Dynamic capital structure choice :
Japanese evidence

Hidetaka Mitani
Graduate School of Economics, Kyoto University,
Yoshida-honmmachi, Sakyo-ku, Kyoto, 606-8501, JAPAN
mitani.hidetaka@e03.mbox.media.kyoto-u.ac.jp

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Abstract
This paper examines a dynamic adjustment model of capital structure, using a sample of Japanese firms over the period from 1989 to 2004. This paper verifies the adjustment process towards a target leverage ratio and specifies the factors that determine the speed of adjustment. It highlights the finding that the adjustment cost towards the target leverage ratio clearly differs between over- and under- leveraged firms. The adjustment cost towards the target leverage ratio for overleveraged firms is a variable cost which increases in proportion to the size of the difference between the target leverage ratio and the current leverage ratio. By contrast, the adjustment cost for underleveraged firms is a fixed cost, regardless of the size of the difference between the target leverage ratio and the current leverage ratio. In other words, it is easier for underleveraged firms to reach their target leverage ratio by raising additional debt, whereas overleveraged firms actually have difficulties reducing the current leverage ratio to the target level.

Key words : Capital structure, Dynamic analysis, Panel data
JEL Classification : G32
1. Introduction

The trade-off theory of capital structure suggests that firms choose a target leverage ratio by balancing the tax and incentive benefits of debt financing against expected bankruptcy costs.\(^1\) If immediate adjustment to the target is costly, the theory turns out to be a target-adjustment model. The target is not observed directly, and would probably vary through time. Most of the empirical literature of capital structure regard an observed leverage ratio as a proxy for a firm’s target leverage (for example, Titman and Wessels[1988] and Rajan and Zingales[1995]). However, using an observed leverage ratio as a proxy for a firm’s target leverage is problematic if adjustment to the target leverage is costly. In the presence of adjustment costs, firms may prefer to maintain the existing levels of their leverage ratios rather than fully adjusting to the target levels even if they recognize that their existing levels do not equal the target levels. Thus, an observed leverage ratio does not necessarily equal to a target leverage ratio.

Indeed, a number of empirical studies suggest that adjustment costs affect leverage ratios (Fischer, Heinkel and Zechner[1989], Hovakimian, Opler and Titman[1995], Shyam-Sunder and Myers[1999]). Almost all of these studies think that adjustment costs are the reason why firms do not readily adjust their leverage ratios in response to changes in their target leverage ratios. However, these studies do not specify precisely what factors give rise to adjustment costs (with the exception of Fischer et al[1989]).\(^2\)

In this paper, I suppose that adjustment costs toward a target leverage ratio arise from

\(^1\) The tradeoff includes, among others, tax benefits versus bankruptcy costs (Modigliani and Miller[1963]), agency costs of debt and equity financing (Jensen and Meckling[1976], Myers[1977], Stulz[1990], Hart and Moore[1995] and Zwiebel[1996]), and signaling models (Ross[1977]).

\(^2\) Gilson[1997] suggests that what lies inside the “black box” called adjustment costs is not obvious. He directly relates debt adjustment costs of financially distressed firms to empirical proxies for adjustment costs.
additional external financing costs needed for adjustment (e.g., legal fees and to some extent, investment bank fees). \(^3\)

By distinguishing between an observed leverage ratio and an estimate of a target leverage ratio in the presence of adjustment costs, this paper empirically attempts to determine factors that affect the target leverage ratio, and factors that affect the dynamics of adjustment process toward the target leverage ratio. The analysis verifies whether the observed leverage ratio moves towards the target leverage ratio, and identifies factors that determine the speed with which it does so. This approach is in contrast to the traditional one in the empirical capital structure research because it gives a dynamic specification allowing for adjustment of the capital structure over time. Hence, it is possible to identify factors that determine the speed of adjustment toward the target capital structure.

Several previous studies have adopted a more dynamic approach by taking account of the difference between an observed and a target leverage ratio in to the presence of adjustment costs. Jalivand and Harris[1984] are the first to recognize the importance of a dynamic adjustment model in their study of the capital structure of firms. They characterize financial behavior of firms as a partial adjustment to a long run financial target. However, the long-run financial target towards which firm’s leverage ratio partially moves is given exogenously. Fischer, Heinkel and Zechner[1989] use a dynamic adjustment model to study the difference between the maximum and minimum leverage ratios of firms over a sample period and try to identify factors that determine the range of capital structure. Their results are consistent with the financial behavior of firms.

\(^3\) In regard to this point, Leary and Roberts[2005] use three different proxies for the adjustment costs. Specifically, they use the underwriter spread, credit ratings and the provisions of SEC Rule 10b-18.
firms in the presence of adjustment costs. However, they exploit an observed leverage ratio as an empirical measure of a target capital structure.

Recently, de Miguel and Pindado[2001] present a methodology to capture the adjustment of capital structure dynamics more appropriately. They use a target adjustment model which has also recently been used by Gilson[1997] for financially distressed firms. This model supposes that firm’s actual leverage ratio in the current period is determined by the change that is required for the firm to attain the target leverage ratio in the current period. In their model, the firm’s target leverage ratio is expressed as a linear function of the explanatory variables suggested by capital structure theories. Thus, they endogenize the target leverage ratio. In addition, they apply the Dynamic Panel Data methodology by Arellano and Bond[1991]. Although, they apply new analytical methodology to capture more realistic test of capital structure dynamics, their research makes no reference to what kind of factors affect the adjustment process toward the target leverage ratio.

Banerjee, Heshmati and Wihlborg[2004] represent one of the first attempts to endogenize both the adjustment factors and the target leverage ratio. They identify not only the determinants of the target capital structure but also the factors determining the speed of adjustment toward the target capital structure. They hypothesize that the speed of adjustment may itself be a function of some underlying variables affecting adjustment costs which are defined by the absolute difference between the current and the target leverage ratios.4 However, they do not find a significant relationship between the speed of adjustment and the absolute distance from the target leverage ratio.

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4 More specifically, they hypothesize that the speed of adjustment depends on the absolute difference between the current and the target leverage ratios, the firm’s growth opportunities and its size.
The purpose of this paper is to make an empirical investigation on adjustment process toward the target capital structure in the presence of adjustment cost. Specifically, this paper starts by identifying the determinants of the target leverage ratio, which is estimated by a function of well-known firm characteristics, such as profitability, growth and tangibility. The adjustment process toward the target leverage ratio is also analyzed with the dynamic panel data methodology. As a result, this paper is able to present empirical evidence on the determinants of the target leverage ratio rather than the observed leverage ratio and on the determinants of the adjustment process towards the target leverage ratio. Alternatively, in contrast to the previous literature, this paper examines the effect of differences in over- and under- leveraged firms on the speed of adjustment toward the target leverage ratio.

The estimates obtained in this paper provide the following results. First, firms with higher growth opportunity are more likely to adjust faster towards the target leverage ratio. Second, more profitable firms are more likely to adjust faster towards the target leverage ratio. With regard to the determinants of the adjustment speed, the most important finding is that the distance from the target leverage ratio is positively related to the adjustment speed. That is, firms which are further away from their target leverage ratio tend to readjust their capital structure faster. This result indicates that the adjustment costs towards the target leverage ratio are small relative to firms’ cost of maintaining a suboptimal leverage ratio, and that firm’s fixed costs constitute a substantial portion of their total costs of changing their capital structure.

Furthermore, this paper suggests that the adjustment cost towards the target leverage ratio is asymmetric between over- and under- leveraged firms. There is a clear asymmetric effect that capital structure adjustment behavior differs between over- and
under-leveraged firms. Specifically, in overleveraged firms, the distance from the target
leverage ratio is negatively related to the adjustment speed. By contrast, in
underleveraged firms, this variable is positively related to the adjustment speed. Hence,
the adjustment cost towards the target leverage ratio for overleveraged firms is larger
than that for underleveraged firms. In other words, it is easier for underleveraged firms
to reach their target leverage ratio by raising additional debt, whereas overleveraged
firms actually have difficulties reducing debt-burdened to the target level.

The organization of this paper is as follows. Section 2 starts by discussing the basis of
the model of capital structure adjustment dynamics and introducing determinants of the
target leverage ratio. I provide the variables which affect the adjustment speed towards
the target leverage ratio. Section 3 presents the data and the definition of the dependent
and independent variables. Section 4 explains the empirical results and section 5
concludes.

2. A dynamics of capital structure and adjustment

This section discusses a dynamic capital structure model. Subsection 2.1 presents the
model and the estimation method. Subsequently, subsection 2.2 introduces the
determinants of the target leverage ratio. Subsection 2.3 provides the determinants
which affect the speed of adjustment towards the target leverage ratio, and explains the
testing hypotheses simultaneously.
2.1 The model

Let the target leverage ratio (debt / total asset) of firm \( i \) at time \( t \), \( L^*_i \), be a function of a set of explanatory variables, \( X_{jt} \).

\[
L^*_i = \sum_{j=1}^{L} \alpha_j X_{jt}.
\] (1)

The purpose of (1) is to determine an estimate of the target leverage ratio of firm \( i \).

If adjustment cost is zero and \( L_i \) is the actual leverage level in the current period, the target leverage ratio is to equal to its actual level, i.e., \( L^*_i = L_i \). However, if adjustment is costly, firms do not fully adjust their current leverage ratios towards their target levels, but do only partially. This is represented by

\[
L_i - L_{i-1} = \delta_i (L^*_i - L_{i-1}),
\] (2)

where \( \delta_i \) is the adjustment speed to the target leverage ratio between two subsequent periods. If \( \delta_i \) is equal to one, deviations from the target leverage ratio are adjusted readily and the firm’s leverage ratio is always at the target. If \( \delta_i \) is equal to zero, the firm cannot adjust its leverage ratio, thus holding the leverage level of the previous period. If adjustment is costly but is not prohibitive, \( \delta_i \) lies between zero and one. Finally, if \( \delta_i \) is larger than one, the firm over-adjusts in the sense that it makes more adjustment than the target level. Looff[2003] argues that over-adjustment may reflect unanticipated changes in economic conditions.

The speed of adjustment is determined by explanatory variables. A determinant of adjustment speed is a firm-specific variable that influences adjustment behavior significantly (see sub-section 2.3). Specifically,
\( \delta_{it} = \beta_0 + \beta_1 Z_{it} \) \hfill (3)

where \( Z_{it} \) is a vector of variables which determine the speed of adjustment towards the target leverage ratio.

Rewriting the target adjustment model in (2) with (1) and (3), I finally obtain the following estimation equation:

\[
L_{it} = (1 - \beta_0) L_{it-1} - \beta_1 Z_{it} L_{it-1} + \beta_0 \sum_{j=1}^{t} \alpha_j X_{ij} + \beta_1 Z_{it} \sum_{j=1}^{t} \alpha_j X_{ij} + d_i + \eta_i + \mu_{it}. \hfill (4)
\]

where \( d_i \) is a time-specific effect, and \( \eta_i \) is a firm-specific effect, \( \mu_{it} \) is a statistical error term with mean zero and constant variance. When estimating equation (4), my focus is on \( \beta_1 \), which is the coefficient on the interaction term between the determinant variables of the speed of adjustment, \( Z_{it} \), and the lagged leverage ratio, \( L_{it-1} \), and on \( \beta_0 \) (or \( 1 - \beta_0 \)). The null hypothesis is that \( \beta_1 = 0 \) : firm characteristics do not affect the speed of adjustment towards the target leverage ratio.

2.1.1 Econometric analysis

When estimating equation (4), I cannot use the ordinary least squares methodology, because \( L_{it-1} \) is correlated with \( \mu_{it} \) so that the ordinary least squares methodology will not lead to consistent estimates. Thus, I exploit the Dynamic Panel Data analysis developed by Arellano and Bond[1991], which prove that Generalized Method of Moments (GMM) estimation provides consistent parameter estimates by utilizing instruments that can be obtained from orthogonality conditions that exist between the lagged values of the variables and the disturbances. Specifically, I estimate equation (4) in the first difference by GMM, where the levels of all the second lagged explanatory
variables are used as instruments.

As suggested by Arellano and Bond[1991], I use the one-step results for checking the inference on coefficients. Arellano and Bond[1991] propose that estimated coefficients are consistent only if there is no second-order serial correlation in the first-difference residuals. Hence, this paper reports the $Z_2$ statistic, which tests for the lack of second-order serial correlation in the first-difference residuals. Furthermore, As recommended by Arellano and Bond[1991], I use the two-step Sargan[1958] test about checking the inference on the model specification. The Sargan’s statistic of over-identifying restrictions tests the absence of correlation between the instruments and error terms.

2.2 The determinants of the target capital structure

This section provides the set of explanatory variables that are thought to affect the firm’s leverage ratio in the existing literature. Based upon Titman and Wessels[1988], Harris and Raviv[1991], Rajan and Zingales[1995] and Hovakimian et al[2001], this paper selects eight of these variables to estimate the target leverage ratio: growth opportunities, tangibility of assets, profitability, specificity, dividend, size, industry specific effect and bankruptcy risk. I briefly discuss the theoretic predictions of each variable.

\footnote{I estimate equation (4) by including the second lagged leverage, $L_{it-2}$, as an additional explanatory variable in order to guarantee consistent parameter estimates. Thus, I do not provide economic interpretation of this variable. I omit reporting the corresponding estimates.}
**Growth opportunities** (Market-to-book) : Firms with the higher market-to-book ratios tend to have the lower leverage ratios. The usual argument is that these firms have the higher growth opportunities, thus choosing the lower leverage ratios to retain investment flexibility. I expect that the higher the value of growth opportunities, the lower will be the target leverage ratio.

**Tangibility** (Tangibility) : Firms with the higher proportional collateral values tend to have the higher target leverage ratios. I expect that the higher the value of tangibility, the higher will be the target leverage ratio.

**Profitability** (Profitability) : According to the pecking order hypothesis, there should be a negative relationship between the profitability and the leverage ratio. By contrast, under the trade-off theory, firms with the higher profitability have the higher leverage ratios, because the higher profitability implies the lower expected costs of financial distress and the greater desire for firms to shield profits from taxes. Hence, the more profitable firms are expected to have the more leverage ratio.

**Specificity** (Selling expenses ratio) : Firms with the more corporate overhead (selling, general and administrative expenses) have the less leverage ratio. The more specific the firm’s assets, the thinner is the market for those assets and the lower is the expected value recoverable by the lender in the event of bankruptcy. Thus, I expect that the higher the value of specificity, the lower will be the target leverage ratio.

**Dividend** (Dividend dummy) : The dividend paying dummy is equal to one if the firm pays dividend and zero otherwise. According to the pecking order hypothesis, as interpreted by Shyam-Sunder and Myers[1999], dividends are part of the financing deficit. The greater dividends cause the greater financing needs, other things equal. Since financing is implemented by debt, the implication is that dividend paying firms may have the greater leverage ratio. In contrast, under the trade-off theory, dividend paying firms may have lower leverage ratio. Dividend paying firms have the lower agency costs of equity and this allows firms to raise more equity (e.g., Easterbrook[1984]). If so, dividend firms should have the less leverage ratio.6

**Size** (Firm size) : The larger firms tend to have the higher leverage ratios, because the larger firms are more diversified and face the lower bankruptcy risk. Thus, I expect that the higher the value of size, the higher will be the target leverage ratio. I use the logarithm of sales to test the effects of firm size on the target leverage ratio.

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6 The interpretation of dividends needs further development beyond that studied in the literature. Analysis of both pecking order theory (Shyam-Sunder and Myers[1999]) and trade-off theory (Hennessy and Whited[2003] and Strebulaw[2003]) often treat the dividend decision as exogenous.
Industry-specific effect (Industry median): To control for industry-specific effects, I include the industrial median leverage ratio. MacKay and Phillips[2002] present that industry-specific effect affects the firm’s leverage ratio. Thus, I expect that the higher the value of industry-specific effect, the higher will be the target leverage ratio.

Bankruptcy risk (Z-score (un-levered)): Firms with the lower bankruptcy risk have lower leverage ratio. I use Z-score, a measure developed by Altman[1968], to capture the firm’s bankruptcy risk. The higher Z-score represents the lower bankruptcy risk. Thus, I expect that the higher the value of bankruptcy risk, the lower will be the target leverage ratio. The unlevered Z-score, Z-score without the leverage ratio component, is used to avoid the possible endogeneity problem when estimating the target leverage ratio.

2.3 The determinants of the speed of adjustment

The speed of adjustment towards the target leverage ratio depends on a set of variables which may or may not include those that affect the target leverage ratio. This paper hypothesizes that the speed of adjustment towards the target leverage ratio depends on the following four variables: size, growth opportunities, profitability and the distance between the target leverage and current leverage ratios. I will explain them briefly in the following.

Firm size (SIZE): The firm size is expected to be positively correlated with the speed of adjustment. Larger firms are easy to change their capital structure by issuing debt or equity, because they are easier to issue both equity and debt at a relatively lower cost.

Growth opportunities (GROWTH): Firms with the higher growth opportunities can change their capital structure by choosing the source of the new financing. Thus, I expect firms with the higher growth opportunities are more likely to adjust the target capital structure than firms with the lower growth opportunities.

Profitability (PROF): There is a possibility that the effect of profitability on the speed of adjustment is expected to be both positive and negative effects. If firms conduct the adjustment of capital structure by internal funds, i.e., the sum of earnings and actual profits, the adjustment of capital structure is slower. Hence, there is a negative relationship between the profitability and the speed of adjustment, because firms will
refrain from using all internal funds for capital structure adjustments. By contrast, if firms conduct the adjustment of capital structure by external funds, the adjustment of capital structure is faster. Thus, there is a positive relationship between the profitability and the speed of adjustment, because an increase in the profitability helps the firm lower the cost of external financing.

**Distance from the target leverage ratio (DIST):** The most important variable of $Z_u$ is the distance from the target leverage ratio is the difference between the target leverage and actual leverage ratios at the beginning of the current period $t$. Specifically, I define the variable as

$$DIST_u = L^*_u - L_u$$

where $L^*_u$ is constructed as the fitted value from the equation (1). If fixed costs (e.g., legal and investment bank fees) constitute a major portion of the total costs of the firm changing capital structure, firms with sub-optimal leverage ratio will alter their capital structure only if they are sufficiently far from the target leverage ratio, because the costs of changing the leverage ratio towards the target level are lower than the cost of maintaining the current situation that is far away from the target leverage ratio. Then, the costs of changing the leverage ratio towards the target level have a positive effect on the likelihood of adjustment. In contrast, if the costs of adjustment consist of both fixed and variable costs which go up in proportion to the rate of difference between target leverage ratio and current leverage ratios, firms may not readily adjust towards the target leverage ratio, because the costs of changing the leverage ratio towards the target level are prohibitively high when the current leverage ratio is far away from the target leverage ratio. Then, the likelihood of adjustment is negatively affected by the difference between the target and actual leverage ratios.

3. **Data and variables definitions**

Our sample consists of 799 manufactures listed on the first section of the Tokyo Stock Exchange from 1989 to 2004. Following the procedure of the existing literature on capital structure, I exclude nonmanufactures, financial firms and regulated utilities from

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\(^7\) In other words, $L_u$ is the observed leverage ratio at the end of previous period $t - 1$.

\(^8\) If the costs of adjustment consist of both fixed costs and variable costs which go up in proportion to the rate of difference between target leverage ratio and current leverage ratio, firms that are near their target leverage ratio do not close the remaining gap, because the adjustment costs as fixed costs are higher than the costs of maintaining the situation that is closer to the target leverage ratio.
the sample. Such firms’ financial data are obtained from Nikkei-NEEDS Financial Quest. Data on stock prices are obtained from CD-ROM which is published by Toyo Keizai Inc.

This paper applies two alternative measures of leverage as dependent variables. The first definition of leverage is defined as debt over the book value of total assets, where debt is given by (long-term debt) + (short-term debt), denoted as $TDA$. The other definition of leverage is defined as debt over the market value of total assets, where the market value of total assets are defined as $[(\text{book value of assets}) - (\text{book equity}) + (\text{market value of equity})]$, denoted as $TDM$. The market value of equity is defined as the closing stock price at the fiscal year end multiplied by shares outstanding. Market-to-book is defined as $[(\text{book value of assets}) - (\text{book equity}) + (\text{market value of equity})] / (\text{book value of total assets})$. Tangibility is defined as net property, plant, and equipment divided by the book value of total assets. Profitability is defined as earnings before interest, taxes, and depreciation divided by the book value of total assets. Selling expenses ratio is defined as selling, general and administrative expenses divided by the book value of total assets. Firm size is measured as the natural logarithm of sales. A summary of statistics for the main variables is given in Table 1.

【Insert table 1 about here】

4. Empirical results

4.1 Determinants of the target leverage ratio

The estimation of the target leverage ratio model in equation (1) is presented in Table
2. This paper tests the basic specification of the target leverage ratio in equation (1) by running the double-censored Tobit model.

The estimation result shows that the coefficient of the growth opportunities (Market-to-book) is negatively related to the leverage ratio, indicating that firms with the higher market-to-book ratios tend to choose the lower leverage ratio to keep investment flexibility. The leverage ratio is increasing in tangibility (Tangibility). This result supports the prediction of the trade-off theory that the debt-capacity increases with the ratio of tangible assets. The coefficient of the profitability (Profitability) is negatively related to the leverage ratio, consistent with the theoretical prediction of the pecking order theory. Specificity (Selling expenses ratio) is negatively related to the leverage ratio. This result supports the hypothesis that the more specific the firm’s assets, the thinner is the market for those assets and the lower is the expected value recoverable by the lender in the event of bankruptcy. The coefficient of the dividend (Dividend dummy) is negatively related to the leverage ratio. This result is consistent with the trade-off theory hypothesis. Size (Firm size) is positively related to the leverage ratio, indicating that the larger firms tend to be more diversified and have the lower risk of bankruptcy costs. The industry-specific effect (Industry median) is also positively related to the leverage ratio. The industrial median leverage ratio may capture the strong industrial effect. Lastly, the coefficients of the bankruptcy risk (Z-score (un-levered)) are negatively related to the leverage ratio. Firms with the lower bankruptcy probability have the lower target leverage ratio. Over all, these results are consistent with those reported by previous empirical work (e.g., Titman and Wessels[1988], Harris and Raviv[1991], Rajan and Zingales[1995] and Hovakimian et al[2001]).
4.2 Determinants of the adjustment speed

This subsection reports the estimation results of equation (4). Table 3 presents the speed of adjustment towards the target leverage ratio. I use the fitted values obtained by estimating the target leverage ratio of equation (1). The focus of this analysis is to examine the estimate of $\beta_1$, which is the coefficient of the interaction term between $Z_{it}$ (determinants of adjustment speed) and $L_{it-1}$ (lagged leverage ratio) in equation (4). As a result, I focus on the discussion of the estimated coefficients of $L_{it-1}$ and of the interaction term between $Z_{it}$ and $L_{it-1}$.

Table 3 summarizes the effects of firm characteristic variables on the speed of adjustment towards the target leverage ratio.

The estimated coefficients for size (SIZE) are not significant. This result implies that the firm size does not affect the speed of adjustment. The estimated coefficients for growth opportunities (GROWTH) are almost positive and significant. This finding supports that firms with the higher growth opportunities adjust more rapidly towards the target leverage ratio. In addition, the estimated coefficients for profitability (PROF) are significantly positive: the more profitable firms adjust more rapidly towards the target leverage ratio. Most importantly, the coefficients for the variable distance (DIST) are positively related to the adjustment speed. That is, firms that are far away from their

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9 This procedure is similar to Hovakimian, Opler and Titman[2001]. They use a two stage procedure, wherein the adjustment coefficients estimated in a first stage are regressed on explanatory variables in a second stage.

10 Note that the coefficient of $\beta_1$ in equation (4) is negative sign. Therefore, the signs of the interaction term between $Z_{it}$ and $L_{it-1}$ must be interpreted accordingly, i.e., a negative (positive) sign means faster (slower) adjustment.
target leverage ratios tend to adjust more rapidly. This result supports the hypothesis that adjustment costs towards the target leverage ratio are small relative to firms’ cost of maintaining a suboptimal leverage ratio, and that fixed costs constitute a substantial portion of firms’ total costs of changing capital structure.

However, these results are not clear and unambiguous, because Sargan test statistics are significant. Furthermore, these results are not sufficient to interpret the effect of the distance variable (DIST) on the speed of adjustment, because this variable can take both positive ($L^*_u \geq L_u$) and negative ($L^*_u < L_u$) values. Since the effect of DIST on the adjustment speed depends on the condition of whether firms are under- or over-leveraged, to capture the asymmetries in the adjustment process, I split the sample firms in two subsamples, depending on whether firms are overleveraged ($L^*_u < L_u$) or underleveraged ($L^*_u \geq L_u$).

Overleveraged firms may have difficulties in reducing their debt burden because of liquidity constraints. Accordingly, I expect that the distance from the target leverage ratio is negatively related to the adjustment speed for overleveraged firms: The adjustment cost towards the target leverage ratio is a variable cost which is increasing in the distance between the target leverage and current leverage ratios. Hence, overleveraged firms may not readily adjust towards the target leverage ratio. By contrast, it may be easier for underleveraged firms to assume additional debt. Thus, I expect that the distance from the target leverage ratio is positively related to the adjustment speed for underleveraged firms: The adjustment cost towards the target leverage ratio is a fixed cost. As a result, underleveraged firms may readily adjust towards the target leverage ratio.
Table 4 and 5 report the coefficients estimated using two subsamples. There is a clear asymmetric tendency that the capital structure adjustment cost clearly differs between over- and under-leveraged firms.\textsuperscript{11} Furthermore, these results cannot reject the null hypothesis in the Sargan test.

【Insert table 4 about here】
【Insert table 5 about here】

Specifically, in overleveraged firms (see table 4), the distance from the target leverage ratio is negatively related to the adjustment speed. In contrast, in underleveraged firms (see table 5), this variable is positively related to the adjustment speed. These results imply that the adjustment cost towards the target leverage ratio is sharply different between over- and under-leveraged firms. In other words, adjustment costs for overleveraged firms are variable costs which are increasing in the distance between the target and current leverage ratios. On the other hand, these costs for underleveraged firms are fixed costs, regardless of the distance between the target leverage and current leverage ratios. Hence, it is easier for underleveraged firms to reach their target leverage ratio by raising additional debt, whereas overleveraged firms actually have difficulties reducing their debt to the target level.

In addition, the estimated coefficients for firm size (SIZE) are significantly negative for overleveraged firms. The estimated coefficients for growth opportunities (GROWTH) are significantly positive for over- and under-leveraged firms. The estimated coefficients for profitability (PROF) are significantly positive for overleveraged firms. This result suggests that more profitable firms adjust faster

\textsuperscript{11} The distance from the target leverage ratio (DIST) is expressed in absolute terms in both cases.
towards the target leverage ratio. That is, overleveraged firms are more likely to give priority to reducing their debt burden.

5. Conclusion

This paper uses a dynamic model of capital structure adjustment on panel data. Using a dynamic adjustment model and panel data methodology for a sample of 799 manufactures in Japan over the period from 1989 to 2004, I empirically clarify the determinants of the target leverage ratio rather than the observed leverage ratio and the determinants of the adjustment speed.

This paper presents that capital structure adjustment behavior clearly differs between over- and under-leveraged firms: overleveraged firms adjust slowly, whereas underleveraged firms reach their targets faster. These results imply that the adjustment cost towards the target leverage ratio is asymmetry between over- and under-leveraged firms. The adjustment costs for overleveraged firms are variable costs which are increasing in the distance between the target and current leverage ratios. By contrast, these costs for underleveraged firms are fixed costs, regardless of the distance between the target and current leverage ratios. Therefore, it is easier for underleveraged firms to reach their target leverage ratio by raising additional debt, whereas overleveraged firms actually have difficulties reducing debt-burdened to the target level.
References


The table presents descriptive statistics for the main variables. Market-to-book ratio is defined as (market value of equity + book value of debt) / total assets. Tangibility is the ratio of fixed assets to total assets. Profitability is the ratio of EBITDA (Earnings Before Interest, Tax, Depreciation and Amortization) to total assets. Selling expenses ratio is the ratio of selling, general and administrative expenses to total assets. Size is the natural log of total assets. Z-score is the index of firm’s bankruptcy probability which was developed by Altman[1968].

TDA is total debt/book value of assets, TDM is total debt / market value of assets. I also present two target leverage ratio measures: industry median leverage ratio and the target leverage ratio. The former is the industry median in the same year, and the latter is estimated using the double-censored Tobit model (lower level is zero, upper level is one). DIST is the difference between the target and the actual leverage ratio.
I use the double-censored Tobit model to estimate the target leverage ratio. Four leverage ratio measures are used: TDM is total debt / market value of assets, LDM is long-term debt / market value of assets, TDA is total debt / book value of assets, LDA is long-term debt / book value of assets. The choice of independent variables follows Titman and Wessels[1988], Rajan and Zingales[2001] and Hovakimian et al[2001].

Coefficients estimates are reported in the first row, t-values are reported in parentheses in the second row. Values significantly different from zero at 10%, 5% and 1% levels are marked *, ** and ***, respectively.

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<td>Dividend dummy</td>
<td>-0.11***</td>
<td>-0.16***</td>
</tr>
<tr>
<td></td>
<td>[-25.24]</td>
<td>[-31.11]</td>
</tr>
<tr>
<td>Firm size</td>
<td>0.02***</td>
<td>0.04***</td>
</tr>
<tr>
<td></td>
<td>[19.92]</td>
<td>[28.66]</td>
</tr>
<tr>
<td>Industry median</td>
<td>0.30***</td>
<td>0.30***</td>
</tr>
<tr>
<td></td>
<td>[5.91]</td>
<td>[5.91]</td>
</tr>
<tr>
<td>Z-score (un-levered)</td>
<td>-0.01***</td>
<td>-0.01***</td>
</tr>
<tr>
<td></td>
<td>[-4.33]</td>
<td>[-4.33]</td>
</tr>
<tr>
<td>Observations</td>
<td>11448</td>
<td>11448</td>
</tr>
<tr>
<td>Prob.χ²</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>LRχ²(8)</td>
<td>3800.61</td>
<td>1772.57</td>
</tr>
</tbody>
</table>
### Table 3: Adjustment speed determinants

<table>
<thead>
<tr>
<th></th>
<th>Panel A: TDA</th>
<th>Panel B: TDM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LV_{it-1}</strong></td>
<td>-0.850 -0.242 0.810** 1.100*** 0.475</td>
<td>1.306 -0.499 1.495*** -0.230 -0.732***</td>
</tr>
<tr>
<td></td>
<td>[0.919] [0.994] [0.376] [0.390] [0.503]</td>
<td>[0.835] [0.932] [0.300] [0.264] [0.231]</td>
</tr>
<tr>
<td><strong>LV_{it-1} \times \text{SIZE}_{it}</strong></td>
<td>0.066 0.018</td>
<td>-0.054 0.008</td>
</tr>
<tr>
<td></td>
<td>[0.073] [0.085]</td>
<td>[0.063] [0.076]</td>
</tr>
<tr>
<td><strong>LV_{it-1} \times \text{GROWTH}_{it}</strong></td>
<td>0.019 -0.033*</td>
<td>-0.499*** -0.654***</td>
</tr>
<tr>
<td></td>
<td>[0.015] [0.018]</td>
<td>[0.113] [0.117]</td>
</tr>
<tr>
<td><strong>LV_{it-1} \times \text{PROF}_{it}</strong></td>
<td>-1.336 -1.502***</td>
<td>-0.635 -1.860**</td>
</tr>
<tr>
<td></td>
<td>[0.345] [0.274]</td>
<td>[0.723] [0.729]</td>
</tr>
<tr>
<td><strong>LV_{it-1} \times \text{DIST}_{it}</strong></td>
<td>-0.142 0.088</td>
<td>-0.188** -0.570***</td>
</tr>
<tr>
<td></td>
<td>[0.109] [0.198]</td>
<td>[0.096] [0.091]</td>
</tr>
<tr>
<td><strong>Z_2</strong></td>
<td>0.45 0.46 0.99 0.89 0.81</td>
<td>1.77* 0.98 0.91 1.13 1.71*</td>
</tr>
<tr>
<td><strong>Sargan test</strong></td>
<td>133.70** 142.40*** 134.39** 134.62** 141.22***</td>
<td>120.160 126.05* 123.42* 126.52** 124.45*</td>
</tr>
<tr>
<td>Observations</td>
<td>3154 3154 3154 3154 3154</td>
<td>1799 1799 1799 1799 1799</td>
</tr>
<tr>
<td>Groups</td>
<td>245 245 245 245 245</td>
<td>140 140 140 140 140</td>
</tr>
</tbody>
</table>

The table reports the results of estimating equation (5) with the panel data estimator proposed by Arellano and Bond[1991]. The table shows coefficients and robust standard errors (in brackets) of lagged debt ratios and of interaction terms of the determinant of adjustment speed with the lagged leverage ratio.

The test statistic $Z_1$ tests the null hypothesis of no first order serial correlation in the residuals. The test statistic $Z_2$ tests the null hypothesis of no second order serial correlation in the residuals. The Sargan test statistics refer to the null hypothesis that the over-identifying restrictions, which test for the absence of correlation between instruments and error terms, are valid and uses the Arellano and Bond[1991] two-step estimator. Values significantly different from zero at 10%, 5% and 1% levels are marked *, ** and ***, respectively.
The table reports the results of estimating equation (5) with the panel data estimator proposed by Arellano and Bond[1991] for over-levered firms. The table shows coefficients and robust standard errors (in brackets) of lagged debt ratios and of interaction terms of the determinant of adjustment speed with the lagged leverage ratio.

The test statistic $Z_1$ tests the null hypothesis of no first order serial correlation in the residuals. The test statistic $Z_2$ tests the null hypothesis of no second order serial correlation in the residuals. The Sargan test statistics refer to the null hypothesis that the over-identifying restrictions, which test for the absence of correlation between instruments and error terms, are valid and uses the Arellano and Bond[1991] two-step estimator. Values significantly different from zero at 10%, 5% and 1% levels are marked *, ** and ***, respectively.
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