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# The Long-Term Stability of Corporate Capital Structure: Evidence from Japanese Firms

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Key words: leverage, persistence, capital structure, permanent component, bank loans

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Abstract

This paper attempts to examine whether there exists long-term stability of corporate leverage among Japanese firms, following the study of Lemmon, Roberts and Zender (2008) who find that US firms exhibit the remarkable long-term stability of leverage. The obtained results show that the leverage cross-sections of Japanese firms are also stable for a long time. Specifically, firms with relatively high (low) leverage continue to exhibit relatively high (low) leverage for twenty years. The results indicate that the theory of capital structure should incorporate permanent, time-invariant factors as important determinants of corporate capital structure. We also obtain the additional evidence that loans from commercial banks contribute to the stability of leverage considerably for Japanese firms.

## 1. Introduction

How do corporations determine their capital structure? This is still an important question in corporate finance which has generated a vast extent of theoretical and empirical research for the past several decades (refer to Graham and Leary (2011), Parsons and Titman (2008), and Harris and Raviv (1991) for comprehensive review). The recent addition to this literature is finding that firms with relatively high (low) leverage tend to hold relatively high (low) leverage even a few decades later as reported by Lemmon, Roberts and Zender (2008) (hereafter LRZ (2008)). This paper attempts to examine whether or not Japanese firms are also characterized by such a long-term stability in their capital structure.

The extant theory of capital structure identifies a set of potentially important determinants for corporate leverage (Harris and Raviv (1991)). In many previous studies determinants of capital structure are assumed to have time-varying features which also suggest that corporate capital structure may vary over time. For example, firms with relatively high growth opportunities are less levered because of debt-overhang problems according to the tradeoff theory of capital structure. Alternatively, the pecking order theory predicts that firms with high growth opportunities are more levered due to financing deficit covered with debt issuances. Intuitively, growth opportunities are likely to vary over time as firms go through their different life-cycle stages. Consequently both theories imply that leverage also varies over time with growth opportunities (in an opposite direction) for any single firm, given other conditions are unchanged.

LRZ (2008) provide empirical evidence which appears to contradict with the time-varying features of capital structure. Specifically, they show that US firms with relatively high (low) leverage tend to exhibit relatively high (low) leverage even for a few decades. The importance of this finding is obvious because the finding suggests that the traditional theory of capital structure might have missed something to the extent to which leverage determinants implied by the theory have time-varying components. Thus, Graham and Leary (2011) and Parsons and Titman (2008) emphasize that future research should focus on temporarily stable determinants for corporate capital structure rather than those which vary over time. Rauh and Sufi (2011) also argue that the cross-sectional determinants of leverage are more important than determinants which explain the time-series pattern of leverage. In contrast, DeAngelo and Roll (2015) in their recent attempt challenge the assertion of LRZ (2008). DeAngelo and Roll (2015) show that the stability of corporate leverage is relatively short-lived for most US firms when the sample period is sufficiently expanded. According to their study, in the longer term the US firms change their leverage frequently and dramatically, and the time-series behavior of leverage is consistent with particular versions of the tradeoff theory.

This paper attempts to contribute to this ongoing debate about the long-term stability of leverage by providing additional evidence using the data of Japanese firms. Since the results of LRZ (2008) and DeAngelo and Roll (2015) are only based on the data of a single country, an examination of a completely different dataset such as that of Japanese firms should provide more clean tests about the long-term stability of leverage and shed some light on the issue of whether temporarily stable determinants are more important than time-varying traditional determinants for corporate capital structure.

Following the inspiring study of LRZ (2008), this paper begins by examining the future evolution of leverage for four portfolios constructed by sorting firms according to their current leverage. Immediately we observe two distinct features. First, corporate leverage among Japanese firms exhibit a significant amount of convergence over time. Second, despite this convergence, the cross-sections of corporate leverage are surprisingly persistent and stable over time. These two features are consistent with the finding of

LRZ (2008) for US firms. In later sections of this paper we show that these two notable features are unexplained by determinants which many previous studies have intensively used (e.g., size, profitability, market-to-book, industry, etc.) or changes in sample composition which firm exits from the sample may cause.

Next, this paper turns to the panel regression of leverage in order to examine how important the suggested time-invariant components are in determining corporate capital structure. We run the regression of leverage on previously identified determinants and initial leverage and find that initial leverage is the single most important explanatory variable.[1] We also run the panel regression of leverage with the firm fixed effects which capture time-invariant components in leverage. The adjusted R-squares from traditional leverage regressions using previously identified determinants range from 24% to 31%, depending on the specification. In contrast, the adjusted R-squares from the leverage regressions on the firm fixed effects in addition to other determinants increase to about 80%. These results imply that most variation in leverage in the panel of Japanese firms is attributable to time-invariant components and is largely unexplained by previously identified determinants.

In response to the counter-evidence provided by DeAngelo and Roll (2015), this paper replicates some of their analyses using our data about Japanese firms. First, we examine the explanatory power of a given cross-section for the sequence of future cross-sections. The obtained results show that an average $R^2$ for two leverage cross-sections declines gradually as the number of years between them increases, but does not go down below 0.3 even for cross-sections 20 years apart. This result is remarkably different from the result of DeAngelo and Roll (2015) who report that for US firms the average $R^2$ goes down to less than 0.1 for cross-sections 20 years apart. Second, this paper examines the fractions of firms remaining in their initial leverage quartiles for 20 years. The results show that many firms move out of their initial leverage quartiles, but the fractions of firms which have remained in the lowest and highest leverage quartiles over the 20 years are remarkably high. Especially the fraction of firms remaining in the highest quartile (31.4%) among Japanese firms is 2.7 times higher than what DeAngelo and Roll (2015) find for US firms (11.7%).

Finally, this paper relates the long-term stability of leverage cross-sections to

[1] We define initial leverage of the firm as leverage observed at the beginning of the sample period if available or as leverage in the year when the firm enters the sample.

borrowings from commercial banks. Historically, the Japanese economy has been characterized by the bank-centered financial system (Aoki, Patrick and Sheard (1994)). While the restructurings of the banking sector in Japan have taken place for the past twenty years, Hirota (2009) shows that the borrowings from firms' main banks are relatively stable even after the restructurings in the banking sector. Therefore, we divide leverage into loans from commercial banks and corporate bonds and replicate several analyses for loans and corporate bonds separately. The results indicate that loans from commercial banks are associated with the long-term stability of leverage rather than corporate bonds for Japanese firms.

In conclusion, we draw several implications from our results. First, the primary results in this paper strongly demonstrate that the leverage cross-sections of Japanese firms are persistent and stable for a long time. We interpret the overall results as providing further evidence consistent with the assertion that the theory of capital structure should incorporate time-invariant factors as important determinants of leverage. Second, we obtain the additional evidence that loans from commercial banks contribute to the long-term stability of leverage considerably. This may suggest that for Japanese firms the historically close relationship with the main bank is still important even after the restructurings of the banking sector and is possibly related to the stability of leverage cross-sections.

Third, from a bigger perspective, the long-term stability of leverage is observed for both market-based financial system (US) and the bank-centered financial system (Japan). If the persistence of leverage is related to information asymmetries and agency problems which the traditional theory of capital structure heavily relies on, we should expect less persistence in corporate leverage for the bank-centered system because this system is likely to lead to less severe information asymmetries and agency problems (Aoki, Patrick and Sheard (1994)). Considering an observed, even stronger persistence of leverage for Japanese firms, this line of argument implies that leverage stability may be associated with a factor which the traditional theory does not rely on, for example, a cultural factor.

This paper is organized as follows. Section 2 describes the data and reports some basic statistics. Sections 3 and 4 examine the long-term stability of leverage, following the methodology of LRZ (2008). Section 5 examines the robustness of our findings by applying some analyses of DeAngelo and Roll (2015). Section 6 examines which factor more contributes to the stability of leverage between loans and corporate bonds. Section 7 discusses what drives the observed stability of leverage. Section 8 concludes this paper.

## 2. Data and Basic Statistics

Our initial sample and data are drawn from Astra Manager provided by QUICK and consists of all listed companies in Japan during the period 1979-2013, excluding firms operating in the financial sectors. Our initial sample includes firms that are delisted during the sample period and firms that enter the sample by IPO.

Our main variable, leverage, comes in the form of both book leverage and market leverage. We define total debt as the sum of long-term interest-bearing debt and short-term portion of long-term interest-bearing debt. Then book leverage is defined as total debt divided by book assets. For market leverage the denominator is replaced by the sum of total debt and the market value of equity. The detailed definitions of all other variables we use in this paper are listed in Table 1.

We require that all firm-years have nonmissing data for the relevant variables when conducting multivariate analysis. We require leverage—both book and market—to lie in the closed unit interval. All other variables are trimmed at the upper and lower one-percentiles to mitigate the effect of outliers and avoid the contamination of the data with errors.

Table 2 reports basic statistics for variables we use in this paper. The average and median of book leverage for Japanese firms are 0.26 and 0.23 as a ratio of total assets, respectively and are equivalent to 0.27 and 0.24 for US firms presented in LRZ (2008). Average loans account for 0.22 of total assets and dominate book leverage. Average corporate bonds take quite a small portion of book leverage, accounting for only 0.04 as a ratio of total assets. We also observe that the average and median of market leverage is higher than those of book leverage, possibly reflecting low average market-to-book in the Japanese stock market.

## 3. The Time-Series Pattern of Leverage Cross-Sections

We examine the time-series pattern of leverage cross-section for Japanese firms. Figure

1 presents the average leverage ratios of four portfolios in terms of event time. The figure is constructed in the following manner. Each calendar year, we sort firms into quartiles (i.e., four portfolios) according to their leverage ratios. The portfolio formation year is denoted event year 0. We then compute the average leverage for each portfolio in each of the subsequent 20 years, holding the portfolio composition constant (except for firms that exit the sample, for example, due to M&A). We repeat these two steps of sorting and averaging for every year in the sample period. This process generates 35 sets of event-time averages, one for each calendar year in our sample. We then compute the average leverage of each portfolio across the 35 sets within each event year. We perform this exercise for both book leverage and market leverage, the results of which are presented in Panels A and B with the 95% confidence interval, respectively.

By observing Figure 1, several notable features emerge. First, there is a great deal of cross-sectional dispersion in event year 0, the portfolio formation period. The range of average book (market) leverage is 50% (64%). Second, there is a gradual convergence across the four portfolio averages over time. 20 years later, the average book leverage of the highest quartile portfolio has declined from 54% to 40%, whereas that of the lowest quartile portfolio has increased from 4% to 12%. (The market leverage portfolios demonstrate a similar pattern.) Finally, despite the convergence, the differences in the average leverage across the portfolios 20 years later remain large and statistically significant. The average book leverage ratios in the highest to lowest quartile portfolios after 20 years are 40%, 27%, 21%, and 12%, respectively. Since the average within-firm standard deviation of book leverage is 8%, this differential is economically large. Our investigation of Panels A and B in Figure 1 suggests that there exists a permanent component that generates highly persistent cross-sectional differences in leverage, as well as a transitory component that generates a gradual convergence in leverage.

For the remaining part of this paper, we focus on book leverage instead of market leverage. First, as reported in Graham and Harvey (2001), most firms pay closer attention to book leverage than market leverage. Second, as we run the regression of leverage on potential determinants of capital structure, explanatory variables partially composed of stock prices (like market-to-book of equity) may cause spurious correlation with market leverage. If we use book leverage, we can avoid this "spurious correlation" problem. Third, we notice that there is a high correlation between book leverage and market leverage (0.821 for Japanese firms in this paper and 0.878 for US firms in DeAngelo and Roll (2014)). This high correlation suggests that there may not be much incremental information in the use of market leverage over the use of book leverage. Actually, we confirm that the major results of this paper are unchanged if we use market leverage instead of book leverage.

One potential concern with interpreting Figure 1 is the effect of survivorship bias. Our sample includes firms spending less than 20 years in the sample. First, some firms drop out of the sample due to exit through bankruptcy, acquisitions, or buyouts. Second, since our data ends in 2013, firms entering the sample by IPO from 1994 onward cover less than 20 years. For firms with less than 20 years, their leverage appears stable due to their shorter life in the sample, potentially inflating the observed long-term stability of leverage. To address this issue, we repeat the analysis described above for the sample of firms existing for 20 years or longer. The result for this subset of firms is presented in Panel C of Figure 1, and is qualitatively very similar to that of the full sample in terms of leverage cross-section. While the full sample contains 4,976 firms and 97,101 firm years, the subsample of firms existing for at least 20 years contains 2,329 firms and 68,599 firm years.

Additionally, we examine the evolution of leverage in the subset of firms that exit the sample before 2013. The leverage of these firms may change more dramatically before exiting the sample, for example, because of near bankruptcy status. The result is presented in Panel D of Figure 1, and is surprisingly very similar to those found in Panels A and B. That is, the evolution of the leverage ratios for firms that exit the sample looks very similar to the evolution of the leverage ratios for the broader sample of firms. The number of firms that exit the sample is 1,587 and the corresponding number of firm years is 25,000.

The industry effect is assumed to play an important role in determining capital structure (Mackay and Phillips (2005) and Frank and Goyal (2009). Therefore, we apply the same analysis to individual industries.[2] For most industries, we notice that there exists remarkable long-term stability in leverage cross-sections, similar to those found in Panels A and B of Figure 1. While there is a gradual convergence across the four portfolio averages over time, the average leverage across the portfolios 20 years later remains surprisingly different.[3] We also examine the time-series pattern of leverage

[2] The industry classification is based on the classification of Tokyo Stock Exchange and consists of 29 sectors excluding the financial industries.

[3] In order to save the space we do not report the results here. They are available upon

cross-sections over 35 years, our maximum length of time to which we can extend the event time. Although we do not report the result here, we again find that the leverage cross-sections of Japanese firms exhibit remarkable long-term stability.

A final potential concern with interpreting the figures is that the sorting of firms by actual leverage may simply reflect cross-sectional variation in underlying factors associated with cross-sectional variation in leverage. To address this concern, for each calendar year we estimate a cross-sectional regression of leverage on 1-year lagged factors that have been previously identified by the literature as being relevant determinants of capital structure (e.g., Titman and Wessels (1988), Rajan and Zingales (1995), Mackay and Phillips (2005), and others). Specifically, each calendar year, we run the cross-sectional regression of leverage on firm size, profitability, market-to-book, tangibility, and industry dummies. We then sort firms into four portfolios according to the residuals from this regression, which we call "unexpected leverage," and then compute the average actual leverage of each portfolio over the subsequent 20 years. By running the regressions each year, we control for the time-varying effects of traditional determinants for capital structure. Figure 2 presents a graph for the unexpected leverage portfolios.

Figure 2 shows that the results are remarkably similar to those presented in Figure 1.[4] Specifically, the range of actual leverage between the highest and lowest unexpected leverage quartiles is still large (41%) in event year 0. As time goes by, we see similar patterns of convergence across the portfolios. However, there still remain substantial and statistically significant differences in leverage among the portfolios for most of the event years. Even 20 years after the portfolio formation period, the average leverage of the lowest quartile is below that of all other portfolios, and the difference between the lowest and highest quartiles is 18%. Thus, even after controlling for all observable heterogeneity associated with previously identified determinants for capital structure, the cross-sectional dispersion of leverage still remains highly persistent.

In sum, the results presented in Figures 1 and 2 for Japanese firms are very similar to

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request.

4 To the extent that the cross-sectional regression model of leverage is well specified, we expect that differences in the average leverage ratios across portfolios should be quickly reduced as the random shock to leverage wanes away. The results do not indicate such a tendency.

those presented in LRZ (2008) for US firms. Figure 1 shows that the cross-section of leverage tends to converge over time. However, the differences in leverage across firms are highly persistent even 20 years later. Further, Figure 2 shows that controlling for previously identified determinants for leverage, the differences across the unexpected leverage portfolios are still large 20 years after the portfolio formation period. This last result indicates that traditional leverage determinants do not explain much of the variation in leverage, suggesting that we may have missed an important factor as a determinant of capital structure, which contains a permanent, time-invariant component, as well as a slowly decaying, transitory component.

## 4. Implications for Regression Using Traditionally Identified Capital Structure Determinants

A graphical examination of Figures 1 and 2 shows that a potentially important missing factor for capital structure may contain a permanent, time-invariant component, as well as a slowly decaying, transitory component. In this section we explore implications of such a missing factor for regression using traditionally identified determinants of capital structure by incorporating the above two feature of a missing factor in the regression approach.

### 4.1. Importance of Initial leverage and firm fixed effects

Figures 1 and 2 show that leverage cross-section appears to be persistent over time, suggesting that firms' future leverage ratios are closely related to their initial leverage ratios where we define initial leverage of the firm as leverage observed at the beginning of the sample period if available or as leverage in the year when the firm enters the sample. To measure the impact of initial leverage on future leverage quantitatively, we estimate the following regression,

$$Leverage_{it} = \alpha + \beta X_{it-1} + \gamma Leverage_{i0} + v_t + \varepsilon_{it} \;\ldots\ldots(1)$$

where $i$ indicates firms; $t$ indicates years; $X$ is a set of 1-year lagged explanatory variables; $Leverage_{i0}$ is firm i's initial leverage, which we proxy for with the first nonmissing value for leverage; $v$ is a year fixed effect; and $\varepsilon$ is a random error term assumed to be possibly heteroskedastic and correlated within firms (Petersen (2007)). The coefficient of interest is $\gamma$ , which measures the importance of firms' initial leverage ratios in determining future leverage ratios. By including a set of control variable X, we can compare the importance of firms' initial leverage with those of 1-year lagged determinants.

The results from estimating equation (1) (based on book leverage) are presented in Table 3. For the purpose of comparisons across explanatory variables, we scale each coefficient by the corresponding variable's standard deviation. Thus, each reported estimate measures the change in leverage in response to a one-standard deviation change in X. The first column for a model consisting of only initial leverage shows that the initial leverage ratio (Initial Leverage) is highly significant and that a one-standard deviation change in a firm's initial leverage ratio corresponds to an average change of 13% in future values of leverage. For the regression with Initial Leverage alone the adjusted $R$-square is 0.47.

Next, we incorporate two sets of determinants into the specification. The first set consists of those variables suggested by Rajan and Zingales (1995) and subsequently used in many capital structure studies (e.g., Baker and Wurgler (2002), Frank and Goyal (2003), and Lemmon and Zender (2010)), augmented with yearly fixed effects. The coefficient estimates are largely consistent with previous findings in terms of sign and statistical significance. However, Initial Leverage remains highly significant and reveals a minor change from 13% to 11%. The adjusted $R$-square increases by 0.04 from 0.47 to 0.51. The final specification incorporates additional variables motivated by Frank and Goyal (2004). Again, the inclusion of these additional variables does little to reduce the relative importance of Initial Leverage. The estimated coefficient on Initial Leverage is still 10%, highly significant and larger in magnitude than other determinants. The adjusted $R$-square shows a minor increase from 0.51 to 0.52.

As an additional investigation, we run the regressions by replacing Initial Leverage with firm fixed effects and report the results in various specifications in Table 4. For a model consisting of only firm fixed effects (column (a)), the adjusted $R$-square exhibits high value of 0.75. In contrast, for the regression consisting of the variables suggested by Rajan and Zingales (1995) and without firm fixed effects (column (d)), the adjusted $R$-square is only 0.24. Column (e) corresponds to the regression which includes firm fixed effects in addition to the explanatory variables used in column (d). For this model, the adjusted $R$-square jumps up from 0.24 to 0.80, indicating the significant importance of firm fixed effects. Similarly, column (f) corresponds to the regression consisting of the variables suggested by Rajan and Zingales (1995) and Frank and Goyal (2004) but without firm fixed effects. For this model the adjusted *R*-square is 0.31. When we include firm fixed effects into this specification (column (g)), the adjusted *R*-square increases from 0.31 to 0.81, indicating again the significant importance of firm fixed effects.

The results strongly indicate that even after controlling for variation from traditionally identified determinants, Initial Leverage is the single most important determinant of future capital structure. When we attempt to measure a time-invariant component in terms of firm fixed effects, the firm fixed effects explain large fraction of variation in leverage ratios. These results are consistent with those presented in Figure 2, although the regression approach here provides a more stringent test of persistence in leverage cross-sections because the assumed determinants of leverage (other than initial leverage) are allowed to vary over time.

### 4.2. Firm Fixed Effects and Serially Correlated Errors

One obvious way to model a permanent time-invariant component and a slowly decaying transitory component in capital structure is to use a panel regression with firm fixed effects and serially correlated errors. Using this approach, we examine how sensitive the results of simple pooled OLS regressions of leverage ratios, which have been used in many previous studies, are to failing to consider a time-invariant component as well as a transitory component in capital structure.

One implication of ignoring a significant time-invariant component of leverage ratios, if this component is correlated with explanatory variables in traditional capital structure regressions, is that parameter estimates obtained from the data may be contaminated by omitted variable bias (Arellano (2003) and Hsiao (2003)). Similarly, the unobserved transitory component of leverage ratios may also have implications for traditional capital structure regressions. That is, ignoring this transitory component will lead to inefficient parameter estimates and can have adverse impact on statistical inferences (Greene (2012)).

In order to examine the importance of these considerations, Table 5 compares the results of estimating capital structure regressions using a pooled OLS approach that ignores firm fixed effects and serial correlation in the error term, with the results from using a firm fixed effect and serially correlated errors. Specifically, the pooled OLS approach estimates equation (1), excluding Initial Leverage. The firm fixed effect estimation estimates

$$Leverage_{it} = \alpha + \beta X_{it-1} + \eta_i + v_t + u_{it}, \quad u_{it} = \rho u_{it-1} + \varepsilon_{it} \cdots\cdots (2)$$

where $\eta$ is a firm fixed effect; $X$ and $v$ are as defined in equation (1); $u$ is assumed to be stationary; and $\varepsilon$ is assumed to be serially and cross-sectionally uncorrelated but possibly heteroskedastic.

The results show that most determinants are highly statistically significant across various model specifications. However, the estimated values of coefficients are very sensitive to the model specifications. Additionally, the estimated serial correlation coefficients are statistically large for both Rajan and Zingales (1995) variables (0.79) and Frank and Goyal (2004) variables added (0.79), consistent with leverage shocks that slowly decay away. Coefficient estimates exhibit large declines in magnitude moving from the pooled OLS to the firm fixed effects with serial correlated errors. They decline by approximately 46% on average.

We have to be careful about the interpretation of these results. Actually, the firm fixed effects may capture some of the between variation associated with traditional determinants of capital structure, thus indicating the possible overestimation of the importance of firm fixed effects. However, taking into consideration the empirical results obtained in the previous section (Section 3) and 4.1 in this section, we suspect that neither permanent or transitory components of leverage are properly captured by traditionally identified determinants of capital structure.

## 5. Stability of the Leverage Cross-Section

DeAngelo and Roll (2015) challenge the assertion of LRZ (2008) that there may be an important missing factor as a determinant of capital structure, which contains a significant time-invariant component. In this section, we examine how stable the cross-sections of leverage are by applying two analyses conducted by DeAngelo and Roll (2015) to the data of Japanese firms. First, we assess the stability of leverage cross-sections by examining the explanatory power of a given cross-section for the sequence of future cross-sections. Second, using the data of firms remaining in the sample for at least 20 years, we examine how firms move across leverage quartiles defined for each year over the 20 year period.

Figure 3 shows that the average $R^2$s that measure the extent to which firms with high (or low) leverage in a given cross-section tend to have high (or low) leverage in the cross-section T years apart in time. The vertical axis corresponds to the average squared cross-sectional correlation coefficient over all pairs of cross-sections that differ by T years. The horizontal axis corresponds to the time length T between two cross-sections for which correlation coefficients are calculated.

According to Figure 3, the average $R^2$ for adjacent-year leverage cross-sections is about 0.90, declines to about 0.64 for cross-sections five years apart, and to 0.47 for cross-sections 10 years apart. However, leverage cross-sections 20 years apart still have an average $R^2$ of 0.31. These results are in a sharp contrast with the results of DeAngelo and Roll (2015) for US firms which show that the average $R^2$ between cross-sections declines as the time between them increases, approaching to near-zero value in 20 years. We interpret these findings as indicating that the leverage ratios of Japanese firms are more stable than the US counterparts.

Next, we examine the fraction of firms remaining in the initial leverage quartiles for 20 years and Table 6 reports the obtained results. For this analysis, we use the subsample consisting of firms that have at least 20-year data. Specifically, we start with calendar year 1979 and sort firms into four equal-sized groups (leverage quartiles) based on leverage ratios in that year. We track forward from this year of group formation (event year t = 0) and record the fraction of firms that remain in the same quartile in each of the subsequent 19 years. We repeat the process for 1980, 1981, . . .1994, treating each of these calendar years in turn as the initial event year and then noting the quartile location of each firm in each of the subsequent 19 years. In columns (1) to (5), we report the average value over all 16 calculations of the fraction of firms that have remained in a given formation-year leverage quartile in every year up to the event year of 19. For example, column (1) indicates that an average of 13.1% of firms remain in the same quartile for 20 years. The rows at the bottom of the table give the fractions of firms in four different quartiles, at least three different quartiles, and at least two quartiles at different times over the 20 years.

Table 6 presents the results in a similar format to the corresponding table of DeAngelo and Roll (2015). The fractions of firms remaining in the lowest and highest quartiles for 20 years (16.8% and 31.4%, respectively) exhibit a notable persistence of leverage, compared with the factions of firms remaining in the two medium quartiles for 20 years (2.1% and 3.3%, respectively). Especially the fraction of firms remaining in the highest quartile (31.4%) among Japanese firms is 2.7 times higher than what DeAngelo and Roll (2015) find for US firms (11.7%).

The rows at the bottom of Table 6 show how frequently firms move across yearly leverage quartiles over the 20 years. From this table, we can calculate the fraction of firms that have moved out to at most one different leverage quartile over the 20 years, which is given by 43.6%=100%-56.4%. That is, 43.6% of our sample firms have never left the initial leverage quartile or have moved to only one different leverage quartile. This is again in a sharp contrast with the corresponding value of DeAngelo and Roll (2015) which is 30.5%. When we examine columns (2) to (5), we notice that this kind of moderate persistence in leverage is more evident in two extreme quartiles. For the lowest quartile and highest quartile, the corresponding values are 46% and 64.4%, respectively (for US firms 36.8% and 35.4%, respectively according to DeAngelo and Roll (2015)). For the two medium quartiles (the second lowest quartile and second highest quartile), the corresponding values are much smaller, 28.8% and 30.5%, respectively (for US firms, 25.9% and 23.6%, respectively according to DeAngelo and Roll (2015)).

The overall results in this section suggest that for Japanese firms the cross-sections of leverage ratios are stable for the 20-year window. The results indicate that two leverage cross-sections 20 years apart still have an average $R^2$ of 0.31. The fractions of firms that have remained in the lowest and highest quartiles for 20 years are relatively high, compared with the results of US firms as in DeAngelo and Roll (2015). The significant fraction of our sample firms have never left the initial leverage quartile or have moved to only one different leverage quartile over the 20 years, and this kind of moderate persistence is stronger in the two extreme leverage quartiles, the lowest and highest quartiles.

## 6. Decomposing Leverage into Loans and Corporate Bonds

Historically, the Japanese economy has been characterized by the bank-centered financial system (Aoki, Patrick and Sheard (1994)). Borrowings from commercial banks may be related to the stability of total corporate leverage, for example, because of the close relationship between the commercial banks and their client firms. Therefore, we attempt to examine the evolution of loans from commercial banks and how the long-term stability of leverage cross-sections is associated with long-term behavior of loans. For this analysis, we divide corporate leverage (total leverage) into loans-to-total-assets and corporate-bonds-to-total-assets, and apply the previous analyses to each of them separately. The detailed definitions of these variables are described in Table 1.

First, we examine the evolution of loans and corporate bonds over time separately by following the same method as that used to draw Figure 1. Specifically, Panel A of Figure 4 shows the evolution of cross-sections of loans-to-total-assets denoted by Book Leverage (Loans) over the 20 years while Panel B of the same table corresponds to the evolution of cross-sections of corporate-bonds-to-total-assets denoted by Book Leverage (Corporate Bond) over the 20 years. Quite evidently, the time-series pattern of cross-sections based on the loan ratios is very similar to that of total leverage (book and market leverage) depicted in Figure 1. In other words, while there is a gradual convergence across four portfolios, firms with relatively high (low) loan ratios still continue to exhibit relatively high (low) loan ratios for 20 years. In contrast, the corporate bond ratio exhibits a very different pattern. That is, there is no significant difference across quartiles based on corporate bonds except for the highest quartile.[5]

Next, as in Figure 2 for total leverage, we sort firms into four portfolios based on the residuals of the cross-sectional regression of the loan ratio. Specifically, each calendar year, we run the cross-sectional regression of the loan ratio on firm size, profitability, market-to-book, tangibility, and industry dummies. We then sort firms into four portfolios according to the residuals from this regression and compute the average actual loan ratio of each portfolio over the subsequent 20 years. Figure 5 presents a graph of the evolution of four portfolios based on the regression residuals. Similarly to Figure 2, we notice that after controlling for variation associated with traditional determinants of capital structure, the cross-sectional dispersion of loan ratios still

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[5] This result is somewhat expected because of the following. First, historically, only limited number of firms such as electricity firms issued a relatively large amount of corporate bonds in Japan. Furthermore, 58.7% of all firm-years in our sample have zero amount of corporate bonds outstanding.

remains persistent.

Figures 4 and 5 suggest that the long-term stability of loan ratios may drive the long-term stability of total leverage for Japanese firms. We examine this conjecture by running the regression of the leverage ratio on the initial loan ratio (or the initial corporate bond ratio), previously identified determinants of capital structure and yearly fixed effects. The estimation results are presented in Table 7. The initial loan ratio and the initial corporate bond ratio are defined in a similar manner to the initial leverage ratio in Table 3. We also scale each coefficient by the corresponding variable's standard deviation as in Table 3. The results indicate that the initial loan ratio is the most important single variable while an importance of the initial corporate bond ratio is relatively minor. The coefficient estimates of initial loan ratios range from 0.1 to 0.13 depending on the specification, and are much higher than the coefficient estimates of other capital structure determinants.

For the final exercise, we assess a forecast power of a cross-section in a given year for the sequence of future cross-sections for loan ratios and corporate bond ratios separately. The detailed method is the same as that used in drawing Figure 3. Panel A of Figure 6 corresponds to loan ratios and Panel B corresponds to corporate bond ratios. Clearly the cross-sections of loan ratios exhibit a long-term persistence. Two cross-sections 20 years apart still have an average $R^2$ of 0.28. In contrast, for corporate bond ratios the average $R^2$s between two cross-sections dramatically decline for the first five years and approach to about 0.1 when the time between them increase to 20 years.

In summary, the cross-sections of loan ratios exhibit a persistence which is very similar to what we find for total leverage. This evidence suggests that for Japanese firms the long-term stability of leverage cross-sections is associated with the long-term stability of loans from commercial banks.

## 7. Why is Corporate Leverage Stable?

How should we explain the long-term stability of corporate leverage? LRZ (2008) suggest a possible link to the study of Bertrand and Schoar (2003) which shows that the manager-specific fixed effects are significantly related to firm-specific fixed effects in the leverage regression. Possibly, factors such as personal attributes of managers may be associated with the financial policies leading to the long-term stability of corporate leverage. However, considering that the persistence of leverage is observed for 20 years, it may be difficult to assume that an influence of a single manager alone explains the stability of leverage over such a long time period.

Graham and Harvey (2001) conduct a survey type of research for US firms in a large scale. Their primary results show that preserving the financial flexibility in response to the arrival of unexpected future investment opportunities is the most important consideration in forming financial policies. This may suggest that firms try to keep their leverage within a certain range so that they could raise money in a timely manner by using the portion of remaining debt-financing capacity. That is, adjusting capital structure to the optimal level continuously may not be of a first-order importance, and firms do not move their leverage very frequently as far as leverage remains within a targeted range. In addition, van Binsbergen, Graham and Yang (2010) and Koteweg (2010) empirically examine the net benefits of debt financing for US firms. Their results suggest that the deviation of the actual leverage from the theoretically predicted optimal capital structure may not necessarily lead to an economically large reduction of firm value.

For the final consideration, the relation between firms and their main banks may be related to the long-term stability of leverage for Japanese firms. For large listed Japanese firms, Hirota (2008) shows that while the average total leverage (the average loan ratio) declines steadily from 61.9% (58%) in 1973 to 32.9% (26%) in 2008, the average loan ratio from the main bank remains relatively stable, fluctuating between 6% and 9% especially after 1990. If the heterogeneity of corporate leverage is associated with the borrowings from the main bank, the cross-sections of leverage are likely to be stable to the extent to which the close relationship with the main bank leads to relatively stable borrowings from the main bank.

## 8. Conclusions

This paper attempts to contribute to an ongoing debate about the long-term stability of leverage by providing additional evidence using the data of Japanese firms. Since the results of LRZ (2008) and DeAngelo and Roll (2015) are only based on the data of a single country, an examination of a completely different dataset such as that of Japanese firms should provide more clean tests about the long-term stability of leverage and shed some light on this debate.

Following the study of LRZ (2008), this paper examines the future evolution of leverage for four portfolios constructed by sorting firms according to their current leverage. We find that while corporate leverage among Japanese firms exhibits a gradual convergence over time, the cross-sections of corporate leverage are surprisingly persistent and stable over time. These two features are consistent with the findings of LRZ (2008) for US firms. We also show that these two notable features are unexplained by determinants which many previous studies have intensively used (e.g., size, profitability, market-to-book, industry, etc.).

Next, this paper turns to the panel regression of leverage in order to examine how important the suggested time-invariant components are. We find that most variation in leverage in the panel of Japanese firms is attributable to time-invariant components and is largely unexplained by previously identified determinants of capital structure. Furthermore, we show that the size of the coefficient estimates of traditional variables is very sensitive to the inclusion of firm-specific time-invariant components in the leverage regression.

In response to the counter-evidence provided by DeAngelo and Roll (2015), this paper applies some of their analyses to the Japanese data. The obtained results show that the average $R^2$ for two leverage cross-sections does not go down below 0.3 even for cross-sections 20 years apart. This result is remarkably different from the result of DeAngelo and Roll (2015) which reports that for US firms the average $R^2$ approaches to near-zero for cross-sections 20 years apart. We also find that while many firms move out of their initial leverage quartiles, the fractions of firms remaining in the lowest and highest leverage quartiles are remarkably high. Especially the fraction of firms remaining in the highest quartile (31.4%) among Japanese firms is 2.7 times higher than what DeAngelo and Roll (2015) find for US firms (11.7%).

Finally, this paper relates the long-term stability of leverage cross-sections to borrowings from commercial banks. We divide leverage into loans from commercial banks and corporate bonds and replicate the several analyses for the cross-sections of leverage based on loans and corporate bonds separately. The results indicate that loans from commercial banks are associated with the long-term stability of leverage rather than corporate bonds.

This paper provides the additional evidence about the long-term stability of leverage by examining the Japanese data. For future research, we could further narrow down empirical features of time-invariant components in leverage. Alternatively, we could propose a novel explanation for such time-invariant components, which then should be tested against the data available to us. Either approach may contribute to enhancing our understanding of how firms determine capital structure.

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Table 1 Definitions of Variables

This table describes the definition of variables used in this paper.

| | | |
|---|---|---|
| Total Debt | = | short term debt + long term debt,<br>where debt are divided into loans and corporate bond. |
| Book Leverage | = | total debt/book assets. |
| Market Equity | = | stock price x shares outstanding. |
| Market Leverage | = | total debt/(total debt + market equity). |
| Firm Size | = | log(book assets), where assets are deflated by the GDP deflator. |
| Market to Book | = | (market equity + total debt)/book assets. |
| Profitability | = | operating income/book assets. |
| Tangibility | = | net PPE/book assets. |
| Total Loans | = | short term loan + long term loan. |
| Book leverage(Loans) | = | total loans/book assets. |
| Total Corporate Bond | = | short term corporate bond + long term corporate bond. |
| Book leverage (Corporate Bond) | = | total corporate bond/book assets |

Table 2 Basic Statistics

Our sample is drawn from Astra Manager provided by QUICK and consists of all listed companies in Japan during the period 1979-2013, excluding firms operating in the financial sectors. Our sample includes firms that are delisted during the sample period and firms that enter the sample by IPO. We require that all firm-years have nonmissing data for the relevant variables when conducting multivariate analysis. We require leverage to lie in the closed unit interval. All other variables are trimmed at the upper and lower one-percentiles to mitigate the effect of outliers and avoid the contamination of the data with errors.

| Variable | Mean [Median] | SD |
|---|---|---|
| Book leverage | 0.26 | 0.20 |
| | [0.23] | |
| Market leverage | 0.33 | 0.27 |
| | [0.29] | |
| Book leverage(Loans) | 0.22 | 0.19 |
| | [0.18] | |
| Book leverage(Corporate Bond) | 0.04 | 0.06 |
| | [0.00] | |
| Firm size | 5.95 | 1.45 |
| | [5.79] | |
| Market to book | 0.91 | 0.58 |
| | [0.77] | |
| Profitability | 4.85 | 4.83 |
| | [4.28] | |
| Tangibility | 0.29 | 0.17 |
| | [0.27] | |
| Median industry book leverage | 0.24 | 0.11 |
| | [0.22] | |
| Dividend payer | 0.82 | 0.39 |
| | [1.00] | |
| Obs. | 87,666 | |

Table 3 Impact of Initial Leverage on Future Leverage

The sample consists of all nonfinancial firms in Astra Manager from 1979 to 2013. The table presents parameter estimates, scaled by the standard deviation of the underlying variable, from panel OLS regressions of book leverage on several different specifications. We define initial leverage of the firm as leverage observed at the beginning of the sample period if available or as leverage in the year when the firm enters the sample. All variables are trimmed at the upper and lower 1 percentiles. Variable definitions are given in Table 1. The t-statistics are shown in parentheses and are computed using standard errors robust to both clustering at the firm level and heteroskedasticity. ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

| Variable | | | | | | |
|---|---|---|---|---|---|---|
| Initial leverage | 0.13 | | 0.11 | | 0.10 | |
| | (49.92) | *** | (41.79) | *** | (36.99) | *** |
| Firm size | | | 0.01 | | 0.01 | |
| | | | (6.84) | *** | (5.53) | *** |
| Market to book | | | 0.02 | | 0.02 | |
| | | | (13.65) | *** | (13.81) | *** |
| Profitability | | | -0.05 | | -0.05 | |
| | | | (-35.30) | *** | (-35.55) | *** |
| Tangibility | | | 0.02 | | 0.01 | |
| | | | (9.60) | *** | (6.83) | *** |
| Industry median lev. | | | | | 0.03 | |
| | | | | | (11.34) | *** |
| Dividend payer | | | | | -0.02 | |
| | | | | | (-3.55) | *** |
| Year fixed effects | Yes | | Yes | | Yes | |
| Adj. $R^2$ | 0.47 | | 0.51 | | 0.52 | |
| Obs. | 87,666 | | 82,871 | | 82,871 | |

Table 4 Panel Regression with Firm Fixed Effects

The sample consists of all nonfinancial firms in Astra Manager from 1979 to 2013. The table presents parameter estimates, scaled by the standard deviation of the underlying variable, from panel OLS regressions of book leverage on firm fixed effects and other determinants for various specifications. All variables are trimmed at the upper and lower 1 percentiles. Variable definitions are given in Table 1. The t-statistics are shown in parentheses and are computed using standard errors robust to both clustering at the firm level and heteroskedasticity. ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

| Variable | (a) | (b) | (c) | (d) | | (e) | | (f) | | (g) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Firm fixed effect | Yes | No | Yes | No | | Yes | | No | | Yes | |
| Year fixed effect | No | Yes | Yes | Yes | | Yes | | Yes | | Yes | |
| Firm size | - | - | - | 0.02 | | 0.06 | | 0.01 | | 0.06 | |
| | | | | (11.67) | *** | (16.92) | *** | (8.69) | *** | (16.67) | *** |
| Market to book | - | - | - | 0.06 | | 0.02 | | 0.06 | | 0.02 | |
| | | | | (16.01) | *** | (12.60) | *** | (16.01) | *** | (12.33) | *** |
| Profitability | - | - | - | -0.01 | | -0.01 | | -0.01 | | -0.01 | |
| | | | | (-42.72) | *** | (-35.51) | *** | (-41.76) | *** | (-34.68) | *** |
| Tangibility | - | - | - | 0.28 | | 0.12 | | 0.18 | | 0.12 | |
| | | | | (20.33) | *** | (7.72) | *** | (13.18) | *** | (7.82) | *** |
| Industry median lev. | - | - | - | - | | - | | 0.58 | | 0.23 | |
| | | | | | | | | (23.16) | *** | (7.80) | *** |
| Dividend payer | - | - | - | - | | - | | -0.05 | | -0.01 | |
| | | | | | | | | (-3.94) | *** | (-1.69) | * |
| Adj. $R^2$ | 0.75 | 0.05 | 0.77 | 0.24 | | 0.80 | | 0.31 | | 0.81 | |
| Obs. | 87,666 | 87,666 | 87,666 | 82,871 | | 82,871 | | 82,871 | | 82,871 | |

## Table 5 Parameter Sensitivities to Model Specifications

The sample consists of all nonfinancial firms in Astra Manager from 1979 to 2013. This table reports coefficient estimates for two specifications corresponding to a pooled OLS regression and a firm fixed effects regression. The standard errors for the pooled OLS regression are robust to heteroskedasticity and clustering at the firm level. The standard errors for the firm fixed effects regression are robust to heteroskedasticity and within-firm first-order serial correlation. This table also reports the percent change in the magnitude of the coefficient when changing the model specification from Pooled OLS to Firm FE. AR(1) is the estimated first-order serial correlation coefficient. All variables are trimmed at the upper and lower 1 percentiles. Variable definitions are given in Table 1. ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

| Variable | Pooled OLS | Firm FE | % Change | Pooled OLS | Firm FE | % Change |
|---|---|---|---|---|---|---|
| Firm size | 0.02 | 0.04 | 96% | 0.01 | 0.04 | 182% |
| | (11.67) *** | (12.71) *** | | (8.69) *** | (12.75) *** | |
| Market to book | 0.06 | 0.00 | -100% | 0.06 | 0.00 | -100% |
| | (16.01) *** | (-0.18) *** | | (16.01) *** | (-0.21) | |
| Profitability | -0.01 | 0.00 | -93% | -0.01 | 0.00 | -92% |
| | (-42.72) *** | (-9.58) *** | | (-41.76) *** | (-9.31) *** | |
| Tangibility | 0.28 | 0.06 | -78% | 0.18 | 0.06 | -65% |
| | (20.33) *** | (6.57) *** | | (13.18) *** | (6.53) *** | |
| Industry median lev. | | | | 0.58 | 0.04 | -92% |
| | | | | (23.16) *** | (2.98) *** | |
| Dividend payer | | | | (0.05) | (0.00) | -95% |
| | | | | (-3.94) *** | (1.00) | |
| Year fixed effect | Yes | Yes | | Yes | Yes | |
| Adj. $R^2$ | 0.24 | | | 0.31 | | |
| AR(1) | | 0.79 | | | 0.79 | |
| Obs. | 82,871 | 78,189 | | 82,871 | 78,189 | |

Table 6 Fraction of Firms Always in Their Initial Leverage Quartile

For this analysis, we use the subsample consisting of firms that have at least 20-year data. Specifically, we start with calendar year 1979 and sort firms into four equal-sized groups (leverage quartiles) based on leverage ratios in that year. We track forward from this year of group formation (event year t = 0) and record the fraction of firms that remain in the same quartile in each of the subsequent 19 years. We repeat the process for 1980, 1981, . . .1994, treating each of these calendar years in turn as the initial event year and then noting the quartile location of each firm in each of the subsequent 19 years. In columns (1) to (5), we report the average value over all 16 calculations of the fraction of firms that have remained in a given formation-year leverage quartile in every year up to the event year of 19. The rows at the bottom of the table give the fractions of firms in four different quartiles, at least three different quartiles, and at least two quartiles at different times over the 20 years.

| | Fraction of firms *always* in initial (t=0) leverage quartile: | | | | |
|---|---|---|---|---|---|
| | Full sample | Lowest leverage | Second lowest leverage | Second highest leverage | Highest leverage |
| | (1) | (2) | (3) | (4) | (5) |
| | 13.1% | 16.8% | 2.1% | 3.3% | 31.4% |
| Fraction of firms with leverage in four, three or two different quartiles in different years: | | | | | |
| 4 quartiles | 18.1% | 21.1% | 20.8% | 13.4% | 14.5% |
| at least 3 | 56.4% | 54.0% | 71.2% | 59.5% | 35.6% |
| at least 2 | 89.4% | 85.9% | 99.5% | 99.0% | 69.3% |

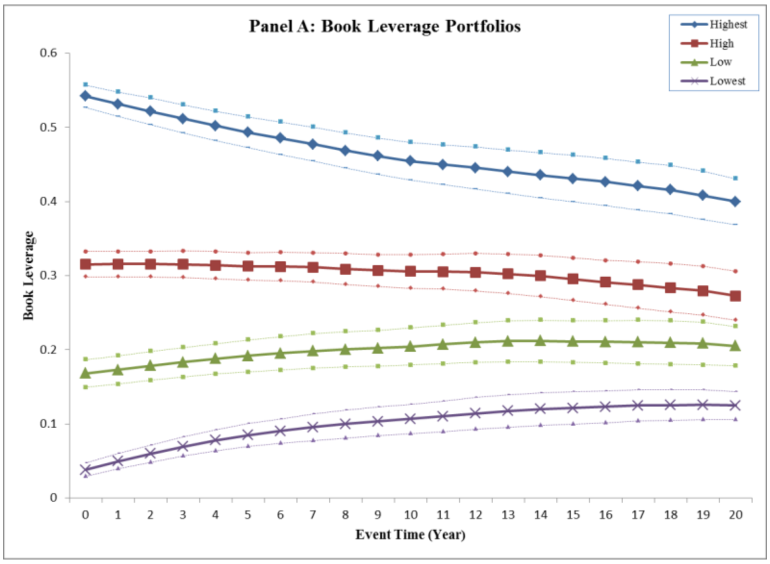
Table 7 The Effect of Initial Loan Ratio and Initial Corporate Bond Ratio on Future Leverage

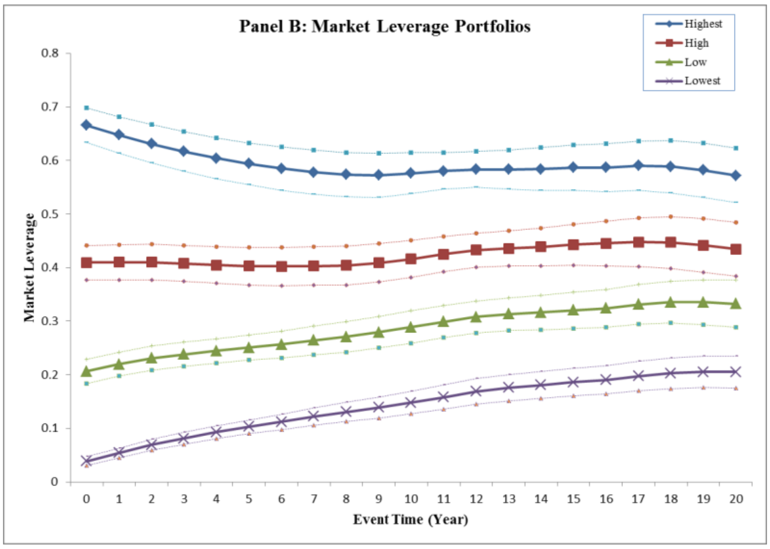
The sample consists of all nonfinancial firms in Astra Manager from 1979 to 2013. The table presents parameter estimates, scaled by the standard deviation of the underlying variable, from panel OLS regressions of book leverage on several different specifications. All variables are trimmed at the upper and lower 1 percentiles. Variable definitions are given in Table 1. The t-statistics are shown in parentheses and are computed using standard errors robust to both clustering at the firm level and heteroskedasticity. ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

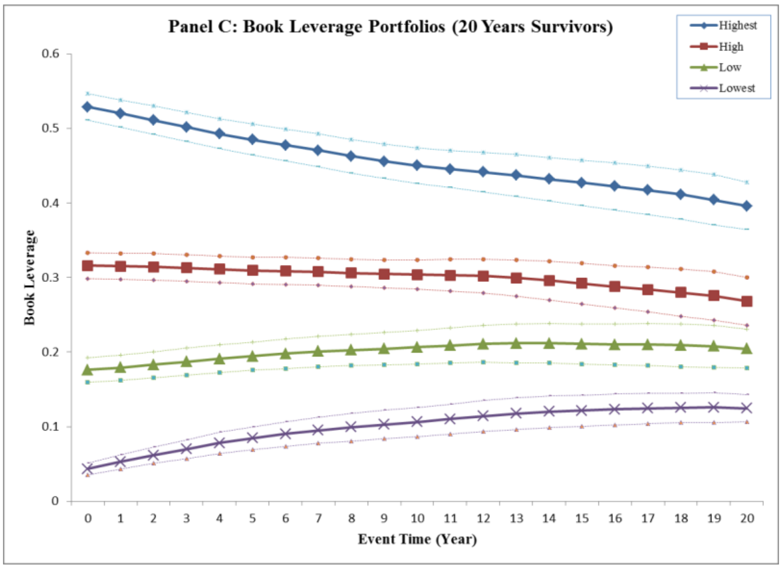
| Variable | | | | | | |
|---|---|---|---|---|---|---|
| Initial loan ratio | 0.13 | 0.11 | 0.10 | | | |
| | (47.86) *** | (41.04) *** | (36.24) *** | | | |
| Initial corporate bond ratio | | | | 0.03 | 0.01 | 0.01 |
| | | | | (10.52) *** | (5.55) *** | (5.53) *** |
| Firm size | | 0.02 | 0.01 | | 0.03 | 0.02 |
| | | (9.83) *** | (8.31) *** | | (9.79) *** | (7.08) *** |
| Market to book | | 0.03 | 0.03 | | 0.03 | 0.03 |
| | | (14.16) *** | (14.31) *** | | (15.73) *** | (15.72) *** |
| Profitability | | -0.05 | -0.05 | | -0.07 | -0.07 |
| | | (-35.20) *** | (-35.49) *** | | (-42.69) *** | (-41.78) *** |
| Tangibility | | 0.02 | 0.02 | | 0.05 | 0.03 |
| | | (11.16) *** | (8.17) *** | | (19.32) *** | (12.31) *** |
| Industry median lev. | | | 0.03 | | | 0.07 |
| | | | (11.57) *** | | | (22.86) *** |
| Dividend payer | | | -0.01 | | | -0.02 |
| | | | (-3.38) *** | | | (-3.99) *** |
| Year fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Adj. $R^2$ | 0.45 | 0.50 | 0.51 | 0.07 | 0.24 | 0.32 |
| Obs. | 87,666 | 82,871 | 82,871 | 87,666 | 82,871 | 82,871 |

Figure 1. Average Leverage of Actual Leverage Portfolios in Event Time

Each calendar year, we sort firms into quartiles (i.e., four portfolios) according to their leverage ratios. The portfolio formation year is denoted event year 0. We then compute the average leverage for each portfolio in each of the subsequent 20 years, holding the portfolio composition constant (except for firms that exit the sample, for example, due to M&A). We repeat these two steps of sorting and averaging for every year in the sample period. This process generates 35 sets of event-time averages, one for each calendar year in our sample. We then compute the average leverage of each portfolio across the 35 sets within each event year. We perform this exercise for both book leverage and market leverage, the results of which are presented in Panels A and B with the 95% confidence interval, respectively. Panel C corresponds to a graph of the subsample of firms existing for at least 20 years (20 year survivors). Panel D corresponds to a graph of the subset of firms that exit the sample before 2013.




Panel C: Book Leverage Portfolios (20 Years Survivors)
Highest
High
Low
Lowest
0.6
0.5
0.4
0.3
0.2
0.1
0
Book Leverage
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Event Time (Year)

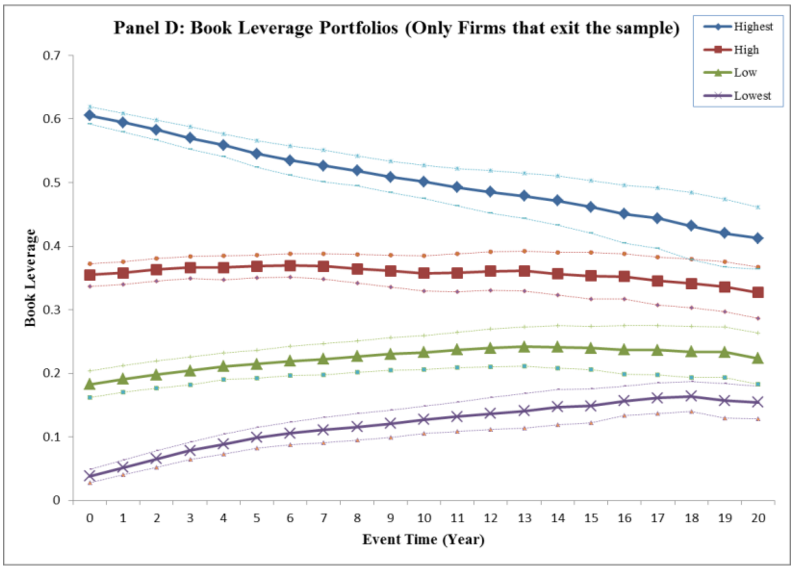

Panel D: Book Leverage Portfolios (Only Firms that exit the sample)
Highest
High
Low
Lowest
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Book Leverage
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Event Time (Year)

Figure 2. Average Leverage of Unexpected Leverage Portfolios in Event Time

Each calendar year, we run the cross-sectional regression of leverage on firm size, profitability, market-to-book, tangibility, and industry dummies. We then sort firms into four portfolios according to the residuals from this regression, which we call "unexpected leverage," and then compute the average actual leverage of each portfolio over the subsequent 20 years.

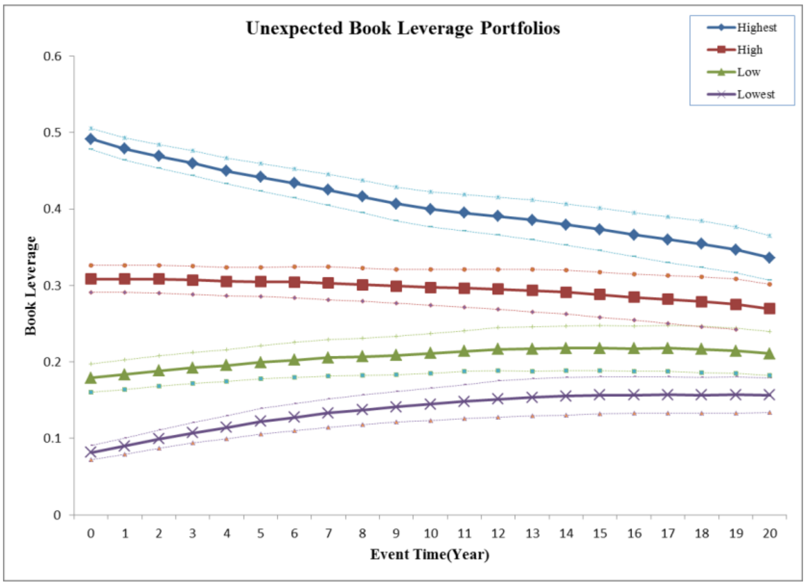


Figure 3. Forecast Power of a Given Cross-Section for the Sequence of Future Cross-Sections

This figure shows that the average $R^2$s that measure the extent to which firms with high (or low) leverage in a given cross-section tend to have high (or low) leverage in the cross-section T years apart in time. The vertical axis corresponds to the average squared cross-sectional correlation coefficient over all pairs of cross-sections that differ by T years. The horizontal axis corresponds to the time length T between two cross-sections for which correlation coefficients are calculated.

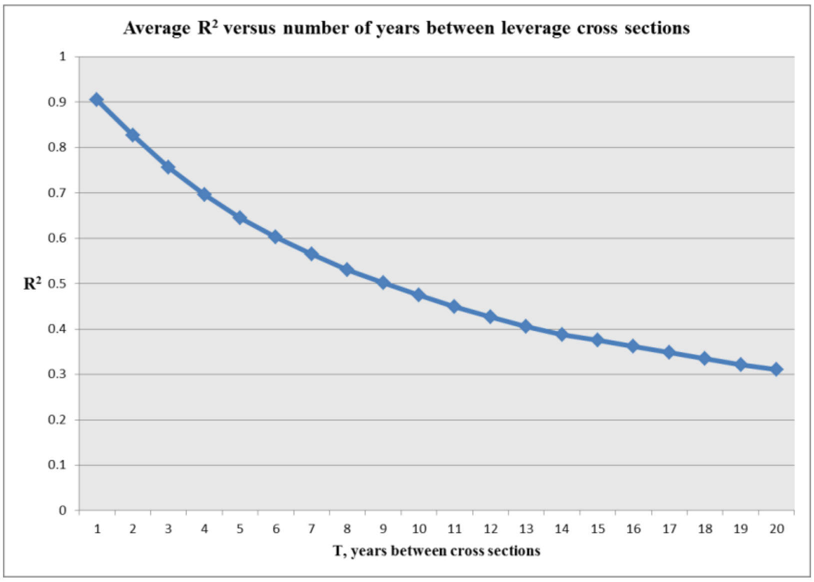
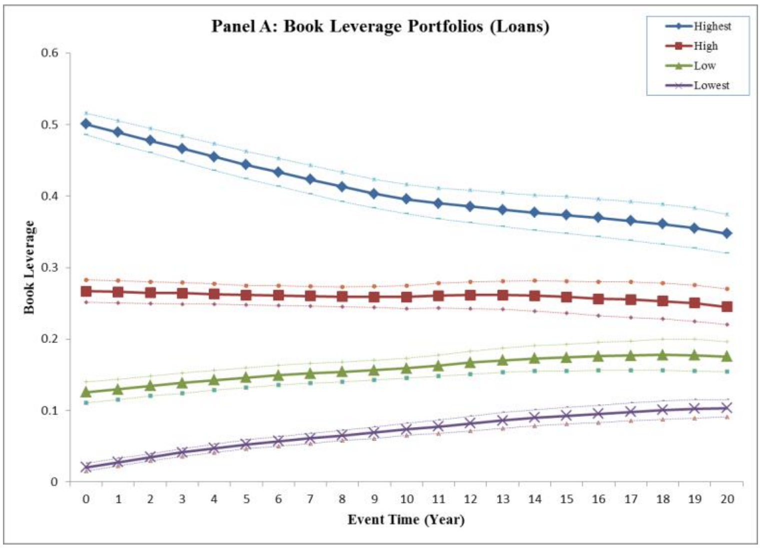


Figure 4. Evolution of Portfolios Sorted According to Loan Ratio and Corporate Bond Ratio

Each calendar year, we sort firms into quartiles (i.e., four portfolios) according to their loan ratios (corporate bond ratios). The portfolio formation year is denoted event year 0. We then compute the average loan ratio (corporate bond ratio) for each portfolio in each of the subsequent 20 years, holding the portfolio composition constant (except for firms that exit the sample, for example, due to M&A). We repeat these two steps of sorting and averaging for every year in the sample period. This process generates 35 sets of event-time averages, one for each calendar year in our sample. We then compute the average loan ratio (corporate bond ratio) of each portfolio across the 35 sets within each event year. Graphs of loan ratios and corporate bond ratios are presented in Panels A and B with the 95% confidence interval, respectively.



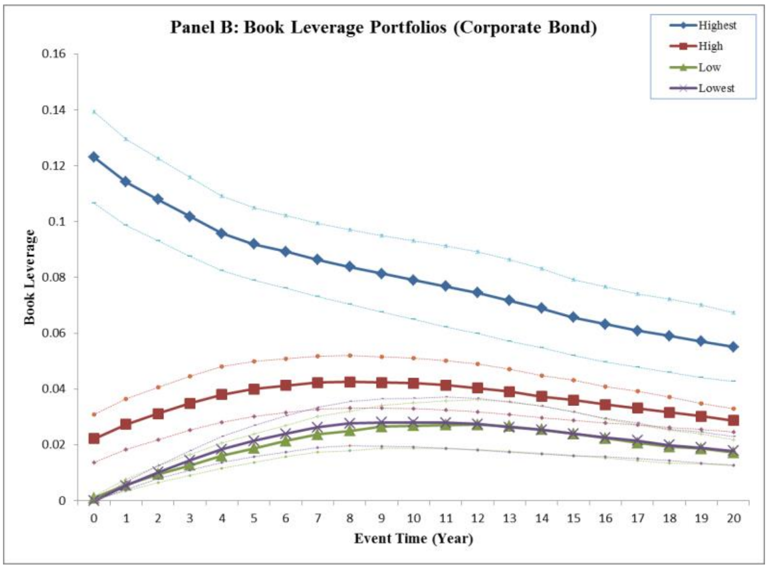



Figure 5. Average Leverage of Unexpected Loan Ratio Portfolios in Event Time

Each calendar year, we run the cross-sectional regression of the loan ratio on firm size, profitability, market-to-book, tangibility, and industry dummies. We then sort firms into four portfolios according to the residuals from this regression, which we call "unexpected loan ratio," and then compute the average actual loan ratio of each portfolio over the subsequent 20 years.

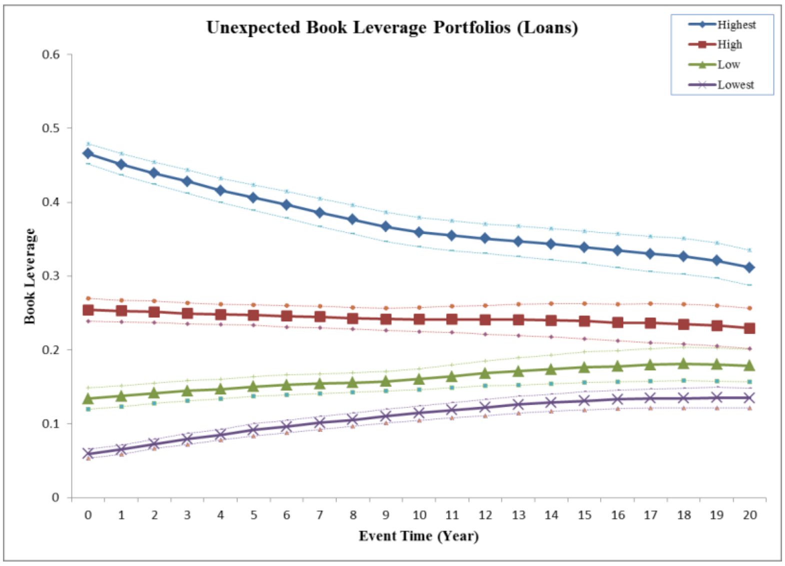


Figure 6. Average $R^2$ versus Number of Years between Cross-Sections based on the Loan Ratio and Corporate Bond Ratio

Panel A of this figure shows that the average $R^2$s that measure the extent to which firms with high (or low) loan ratio in a given cross-section tend to have high (or low) loan ratio in the cross-section T years apart in time. The vertical axis corresponds to the average squared cross-sectional correlation coefficient over all pairs of cross-sections that differ by T years. The horizontal axis corresponds to the time length T between two cross-sections for which correlation coefficients are calculated. Panel B of this figure shows a graph of the average $R^2$ versus number of years between cross-sections based on the corporate bond ratio.