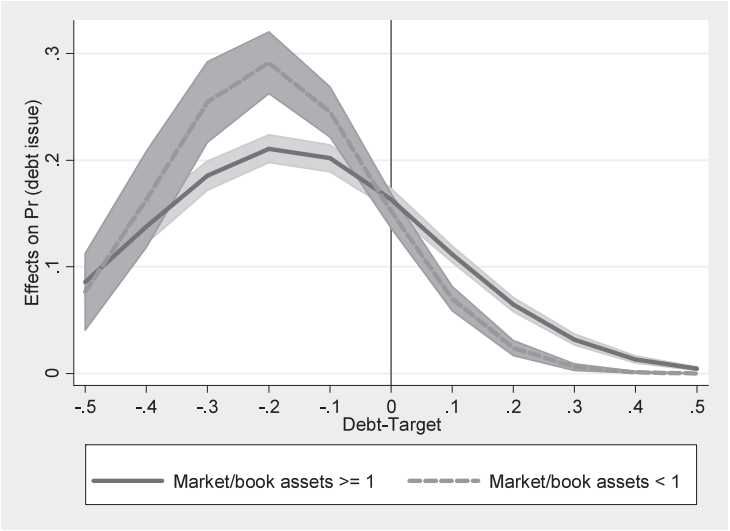
though deviations from targets have a 1% positive effect on equity issue for both groups, investment spikes matter only for financially constrained firms. A comparison of the average marginal effects on both groups is illustrated in Panels A and B of Figure 3. Panel A of Figure 3 shows that financially constrained firms are more sensitive to spikes, suggesting that the benefits of financing investments are greater, and due to limited internal funds they are more likely to depend on external funds. On the other hand, large financially unconstrained firms can fund investments with internal funds and are less likely to issue debt or equity.

B. Investment opportunities

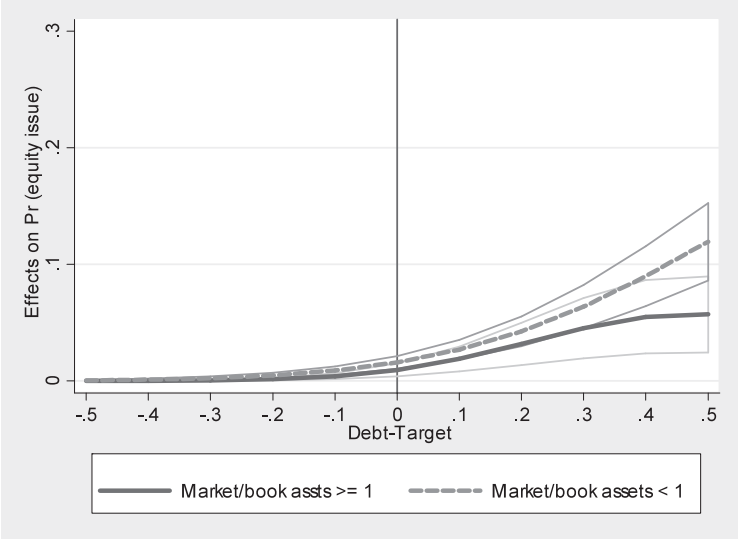
Firms whose market-to-book ratio is greater (less) than one are classified as firms with high (low) investment opportunities. Panel B of Table 4 shows the estimation results. Deviations from target and investment spikes have the expected signs and are significant at the 1% level for the issue of both debt and equity. The test statistics of equal coefficients for two groups are also significant at the 1% level, suggesting that firms' target behaviors differ between growing and mature firms. The effects of investment spikes are shown in Panels A and B of Figure 4. Panel A of Figure 4 shows that mature firms with below-target debt are more likely to issue debt compared with growing firms. Moreover, it reveals that debt issues by growth firms with above-target debt are more sensitive to spikes compared with mature firms with above-target debt, suggesting that the benefits of financing investments by debt issue are greater for growing firms with above-target debt compared with mature firms with above-target debt, despite deviating further from the target.

Figure 4. The average marginal effect of spikes by investment opportunity

Panel A. Average marginal effects of spikes on debt issue by investment opportunity



Panel B. Average marginal effects of spikes on equity issue by investment opportunity



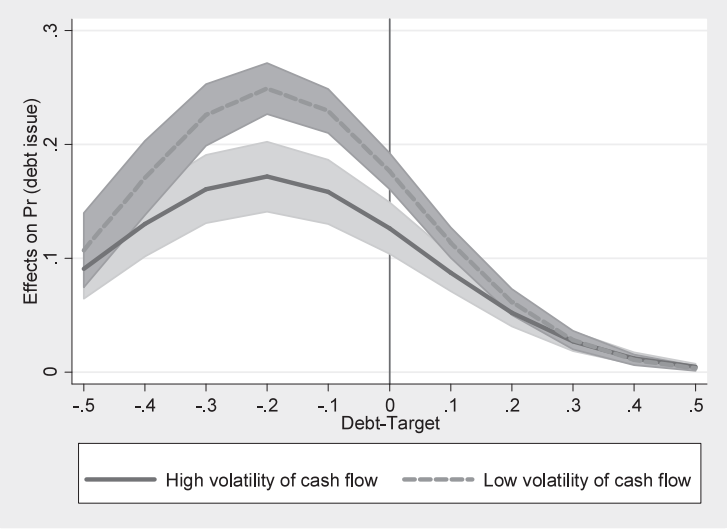
In other words, the opportunity costs of forgoing the investment opportunities are greater for growing firms compared with mature firms with above-target debt.

C. Earnings volatilities

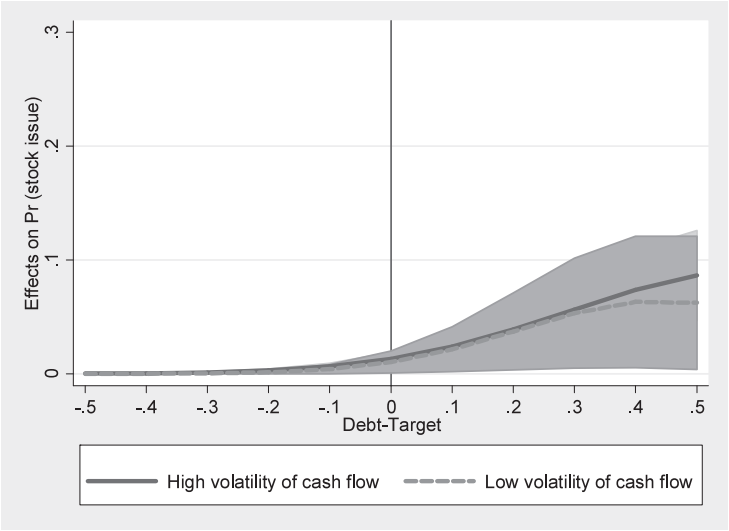
Firms with high earnings volatility incur higher costs for issuing debt or equity ; therefore, they are less likely to adjust their capital structure and less responsive to investment spikes. If the coefficient of variation of firms' EBITDA to assets is greater (less) than 70th (30th) percentile, they are classified as high (low) volatile. In Panel C of Table 4, the coefficients of deviation from the target in the equity issue equation differ significantly between the two samples but not in the debt issue equation. Ex-

Figure 5. The average marginal effect of spikes by cash flow volatility

Panel A. Average marginal effects of spikes on debt issue by cash flow volatility



Panel B. Average marginal effects of spikes on equity issue by cash flow volatility



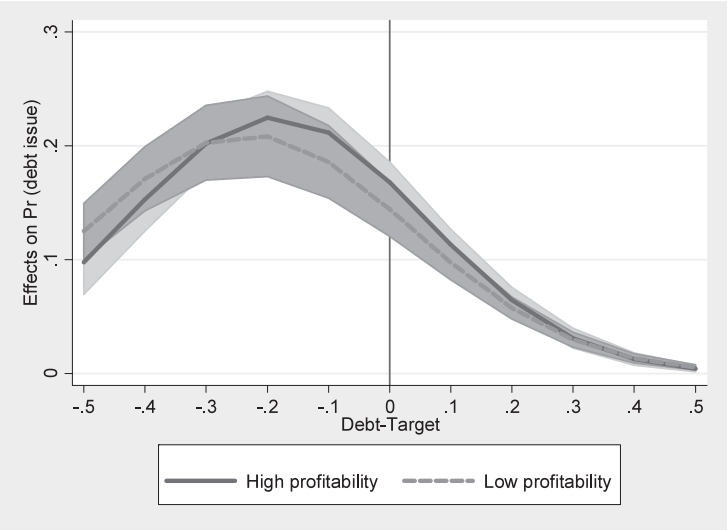
pectedly, Panel A of Figure 5 indicates that the effect of investment spikes on debt issue is greater for lower volatility firms with below-target debt, suggesting that high volatility firms have difficulty attracting external financing investment.

D. Profitability

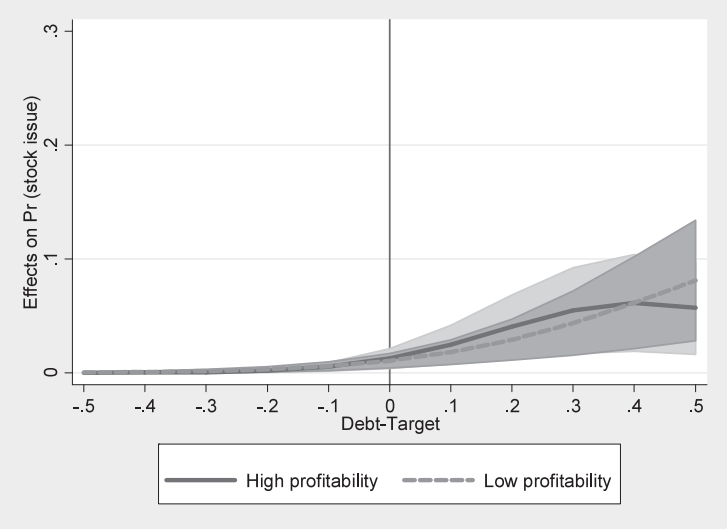
Profitable firms have more retained earnings and can rebalance their capital structure with internal funds; therefore, they are less likely to issue debt when they have below-target debt. High (low) profitability firms are defined as firms with an EBITDA-to-assets ratio greater (less) than the 70th (30th) percentile. In Panel D of Table 4, the deviations from the target have the expected signs and are significant at the 1% level. Contrary to expectations, however, there are no significantly different effects of deviation on debt issue between two groups. On the

Figure 6. The average marginal effect of spikes by profitability

Panel A. Average marginal effects of spikes on debt issue by profitability



Panel B. Average marginal effects of spikes on equity issue by profitability



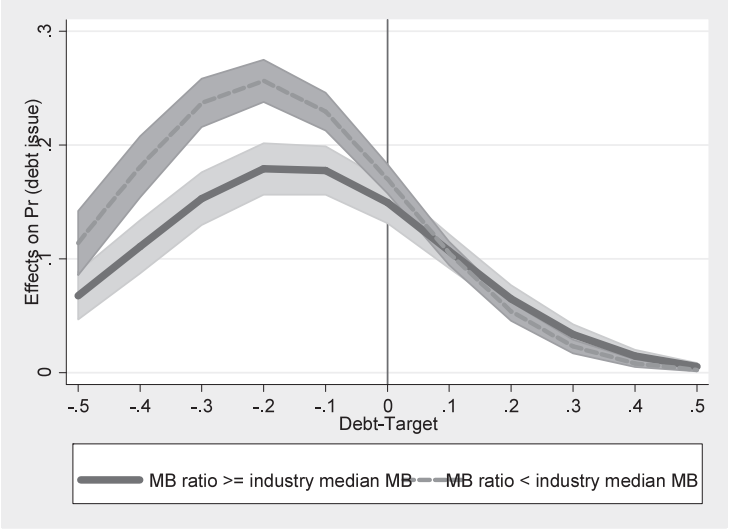
other hand, when the deviation increases, the probability of equity issuance is higher for profitable firms than for their less profitable counterparts, suggesting that adjustments can be made more easily because the transaction costs of equity issue are lower for profitable firms. Regarding the effect of investment spikes, Panels A and B of Figure 6 reveal no differences between the two groups.

E. Market timing

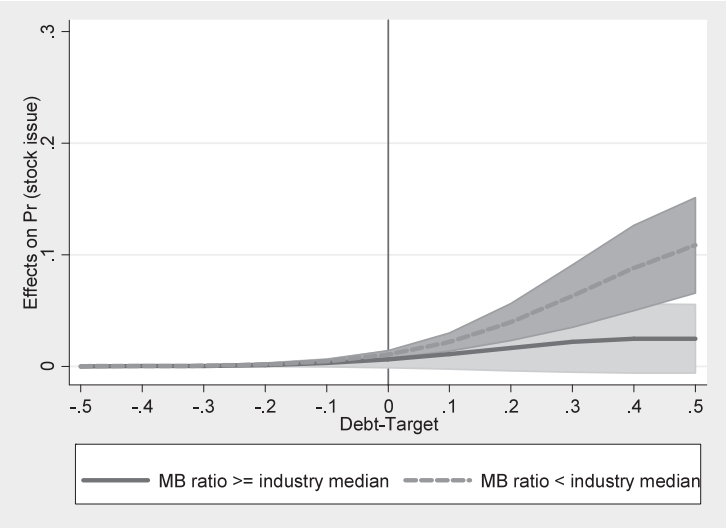
Firms issue equity when they are highly evaluated (Baker and Wurgler 2002, Welch 2004, Alti 2006). Following Faulkender *et al.*(2012), samples are divided into two groups based on whether a firm's market-to book-ratio is greater than the industry median or not. The results listed in Panel E of Table 4 indicate that target behavior does not differ

Figure 7. The average marginal effect of spikes by market timing

Panel A. Average marginal effects of spikes on debt issue by market timing



Panel B. Average marginal effects of spikes on equity issue by market timing



among these two groups ; indeed, the effect of investment spikes on debt issuances is significantly greater for firms with lower market-to-book ratios than for firms with higher market-to-book ratios. Panel A in Figure 7 indicates that under-leveraged firms with low market-to-book ratios are more likely to issue debt during investment spikes compared with those firms with higher market-to-book ratios.

4.3 **Firm's rebalancing behavior following investment shocks**

Prior sub-section reveals that firms with above-target debt are likely to issue debt when they have investment spikes and deviate further from the target. Since having above-target debt is costly, it is expected that they may rebalance their capital structure toward the target in the following years. Figure 8 shows the deviation from the target in the 12 year window, from –2 to 9 years. We set the year when a firm hits an

Figure 8. Over-leveraged firms' deviation from the target following investment shocks

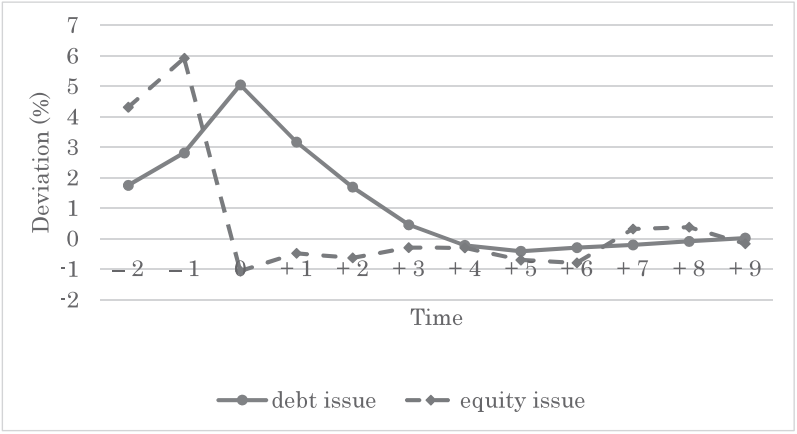


Table 5. The effect of investment spike on changes in deviation from the target

Year	Coefficient of investment spike	Robust Std. Err.	N	r2
Debt issue + 1	0.536***	(0.202)	4995	0.070
Debt issue + 2	1.020***	(0.305)	4766	0.083
Debt issue + 3	0.928*	(0.511)	4418	0.079
Debt issue + 4	0.658	(0.948)	4109	0.070
Debt issue + 5	1.363	(1.835)	3777	0.062

Sample consist of firms who issue debt when they have above-target debt. The dependent variable is changes in deviation from the target. Independent variables are investment spike, industry dummies, and year dummies. Robust standard errors are in parenthesis. * p<0.1, ** p<0.05, *** p<0.01.

investment spike and issues debt to 0. Sample firms are those who have above-target debt at the event year (0). Although debt issuers move away from the target during investment spikes, the median firm rebalances their capital structure within four years. Next, we explore the effect of investment spikes on capital structure by regressing changes in

deviation from the target on investment spikes. Estimation results are presented in Table 5. The dependent variable in the first row (Debt issue +1) is the change in deviation from the event year to the event year + 1 year. Likewise, the one in the Debt issue + t row denotes the changes in deviation from the event year to the event year + t. Besides an investment spike variable, all models include year dummies and firm fixed effects. The results show that investment spikes have a positive effect on changes in deviation even three years after the investment shock, suggesting that shock do not disappear immediately.

5 Conclusion

This study analyzes the effect of a firm's real investments on their target behavior. Using data from listed Japanese companies in 1978–2008, we first find that debt issue is more sensitive to deviation from the target compared to equity issue. Second, the effects of deviation are found to differ between financially constrained and financially unconstrained firms, and growth and non-growth firms. As for the economic impact, the effects of deviation are found to be relatively small compared to investment spikes. Moreover, we found asymmetry in the effects of spikes. The positive effect of investments on debt issue is greater for firms with below-target debt than for those with above-target debt. The results imply that firms with below-target might move toward the target debt whereas those with above-target debt move away from it during large investments. On the other hand, the effect of investment on equity issue is consistent with the trade-off theory.

Some studies on capital structure adjustment have found evidence

that adjustment speed is asymmetric. This study finds that firms can move toward their target during large investments even if the sensitivity of debt (equity) issuance to deviation is constant. Adjustment asymmetry is possibly caused by either a variation in adjustment costs or the varying effects of investments, depending on the firm's debt position. An investigation in to which factors are dominant is left for future research.

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