# What happens at a refinancing point? Changes in debt structure and firm profitability

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## Abstract

This paper develops a theory of liquidity management that highlights the trade-off between the disciplinary role of short-term debt and financial flexibility. We empirically test the theory by examining changes in the structure of debt claims when firms rebalance their capital structure. As predicted by the theory, firms adjust both the priority and maturity of their debt claims when they refinance. We show that the correlation between debt and profitability at refinancing points varies with the type of debt and the type of firm. Short-term claims and subordinated claims are more correlated with profitability than other types of debt claims, and this correlation is strongest in firms with high-hedging needs.



Keywords: capital structure, debt structure, leverage, profitability, financial flexibility, liquidity management

JEL classification: G32

## I. Introduction

One of the enduring puzzles in the capital structure literature has been the persistent negative correlation between profitability and leverage. The sign of this correlation is contrary to the predictions by trade-off models of capital structure, which predict that more profitable firms use more debt in order to take advantage of the tax deductibility of interest. Myers (1984) and others have argued that the observed relation between profits and leverage is consistent with alternative theories of capital structure that emphasize information asymmetries between insiders and outsiders. However, recent theoretical advances in capital structure theory indicate that this relation is not inconsistent with trade-off theory, the reason being that firms rebalance intermittently. Danis *et al.* (2014) show that if firms are close to their target leverage ratio, the correlation turns positive, providing evidence that is supportive of trade-off theory.

Their analysis raises several questions. First, do firms also change the structure of their debt claims at a refinancing point, or is the proportional increase in each type of debt equal across debt maturity and priority? Second, what types of debt are more correlated with firm profitability? Since debt types vary in terms of maturity and priority, it is likely that some firms will prefer issuing certain types of debt over others in response to positive profitability shocks. Third, for which types of firms is the relation between these types of debt and profitability the strongest? Firms differ with respect to the correlation of their cash flows with their investment needs, and the desire to transfer cash from high-profitability to low-profitability states may also affect the observed correlation between the choice of debt-type and profitability.

We answer these questions by empirically investigating what happens when firms rebalance their capital structures. Our empirical strategy is theoretically motivated by a class of models in which the presence of rebalancing costs implies that firms rebalance their capital structure infrequently (see Fischer *et al.* 1989, Strebulaev 2007, and Goldstein *et al.* 2001). These models enjoy strong empirical support from Leary and Roberts (2005), Flannery and Rangan (2006), and Danis *et al.* (2014) among others. However, a common feature of these models is that treat debt as homogeneous in terms of priority and maturity (for example in Goldstein *et al.* (2001) there is only one kind of debt and it is perpetual). This assumption is made in order to make these models tractable, but it ignores substantial variation in the observed priority and maturity of claims (Rauh & Sufi 2010).

In order to formalize our hypotheses, we develop a stylized model that takes into account differences in the priority and maturity of debt claims. In the model, there are two periods and there is moral hazard in the first period due to private benefits and different levels of managerial effort. First-period moral hazard affects second-period profits, and information about future profits is revealed at the end of the first period, based on the manager's level of effort. At the end of the first period, the firm may face a liquidity shock with positive probability. An investment opportunity can arrive at the beginning of the second period, and the probability of arrival varies with whether the firm experiences a liquidity shock. In order to preserve incentives, the optimal contract punishes managers for negative information about future profitability. Punishment is implemented by liquidating the firm when it experiences a liquidity shock even though continuation may be a positive net-present-value (NPV) project. The entrepreneur is rewarded for good news about future profits with a high continuation threshold with respect to the liquidity shock. For very high continuation thresholds, the manager receives a cash payout in the first period.

The optimal debt structure is implemented with long-term subordinated debt (or equity), a line of credit and the right to dilute long-term claimants.[1] Intuitively, this debt structure arises from the need to balance the disciplining effect of short-term debt with future financial flexibility. For most firms, this is a credible reward system because the investors would engage in credit rationing if moral hazard were absent in the first period. For very low profit firms, credit lines are revoked and the firm is limited to what it can raise by diluting existing subordinated claim holders.

We define firms with high-hedging needs as firms for whom the likelihood of arrival of an investment opportunity in the liquidity shock state is high.[2] In contrast, the investment activity of firms with low-hedging needs is not correlated with liquidity shocks. The model's main prediction is that firms

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[1] A similar implementation is derived in Tirole (2006), and DeMarzo and Sannikov (2006) who find that the use of a credit line increases with liquidation costs.

[2] The distinction between the two types of firms is also used in Acharya *et al.* (2007), who examine the circumstances under which firms prefer to issue debt or save cash.

with high hedging needs have a higher sensitivity of short-term and subordinated debt to profits. The reason is that because of the negative correlation between cash-flows and investment, punishment through liquidation is more severe for this type of borrower. When first-period information reveals that future performance will be low, these firms' investors penalize the borrower by liquidating the firm for lower liquidity shocks even though there may be valuable future growth opportunities. Liquidation is implemented by preventing the firm from raising enough capital to meet its liquidity needs and finance new investment.

Two aspects of the model's prediction are worth highlighting. First, the sensitivity of debt to profits occurs even though there are no taxes. This distinguishes our theory from standard models of trade-off theory in which the relation between leverage and profits is driven by the tax-shield benefits of debt (see Bradley *et al.* 1984 and Leland 1994). The lack of a positive relation between debt and profitability has led researchers to question whether taxes are of first order importance to financial managers. Although empirical studies suggest that the value of tax shields is high, firms appear not to take advantage of this feature of the tax code (see Graham 2000 and Binsbergen *et al.* 2010 for a comprehensive analysis). Survey evidence provided by Graham and Harvey (2001) also indicates that managers value financial flexibility over maximizing the debt tax shields.

Second, we provide an explanation for why the availability of short-term debt such as credit lines is often contingent on operating performance (Sufi 2009). Our theory predicts that the firm's debt structure acts as a disciplinary device, with reported operating performance being used as a metric to judge managerial effort levels. This rationale is similar to Acharya *et al.* (2014) where credit lines are revoked in response to illiquidity seeking behavior by the borrower. We differ from their study in that we use the disciplinary role of debt structure to explain changes in the priority and maturity structure of debt claims when firms are close to their target leverage ratio.

We empirically test the model's main prediction that there are cross-sectional differences in the sensitivity of debt to profits, with some firms having a greater sensitivity of short-term and subordinated debt to profits than other firms. The empirical analysis uses a sample of U.S. industrial firms between

2002 and 2012 that has detailed information on the structure of their debt claims. Debt is classified along several dimensions, including the type of debt, maturity and priority based on information provided by CapitalIQ and COMPUSTAT.

Our tests investigate changes in the structure of debt claims when firms reach a refinancing point. Refinancing points are identified as years in which firms issue large amounts of debt. Unlike Danis *et al.* (2014), we do not restrict the use of debt proceeds to equity payouts. The reason is that liquidity shocks can arise because of cash shortfalls or unexpected financing needs (Lins *et al.* 2010). Ignoring these two possible uses of the proceeds from debt issues, while empirically appealing, would limit the inferences made from the empirical analysis.

Consistent with our main prediction, the response of short-term and subordinated debt claim changes to profitability is stronger for firms with high hedging needs. We establish this empirical relation in a number of ways. We first compare the proportion of each type of debt over total capital at refinancing and non-refinancing points. For high hedging need firms in high profitability states, refinancing points are associated with significant increases in short-term and subordinated debt claims compared to low profitability states. In contrast, we don't observe any differences in debt structure changes across high and low profitability states for low hedging need firms. We next investigate whether this result holds in a multivariate context that controls for firm-level determinants of debt structure. Consistent with the summary statistics, high hedging need firms' short-term and subordinated debt issuance is more sensitive to profits than for low hedging need firms.

We next examine the sensitivity of our results to alternative specifications that involve variations in macro-economic conditions at refinancing points. We continue to find a stronger relation between short-term and subordinated debt and profits for high hedging need firms, controlling for the level of the term spread, credit spreads, the real rate of interest, and GDP growth at a refinancing point. We further test our hypotheses by comparing the sensitivity of short-term and subordinated debt to firm-level performance measures and macro-level variables, which are outside of the manager's control. Consistent with the monitoring role played by debt, the debt structure of high hedging need firms is sensitive to firm performance but insensitive to macro-economic conditions.

Interestingly, low hedging need firms' choice of debt structure is more sensitive to macro-economic conditions than high hedging need firms, indicating that firms with low hedging needs may have more flexibility in their choice of debt structure over the business cycle. This finding is new to the literature. Prior studies on cross-sectional differences in firms' ability to issue debt across the business cycle focus on firms' access to capital markets (Korajczyk & Levy 2003; Erel *et al.* 2012).

Our study makes three contributions to the literature. First, we show that the contingency of debt capacity to news about future performance is a function of the firm's investment opportunity set. The sensitivity of short-term and subordinated debt capacity to profits is decreasing in the correlation between the firm's cash flows and the arrival rate of its investment projects. Second, we provide evidence that the structure of debt claims on the firm's balance sheet is organized in order to enable monitoring by creditors. One of the questions raised in both Rauh and Sufi (2010) and Colla *et al.* (2013) is whether debt structure's primary role is to facilitate monitoring of management or to reduce distress costs. Our study addresses this question. Specifically, the evidence on the differential sensitivity of various types of debt to profit realizations indicates that the optimal debt structure for firms with high hedging needs balances the information sensitivity of short-term debt with liquidation risk, as first suggested in Diamond (1991a, 1993). Our results on the information sensitivity of the firm's debt structure are also related to Gomes and Phillips (2012), who find that, conditional on raising capital in private capital markets, firms with more information asymmetry issue more information-sensitive securities. Furthermore, we show that differential sensitivity of debt types to profits cannot be explained by tax-motivated rationales for debt, nor with arguments based on the minimization of distress costs.

Third, our study offers a way to reconcile two contrasting perspectives on capital structure choice. The dynamic capital structure literature emphasizes the trade-off between the tax benefits of debt and bankruptcy costs in a context with fixed adjustment costs (Strebulaev 2007) and investment activity (DeAngelo *et al.* 2011). Contracting theories of debt structure emphasize the organization of debt claims in order to facilitate monitoring and information acquisition (Aghion & Bolton 1992; Gârleanu & Zwiebel 2009). We show that both perspectives are empirically important determinants of capital structure choice. Specifically, firms rebalance their leverage ratios when they undertake lumpy investments. At these rebalancing points, the firm's debt structure is organized in order to enhance monitoring by the firm's creditors, and to ensure future financial flexibility.

The rest of the paper is organized as follows. Part II outlines the model and illustrates the intuition behind our hypotheses. Part III describes the sample and data sources. Part IV reports results on variations in debt structure at refinancing points, and part V concludes.

## II Hypotheses

In this section we outline a two-period model with moral hazard in both periods. The analysis is an adaptation of the soft-budget constraint model in Tirole (2006). At time 0, an investment of variable size $I$ is made that generates at date 1 news $R_L$ about date 2 revenue. At date 2, the original project pays $R + R_L$ with probability $p_H$ in case of success and $R_L$ with probability 1-$p_H$ in case of failure. Following Tirole (2006), we define

$$\rho_0 = p_H \left( R - \frac{B}{\Delta p} \right) < \rho_1 = p_H R. \qquad (1)$$

The quantity $B$ represents the benefits from shirking in the second period, and $\Delta p$ represents the increase in the probability of success when there is effort by the manager. The ratio $\frac{B}{\Delta p}$ represents the manager's rents received in exchange for incurring high effort. The project's income is also subject to moral hazard in the first period and the decision to shirk in this period affects the distribution of $R_L$. Date-2 income $R_L$ is distributed over the interval $[0, {R_L}^+]$ with distribution function $G(R_L)$ if the entrepreneur works and distribution function $\tilde{G}(R_L)$ if the entrepreneur shirks. We assume that the likelihood ratio $\ell(R_L) := \frac{g(R_L) - \tilde{g}(R_L)}{g(R_L)}$ is weakly increasing in $R_L$ (i.e. it has the monotone likelihood property). After the initial investment is made and first period effort is chosen, investors observe at date 1 the value of $R_L$ that will be realized at date 2.

At the end of the first period, the firm is exposed to a liquidity shock that occurs with probability $\lambda$. The liquidity shock requires an investment $\rho$ in the firm, which must be financed externally or else the firm is liquidated. The liquidity shock amount is random and has cumulative distribution function $F(\rho)$. The main insight of the soft budget constraint model is that liquidation promotes first-period effort because the liquidation threshold is a function of news about future income. The revelation of this news at date 1 may occur in a number of ways. For example, audited operating performance over the first period may provide a forecast $R_L$ of date-2 income. Alternatively, non-verifiable information about the firm's prospects in the next period may be revealed through analyst reports, or management's earnings guidance. In both cases, the optimal contract specifies a liquidity-shock threshold $\rho^*(R_L)$ that is a function of $R_L$.

Assuming there is no liquidation (either because there was no liquidity shock or because the firm's liquidity needs were met), there may arrive at the beginning of the second period an opportunity for a deepening investment in the firm's existing assets. The deepening investment requires an additional investment $xI$ on the part of the firm's external investors, and the project increases the rate of return on the initial investment by $\mu$.[3] Thus date 2 revenue is proportional to the original investment amount $I$ and it equals $(\rho_1 + R_L)I$ if there is no new investment opportunity, and it equals $((1+\mu)\rho_1 + R_L - x)I$ when there is an investment arrival and no liquidation. We assume that the firm can contract at time 0 to borrow an amount $x$ in the event of an investment project arrival. In order for external investors to break even on this deepening investment, we assume that the increase in pledgeable income from this investment is greater than the amount invested: $\rho_0\mu - x \geq 0$. Figure 1 describes the timeline of events.

[3] The amount $\rho_1 + R_L$ is expected income at date 2. Using the notation from Tirole (2006), the project pays $R + R_L$ in case of success and $R_L$ in case of failure. The probability of success is $p_H$ and $\rho_1 = p_H R$. The deepening investment increases the probability of success by $\tau$. The investors' expected return is then $(p_H + \tau)\left(R - \frac{B}{\Delta p}\right) + R_L - x = (1+\mu)\rho_0 + R_L - x$, where $\mu = \tau / p_H$, $\rho_0 = p_H\left(R - \frac{B}{\Delta p}\right)$ and $\frac{B}{\Delta p}$ equals the managerial rents.

The key ingredient of the model is the fact that the arrival rate of the deepening investment at the beginning of the second period is a function of whether there is a liquidity shock. Conditional on a liquidity shock, the arrival rate is $z$. Conditional on no liquidity shock, the arrival rate is $h \neq z$. Intuitively, having a high arrival rate conditional on a liquidity shock makes the cost of liquidation more severe for the manager. The reason is that his forgone rents in the case of liquidation when there is a deepening investment are equal to $(1 + \mu)(\rho_1 - \rho_0)$, compared with only $(\rho_1 - \rho_0)$ when there is a liquidation shock but no possibility of a deepening investment. In expectation, the cost of liquidation to the manager due to the missed investment opportunity equals $z\mu(\rho_1 - \rho_0)$.

In what follows we use the arrival rates $z$ and $h$ to define two types of firms. Firms with high $z$ and low $h$ are firms with high hedging needs. These firms, first described by Acharya *et al.* (2007), wish to transfer cash flows from high to low-profit states of the world because their investment opportunities occur in low liquidity states. In contrast, firms with low levels of $z$ and high levels of $h$ see their investment opportunities arriving in high liquidity states. Consequently, these firms have low hedging needs. In the appendix, we solve this model and show that high- and low-hedging need firms differ in the sensitivity of the liquidation threshold $\rho^*(R_L)$ to news about future profits $R_L$.

### 2.1 Empirical implications

The model makes two predictions with respect to the relation between the firm's debt structure, news about future profits, and the rate of arrival of investment projects in the liquidity shock state.

*Prediction 1: The proportions of short-term debt and subordinated debt to total capital when the firm refinances are positively related to news about future profitability.*

The rationale for this prediction is that making short-term and subordinated debt capacity sensitive to news about future profits has a disciplinary effect on the manager. This prediction is not new and it follows directly from Tirole's soft-budget constraint model. The sensitivity of short-term and subordinated claims arises from the fact that the manager can dilute existing claimholders to finance a liquidity need by issuing more subordinated claims. Because there is a limit to how much future income can be pledged, the manager must also contract at time zero to be able to issue an additional senior claim to meet future liquidity needs. Making this amount sensitive to news about future profits ensures that the manager does not shirk in the first period.

The novel part of the model is reflected in the following prediction.

*Prediction 2: The sensitivity of short-term and subordinated debt capacity to news about future profitability is increasing in $z$, the rate of arrival of investment projects conditional on a liquidity shock.*

When the rate of arrival of investment opportunities is high in the liquidity shock state, then the cost of liquidation to the manager is large because he loses his continuation rents when the firm is liquidated. These continuation rents are higher when the firm has the opportunity to make a deepening investment, which occurs with probability $z$, conditional on the liquidity shock state. This creates a greater incentive to put in effort in the first period, and the incentive to do so is greater in high hedging need firms because low profit states are associated with higher investment opportunities. We test these predictions using detailed data on firms' debt structure. The following section describes our data.

## III. Data sources and sample description

The empirical analysis uses multiple data sources on debt structure. Debt maturity structure data are obtained from the annual Compustat Database. We define short-term debt as debt in current liabilities plus long-term debt due in one year, and we define long-term debt as debt maturing in more than one year. Information on the type of debt as well as the priority and maturity structure of the firms' claims is obtained from the Capital IQ Database, which provides detailed data on firms' debt claims beginning in 2002. This database offers the amount of total debt, credit lines, senior secured and senior unsecured debt. Subordinated debt is obtained by subtracting senior secured and senior unsecured debt from total debt.

Bank debt is defined as the sum of drawn credit lines and term loans. Any remaining debt is defined as non-bank debt. Data on public debt is obtained from FISD. This database offers firm-level data with respect to issues of public bonds. Based on these data, we are able to calculate the amount of bonds outstanding at the end of a given year for each firm in our sample. Other financial information is obtained from the Compustat Database. We merge Compustat and Capital IQ using firms' CIK identifiers, and merge FISD and Compustat by CUSIP.

The final sample includes all U.S. firms traded on major U.S. stock exchanges (Amex, Nasdaq and NYSE) anytime between fiscal year 2002 and 2012 that are included in all three databases (Compustat, Capital IQ, FISD). To construct the final sample, we delete the following observations: 1) the value of any debt composition group in Capital IQ is missing; 2) total debt is always zero during the entire sample period; 3) the difference between total debt from the Capital IQ Database and total debt from the Compustat Database is higher than 10% relative to maximum between these two numbers; 3) outstanding bonds for a given firm at a given year exceeds the total debt in Compustat or Capital IQ; 4) the firms belong to financial (SIC codes 6000-6999) or utility (SIC codes 4000-4999) industries; 5) the book value of total assets is missing. The final sample forms an unbalanced panel, and it includes 15,836 firm-year observations for 2,192 non-financial and non-utility U.S. firms traded on the Amex, Nasdaq, and NYSE. [4]

Table 1 offers summary statistics for the main variables. The exact definitions for all the variables are provided in Table C.1 in the Appendix, and all variables are winsorized at 1% level. Panel A in Table 1 indicates that the average proportion of short-term debt to total debt (ShortTerm) is 25%, and the average proportion of long-term debt to total debt (LongTerm) is 75%. The average proportions of senior secured debt (SrSc), senior unsecured debt (SrUnSc), and subordinated debt (Sub) relative to total debt are 41%,

[4] In the following sections, this is the sample used unless otherwise indicated. Also, when we conduct regressions involving other financial information such as profitability, hedging needs, refinancing points, etc., we further restrict the sample to observations with data that are non-missing for these additional variables.

32% and 27%, respectively. The average proportion of bank debt to total debt is 42%. The proportion of public bonds to total debt is 20%. Panel B of Table 1 also indicates that the main characteristics of our sample firms are similar to Colla *et al.* (2013) and the sample of all industrial firms in Compustat.

## IV. Empirical Results

As discussed in Section 2, whether or not investments arrive during low cash-flow states determines the monitoring effectiveness of short-term debt. For firms with high hedging needs, the liquidity shock is more likely to occur when there is a high likelihood of valuable future investment opportunities. Liquidations in high-investment states are costlier for managers to bear in these firms, making limits on short-term debt capacity more effective in curbing moral hazard. Empirically these firms exhibit low investment-cash flow correlations. In contrast, for low hedging need firms, liquidity shocks don't coincide with the arrival of investment opportunities. Empirically, these firms exhibit higher correlations between investment and cash flows than high hedging need firms.

Following Acharya *et al.* (2007), we use industry-level data to identify high and low hedging need firms. Specifically, we calculate annual average cash flows for each industry based on firms' three-digit SIC code. To mitigate the endogeneity problem that cash flows may be affected by financing constraints, we calculate three-digit SIC industry average investment opportunities only for financially unconstrained firms (i.e., firms that pay dividends, have assets above $500 million, and have higher than B+ credit ratings).[5] Firms are divided into two groups based on where their industry-level investment- cash-flow correlation lies relative to the median correlation across all industries. Firms belonging to the industries with higher than median investment-cash flow correlation are classified as low hedging need firms. We classify firms belonging to the industries with a lower than median investment-cash flow correlations as high hedging need firms.[6]

[5] Detailed definitions about cash flows and investment are in Appendix C.
[6] Although not tabulated, the median industry investment-cash flow correlation is 0.09. The average value of industry investment-cash flow correlations that are lower than this median is -0.27. The average value of industry investment-cash flow correlations that are higher than this median is 0.40. Therefore, on average, "high hedging needs" firms tend

To test the main predictions about changes in the maturity and priority structure of debt claims, our principal empirical strategy focuses on changes in debt structure when firms increase their debt. The rationale for doing so is two-fold. First, there are strong theoretical reasons for changes in debt structure to occur when firms increase their leverage ratios. For example, dynamic trade-off models such as Goldstein *et al.* (2001) predict that capital-structure adjustments increase the firm's leverage ratio, while downward adjustments are associated with debt restructuring when the firm is in distress. Second, there is also strong empirical evidence that firms rebalance their leverage ratios at discrete points in time (Leary & Roberts 2005). Furthermore, Danis *et al.* (2014) empirically identify refinancing points as points at which firms issue debt and repurchase equity. They find a positive correlation between leverage and profitability at these points in time, which they interpret as consistent with firms being close to their target leverage ratio. Given these findings and our hypotheses on debt structure, we predict that firms change their debt structure when they rebalance their leverage ratio.

This empirical strategy can be understood in the context of Section 2 by verifying that points in time at which the firm undergoes a large increase in leverage also coincide with significant investment activity. As we show below, these increases in debt occur because the firm has significant liquidity and/or financing needs, which also cause firms to adjust the structure of their debt claims. Prior empirical evidence suggests that such changes are long lasting. For instance, Denis and McKeon (2012) identify pro-active changes in debt structure by identifying large changes in debt that adjust firms' leverage ratios, controlling for the change in the proportion of debt that would be necessary to match a change in the firm's assets. They show that these changes are permanent adjustments in the firms' leverage ratio. DeAngelo *et al.* (2011) formally model these types of events and argue that the proceeds from the debt issues are used to finance immediate investment needs.

### 4.1 Descriptive statistics

to have negative correlation between investment opportunities and cash flows, and "low hedging needs" firms tend to have positive correlation between investment opportunities and cash flows.

We define refinancing points as years in which the proceeds from debt issuance net of the change in cash exceed 5% of total assets at the end of the previous fiscal year. Defined in this manner, there are in total 4,855 refinancing points, representing 31% of all of the observations.[7] We control for the change in cash, in order to make sure debt issues are motivated by the firm's investment needs. This definition differs from the way refinancing points are defined in Danis *et al.* (2014), who condition on the debt proceeds being paid out to shareholders. However, we find that this use of funds comprises a very small fraction of net debt issuance at refinancing points (approx. 5% based on the mean of the ratio of total payouts to net debt issuance, or 2% based on the median). The majority of firms use debt issue proceeds at refinancing points (defined in this manner) to finance investments or acquisitions. For example, Figure 3 plots the evolution of cash flow from operations net of investment expenditures in event time relative to a refinancing point. The year of the refinancing is characterized by a large financing deficit, defined as the difference between cash flow from operations and investment expenditures. This increase indicates that around the refinancing points, internal funds generated from continued operation are insufficient to meet investment needs, and firms have a greater demand for external financing. This sharp increase in the financing deficit in the event year is larger for high hedging need firms because of the arrival of investments in low cash-flow states for these firms.

Table 2 presents time-series evidence on the distribution of refinancing points in our sample. The yearly frequencies of refinancing points are based on different cutoffs for net debt issuance. The table shows that the refinancing points seem to be evenly distributed year over year: the percentage of refinancing points relative to total observations in a given year is approximately 31%. The distributions of refinancing points do not change when cutoff values of 3% or 7% are used instead of 5%.

Our first test divides both high and low hedging need firms into five quintiles based on observed profitability at the end of the previous fiscal year. We measure changes in debt structure around refinancing

[7] The numbers in this table are based on our original sample with 15,835 firm-year observations to have a sense about the overall distribution of refinancing points in our sample. In later analyses, we focus on firms with non-missing values of relevant firm characteristics and firms that exist in the sample for more than three years. The distribution of refinancing points remains similar even if we use the sub-sample.

points by measuring the sensitivity of the proportion of each type of debt-to-total capital to profitability. The debt-to-profit sensitivity provides a common metric with which to measure changes in debt structure when firms reach a refinancing point. This metric allows us to compare changes in the structure of debt in response to good news or bad news about future profits. It also allows a comparison of changes in debt structure between high and low hedging need firms.

Figure 4 reports the average fraction of each type of claim over total debt by type of firm and by profitability quintile. The figure provides evidence that there are differences in the structure of debt claims across profitability quintiles, and between high and low hedging need firms. For example, in Panel A the use of short-term debt increases with profitability for high hedging need firms, and this increase is greater than for low hedging need firms. Panel B shows that the priority structure also varies with profitability. As shown, the proportions of senior unsecured and subordinated debt increase with profitability, and this relation is stronger for high hedging need firms. It is also the case that priority spreading is most likely to occur when firms are in the lowest profitability quintile. The proportion of senior unsecured claims relative to total debt is lowest in quintile 1, with the remaining proportions equally made up of senior secured and subordinated claims. Summarizing, the two panels indicate a positive correlation between short-term debt and profitability, and senior unsecured and subordinated debt with profitability. Consistent with the monitoring hypothesis, this correlation is greater for high hedging need firms.

We next investigate the use of debt proceeds at a refinancing point. Table 3 compares the uses of funds for high and low hedging need firms, sorted by profitability. We define high and low profitability states according to whether the firm's ROA at the beginning of a given year is greater than the median ROA across all firms. High profitability firms are those with higher than median ROA, and low profitability firms are those with lower than median ROA. For purposes of comparison, we also include non-refinancing years. Equity payouts (defined as dividends plus stock repurchases minus stock issuance) at refinancing points are lower than at non-refinancing points, suggesting that firms retain their cash flows to finance investments. Both investments (defined as the sum of R&D expenses and cash outflows from investment activities) and capital expenditures are higher at refinancing points, except for capital expenditures for high hedging need firms in the high-profitability group. Firms tend to hold more cash at debt refinancing points compared with non-refinancing points. These results indicate that the proceeds from large debt issues are more likely to be used to fund investment opportunities or increase cash reserves than in making equity payouts.

Profit levels affect the use of debt proceeds. Panel A of Table 3 shows that high hedging need firms in low-profitability states have smaller equity payout ratios (-26.3% vs. -1.7%), and accumulate much more cash (31.3% vs. 9.4%) relative to high-profitability states. The differential behavior across profitability levels underscores these firms' concern with preserving financial flexibility. Compared with high hedging need firms, preserving financial flexibility is less important for low hedging need firms. The difference in payout ratios across high and low profit states is smaller than for high hedging need firms (Panel B). It is also the case that the difference in changes in cash reserves across high and low profits states are smaller for this type of firm.

We next investigate how the debt structure at refinancing points compares with the debt structure observed in non-refinancing years. In each of these years we measure the proportion of each type of debt to total capital and compare these proportions across high and low profitability states and between refinancing and non-refinancing points. We also compare each difference-in-difference between high and low hedging need firms (this test is essentially a triple difference in difference). Panel A of Table 4 shows that changes in the proportions of short-term and subordinated claims are more sensitive to profitability levels for high hedging need firms than for low hedging-need firms. For example, when profits are high for high hedging need firms, the proportion of short-term debt at a refinancing point increases by 1.3% relative to non-refinancing points, compared with only 0.89% in low profitability states. For low hedging need firms, profits are negatively associated with the change in short-term debt at a refinancing point. Moreover, changes in the proportion of each type of claim are insensitive to the level of profitability for low hedging need firms (see Panel B).

More evidence on the sensitivity of debt usage to profitability is provided in Table 5, which examines security issuance at refinancing points. The table reports mean issuance of each type of debt by type of firm and by whether profitability is high or low. In general, debt issuance is insensitive to profitability for low hedging need firms, but short-term and subordinated claim issuance by high hedging need firms are positively related to profit levels. As shown, for high hedging need firms, short term debt is 1.4% in high profits states compared with low profits states, and subordinated debt issuance is 2.4% higher in high profits states than in low profits states. Both differences are statistically significant at the 1% level of confidence. None of the other types of debt show significant differences between high and low profitability states.

### 4.2 Debt structure change around debt refinancing points—multivariate regressions

We next examine the determinants of a change in debt structure in a multivariate context. Controls for firm- and macro-level variables that may be correlated with firm profits and the choice to issue debt are included in the regression equation. The principal variable of interest is the interaction of ROA and a dummy for a refinancing point. The firm-level controls include the ln(real total assets), the MB ratio, asset tangibility, R&D expenses to assets ratio, a dummy for dividend payers, a dummy for having a credit rating, and the median level of industry leverage. The macro-economic variables consist of the default spread, the term spread, the real interest rate, the real market return, and a measure for GDP growth.

For each subsample (i.e. high vs. low hedging needs) we estimate the following regression model.

$$Y_{it} = a + b\ Refinance_{it} + c\ Refinance_{it} \times ROA_{it-1} + d\ ROA_{it-1} + \ e\ X_{it-1} + f\ W_t + \varepsilon_{it} \qquad (2)$$

where $Y_{it}$ indicates book leverage or debt structure measures (short-term debt, long-term debt, senior secured debt, senior unsecured debt, subordinated debt, bank debt, or bonds) relative to total capital. The proportion of each type of debt is scaled by total capital because equity may be issued at a refinancing point. $Refinance_{it}$ is a dummy for debt refinancing point at year $t$. We use a Tobit model to estimate equation (5) because the dependent variables are fractional variables left censored at zero (and right-censored at 100).

As shown in Table 6, there exist important cross-sectional differences in the sensitivity of the proportion (relative to total capital) of the various types of debt to profitability at a refinancing point. For firms with high hedging needs, the proportions of short-term, senior secured and subordinated debt have positive coefficients with respect to the interaction term between profits and the refinancing dummy. In terms of economic significance of the interaction terms, a two standard deviation increase in the profitability (=2*18%) leads to a 2.7% increase in short-term debt, a 2.5% increase in senior secured debt, and a 1.9% increase in subordinated debt. These numbers account for 27%, 14%, or 14% of the standard deviation of proportions of short-term debt, senior secured debt, and subordinated debt, respectively.[8] The differential sensitivity of debt proportions to profitability for the two groups of firms is consistent with Prediction 2. Table 6 also shows that bank debt is correlated with profitability levels at a refinancing point, which is consistent with the monitoring role played by the firm's informed lenders.

As shown in Table 6, the interaction terms between profitability and debt type is insignificant for low hedging need firms, with the exception of long-term debt. However, short-term debt is not used as a disciplinary mechanism by these firms' creditors, as evidenced by the weak interaction between profitability and the refinancing dummy for short-term claims. This is consistent with the argument that the incentive effect created by short-term debt is strongest when investments arrive in low cash-flow states. Panel C tests the difference in the coefficient on the interaction term between the refinancing dummy and profitability between high hedging need firms and low hedging firms. The t-values suggests that this coefficient is statistically different across the two types of firms for short-term debt and subordinated debt.

Our results cannot be explained with tax related arguments. The tax argument implies that high hedging need firms have a lower sensitivity of debt to profits because these firms face a greater risk of liquidation in low cash flow states, resulting in the loss of future debt-tax shields. It is also the case that our results cannot be attributed to different levels of investment opportunities between high and low hedging need firms. First, we control for the level of the firm's growth options with the market-to-book ratio. One

[8] Although not tabulated, the standard deviation of the ratio between short-term (senior secured, or subordinated,) debt and total capital is 10.2% (17.7%, or 13.6%).

might argue that higher levels of ROA are indicative of more profitable investment opportunities, even after controlling for the market-to-book ratio. However, our classification of firms into high and low cash-flow with investment correlations would then imply a lower sensitivity of debt to profitability for firms with high hedging needs. Finally, neither taxes nor differences in the levels of growth options across the two types of firms can explain why some types of debt (e.g. bank vs. bond) are more sensitive to realized profits than other types of debt.

Table 6 shows that for high hedging need firms, the effect of profitability on debt proportions is close to zero at a refinancing point (this can be seen by summing up the coefficients on ROA and the interaction term for short-term debt, for example), but negative at other points in time. Thus our findings do not imply that the relation between leverage and profits is positive at a refinancing point. The reason is that profitability also increases the denominator (total capital), leading to a negative relation between debt proportions and profits outside of non-refinancing points. This negative and mechanical relation is partially offset by the increased use of debt high hedging need firms when profits are high at a refinancing point. Frank and Goyal (2015) also document that firms only partially offset the effect of profits on leverage between refinancing points.

In summary, liquidity risk and the disciplinary role of debt are important factors that determine debt structure changes at refinancing points for firms for whom the threat of liquidation is severe.[9]

### 4.3 Effect of macro-economic conditions on debt structure change around debt refinancing points

We next examine the impact of macro-economic conditions at a refinancing point on firms' debt structure. Specifically, in this section we test whether high and low hedging need firms' debt issuance is sensitive to macro-economic conditions. The rationale for finding no sensitivity is that these variables lie

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[9] In un-tabulated results we show that our results are robust to alternative specifications. First, the results do not change significantly if firm-fixed effects are excluded. Moreover, the sensitivity of debt to profits is robust to using different cutoffs for debt refinancing points (e.g. 3% or 7%). In addition, when investment-cash flow correlations are measured at the firm-level instead of at the industry-level, the results are qualitatively the same.

outside the scope of the manager's control, and should therefore not affect the liquidation decision, conditional on observing news about future profits.

We test this prediction by interacting macro-economic variables with the refinancing dummy. Because macro variables are highly correlated with each other, we interact each macro-economic variable in turn with the refinancing dummy variable, while keeping the interaction of this variable with profitability in Table 7. Overall, we find that the debt structure of low hedging need firms is more sensitive to macro-economic conditions than for high hedging need firms. For example, Panel A examines the effect of GDP growth on the structure of debt claims. Other than long-term debt, the proportion of debt issued by high hedging need firms is insensitive to GDP growth. In comparison, low hedging need firms issue more of each type of debt in response to higher levels of GDP.

Panel B reports the effect of credit conditions (measured with the credit spread) on the proportion of each type of debt. Conditional on issuing debt, the proportion of each type of claim for high hedging need firms is not related to this variable. Low hedging firms have lower proportions of long-term, senior secured, and bank debt when credit spreads are high. Panel C examines the sensitivity of the structure of debt claims to the real rate. As shown, high hedging need firms are unresponsive to the real interest rate. In contrast, low hedging need firms increase the proportion of just about each type of debt except for senior unsecured claims in response to higher real rates. Panel D examines the effect of stock-market performance on debt structure. This variable elicits a common response by both types of firms. As shown, both types of firms have lower proportions of total debt and of each type of debt individually when stock market returns are high.

Overall the results reported in this section indicate that high and low hedging need firms respond differently to macro-economic conditions. Conditional on issuing debt, the debt structure of low hedging need firms is more sensitive to changes in the level of credit conditions, the term-structure of interest rates, the real interest rate and GDP growth. For firms with high hedging needs, macro-economic conditions have very little impact on the debt structure at a refinancing point. For these firms, firm specific performance (measured by ROA) seems to dominate other economic factors that could affect the structure of debt claims.

### 4.4 Convergence of borrower and lender interests over time

Managers may use the firm's debt structure to convey information about the congruence of their interests and the lender's interests in the near future (Demiroglu & James 2010). Gârleanu and Zwiebel (2009) develop a model in which the borrower has superior information about the benefits of expropriating lenders in future low cash-flow states. Entrepreneurs that face high adverse selection costs relative to their personal benefit of lender expropriation choose to give away control rights to lenders when renegotiation costs are low and information asymmetry is high. Thus their theory predicts an increase in performance at later refinancing points relative to earlier ones for firms whose investments arrive in low cash-flow states (i.e. high hedging need firms). The signaling model of Gârleanu and Zwiebel (2009) also predicts a reduction in uncertainty (measured with profit volatility) over time as managers that give away control rights are less likely to engage in asset substitution in the future.

We test the congruence prediction by comparing average profitability and the dispersion of profits at the earliest refinancing point for each firm in our sample with profitability and profit dispersion at all subsequent refinancing points. Results are reported in Table 8. The first row of Panel A reports the average level of profits at the earliest refinancing point, compared with all subsequent refinancing points. As shown, profits increase significantly for both types of firms, but the increase is larger for high hedging need firms. The third row in square brackets computes the standard deviation of profits at the earliest and later refinancing points. Uncertainty, as measured with profit volatility, decreases for both types of firms, and the decrease in uncertainty is greater by at least one order of magnitude for high hedging need firms. The improvement in profits and reduction in dispersion is consistent with Demiroglu and James (2010) who find improvements in the covenant variable for firms with tighter covenants, and with Manso *et al.* (2010) who find that firms that issue performance-sensitive debt experience improvements in their credit rating relative to firms that choose fixed-rate debt.

Panel B replicates these results on the subsample of firms that appear in the sample after 2002. The rationale for restricting the test to these firms is that the first refinancing point in this subsample is the earliest point after they go public, and we therefore expect the convergence between borrower and lender interests to be strongest since these firms are younger and have potentially greater information asymmetries. Our results confirm this intuition. Specifically, the increase in profits and the reduction in volatility for high hedging need firms is greater in Panel B than in Panel A. Moreover, low hedging need firms in panel B do not show any significant change in profits or profit dispersion between early and later refinancing points.

**4.5 Discussion**

The results presented in Section 4 highlight the monitoring and disciplinary role of debt structure. One of the questions raised by Colla *et al.* (2013) and Rauh and Sufi (2010) is whether the principal function of the structure of debt claims is to mitigate distress costs or to monitor management. The differential sensitivity of short-term debt to profits across high and low hedging need firms indicates that the latter explanation explains variations in the structure of debt claims observed for a large portion of the firms in our sample. Firms with high hedging needs face a high risk of liquidation because they have valuable investment opportunities during low cash flow states. Managers at these firms are willing to bear the monitoring effects of short-term debt and the threat of liquidation risk in exchange for securing future financing during these low cash flow states. We show that the optimal claim structure for these firms emphasizes this trade-off. Moreover, consistent with this monitoring role, we find that borrower and lender interests converge over time across consecutive refinancing points, and this effect is strongest in firms with high information asymmetry and high liquidation costs.

Our findings do not exclude the distress cost explanation for some of the observed debt structures in our sample. For example, we find that the proportion of senior secured claims is greater in the bottom profitability quintile than in the top profitability quintile. This finding is consistent with theories of bank debt that predict secured debt claims are more likely to be issued by firms with a higher likelihood of distress (Berger & Udell 1990). Furthermore, our empirical analysis does not contain information on the number or type of creditors, and this information is likely to be related to the distress costs associated with different types of debt structure (Bolton & Sharfstein 1996). For example, Gilson (1997) finds that the number of long-term debt contracts is negatively related to the reduction in long-term debt in out-of-court restructurings. For both of these reasons, bankruptcy costs explanations of debt structure cannot be excluded.

Our findings on the differential impact of macro-economic variables on high and low hedging need firms are new to the literature. Erel *et al.* (2012) find that debt issuance by investment-grade firms is counter-cyclical, while non-investment grade firms are shut out of public debt markets. They also find that short-term secured lending is more prevalent during economic downturns. Our results indicate that the firm's correlation between cash flows and investment opportunities is an additional determinant of the impact of macro-economic variables on debt issuance. Specifically, macro-economic variables are more important for firms whose cash flows are positively correlated with investments (i.e. firms with low hedging needs).

**V. Conclusion**

This paper develops a theory of liquidity management that describes how firms organize the structure of their debt claims in response to changes in the level of profitability. The theory highlights the disciplinary role of debt for firms whose investment activities coincide with liquidity shocks, i.e. firms with high hedging needs. The model's main prediction is that the proportion of short-term and subordinated debt claims to total assets are more sensitive to profitability for these types of firms compared with firms with high investment cash-flow correlations. An important feature of the model is that the optimal state-contingent liquidity policy involves the use of contingent credit lines and the right to issue subordinated claims. Because credit lines are primarily used to finance immediate investment needs, credit lines are more likely to be revoked when investment activity is high.

We test these predictions using detailed data on the structure of firms' debt claims. Specifically, the main empirical analysis examines changes in debt structure around refinancing points, i.e. points in time at which the firm increases the amount of debt on its balance sheet. We use the sensitivity of each type of debt to profitability as a common metric by which to measure and compare changes in debt structure across firms with high and low hedging needs. We find that the debt structure of firms with high hedging needs is more sensitive to profitability than firms with low hedging needs. This increased sensitivity is most pronounced in the proportions of short-term and subordinated claims.

Further evidence in support of the monitoring role played by debt is provided by the relation between the structure of the firms' debt claims and macro-economic conditions that prevail at a refinancing point. Consistent with the monitoring role played by debt, the debt structure of high hedging need firms shows very little sensitivity to variables that are correlated with firm profits, but over which the manager has little or no control (e.g. macro-economic variables). Contracting theories predict that the choice of debt structure is informative of congruence between borrower and lender incentives in low cash-flow states. We show that high hedging need firms experience greater increases in profitability and larger reductions in profit volatility over time measured between consecutive refinancing points than low hedging need firms. Overall our paper shows that these firms trade-off the monitoring benefits of debt with the risk of liquidation, and that this trade-off explains observed variations in the structure of debt claims when firms reach a refinancing point.

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## Appendix A1

## Model of liquidation and debt structure

This appendix solves the model described in Section II. Based on the assumptions described in that section, the borrower's program is as follows.

$$\max_{\rho^*(.),\Delta(.)\geq 0}\left\{\int_0^{{R_L}^+}\left(\lambda\left[F(\rho^*(R_L))[z[(1+\mu)\rho_1-x]+(1-z)\rho_1+R_L]-\int_0^{\rho^*(R_L)}\rho f(\rho)d\rho\right]\right.\right.$$
$$\left.\left.+(1-\lambda)[h[(1+\mu)\rho_1-x]+(1-h)\rho_1+R_L]]-1\right)g(R_L)dR_L\right\}I \qquad \text{(A1)}$$

Subject to

$$\left\{\int_0^{{R_L}^+}\left(\lambda\left[F(\rho^*(R_L))[z[(1+\mu)\rho_0-x]+(1-z)\rho_0+R_L]-\int_0^{\rho^*(R_L)}\rho f(\rho)d\rho\right]+(1-\lambda)[h[(1+\mu)\rho_0\right.\right.$$
$$\left.\left.-x]+(1-h)\rho_0+R_L]-\Delta(R_L)\right)g(R_L)dR_L\right\}I\geq I-A \qquad \text{(IR)}$$

And

$$\left\{\int_0^{{R_L}^+}[\lambda[F(\rho^*(R_L))(1+z\mu)(\rho_1-\rho_0)]+(1-\lambda)(1+h\mu)(\rho_1-\rho_0)+\Delta(R_L)][g(R_L)-\tilde{g}(R_L)]dR_L\right\}I$$
$$\geq IB_0 \qquad \text{(IC)}$$

$$\rho^*(R_L)\geq\rho_0(1+z\mu)+R_L-xz \qquad \text{(SBC)}$$

According to equation (A1), borrower utility is a function of date-2 returns, conditional on meeting the liquidity shock $\rho$. The borrower's utility equals the project's net present value, because outside investors are assumed to break-even. The present value consists of the expected return conditional on meeting the firm's liquidity needs when there is a liquidity shock plus the expected return when there is no liquidity shock.

Constraint (IR) is the investors' (binding) break-even constraint. According to this constraint, the expected income that accrues to external investors must be greater or equal to the time-0 investment plus the expected liquidity shock. The investors are limited to pledgeable income because the manager receives rents in exchange for putting in effort. Expected income includes the term $\Delta(R_L)$, which is a transfer payment made from the investors to the manager when the liquidation threshold is lowered.

The second constraint represents the borrowers' incentive compatibility constraint, which ensures he chooses first-period income distribution $G(R_L)$ in the first period. According to this constraint, the increase in expected return to the manager from putting effort in the first period must be larger than the benefits $B_0$ from shirking in that period.

The third constraint ensures that re-negotiation of the liquidation rule cannot occur. This is the soft-budget constraint (SBC). Without this constraint, a severe penalty for low performance $R_L$ (severe in the sense that $\rho^*(R_L)<\rho_0(1+z\mu)+R_L-xz$ ) is not credible because the borrower can raise up to

$[\rho_0(1+z\mu)+R_L-xz]I$ by diluting current investors. The soft budget constraint prevents this type of outcome.

The following proposition characterizes the optimal debt structure.

*Proposition 1: The liquidity threshold $\rho^*(R_L)$ is an increasing function of date-2 income $R_L$ for $R_L > R_{L0}$. A cash payment of $\Delta(R_L) > 0$ is made to the entrepreneur if $\rho^*(R_L) = \rho_1(1+z\mu)+R_L-xz$, otherwise $\Delta(R_L)=0$. The optimal debt contract involves subordinated long-term debt or equity, a line of credit and the right to dilute long-term claimants by issuing up to $[\rho_0(1+z\mu)+R_L-xz]I$ in new claims. The borrowing limit $L^*(R_L)$ on the line of credit is a function of $R_L$ and is given by $L^*(R_L)=[\rho^*(R_L)-(\rho_0(1+z\mu)+R_L-xz)]I$ where*

$$\rho^*(R_L) = R_L - xz + \frac{(1+z\mu)(\rho_1+\phi\rho_0)}{1+\phi} + \frac{v(1+z\mu)(\rho_1-\rho_0)\ell(R_L)}{1+\phi}, for\ R_L > R_{L0} \qquad (A2)$$

$$\rho^*(R_L) = \rho_0(1+z\mu)+R_L-xz, for\ R_L \le R_{L0}$$

*and the constants $\phi$ and $v$ are positive and strictly greater than zero.*

*Proof: See Section A2 below.*

The intuition behind proposition 1 is that the revelation of $R_L$ at the end of the first period is informative about managerial effort. Investors use this information to make a liquidation decision, and the liquidation decision is implemented by restricting the amount of credit available at date 1. Liquidation occurs whenever $\rho > \rho^*(R_L)$ because the entrepreneur will not have enough borrowing capacity to meet the liquidity shock.

The moral hazard problem in the second period implies that the firm's cash flows cannot be pledged entirely to outside investors. Thus, conditional on a liquidity shock, the most that can be pledged to outside investors by diluting existing claimants is

$$\rho_0(1+z\mu)+R_L-xz. \qquad (A3)$$

Making long-term claims subordinated allows the entrepreneur to raise up to $[\rho_0(1+z\mu)+R_L-xz]I$ in subordinated claims in response to a liquidity shock. Then $L^*(R_L)$ can be interpreted as the firm's additional short-term debt capacity, conditional on news $R_L$ .The program is then implemented by committing to allowing the entrepreneur to borrow up to $[\rho^*(R_L)-(\rho_0(1+z\mu)+R_L-xz)]I$ on the credit line.

If profits are below $R_{L0}$, total financing capacity is limited to $\rho_0(1+z\mu)+R_L-xz$. One possible interpretation is that the credit line is revoked, and the borrower is limited to what he can raise by diluting existing subordinated claimants.

When the liquidation threshold is too high in relation to the project's present value ($\rho^*(R_L) \ge \rho_1(1+z\mu)+R_L-xz$), continuation is limited to $\rho \le \rho_1(1+z\mu)+R_L-xz$, and the lender compensates the borrower with cash payment $\Delta(R_L) > 0$.

Proposition 1 implies that the maximal amount of debt issued in response to the liquidity shock is more sensitive to $R_L$ for firms whose investments are more likely to arrive in low cash-flow states (as measured with by the parameter $z$). Intuitively, the cost of liquidation for the entrepreneur is greater the greater the likelihood that the liquidity shock is associated with the arrival of an investment opportunity. The entrepreneur values continuation because of the rents earned from the project, and these rents are increasing in the value of the deepening investment, as measured by $R_L$. This prediction is summarizedin the following two corollaries.

*Corollary 1: The sensitivity of short-term debt capacity $L^*(R_L)$ to news $R_L$ is increasing in the value of the probability of arrival z of an investment project in the liquidity shock state.*

Proof: The derivative of $L^{*}(R_L)$ is increasing in $z$, because

$$\frac{\delta L^{*}(R_L)}{\delta R_L} = \frac{v(1+z\mu)(\rho_1-\rho_0)}{1+\phi}\ell'(R_L) > 0. \qquad (A4)$$

The inequality follows from the monotone likelihood property of $\ell$.

*Corollary 2: The sensitivity of subordinated debt capacity to news $R_L$ is increasing in the probability of arrival z of an investment project in the liquidity shock state.*

Proof: According to Proposition 1, the amount of subordinated debt is given by the following expression.

$$Subordinated = \rho_0(1+z\mu) + R_L - xz. \qquad (A5)$$

Taking the derivative with respect to z,

$$\frac{\delta Subordinated}{\delta z} = \rho_0\mu - x \geq 0. \qquad (A6)$$

The inequality sign follows from the assumption that investors must break even on the deepening investment, conditional on no liquidation.

## Appendix A2

### Proof of proposition 1

The first-order condition for the borrower's program is obtained by solving the Lagrangian for $\rho^*(R_L)$. This yields the following equality with non-negative multipliers $\phi$, v and $\gamma$. Because the constraints (IR) and (IC) are always binding, $\phi > 0, v > 0$ and $\gamma \geq 0$.

Solving the first-order conditions for $\rho^*(R_L)$, and $\Delta(R_L)$ yields three different cases.

Case I:

$$\rho^*(R_L) = R_L - xz + \frac{(1+z\mu)(\rho_1 + \phi\rho_0)}{1+\phi} + \frac{v(1+z\mu)(\rho_1 - \rho_0)\ell(R_L)}{1+\phi}, \text{for } R_L > R_{L0},$$

$$\gamma = 0, \phi > 0, v > 0, \Delta(R_L) = 0, v\ell(R_L) \leq \phi \qquad \text{(A7)}$$

Case II:

$$\rho^*(R_L) = \rho_0(1+z\mu) + R_L - xz, \text{for } R_L \leq R_{L0},$$

$$\gamma > 0, \Delta(R_L) = 0, v\ell(R_L) \leq \phi \qquad \text{(A8)}$$

Case III:

$$\Delta(R_L) > 0, \rho^*(R_L) = \rho_1(1+z\mu) + R_L + xz, v\ell(R_L) = \phi, \gamma = 0 \quad \text{(A9)}$$

Case I describes the relation between $R_L$ and the liquidation threshold when $R_L$ is not too low and the liquidation threshold does not exceed expected date-2 profits. It is straightforward to verify that $\rho^*(R_L) \leq \rho_1(1+z\mu) + R_L - xz$ iff $v\ell(R_L) \leq \phi$. Case I can be implemented by allowing the entrepreneur to raise up to $[\rho_0(1+z\mu) + R_L - xz]I$ by diluting existing claimants, and borrowing up to $[\rho^*(R_L) - (\rho_0(1+z\mu) + R_L - xz)]I$ on the credit line.

Case II describes what happens when $R_L$ is low. Define $R_{L0}$ as the profit level below which the soft budget constraint is binding. For $R_L \leq R_{L0}$, the entrepreneur can only raise up to $[\rho_0(1+z\mu) + R_L - xz]I$ in order to meet the liquidity shock. This is implemented by allowing the entrepreneur to dilute existing claimants and revoking the credit line.

Case III describes the case when the liquidation threshold $\rho^*(R_L)$ exceeds the present value of the date-2 cash flow. If $\rho^*(R_L) > \rho_1(1+z\mu) + R_L - xz$ then continuation is suboptimal and it is efficient to set $\rho^*(R_L) = \rho_1(1+z\mu) + R_L - xz$ and compensate the entrepreneur for lowering the liquidation threshold with a payment of $\Delta(R_L) > 0$. In this case the entrepreneur raises $[(\rho_0(1+z\mu) + R_L - xz)]I$ by diluting existing claimants, and borrows from the credit line up to $[\rho_1(1+z\mu) - \rho_0(1+z\mu)]I$.

The amount $\Delta(R_L)$ is determined by lowering $\rho^*(R_L)$ to $\rho_1(1+z\mu) + R_L$-xz and increasing $\Delta(R_L)$ so that the break-even constraint is binding again:

$$\left\{\int_0^{R_L^+}\left[\lambda\int_0^{\rho^*(R_L)}[z[(1+\mu)\rho_0 - x] + (1-z)\rho_0 + R_L]f(\rho)d\rho - \Delta(R_L) + (1-\lambda)[z[(1+\mu)\rho_0 - x] + (1-z)\rho_0 + R_L]\right]g(R_L)dR_L\right\}I = I - A. \qquad (A10)$$

When the soft-budget constraint (SBC) is binding, $\gamma > 0$ and $R_{L0}$ is implicitly defined by the following equality.

$$\rho^*(R_{L0}) = R_{L0} - xz + \frac{(1+z\mu)(\rho_1 + \phi\rho_0)}{1+\phi} + \frac{v(1+z\mu)(\rho_1 - \rho_0)\ell(R_L)}{1+\phi} + \frac{\gamma}{1+\phi}$$
$$= \rho_0(1+z\mu) + R_{L0} - xz$$

which reduces to,

$$\frac{(1+z\mu)(\rho_1 + \phi\rho_0)}{1+\phi} + \frac{v(1+z\mu)(\rho_1 - \rho_0)\ell(R_L)}{1+\phi} + \frac{\gamma}{1+\phi} = \rho_0(1+z\mu). \qquad (A11)$$

**Figure 1: Timeline of events**

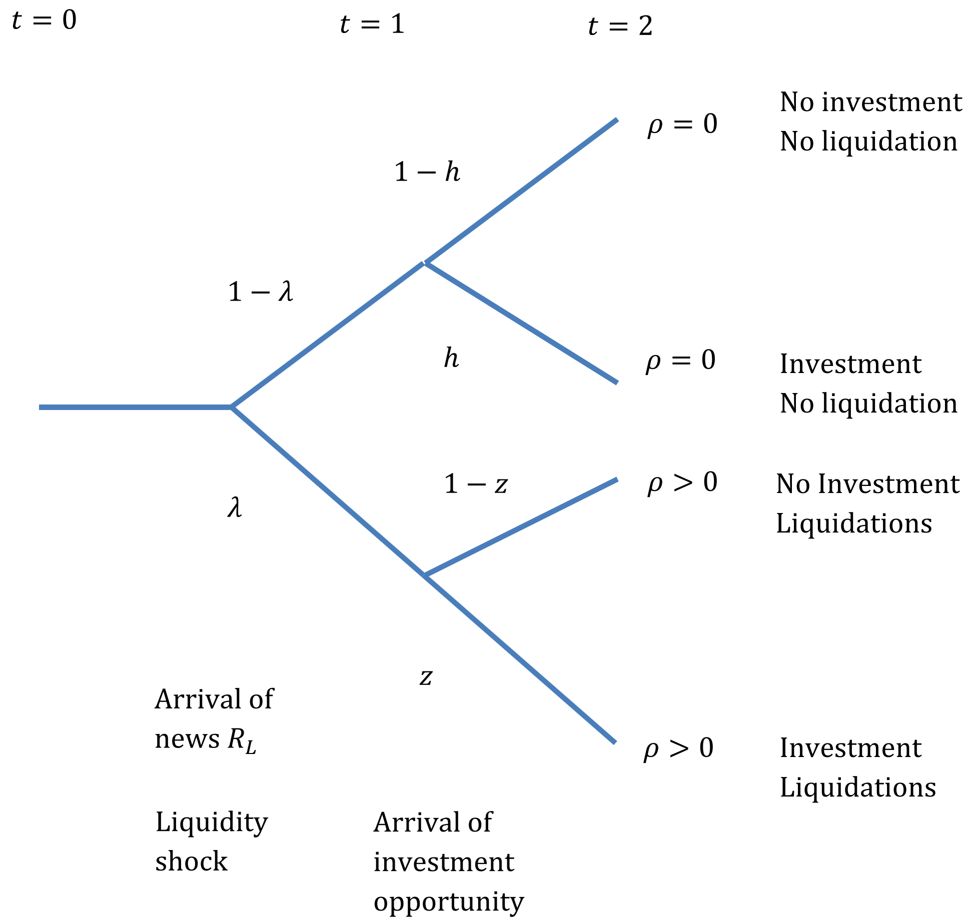
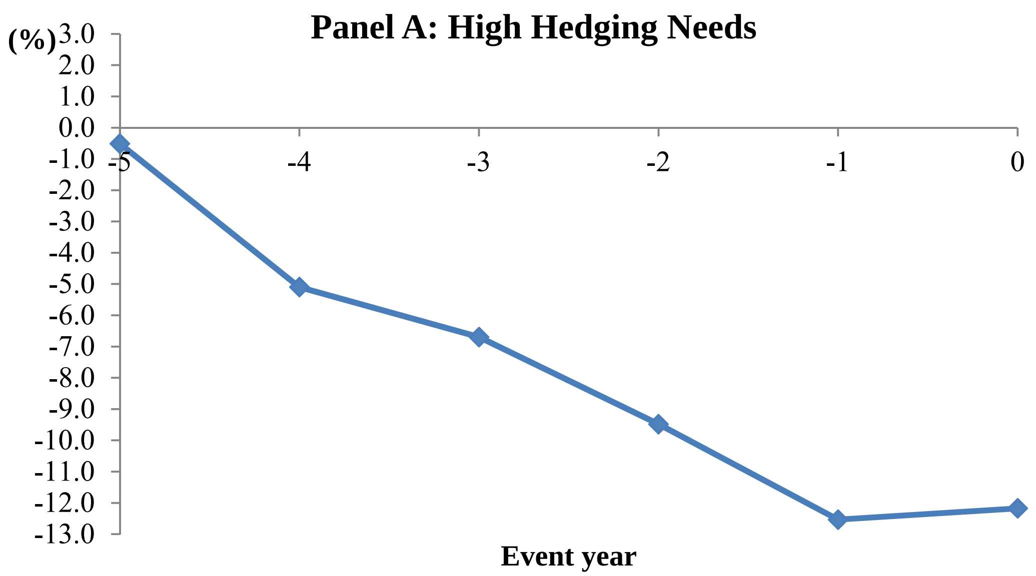


**Figure 2: Operating Cash Flow minus Investment over Event Year**

This figure plots cash flow from continuous operations net of investment over event years splitting the same by hedging-needs. Event year 0 is the refinancing point defined as change of total debt (net of cash) is higher than 5% of lagged total assets. Event years -5 to -1 are ten years to one year prior refinancing points, respectively. Detailed definitions are shown Appendix C.



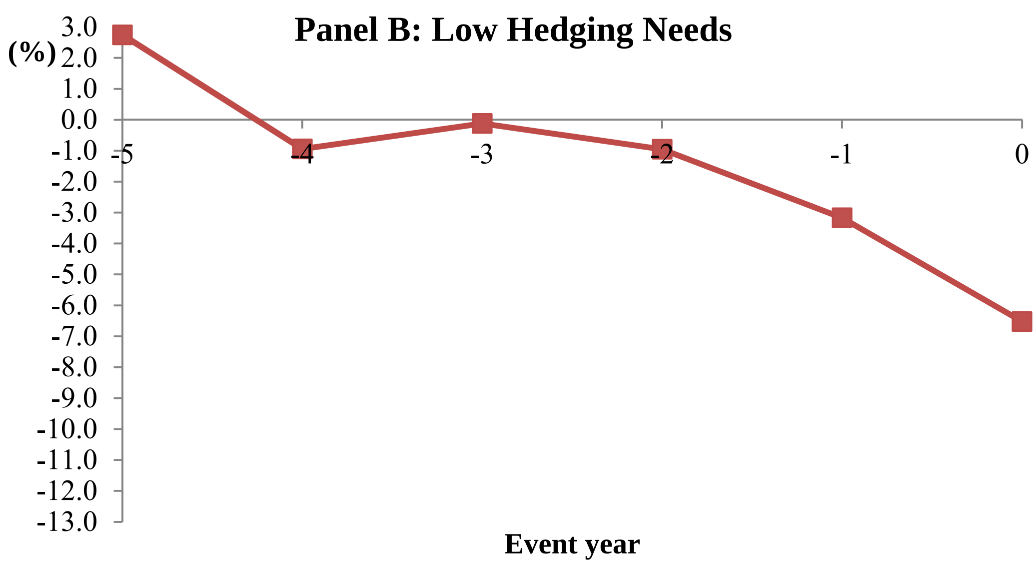
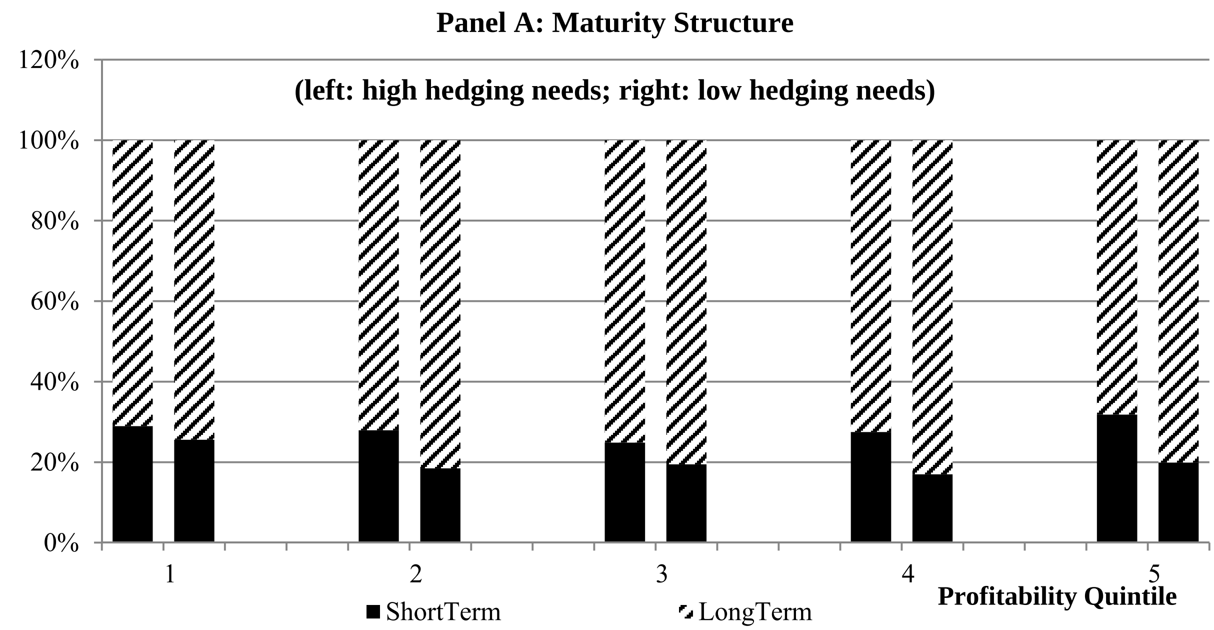



**Figure 3: Debt Maturity and Priority Structure by Profitability Quintiles**

In this figure, we divide the sample firms at debt refinancing points into quintiles based on year-beginning profitability. Then conditional on hedging needs, we examine the average percentage of short-term debt (or long-term debt, senior secured debt, senior unsecured debt, or subordinated debt) relative to total debt within each profitability quintile. Panel A presents average maturity structure, and Panel B presents average priority structure.



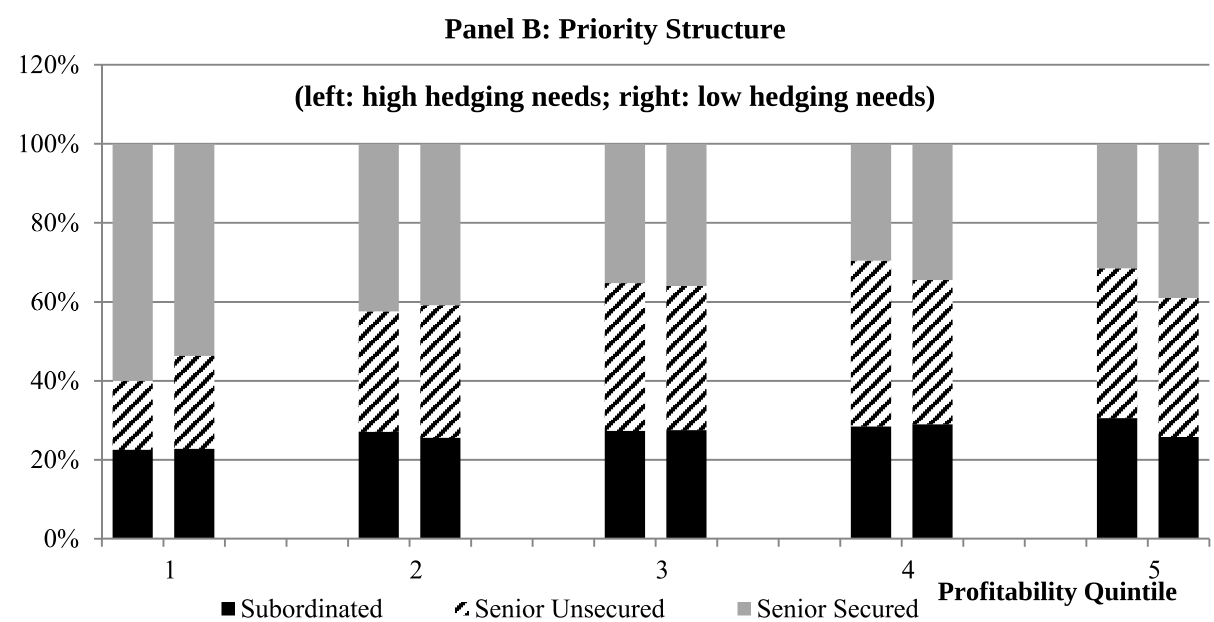



**Table 1: Sample Overview**

Panel A presents summary statistics across all years for our sample including 15,836 firm-year observations for 2,192 non-financial and non-utility firms traded on the Amex, Nasdaq, and NYSE without missing value of debt composition and financial information from year 2002 to 2012. To make sure our sample is representative, Panel B presents mean and median of some main firm characteristics for sample firms in Colla, Ippolito and Li (2013) paper and Compustat-leveraged firms. The numbers reported are directly retrieved from Colla, Ippolito and Li (2013). In this table, debt components are scaled by total debt, denoting the proportion of different kinds of debt in total debt. All variables are in decimal, and their definitions are in Appendix C.

| Panel A: Summary Statistics | | | | | |
|---|---|---|---|---|---|
| variable | Mean | Std.Dev | Min | Median | Max |
| ShortTerm | 0.25 | 0.29 | 0.00 | 0.13 | 1.00 |
| LongTerm | 0.75 | 0.29 | 0.00 | 0.87 | 1.00 |
| SrSc | 0.41 | 0.43 | 0.00 | 0.20 | 1.00 |
| SrUnSc | 0.32 | 0.39 | 0.00 | 0.01 | 1.00 |
| Sub | 0.27 | 0.36 | 0.00 | 0.05 | 1.00 |
| Bank | 0.42 | 0.41 | 0.00 | 0.28 | 1.00 |
| Bond | 0.20 | 0.35 | 0.00 | 0.00 | 1.00 |
| NonBank | 0.58 | 0.41 | 0.00 | 0.72 | 1.00 |
| BLev | 0.24 | 0.19 | 0.00 | 0.21 | 0.94 |
| MLev | 0.23 | 0.21 | 0.00 | 0.17 | 0.90 |
| Real Total Assets | 713.95 | 758.72 | 8.23 | 725.48 | 96372.50 |
| MB | 1.56 | 1.22 | 0.32 | 1.18 | 7.67 |
| ROA | 0.09 | 0.18 | -0.88 | 0.12 | 0.41 |
| TANG | 0.29 | 0.24 | 0.01 | 0.21 | 0.91 |
| RD | 0.04 | 0.10 | 0.00 | 0.00 | 0.63 |
| Dum_Dividend | 0.46 | 0.50 | 0.00 | 0.00 | 1.00 |
| Dum_Rating | 0.39 | 0.49 | 0.00 | 0.00 | 1.00 |
| Med_Lev | 0.16 | 0.09 | 0.02 | 0.16 | 0.48 |

| | CIL(2013) | | Compustat | |
|---|---|---|---|---|
| | Mean | Median | Mean | Median |
| MB | 1.50 | 1.15 | 1.50 | 1.14 |
| ROA | 0.09 | 0.11 | 0.08 | 0.11 |
| Tang | 0.29 | 0.21 | 0.29 | 0.21 |
| MLev | 0.25 | 0.20 | 0.25 | 0.19 |
| Obs | 16115 | | 18164 | |

**Table 2: Frequency of Refinancing Points**

This table counts the number of refinancing firms each year in our sample. Column 2 shows the number of total observations each year. Column 3 to Column 5 show the number of firms that change of total debt (net of cash) scaled by lagged total assets is not less than 3%, 5%, or 7%, respectively.

| | | Different cutoffs for Δ(debt-cash) | | |
|---|---|---|---|---|
| year | # of obs | >=3% | >=5% | >=7% |
| 2002 | 1089 | - | - | - |
| 2003 | 1211 | 473 | 389 | 337 |
| 2004 | 1249 | 490 | 411 | 340 |
| 2005 | 1319 | 505 | 420 | 339 |
| 2006 | 1422 | 616 | 517 | 437 |
| 2007 | 1505 | 654 | 558 | 477 |
| 2008 | 1538 | 570 | 463 | 385 |
| 2009 | 1539 | 542 | 453 | 371 |
| 2010 | 1638 | 632 | 511 | 417 |
| 2011 | 1719 | 644 | 537 | 459 |
| 2012 | 1607 | 735 | 596 | 497 |
| Total | 15836 | 5861 | 4855 | 4059 |

**Table 3: Funding Uses Comparison**

This table divides the entire sample into four groups based on hedging needs and profitability, and compares funding uses between refinancing points and non-refinancing points within each sub-group. Refinancing points are the observations that change in total debt (net of cash) scaled by lagged total assets is not less than 5%. Hedging needs are identified by 3-digit industry annual average investment-cash flow correlation: High hedging needs firms are those with lower than median industry investment-cash flow correlation, and low hedging need firms are those with higher than median industry investment-cash flow correlation. Profitability is identified by firm ROA at the beginning of a given year: high profitability firms are those with higher than median ROA, and low profitability firms are those with lower than median ROA. Funding uses variables are in decimal, and detailed definitions of relevant variables are in Appendix C. ***, **, and * denote the significance level of 1%, 5%, and 10%, respectively.

| Panel A: High Hedging Needs--Low Investment-Cash flow Correlation | | | | | | |
|---|---|---|---|---|---|---|
| | High Profitability | | | Low Profitability | | |
| Variables | Non-ref | Ref | Diff | Non-ref | Ref | Diff |
| Payout | 0.046 | 0.029 | -0.017*** | -0.029 | -0.292 | -0.263*** |
| Investment | 0.094 | 0.149 | 0.055*** | 0.113 | 0.181 | 0.068*** |
| CAPX | 0.051 | 0.047 | -0.004*** | 0.032 | 0.036 | 0.004** |
| ΔCash | -0.012 | 0.082 | 0.094*** | -0.052 | 0.261 | 0.313*** |
| OCF-Investment | 0.030 | -0.024 | -0.054*** | -0.142 | -0.202 | -0.059*** |
| # of obs | 1738 | 1049 | | 1869 | 896 | |

| Panel B: Low Hedging Needs--High Investment-Cash flow Correlation | | | | | | |
|---|---|---|---|---|---|---|
| | High Profitability | | | Low Profitability | | |
| Variables | Non-ref | Ref | Diff | Non-ref | Ref | Diff |
| Payout | 0.036 | 0.021 | -0.014** | -0.004 | -0.073 | -0.069*** |
| Investment | 0.097 | 0.171 | 0.074*** | 0.070 | 0.137 | 0.067*** |
| CAPX | 0.079 | 0.101 | 0.021*** | 0.050 | 0.069 | 0.019*** |
| ΔCash | -0.009 | 0.063 | 0.072*** | -0.022 | 0.145 | 0.168*** |
| OCF-Investment | 0.039 | -0.037 | -0.076*** | -0.020 | -0.092 | -0.072*** |
| # of obs | 1706 | 1154 | | 1830 | 883 | |

**Table 4: Debt Structure Comparison**

This table divides the entire sample into four groups based on hedging needs and profitability, and compares debt structure between refinancing points and non-refinancing points within each sub-group. Refinancing points are the observations that change in total debt (net of cash) scaled by lagged total assets is not less than 5%. Hedging needs are identified by 3-digit industry annual average investment-cash flow correlation: High hedging needs firms are those with lower than median industry investment-cash flow correlation, and low hedging need firms are those with higher than median industry investment-cash flow correlation. Profitability is identified by firm ROA at the beginning of a given year: high profitability firms are those with higher than median ROA, and low profitability firms are those with lower than median ROA. Debt structure variables are scaled by total capital and are denoted in percentage. Detailed definitions of relevant variables are in Appendix C. ***, **, and * denote the significance level of 1%, 5%, and 10%, respectively.

| Panel A: High Hedging Needs--Low Investment-Cash flow Correlation | | | | | | |
|---|---|---|---|---|---|---|
| | High Profitability | | | Low Profitability | | |
| Variables | Non-ref | Ref | Diff | Non-ref | Ref | Diff |
| Leverage | 21.631 | 23.198 | 1.567** | 22.740 | 23.187 | 0.447 |
| ShortTerm | 6.934 | 8.275 | 1.341*** | 9.474 | 10.372 | 0.898 |
| LongTerm | 22.893 | 23.013 | 0.121 | 19.208 | 19.001 | -0.207 |
| Senior Secured | 7.399 | 8.399 | 1.000* | 12.202 | 12.480 | 0.278 |
| Senior Unsecured | 15.037 | 14.130 | -0.906 | 9.465 | 9.366 | -0.099 |
| Subordinated | 7.145 | 8.807 | 1.662*** | 7.073 | 7.579 | 0.507 |
| # of obs | 1738 | 1049 | | 1869 | 896 | |

| Panel B: Low Hedging Needs--High Investment-Cash flow Correlation | | | | | | |
|---|---|---|---|---|---|---|
| | High Profitability | | | Low Profitability | | |
| Variables | Non-ref | Ref | Diff | Non-ref | Ref | Diff |
| Leverage | 25.706 | 29.235 | 3.529*** | 25.555 | 29.330 | 3.775*** |
| ShortTerm | 6.389 | 7.076 | 0.687* | 7.878 | 9.679 | 1.801*** |
| LongTerm | 26.617 | 30.328 | 3.711*** | 26.963 | 28.487 | 1.524 |
| Senior Secured | 10.415 | 13.407 | 2.992*** | 12.709 | 16.569 | 3.860*** |
| Senior Unsecured | 14.397 | 14.097 | -0.300 | 13.761 | 12.633 | -1.128 |
| Subordinated | 8.042 | 9.865 | 1.823*** | 8.339 | 9.026 | 0.687 |
| # of obs | 1706 | 1154 | | 1830 | 883 | |

**Table 5: Issuance Activities At Refinancing Points**

This table analyzes the debt issuance activities at refinancing points. Following Table 4, we identify firms with high or low hedging needs and firms with high or low profitability at refinancing points. For a given firm at a given refinancing point, we calculate the issuance of each debt component from t-1 to t scaled by total capital at t-1. Then we calculate the average value within each sub-group based on hedging needs and profitability. Profitability is identified by firm ROA at the beginning of a given year: high profitability firms are those with higher than median ROA, and low profitability firms are those with lower than median ROA. Then, within high or low hedging need firms, we compare the average issuance between high profitability and low profitability groups. Detailed definitions of relevant variables are in Appendix C. ***, **, and * denote the significance level of 1%, 5%, and 10%, respectively.

| Panel A: High Hedging Needs--Low Investment-Cash flow Correlation | | | |
|---|---|---|---|
| | High Profitability | Low Profitability | Difference |
| ShortTerm | 3.703 | 2.341 | 1.363*** |
| LongTerm | 13.462 | 14.516 | -1.053 |
| Senior Secured | 5.393 | 9.041 | -3.649 |
| Senior Unsecured | 7.442 | 5.231 | 2.211 |
| Subordinated | 5.327 | 2.928 | 2.399*** |
| **Panel B: Low Hedging Needs--High Investment-Cash flow Correlation** | | | |
| | High Profitability | Low Profitability | Difference |
| ShortTerm | 5.934 | 4.889 | 1.045 |
| LongTerm | 16.826 | 18.018 | -1.192 |
| Senior Secured | 9.316 | 9.833 | -0.517 |
| Senior Unsecured | 8.544 | 7.450 | 1.094 |
| Subordinated | 5.129 | 6.594 | -1.465 |

**Table 6: Debt Structure at Refinancing Points--Based on Hedging Needs and Profitability**

This table offers regression results about debt structure change at refinancing points comparable to the summary statistics in Table 4. We divide the entire sample into two groups based on hedging needs, identified by 3-digit industry annual average investment-cash flow correlation: High hedging needs firms are those with lower than median industry investment-cash flow correlation (Panel A), and low hedging need firms are whose with higher than median industry investment-cash flow correlation (Panel B). Panel C tests the statistical difference in the interaction term between refinance dummy and ROA. Debt structure variables are scaled by total capital. We use Tobit model. Explanatory variables include refinancing dummy and its interaction with ROA, other firm characteristics (MB, ln(real total assets), tangibility, R&D expenses, dividend dummy, rating dummy, median industry leverage) and macro-economic conditions (default spread, term spread, real interest rate, real market return, GDP growth). Refinancing points are the observations that change in total debt (net of cash) scaled by lagged total assets is not less than 5%. Firm characteristics are lagged by one year, and macro-economic conditions are at the current year. Except for dummies and MB ratio, all other variables are in percentage. Detailed definitions of relevant variables are in Appendix C. ***, **, and * denote the significance level of 1%, 5%, and 10%, respectively.

| Panel A: High Hedging Needs--Low Investment-Cash flow Correlation | | | | | | |
|---|---|---|---|---|---|---|
| | Leverage | ShortTerm | LongTerm | Senior Secured | Senior Unsecured | Subordinated |
| Refinance | 1.733*** | 0.335 | 2.892*** | 0.047 | 3.043*** | 1.607*** |
| | (0.301) | (0.336) | (0.444) | (0.438) | (0.564) | (0.427) |
| ROA | -0.160*** | -0.082*** | -0.124*** | -0.091*** | -0.144*** | -0.041* |
| | (0.016) | (0.017) | (0.024) | (0.023) | (0.031) | (0.023) |
| Refinance*ROA | 0.087*** | 0.075*** | 0.034 | 0.069*** | -0.003 | 0.053** |
| | (0.013) | (0.015) | (0.021) | (0.020) | (0.029) | (0.021) |
| DefaultSpread | -0.135 | 0.699 | -0.517 | 5.477*** | -3.856*** | -3.170*** |
| | (0.689) | (0.760) | (0.986) | (1.015) | (1.136) | (0.902) |
| TermSpread | -1.102*** | -0.048 | -1.164** | -1.327** | -1.861*** | 1.126** |
| | (0.373) | (0.411) | (0.532) | (0.541) | (0.606) | (0.492) |
| Real Interest Rate | -0.754*** | 0.145 | -0.954*** | -1.843*** | -1.474*** | 1.885*** |
| | (0.194) | (0.211) | (0.274) | (0.278) | (0.311) | (0.255) |
| Real Market Return | -0.043*** | -0.028*** | -0.043*** | -0.036*** | 0.002 | -0.045*** |
| | (0.008) | (0.009) | (0.011) | (0.011) | (0.013) | (0.010) |
| H-P LogGDP | -0.235 | 0.192 | -0.223 | 2.056*** | -1.041* | -1.300*** |
| | (0.338) | (0.371) | (0.482) | (0.495) | (0.558) | (0.440) |
| Firm Controls | | | | Included | | |
| N | 5781 | 5434 | 5434 | 5552 | 5552 | 5552 |
| Nfirms | 798 | 787 | 787 | 792 | 792 | 792 |

| Panel B: Low Hedging Needs--High Investment-Cash flow Correlation | | | | | | |
|---|---|---|---|---|---|---|
| | Leverage | ShortTerm | LongTerm | Senior Secured | Senior Unsecured | Subordinated |
| Refinance | 3.170*** | 0.623 | 3.245*** | 2.441*** | 1.915** | 1.625** |
| | (0.383) | (0.439) | (0.562) | (0.619) | (0.754) | (0.758) |
| ROA | -0.199*** | -0.082*** | -0.204*** | -0.133*** | -0.106*** | -0.007 |
| | (0.020) | (0.022) | (0.029) | (0.032) | (0.038) | (0.032) |
| Refinance*ROA | 0.045** | 0.025 | 0.073** | 0.034 | 0.023 | -0.011 |
| | (0.021) | (0.025) | (0.032) | (0.035) | (0.045) | (0.030) |
| DefaultSpread | 0.962 | -0.190 | 0.070 | 5.180*** | -5.422*** | -2.184* |
| | (0.681) | (0.768) | (0.961) | (1.132) | (1.134) | (1.316) |
| TermSpread | -0.618* | 0.079 | -0.696 | -1.136* | -2.068*** | 2.315*** |
| | (0.353) | (0.403) | (0.500) | (0.581) | (0.583) | (0.702) |
| Real Interest Rate | -0.261 | 0.208 | -0.392 | -1.507*** | -1.510*** | 2.733*** |
| | (0.178) | (0.201) | (0.251) | (0.289) | (0.291) | (0.340) |
| Real Market Return | -0.041*** | -0.013 | -0.037*** | -0.055*** | 0.021* | -0.017 |
| | (0.007) | (0.009) | (0.011) | (0.012) | (0.013) | (0.015) |
| H-P LogGDP | 0.078 | -0.281 | -0.157 | 1.665*** | -1.574*** | -1.195* |
| | (0.334) | (0.379) | (0.473) | (0.557) | (0.557) | (0.654) |
| Firm Controls | | | | Included | | |
| N | 5744 | 5495 | 5495 | 5573 | 5573 | 5573 |
| Nfirms | 750 | 743 | 743 | 746 | 746 | 746 |
| Panel C: Difference in the Coefficient of "Refinance*ROA" (T-value) | | | | | | |
| t-value | 1.701* | 1.715* | -1.019 | 0.868 | -0.486 | 1.748* |

**Table 7: Effect of Macro-economic Conditions**

In this table, the regression models are the same as in Table 6, except that we add an additional interaction term between refinancing dummy and a given macro-economic variable in each panel. From Panel A to Panel E, the added macro-economic condition is default spread, term spread, real interest rate, real market return, or GDP growth measure, respectively. To save space, we only present the coefficients on refinancing dummy, profitability, macro-economic conditions, and their interaction terms. Detailed definitions of relevant variables are in Appendix C. ***, **, and * denote the significance level of 1%, 5%, and 10%, respectively.

| Panel A: MacroVar=GDP Growth Measure (H-P LogGDP) | | | | | | |
|---|---|---|---|---|---|---|
| | Leverage | ShortTerm | LongTerm | Senior Secured | Senior Unsecured | Subordinated |
| *High Hedging Needs-Low Investment-Cash flow Correlation* | | | | | | |
| Refinance | 1.719*** | 0.340 | 2.856*** | 0.029 | 3.039*** | 1.597*** |
| | (0.301) | (0.336) | (0.444) | (0.438) | (0.564) | (0.427) |
| ROA | -0.160*** | -0.082*** | -0.122*** | -0.091*** | -0.144*** | -0.041* |
| | (0.016) | (0.017) | (0.024) | (0.023) | (0.031) | (0.023) |
| Refinance*ROA | 0.087*** | 0.075*** | 0.033 | 0.068*** | -0.003 | 0.053** |
| | (0.013) | (0.015) | (0.021) | (0.020) | (0.029) | (0.021) |
| MacroVar | -0.335 | 0.218 | -0.466 | 1.910*** | -1.067* | -1.353*** |
| | (0.347) | (0.381) | (0.496) | (0.508) | (0.574) | (0.453) |
| Refinance*MacroVar | 0.281 | -0.071 | 0.665** | 0.409 | 0.070 | 0.148 |
| | (0.221) | (0.243) | (0.315) | (0.322) | (0.366) | (0.290) |
| *Low Hedging Needs-High Investment-Cash flow Correlation* | | | | | | |
| Refinance | 3.138*** | 0.604 | 3.212*** | 2.418*** | 1.928** | 1.577** |
| | (0.383) | (0.439) | (0.562) | (0.619) | (0.754) | (0.757) |
| ROA | -0.197*** | -0.081*** | -0.201*** | -0.131*** | -0.107*** | -0.004 |
| | (0.020) | (0.022) | (0.029) | (0.032) | (0.038) | (0.032) |
| Refinance*ROA | 0.043** | 0.023 | 0.069** | 0.031 | 0.024 | -0.016 |
| | (0.021) | (0.025) | (0.032) | (0.036) | (0.045) | (0.031) |
| MacroVar | -0.177 | -0.414 | -0.464 | 1.394** | -1.439** | -1.621** |
| | (0.345) | (0.391) | (0.488) | (0.575) | (0.576) | (0.672) |
| Refinance*MacroVar | 0.614*** | 0.335 | 0.763** | 0.658* | -0.329 | 1.080*** |
| | (0.213) | (0.242) | (0.301) | (0.352) | (0.357) | (0.403) |
| *Difference in the Coefficient of "Refinance*ROA" (T-value)* | | | | | | |
| t-value | 1.782* | 1.784* | -0.941 | 0.898 | -0.504 | 1.843* |
| *Difference in the coefficient of "Refinance*MacroVar" (T-value)* | | | | | | |
| t-value | -1.085 | -1.184 | -0.225 | -0.522 | 0.780 | -1.877* |

| Panel B: MacroVar=Default Spread | | | | | | |
|---|---|---|---|---|---|---|
| | Leverage | ShortTerm | LongTerm | Senior Secured | Senior Unsecured | Subordinated |
| *High Hedging Needs-Low Investment-Cash flow Correlation* | | | | | | |
| Refinance | 1.224 | -0.131 | 3.308*** | 0.516 | 1.864 | 1.553 |
| | (0.858) | (0.947) | (1.228) | (1.255) | (1.440) | (1.135) |
| ROA | -0.160*** | -0.082*** | -0.123*** | -0.091*** | -0.144*** | -0.041* |
| | (0.016) | (0.017) | (0.024) | (0.023) | (0.031) | (0.023) |
| Refinance*ROA | 0.087*** | 0.075*** | 0.034 | 0.068*** | -0.003 | 0.053** |
| | (0.013) | (0.015) | (0.021) | (0.020) | (0.029) | (0.021) |
| MacroVar | -0.268 | 0.575 | -0.407 | 5.601*** | -4.172*** | -3.185*** |
| | (0.721) | (0.795) | (1.032) | (1.062) | (1.190) | (0.944) |
| Refinance*MacroVar | 0.429 | 0.393 | -0.350 | -0.394 | 0.997 | 0.046 |
| | (0.678) | (0.747) | (0.966) | (0.986) | (1.120) | (0.692) |
| *Low Hedging Needs-High Investment-Cash flow Correlation* | | | | | | |
| Refinance | 4.319*** | 1.196 | 5.346*** | 4.544*** | 1.983 | 4.364*** |
| | (0.850) | (0.966) | (1.210) | (1.402) | (1.467) | (1.623) |
| ROA | -0.198*** | -0.082*** | -0.204*** | -0.133*** | -0.106*** | -0.007 |
| | (0.020) | (0.022) | (0.029) | (0.032) | (0.038) | (0.032) |
| Refinance*ROA | 0.046** | 0.025 | 0.073** | 0.034 | 0.023 | -0.010 |
| | (0.021) | (0.025) | (0.032) | (0.035) | (0.045) | (0.030) |
| MacroVar | 1.267* | -0.032 | 0.647 | 5.760*** | -5.404*** | -1.423 |
| | (0.710) | (0.803) | (1.005) | (1.184) | (1.185) | (1.374) |
| Refinance*MacroVar | -0.976 | -0.490 | -1.789* | -1.778* | -0.059 | -2.342* |
| | (0.645) | (0.736) | (0.913) | (1.064) | (1.087) | (1.227) |
| *Difference in the Coefficient of "Refinance*ROA" (T-value)* | | | | | | |
| t-value | 1.660* | 1.715* | -1.019 | 0.843 | -0.486 | 1.720* |
| *Difference in the coefficient of "Refinance*MacroVar" (T-value)* | | | | | | |
| t-value | 1.501 | 0.842 | 1.273 | 0.954 | 0.677 | 1.695* |

| Panel C: MacroVar=Term Spread | | | | | | |
|---|---|---|---|---|---|---|
| | Leverage | ShortTerm | LongTerm | Senior Secured | Senior Unsecured | Subordinated |
| *High Hedging Needs-Low Investment-Cash flow Correlation* | | | | | | |
| Refinance | 2.342*** | 0.124 | 4.217*** | 0.881 | 3.407*** | 1.874*** |
| | (0.535) | (0.590) | (0.772) | (0.784) | (0.923) | (0.717) |
| ROA | -0.160*** | -0.082*** | -0.122*** | -0.090*** | -0.144*** | -0.041* |
| | (0.016) | (0.017) | (0.024) | (0.023) | (0.031) | (0.023) |
| Refinance*ROA | 0.087*** | 0.075*** | 0.033 | 0.068*** | -0.003 | 0.053** |
| | (0.013) | (0.015) | (0.021) | (0.020) | (0.029) | (0.021) |
| MacroVar | -0.975** | -0.092 | -0.892 | -1.149** | -1.788*** | 1.181** |
| | (0.384) | (0.423) | (0.547) | (0.559) | (0.623) | (0.506) |
| Refinance*MacroVar | -0.343 | 0.120 | -0.749** | -0.470 | -0.205 | -0.152 |
| | (0.250) | (0.275) | (0.357) | (0.367) | (0.411) | (0.327) |
| *Low Hedging Needs-High Investment-Cash flow Correlation* | | | | | | |
| Refinance | 4.425*** | 1.347** | 4.622*** | 3.625*** | 0.850 | 3.886*** |
| | (0.577) | (0.658) | (0.834) | (0.950) | (1.062) | (1.117) |
| ROA | -0.195*** | -0.080*** | -0.200*** | -0.130*** | -0.109*** | -0.001 |
| | (0.020) | (0.022) | (0.029) | (0.032) | (0.038) | (0.032) |
| Refinance*ROA | 0.040* | 0.022 | 0.066** | 0.029 | 0.029 | -0.021 |
| | (0.021) | (0.025) | (0.033) | (0.036) | (0.045) | (0.033) |
| MacroVar | -0.374 | 0.221 | -0.429 | -0.902 | -2.271*** | 2.744*** |
| | (0.362) | (0.414) | (0.514) | (0.598) | (0.600) | (0.719) |
| Refinance*MacroVar | -0.697*** | -0.402 | -0.756** | -0.652 | 0.568 | -1.241*** |
| | (0.239) | (0.272) | (0.339) | (0.397) | (0.399) | (0.450) |
| *Difference in the Coefficient of "Refinance*ROA" (T-value)* | | | | | | |
| t-value | 1.903* | 1.818* | -0.844 | 0.947 | -0.598 | 1.892* |
| *Difference in the coefficient of "Refinance*MacroVar" (T-value)* | | | | | | |
| t-value | 1.024 | 1.350 | 0.014 | 0.337 | -1.349 | 1.958* |

| Panel D: MacroVar=Real Interest Rate | | | | | | |
|---|---|---|---|---|---|---|
| | Leverage | ShortTerm | LongTerm | Senior Secured | Senior Unsecured | Subordinated |
| *High Hedging Needs-Low Investment-Cash flow Correlation* | | | | | | |
| Refinance | 1.861*** | 0.513 | 2.655*** | -0.220 | 3.482*** | 1.514*** |
| | (0.423) | (0.471) | (0.616) | (0.614) | (0.746) | (0.585) |
| ROA | -0.160*** | -0.082*** | -0.123*** | -0.091*** | -0.144*** | -0.041* |
| | (0.016) | (0.017) | (0.024) | (0.023) | (0.031) | (0.023) |
| Refinance*ROA | 0.087*** | 0.075*** | 0.034 | 0.068*** | -0.003 | 0.053** |
| | (0.013) | (0.015) | (0.021) | (0.020) | (0.029) | (0.021) |
| MacroVar | -0.730*** | 0.178 | -0.998*** | -1.893*** | -1.392*** | 1.868*** |
| | (0.201) | (0.220) | (0.286) | (0.290) | (0.324) | (0.265) |
| Refinance*MacroVar | -0.069 | -0.095 | 0.127 | 0.145 | -0.236 | 0.049 |
| | (0.160) | (0.158) | (0.228) | (0.234) | (0.263) | (0.175) |
| *Low Hedging Needs-High Investment-Cash flow Correlation* | | | | | | |
| Refinance | 2.977*** | 0.091 | 2.924*** | 1.684** | 2.594*** | 0.543 |
| | (0.471) | (0.540) | (0.681) | (0.763) | (0.868) | (0.913) |
| ROA | -0.198*** | -0.080*** | -0.203*** | -0.130*** | -0.110*** | -0.003 |
| | (0.020) | (0.022) | (0.029) | (0.032) | (0.038) | (0.032) |
| Refinance*ROA | 0.044** | 0.022 | 0.071** | 0.031 | 0.028 | -0.016 |
| | (0.021) | (0.025) | (0.033) | (0.036) | (0.045) | (0.031) |
| MacroVar | -0.303 | 0.095 | -0.463* | -1.676*** | -1.355*** | 2.482*** |
| | (0.187) | (0.212) | (0.265) | (0.306) | (0.307) | (0.360) |
| Refinance*MacroVar | 0.106 | 0.290* | 0.178 | 0.423* | -0.396 | 0.602** |
| | (0.151) | (0.172) | (0.213) | (0.249) | (0.251) | (0.284) |
| *Difference in the Coefficient of "Refinance*ROA" (T-value)* | | | | | | |
| t-value | 1.741* | 1.818* | -0.946 | 0.898 | -0.579 | 1.843* |
| *Difference in the coefficient of "Refinance*MacroVar" (T-value)* | | | | | | |
| t-value | -0.795 | -1.648* | -0.163 | -0.814 | 0.440 | -1.658* |

| Panel E: MacroVar=Real Market Return | | | | | | |
|---|---|---|---|---|---|---|
| | Leverage | ShortTerm | LongTerm | Senior Secured | Senior Unsecured | Subordinated |
| *High Hedging Needs-Low Investment-Cash flow Correlation* | | | | | | |
| Refinance | 1.993*** | 0.358 | 3.347*** | 0.345 | 3.027*** | 1.799*** |
| | (0.312) | (0.348) | (0.459) | (0.454) | (0.583) | (0.440) |
| ROA | -0.160*** | -0.082*** | -0.123*** | -0.091*** | -0.144*** | -0.041* |
| | (0.016) | (0.017) | (0.024) | (0.023) | (0.031) | (0.023) |
| Refinance*ROA | 0.086*** | 0.075*** | 0.032 | 0.067*** | -0.003 | 0.053** |
| | (0.013) | (0.015) | (0.021) | (0.020) | (0.029) | (0.021) |
| MacroVar | -0.028*** | -0.027*** | -0.015 | -0.018 | 0.001 | -0.033*** |
| | (0.009) | (0.010) | (0.013) | (0.014) | (0.015) | (0.012) |
| Refinance*MacroVar | -0.050*** | -0.004 | -0.088*** | -0.058** | 0.003 | -0.037* |
| | (0.016) | (0.018) | (0.023) | (0.023) | (0.026) | (0.021) |
| *Low Hedging Needs-High Investment-Cash flow Correlation* | | | | | | |
| Refinance | 3.355*** | 0.565 | 3.534*** | 2.679*** | 1.665** | 1.711** |
| | (0.392) | (0.450) | (0.576) | (0.634) | (0.773) | (0.775) |
| ROA | -0.197*** | -0.082*** | -0.202*** | -0.131*** | -0.108*** | -0.006 |
| | (0.020) | (0.022) | (0.029) | (0.032) | (0.038) | (0.032) |
| Refinance*ROA | 0.042** | 0.026 | 0.067** | 0.030 | 0.028 | -0.012 |
| | (0.021) | (0.025) | (0.033) | (0.036) | (0.045) | (0.030) |
| MacroVar | -0.030*** | -0.016 | -0.020 | -0.040*** | 0.009 | -0.012 |
| | (0.009) | (0.010) | (0.013) | (0.015) | (0.015) | (0.017) |
| Refinance*MacroVar | -0.033** | 0.010 | -0.048** | -0.043* | 0.037 | -0.015 |
| | (0.015) | (0.017) | (0.021) | (0.024) | (0.025) | (0.028) |
| *Difference in the Coefficient of "Refinance*ROA" (T-value)* | | | | | | |
| t-value | 1.782* | 1.681* | -0.895 | 0.898 | -0.579 | 1.775* |
| *Difference in the coefficient of "Refinance*MacroVar" (T-value)* | | | | | | |
| t-value | -0.775 | -0.565 | -1.284 | -0.451 | -0.943 | -0.629 |

**Table 8: Profitability Change around Multiple Refinancing Points**

This table presents the average profitability (ROA) change from the earliest refinancing points to the later refinancing points for high and low hedging need firms, respectively. Panel A is for the whole sample, and Panel B is for a sub-sample that appears in our sample after 2002. ROA is denominated in percentage. Numbers in parentheses are standard errors of ROA. Numbers in square brackets in columns 1 and 2 are standard deviations of ROA, and numbers in square brackets in column 3 are the difference of standard deviations between column 2 and column 1. Detailed definitions for hedging needs and ROA are in Appendix C. ***, **, and * denote the significance level of 1%, 5%, and 10%, respectively.

| | | | | |
|---|---|---|---|---|
| Panel A: Whole Sample | | | | |
| | | Ref_earliest | Ref_follow | Diff |
| High Hedging Needs | Profitability (ROA) | 4.763 | 7.743 | 2.980*** |
| | | (0.938) | (0.637) | (1.134) |
| | Dispersion | [25.370] | [22.683] | [-2.687] |
| Low Hedging Needs | Profitability (ROA) | 11.996 | 13.721 | 1.726*** |
| | | (0.509) | (0.346) | (0.615) |
| | Dispersion | [13.521] | [12.876] | [-0.645] |
| Panel B: Sub-sample Appearing after 2002 | | | | |
| | | Ref_earliest | Ref_follow | Diff |
| High Hedging Needs | Profitability (ROA) | -1.827 | 2.104 | 3.931* |
| | | (1.913) | (1.427) | (2.337) |
| | Dispersion | [31.316] | [27.077] | [-4.240] |
| Low Hedging Needs | Profitability (ROA) | 12.376 | 11.98 | -0.396 |
| | | (0.850) | (0.704) | (1.110) |
| | Dispersion | [13.215] | [13.598] | [0.383] |

## Table C.1: Variable Definitions

| Notation | Description |
|---|---|
| Total debt | The sum of all seven types of debt in Capital IQ |
| CP | Commercial paper |
| RC | Revolving credit |
| TL | Term loans |
| SrBN | Senior bonds and notes |
| SubBN | Subordinated bonds and notes |
| CL | Capital leases |
| OB | Other borrowings |
| ShortTerm | Short-term debt=Debt in current liabilities+long-term debt due in one year |
| LongTerm | Long-term debt=Total debt-Short-term debt |
| SrSc | Senior secured debt |
| SrUnSc | Senior unsecured debt |
| Sub | Subordinated debt=Total debt-SrSc-SrUnSc |
| Bank | Bank debt=RC+TL |
| NonBank | Non-bank debt=Total debt-bank debt |
| Bond | Publicly traded debt |
| BLev | Book leverage=Total debt / total assets |
| MLev | Market leverage=Total debt / [stock price×shares outstanding+total debt+preferred stock liquidation value-deferred taxes and investment tax credit] |
| Equity | Stockholders' equity |
| Total capital | The sum of total debt and stockholders' equity |
| Refinance | Dummy of debt refinancing point, equal to 1 if change in total debt (net of cash) is not less than 5% of lagged total assets, otherwise=0 |
| Ln(Total assets) | Ln(real total assets)=Natural logarithm of real total assets in 2002 dollars |
| MB | Market-to-book ratio=[Stock price×shares outstanding+total debt+preferred stock liquidation value-deferred taxes and investment tax credit] / book value of total assets |
| ROA | Return on assets=Operating income before depreciation / total assets |
| TANG | Tangibility=Net property, plant, and equipment / total assets |
| RD | R&D expenses=Research and development expenses / total assets |
| Dum_Div | Dummy of dividend payers, equal to 1 if a firm has non-zero dividend payments in year t-1, otherwise=0 |
| Rated | Dummy of firms with credit ratings, equal to 1 if a firm has credit rating in year t-1, otherwise=0 |
| Med_Lev | Industry median of book leverage=Median of book leverage within a given industry based on Fama-French 48-industry classification |
| Payout | Equity payout ratio=(Dividend payouts+repurchases of stocks-issuance of stocks)/total assets at t-1 |
| ΔCash | Change in cash=(cash holdings at t-cash holdings at t-1)/total assets at t-1 |
| CAPX | Capital expenditure ratio=capital expenditures/total assets |
| Investment | Investment ratio=(R&D expenses+cash outflows from investment activities)/total assets |
| Industry investment-cash flow correlation | 3-digit industry annual average investment-cash flow correlation |
| OCF | [Operating activities net cash flow-extraordinary items and discontinued operations(cash flow)]/total assets |
| DefaultSpread | Default Spread=The difference in yields between Moody's Baa- and Aaa-rated corporate bonds |
| TermSpread | Term Spread=The difference in yields between Moody 10- and 1-year treasuries |
| Real_InterestRate | Real Interest Rate=Real annual yield on 1-year treasury bills |
| Real Market Return | Real Market Return=Real annual return on CRSP value-weighted index of stocks traded NYSE, AMEX, and Nasdaq |

| | |
|---|---|
| H-P LogGDP | H-P LogGDP=Hodrick-Prescott filtered log real GDP |
| Total credit lines | The upper limit of revolving credit |
| Drawn credit lines | The amount of used credit lines |
| Undrawn credit lines | The amount of unused credit lines |
| Full revocation of credit lines | Dummy of full revocation of credit lines, equal to 1 if undrawn credit line is positive at t-1, is zero at t, and the amount of used credit lines does not increase from t-1 to t, otherwise=0 |
| Full or partial revocation of credit lines | Dummy of full or partial revocation of credit lines, equal to 1 if the reduction of undrawn credit lines from t-1 to t is higher than 50% relative to undrawn credit lines at t-1, otherwise=0 |
| ΔDrawdown of credit lines | Annual change of used credit lines from t-1 to t scaled by total capital t-1 |
| HighHedge | Dummy of high hedging need firms, equal to 1 if firms belongs to high hedging need group, otherwise=0 |