

# The Effects Of The 2008-2009 Financial Crisis On U.S. Corporate Debt Structure

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## Abstract

This paper evaluates the relationships of liquidity, firm size, price change, asset maturity and leverage relative to debt maturity for a sample of U.S. non-financial firms. Secondly, the objective of the research is to identify any measurable changes in firms' behavior during the 2008-2009 financial crisis with respect to their choice of debt maturity. During the period from 2002 through 2009, data from the sampled firms show significant correlations between liquidity, firm size, asset maturity, and leverage and debt maturity. That is, firms appear to consider liquidity risk when determining the maturity of liabilities. Firms also appear to make an effort to signal their value to the market as a way to reduce mispricing of securities due to information asymmetry. This research therefore provides additional support for the liquidity risk hypothesis, as well as the signaling hypothesis. During the crisis itself, changes in the variables tested did not cause firms to make notable modifications in their behavior, with two exceptions. Firms with increased leverage ratios tend to have longer debt maturity, and this association is even more significant during the crisis. In addition, firms with reduced asset maturity turned to longer-term debt. The recent financial crisis did not appear to significantly affect the other determinants of corporate debt structure. Leverage and asset maturity, however, had a greater impact on firms' decisions during the financial crisis, suggesting that changes in the economic environment affect these determinants individually, but not broadly.

## Introduction

The 2008-2009 economic downturn was significant in that strains in credit markets were severe enough to warrant extreme support from the Federal Reserve Bank, propping up money markets and lending facilities, and depressing interest rates to historical lows<sup>1</sup>.

Corporate debt structure can include debt securities of varying maturities as well as bank financing. During the financial crisis, banks were extremely reluctant to lend, and demand for lending was suppressed. Turmoil in financial markets depressed asset prices and reduced the liquidity of many securities. Though the recession reduced investment activity, financing activities for non-financial firms persisted. In this paper we investigate the changes in corporate debt structure as a result of this financial crisis.

In normal economic times, firms may make decisions for debt financing based on a series of factors. Assuming that changes in corporate debt structure can be seen as a result of the financial crisis, which factors motivated firms to initiate the observed changes? This paper will focus on the liquidity risk and signaling hypotheses, and in part, determine if either or both of these theories persist

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during the crisis. Liquidity risk refers to the inability of firms to maintain sufficient current reserves to cover current obligations. When using short-term debt maturities to finance operations, firms are at the mercy of lenders, who may elect not to roll over the short-term debt, resulting in a cash shortage and inducing substitution into risky low-quality projects (Diamond, 1991).

The signaling hypothesis (Flannery, 1986) suggests that one motivation for firms in making debt structure decisions is to utilize the choice of debt to show investors what a firm's internally perceived value of its share price is. In essence, the firm's issuance of short-term debt maturities is an attempt to get the markets to re-price its securities, so that the prices are in line with what the firm believes its true value is.

The recent financial crisis was unfortunate. The resulting severe credit crunch in the economy left some firms with few alternative sources of external financing. However, the unexpected nature of the crisis provides insights on firms' behavior toward debt maturity decisions when external financing becomes restricted. Debt maturity is a key feature of firm financing because it will eventually determine projects that firms will accept and affect firms' continuing growth potential (Johnson, 2003). Its importance becomes even higher in the presence of an unexpected economic shock.

Moreover, understanding changes in corporate debt structure during periods of high asymmetric information is useful for investors to anticipate these shifts in order to successfully tailor their investment strategy. In addition, structure of leverage is a consideration in evaluating a firm's riskiness, which then affects the firm's credit-rating (Molina 2005). Thus, the structure of firms' debt is important not only for firms but also for investors in evaluating alternative investments and pricing debt securities in the marketplace. From firms' perspective, decisions by investors will in turn affect firms' cost of capital and investment opportunities.

Supporting previous empirical studies<sup>2</sup>, we find that liquidity, firm size, asset maturity, and leverage are correlated to debt maturity. Our main finding is that leverage and asset maturity had a greater impact on firms' debt maturity decisions during the crisis. Firms with greater leverage tend to have longer debt maturity, and this association was even more significant during the crisis. In addition, the proportion of short-term asset maturity is negatively related to debt maturity, and this association was also more significant in the crisis. Overall, our findings indicate that during the crisis, changes in the economic environment affected determinants of debt maturity individually, but not broadly.

The remainder of this article presents a literature review in section II, our empirical hypotheses in section III, the empirical tests in Section IV, and results and implications in sections V and VI. Section VII summarizes our findings.

## **II. Literature Review**

To begin an analysis of changes in debt structure, it is first necessary to understand what drives firms' decisions with respect to the nature and term structure of debt in general. Though varying

theories exist on this matter, the focus here is on those that can be related in some way to macroeconomic conditions.

Deesomsak et al. (2009) analyzed the effects of the 1997 Asian financial crisis on corporate debt maturity structure. Overall, they identified that there was a relationship between the economic environment and firms' decisions with regard to debt structure. In the period preceding the Asian crisis, asymmetric information problems worsened and the deterioration of balance sheets eventually led to the crisis. As market and firm-specific factors changed as a result of this crisis, firms were found to have altered their decisions with respect to the use and term structure of debt. The authors identified several documented hypotheses to explain determinants of choices of debt maturity, among which are moral hazard, signaling and liquidity risk.

The moral hazard hypothesis relates to the usage of short-term debt to reduce agency problems occurring from underinvestment, where firms turn away from low-risk investments to maximize wealth at the expense of the debt-holders. Asset substitution occurs when firms use low risk assets to engage in high-risk investments, to the detriment of bond-holders, who receive no additional compensation for the increased risk. The implication is that short-term debt may entice managers to reduce the riskiness of the firm's investments.

Diamond (1991) discusses how choices with respect to debt structure depend on the timing of cash flows from investments to meet obligations, and credit ratings. Firms with high credit ratings will be more apt to issue short-term debt and lower-rated firms will finance with longer-term bonds or bank financing. As bank financing for low quality firms is also likely to be short-term in nature, the short-term debt markets are heavily utilized by high and low grade firms. Firms using short-term debt, however, are susceptible to liquidity risk, in that there is a potential danger of being unable to refinance or roll-over short-term debt, as refinancing is under the lender's control. This is especially detrimental if cash flows are not in line with the short-term maturity. For higher quality firms, the use of short-term debt is more of an attempt to bridge the gap between periods of bull and bear markets, in essence, to time the market. Diamond's liquidity risk theory suggests that firms weigh the liquidity risk of short-term debt and may then prefer long-term debt.

This is in contrast to Flannery's model (1986) as referenced by Diamond (1991), which concludes that firms will always select short-term debt, unless it is more costly. Flannery (1986) notes that debt structure is irrelevant in the financing decision of firms operating in efficient markets when asymmetric information does not exist between firms and investors. When there is an imbalance in insider over investor information, firms use debt choices to signal to investors their true value. Short-term debt would tend to be undervalued, and therefore more costly to the firm, especially during the times when investors perceive that the value of the firm is less than its intrinsic value. Since this theory states that short-term debt is preferable unless the associated costs are higher, if the firm then issues short-term debt despite the higher costs, it is attempting to inform the market of the undervaluation. The firm's

choice of short-term debt issued in this type of scenario is what Flannery refers to as “signaling”, and is the basis of the signaling hypothesis.

Deesomsak et al. (2009) found that during the Asian financial crisis, while firms appeared to have had optimal debt maturity structures, their ability to react and adjust in the post-crisis period was constrained. Market conditions did appear to have an influence on debt structure decisions and the crisis resulted in higher awareness by managers of debt structure. The study suggests that the Asian financial crisis reduced funding costs and increased liquidity constraints, and required managers to improve the information flow to outside investors to reduce agency problems. Firms with higher leverage ratios tended to select more long-term investments, suggesting that liquidity risk was strongly considered. Firms heavily affected by the crisis were more prone to continue the use of long-term debt after the crisis subsided, to insulate themselves from liquidity risk and higher bankruptcy costs, and to maintain an adequate source of cash. This is consistent with the findings of Diamond (1991). Smaller firms with a higher level of imperfect information tended to move into short-term investments, supporting the signaling hypothesis proposed by Flannery (1986).

This study will use the concepts researched in Deesomsak et al. (2009) and further analyze the impact of the recent financial crisis on the United States non-financial corporate sector, and will assess if the results are consistent. To the extent that the findings deviate from prior research, an attempt will be made to determine the factors affecting the variance

### **III. Hypothesis Development**

We expect to find that the liquidity risk theory explains the term structure of a firm’s debt. We believe that shortages of lending funds during the crisis were severe enough to entice firms who utilize short-term debt during normal times to prefer long-term investments during the crisis period. Further, commercial paper market activity was impaired during the crisis. This may have influenced debt decisions during the crisis. Firms were unable to issue short-term debt, even if it was preferable, because the market was illiquid.

Based upon the magnitude of the asymmetric information problem during the recession, signaling may be a valid hypothesis. We expect that firms would have made attempts to signal the markets as to their intrinsic values and thus re-price securities accordingly. Much of the information imbalance may have been perceived as a result of investor behavior that was caused by panic. Internal managers would have had better knowledge of the firm’s value, and, if signaling to the markets were beneficial, this signaling theory could be a likely factor in firms’ financing decisions. Alternatively, given that markets were so constrained, it may be difficult to determine if the hypothesis were true during the crisis.

Table 1 shows a list of variables considered, the measures for those variables, and the hypothesis against which they are being tested. These variables include liquidity (LIQ), firm size (FS), leverage

(LEV), price change (PC), and asset maturity (AM). The variables are selected based upon their relevance in supporting or refuting the liquidity risk and signaling hypotheses.

Table 1. Variables and Related Hypothesis

Variable	Abbreviation	Measurement	Hypothesis	Expected Correlation
DEBT MATURITY	DM	Total Long-term Debt/Total Liabilities		
LIQUIDITY	LIQ	Total Current Assets/Total Current Liabilities	Liquidity Risk	Negative
FIRM SIZE	FS	Natural Logarithm of Assets	Liquidity Risk/Signaling	Positive
PRICE CHANGE	PC	Annual Changes in Share Prices	Signaling	Positive
ASSET MATURITY	AM	Total Current Assets/Total Assets	Liquidity Risk	Negative
LEVERAGE	LEV	Total Liabilities/Total Equity	Liquidity Risk	Positive

Diamond’s liquidity risk hypothesis suggests that firms with increasing leverage ratios tend to trade off short-term debt for longer term debt. There is expected to be a negative relationship between liquidity and debt maturity; as firms become less liquid, they may prefer to avoid the risks inherent in short-term debt and prefer longer maturities. Finally, it is believed that firms seek to match their debt maturities to cash flows. Asset maturity in this paper refers to the proportion of current assets to total assets, and when it is compared to the ratio of long-term debt to total debt (DM), firms’ asset maturity is expected to be negatively related to debt maturity. This association supports the liquidity risk hypothesis.

An implication from Flannery (1986) is that as firms’ share prices decline below what insiders believe the true market value of the firm is, they will tend to issue more short-term debt, or less long-term debt, as a signal to the market. Therefore, a positive relationship between price change and long term debt maturity is anticipated. That same study suggests that small firms are more prone to the asymmetric information problem, and may therefore be more likely to issue short-term debt in an attempt to signal their true value to the market. This creates an expectation of a positive relationship between firm size and debt maturities.

#### IV. Data Selection

From the Compustat database, we obtained a sample of all U.S. firms listed under the category of “Super”. These firms make up the S&P 1500 Super Composite Index and include S&P 500, S&P Mid-Cap and S&P Small-Cap firms. This list includes the firms we believe should have the greatest flexibility in altering their debt structure as conditions warrant. These firms are well known, publicly-traded companies and therefore we will assume that they have ready access to both long-term and short-term debt financing.

From the original sample of 1500 companies, those which had missing values for one or more years for any of the six variables were removed, as were those companies whose SIC code was either financial in nature or from the utilities sector, as these firms tend to have significantly different financial structures than the average industrial firm. Firms were also removed if they reported negative stockholder’s equity and, therefore, negative leverage ratios. The final sample consists of 891 firms.

Data were obtained for these firms for a period of eight fiscal years from 2002 through 2009. As the purpose of this research is to analyze the changes before and during the crisis, the annual data were then broken down by period, using the six year period of 2002 through 2007 as the pre-crisis sample, and the two year period of 2008 through 2009 as the crisis sample.

#### V. Empirical Analysis

##### A. Descriptive Statistics

Table 2 contains summary statistics of financial attributes of firms in the sample. The mean (median) of current assets is \$ 1.935 billion (\$0.495 billion) prior to the crisis and increases to \$2.445 billion (\$0.674 billion) during the crisis period. As evidenced by the standard deviation, the amount of current assets varies widely across firms.

Turning to the total assets of the sample firms, the average of total assets is \$ 7.074 billion (\$1.684 billion median) in the crisis and \$5.571 billion (\$1.201 billion median) in the years prior to the crisis. One explanation to the large increase in average assets is that firms might have taken over underperforming or illiquid firms that are not listed in the sample during the period of financial crisis.<sup>3</sup> In support of the explanation that acquisition contributes to the rise in the average size of firms, we collected information about merger and acquisition activities of the sample firms from the Security Data Company (SDC) Platinum – Merger database.

The data show that 532 firms in the sample had acquired two or more target companies during the financial crisis. The transaction value of the acquisitions ranges between \$33,000 and \$67.29 billion with a mean of \$513.23 million and a median of \$69.87 million. During the crisis these firms conducted a total of 1574 acquisition transactions. Prior to the crisis, the average size of firms with acquisitions is \$6.79 billion, which then increased significantly to an average of \$9.11 billion during the crisis. In contrast, firms with no acquisition activities in the crisis years have average total assets of \$3.49 billion in the pre-crisis period and \$4.05 billion in the period of financial crisis. Moreover,

Table 2. Summary of statistics of financial values pre-crisis and during the crisis

Financial Items	Mean (\$ million)	Median (\$ million)	Standard Deviation (\$ million)
Panel A. Pre-crisis			
Current Assets	1,934.85	495.42	4,862.35
Total Assets	5,570.82	1,201.07	15,396.05
Current Liabilities	1,340.57	243.72	3,840.62
Long-term Debt	953.27	176.46	2,591.08
Total Liabilities	3,095.10	560.65	8,628.67
Total Equity	2,475.72	587.48	7,205.47
Panel B. During Crisis			
Current Assets	2,445.34	674.75	5,853.18
Total Assets	7,074.18	1,684.34	18,602.14
Current Liabilities	1,642.34	320.24	4,623.84
Long-term Debt	1,327.37	256.18	3,395.32
Total Liabilities	4,050.53	809.46	10,778.82
Total Equity	3,023.65	768.26	8,371.24

although on average the size of firms in the sample increases, a number of companies experienced reduction in their total assets (N=84 for firms with acquisitions, N=81 for companies with no mergers or acquisitions)

We, thus, conclude that acquisition activities by larger, more established firms contribute significantly to the increase in size of sample firms during the crisis. Furthermore, we observed that many firms in our dataset hoarded their cash. This observation is consistent with survey responses reported in the study of Campello et al. (2010), who also find that constrained firms undertook deeper cuts in tech spending, employment, and capital spending in order to preserve cash. Fearing more restrictive access to external funds during the crisis, many firms even raised their cash holding level by issuing short-term or long-term debt, increasing their retained earnings and cutting dividend payments.

<sup>4</sup> As a result of these financial decisions, total assets of some firms may increase during the period of

financial crisis – although the average increase in assets should be relatively modest compared to the rise resulting from acquisitions.

Table 2 also shows that the sample firms have mean (median) current liabilities of \$1.341 billion (\$0.244 billion) in the years leading up to the crisis, and \$1.642 billion (0.320) during the financial crisis. An increase in the mean of long term debt (from \$0.953 billion to \$1.327 billion) suggests the firms step up their long term borrowing during the financial crisis, perhaps in anticipation to finance their assets. The firm's long term debt consists of debt obligations that have a maturity of more than one year. The amount of total liabilities on average increases from \$3.095 billion to \$4.050 billion, and a similar pattern is observed for the equity amount. The total liabilities include current liabilities, long-term debt, and other noncurrent liabilities including deferred taxes and investment tax credit.

Table 3 displays the means, median and standard deviations of debt maturity and the independent variables used for testing the debt maturity hypotheses.

Table 3. Descriptive Statistics of Debt Maturity and Independent Variables

Variable	Mean	Median	Standard Deviation
Panel A. Pre-crisis			
DEBT MATURITY	0.284	0.284	0.231
LIQUIDITY	2.571	1.974	2.235
FIRM SIZE	21.052	20.906	1.588
PRICE CHANGE	0.086	0.072	0.203
ASSET MATURITY	0.473	0.467	0.204
LEVERAGE	1.326	0.934	4.366
Panel B. During Crisis			
DEBT MATURITY	0.295	0.314	0.227
LIQUIDITY	2.499	2.062	1.728
FIRM SIZE	21.386	21.245	1.514
PRICE CHANGE	-0.108	-0.083	0.239
ASSET MATURITY	0.453	0.450	0.198
LEVERAGE	1.480	0.972	2.858

Panel A contains descriptive statistics of firms during the pre-crisis period, while panel B presents firms' descriptive statistics in the crisis period. On average, the total long-term debt over total liabilities (DM) in the crisis years is 0.295 (0.314 median), which is higher than debt maturity in the pre-crisis period (0.284). The cross sectional variation as observed by standard deviation is lower during the crisis period than in the pre-crisis period. Liquidity, defined as the ratio of total current assets over total current liabilities, averages 2.499 (2.062 median) during crisis and 2.571 (1.974 median) in the years prior to the crisis.

Turning to the price change variable, the averages of price change was -0.108 (-0.083 median) when firms faced the financial crisis, which decreased from 0.086 (0.072 median) during the pre-crisis

period. The average of asset maturity, defined as the ratio of total current assets and total assets, is 0.453 (0.450 median) during the crisis, a decline from 0.473 (0.467 median) in the pre-crisis period. Leverage, measured as total liabilities over total equity, averages 1.480 (0.972 median) and 1.326 (0.934 median) during the crisis and the pre-crisis periods, respectively.

Similar to other research that utilizes financial ratios to quantify variables, the measures of variables in this study might have changed due to exogenous factors. For example, as a result of a market downturn, accounting standards may require a firm to reduce one of its asset values, which in turn reduces the firm's total assets. Changes in financial ratios can also result from managers' attempts to move their financial ratios toward a desired target. We believe that a market-wide exogenous factor such as the recent financial crisis would have a greater impact on the financial ratios of firms and provide strong incentive for managers to restructure the firms' debt. Moreover, Wu and Ho (1996) assert that changes in financial ratios due to management strategic adjustment appear to be substantial.<sup>5</sup>

**B. Changes in variables from pre-crisis to crisis**

We then performed a paired *t*-test for each variable to validate that the means of each variable during crisis are significantly different from those in pre-crisis period using matching firm data. The null hypothesis in the paired *t*-test is that the two means of each variable are equal. The *t*-statistics show if the changes in variables tested are significant or the result of chance. Results of the paired *t*-test are shown in Table 4.

Table 4. Paired *t*-Tests to Validate Differences in Means between During Crisis and Pre-Crisis of Debt Maturity and Independent Variables

Variable	Pre-Crisis Mean	During Crisis Mean	Difference	<i>t</i> -value	<i>p</i> -value (two-tail)
DEBT MATURITY	0.284	0.295	0.011	2.22	0.027
LIQUIDITY	2.571	2.499	-0.072	-1.64	0.102
FIRM SIZE	21.05	21.386	0.336	23.42	<0.001
PRICE CHANGE	0.086	-0.108	-0.194	-38.91	<0.001
ASSET MATURITY	0.473	0.453	-0.020	-6.09	<0.001
LEVERAGE	1.326	1.480	0.154	1.67	0.096

Table 4 shows that the value of the paired *t*-test for debt maturity is 2.22 with a corresponding *p*-value of .027, suggesting that there was a reasonably significant change in the mean of debt maturity from the pre-crisis to the crisis period. Although not reported here, an OLS regression between debt maturity as the dependent variable and a dummy variable of 1 for the crisis period as the independent

variable returned identical results, and the dummy coefficient indicates that debt maturity increased by .01094 during the crisis period.

The data also reflect that liquidity decreased during the sample period, although the  $t$ -statistic is on the boundary of being significant. There was an increase in the average firm size during this time - validating our preliminary findings from the descriptive statistics - with a  $t$ -statistic of 23.42, and a  $p$ -value of less than 0.001. This change in firm size is significant. The  $t$ -tests also show that there is a statistically significant decrease in the average share price from pre-crisis to crisis. This is expected, as it is recognized that share prices declined substantially during the crisis. Asset maturity decreased over the two periods, and is also noted to be a significant change. Leverage increased during the crisis period, however the  $t$ -statistic was relatively small, and the corresponding  $p$ -value suggests that this change is significant at a 10 percent level of significance.

### C. Correlations and Regression Analysis

We performed a correlation analysis of the variables tested. Table 5 reports correlations between debt maturity and the variables that determine debt maturity. Debt maturity is negatively correlated with liquidity, price changes, and asset maturity, while it is positively correlated with firm size and leverage ratio. Note that the correlations do not suggest potential multicollinearity between the various explanatory variables.

Table 5. Correlations Matrix of Debt Maturity and Variables Examined

Variable	DM	LIQ	FS	PC	AM	LEV
DEBT MATURITY	1					
LIQUIDITY	-0.139	1				
FIRM SIZE	0.244	-0.350	1			
PRICE CHANGE	-0.038	0.022	-0.099	1		
ASSET MATURITY	-0.504	0.434	-0.393	0.054	1	
LEVERAGE	0.130	-0.118	0.086	-0.030	-0.075	1

We conducted a linear regression using Ordinary Least Squares (OLS) method to evaluate the relationships between each variable and the changes in debt maturity over the entire sample period. A dummy variable of zero or one was added to each variable to test for the effect of the crisis on the dependent variable. Debt maturity is considered the dependent variable against which each additional independent variable was tested.

We include the following control variables in our regression analysis. The first variable, "Long and Short-term Interest Rate Spread," is the spread between the long term and short term interest rate. This variable represents lenders' willingness to provide various terms of debt instruments according to relative interest rates, which may eventually motivate firms to restructure their debt. The variable,

thus, is to account for an exogenous factor that is not under the control of managers, which may affect the decision of debt duration as suggested by Brick and Ravid (1985). They suggest that when the term structure of interest rates is not flat, the debt maturity choice has tax implications. If long-term interest rates are higher than short-term rates, in early years the firms' interest expense from issuing long-term debt is greater than the expected interest expense from rolling over short-term debt. However, in later years the interest expense of long-term debt is less. In this situation, the probability of default falls over time for long-term debt, and consequently the value of the firm's interest rate shield rises, increasing the total value of the firm. In summary, Brick and Ravid postulate that if long-term rates are higher than short-term interest rates, issuing long-term debt reduces the firm's expected tax liability and consequently increases the current firm's market value. A positive association between positive interest rate spread and debt maturity is then expected.

The short-term interest rate we use in the model is measured by the annual prime rate, and the long-term interest rate by the annual BAA corporate yield, which are reported in the Federal Reserve Board's H.15 statistical release. We use the prime rate because it is the one lending rate quoted by a majority of the major banks surveyed by the Federal Reserve and the BAA corporate yield as it is a common indicator of long-term lending interest rate for average firms.

The second factor is a set of variables: "Liquidity pre-crisis", "Asset Maturity pre-crisis", and "Leverage pre-crisis". These variables represent fixed firm characteristics prior to the crisis to account for the fact the financial ratios might have changed for exogenous reasons. Liquidity pre-crisis is calculated as the average of 2002 – 2006 annual liquidity ratio. Asset Maturity pre-crisis and Leverage pre-crisis are measured in a similar way.

The model used to conduct the analysis is as follows:

$$DM = \beta_0 + \beta_1 Dcrisis + \beta_2 LIQ + \beta_3 Dcrisis * LIQ + \beta_4 FS + \beta_5 Dcrisis * FS + \beta_6 PC + \beta_7 Dcrisis * PC + \beta_8 AM + \beta_9 Dcrisis * AM + \beta_{10} LEV + \beta_{11} Dcrisis * LEV + \text{Control Variables} + \varepsilon$$

Where:

DM = Debt Maturity

LIQ = Liquidity

FS = Firm Size

PC = Price Change

AM = Asset Maturity

LEV = Leverage

Dcrisis = Dummy variable, (0 = Pre-Crisis, 1 = During Crisis)

Control Variables = Long and Short-term Interest Rate Spread, Fixed firm variables (Liquidity pre-crisis, Asset Maturity pre-crisis, and Leverage pre-crisis)

$\varepsilon$  = the residual.

The OLS estimation of the model, shown in Table 6, confirms that there is a relation between four of the five independent variables and the dependent variable, debt maturity. Liquidity, firm size, asset maturity and leverage all show statistically significant  $t$ -statistics, with corresponding  $p$ -values of less than five percent. Price change does not appear to have a significant correlation with debt maturity. There is a positive and significant correlation between liquidity and debt maturity. The positive relationship between liquidity and debt maturity is contrary to our expectation of a negative relationship between these two variables. The insignificant dummy coefficient suggests that there was no significant change in this relationship during the crisis period.

Table 6. OLS Model Regression Results with Debt Maturity as the Dependent Variable using Full Sample

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Variable	Parameter Estimate	Standard Error	$t$ -value
Intercept	0.3517	0.0437	8.06 ***
Dcrisis	-0.0930	0.0899	-1.04
LIQUIDITY	0.0212	0.0022	9.69 ***
LIQUIDITY x Dcrisis	0.0046	0.0034	1.34
FIRM SIZE	0.0076	0.0019	3.99 ***
FIRM SIZE x Dcrisis	0.0038	0.0039	0.97
PRICE CHANGE	-0.0064	0.0136	-0.47
PRICE CHANGE x Dcrisis	-0.0517	0.0233	-2.22 **
ASSET MATURITY	-0.4688	0.0333	-14.07 ***
ASSET MATURITY x Dcrisis	-0.0598	0.0310	-1.93 *
LEVERAGE	0.0017	0.0001	2.51 **
LEVERAGE x Dcrisis	0.0058	0.0018	3.28 ***
<i>Control for</i>			
Long and Short -term Interest Spread	0.0053	0.0014	3.76 ***
Liquidity pre-crisis	-0.0010	0.0023	-4.27 ***
Asset Maturity pre-crisis	-0.1197	0.0337	-3.55 ***
Leverage pre-crisis	0.0122	0.0012	10.51 ***
F-value	200.79***		
R-square	0.2975		
N	7128		

\* \*\* \*\*\* represents statistical significance at the 10,5, and 1 percent level of significance, respectively.

The regression also shows a positive relationship between both firm size and leverage with respect to debt maturity. As seen with the data on liquidity, while the full period sample for firm size returns significant results, the crisis sample for this variable shows a positive, yet insignificant change, indicating that the effect of firm size on debt maturity did not change specifically during the crisis. The

significant and positive association between leverage and debt maturity became even stronger during the crisis, as noted by the significant leverage dummy coefficient. The positive correlations between firm size and leverage relative to debt maturity in the regression estimation are consistent with our hypothesis.

Asset maturity was found to have a negative and significant coefficient during the sample period. The dummy coefficient for this variable was consistent, and the corresponding *t*-statistic and *p*-value suggest that the strength of the relationship during the crisis changed. We had expected to find a negative relationship between asset and debt maturities. The results here suggest that as the proportion of current assets to total assets decreases, debt maturity increases.

Price change is the only tested variable that appeared to have no determinable impact on debt maturity over the sample period. The coefficient for this variable is negative over the sample period, but returned an insignificant *t*-statistic and *p*-value. However, during the crisis, the variable shows a significant negative association with debt maturity. Further, the negative coefficient is inconsistent with our supposition that price change and debt maturity are positively related.

Table 7. OLS Model Regression Results with Debt Maturity as the Dependent Variable for Firms without Mergers or Acquisitions during the crisis.

Variable	Parameter Estimate	Standard Error	<i>t</i> -value
Intercept	0.0663	0.0746	0.89
Dcrisis	0.0732	0.1534	0.48
LIQUIDITY	0.0218	0.0034	6.44 ***
LIQUIDITY x Dcrisis	0.0003	0.0051	0.07
FIRM SIZE	0.0210	0.0033	6.30 ***
FIRM SIZE x Dcrisis	-0.0040	0.0069	-0.58
PRICE CHANGE	-0.0112	0.0211	-0.53
PRICE CHANGE x Dcrisis	-0.0571	0.0360	-1.59
ASSET MATURITY	-0.4339	0.0566	-7.66 ***
ASSET MATURITY x Dcrisis	-0.0927	0.0467	-1.99 **
LEVERAGE	0.0007	0.0008	0.80
LEVERAGE x Dcrisis	0.0236	0.0050	4.74 ***
<i>Control for</i>			
Long and Short -term Interest Spread	0.0039	0.0023	1.70 *
Liquidity pre-crisis	-0.0079	0.0038	-2.09 **
Asset Maturity pre-crisis	-0.1431	0.0573	-2.50 **
Leverage pre-crisis	0.0096	0.0014	6.98 ***
F-value	98.80***		
R-square	0.3416		
N	2872		

\* \*\* \*\*\* represents statistical significance at the 10,5, and 1 percent level of significance, respectively.

As mentioned, we found that many firms in our sample conducted acquisitions during the financial crisis. These firms may have acquired underperforming or failing companies during this time, as well as the debts – including long-term debts - of those acquired firms. This activity may lead to an increase in the debt maturities of the sample firms due to these mergers. To exclude potential effects from the acquisitions, it is relevant to analyze the relationship between debt maturity and the explanatory variables only for firms without mergers or acquisition activities. Table 7 shows that for the sample of non-acquisition firms, liquidity has a significant positive relation with debt maturity. The positive relationship is contrary to the negative association that the liquidity risk hypothesis predicts. The regression results also show that firm size is positively related to debt maturity, and asset maturity has a significant negative relationship with debt maturity.

During the crisis period, the non-acquisition firms' debt maturity is significantly influenced by two factors: asset maturity and leverage. These firms increase leverage significantly during the crisis, and the increase is significantly related to an increase in debt maturity. In other words, these firms increase their leverage by employing more long term debt. Regression analysis also shows that asset maturity has a negative and significant coefficient during the crisis, suggesting that as the proportion of short term assets to total assets decreases, debt maturity increases. In general, regression results of firms with no acquisition activities and those of full sample indicate similar variables affecting debt maturity during the crisis years.

## **VI. Implications**

The regression shows a positive relationship between liquidity and debt maturity over the full sample period from 2002 through 2009. This is inconsistent with our hypothesis, but confirms the findings of Deemsosak et al. (2009). That research had also initially expected a negative relationship between these two variables. The positive relationship can be attributed to the possibility that firms with higher liquidity sought to avoid shortages of cash and issued debt with longer maturities. This is still supportive of the liquidity risk hypothesis, as it implies that firms do in fact consider potential liquidity problems as a motive for altering their future debt structure. During the crisis period, the relationship between liquidity and debt maturity remained unchanged, suggesting firms did not specifically consider liquidity risk as a means of selecting their debt maturity during this time.

A negative and significant correlation was also noted between asset and debt maturities. As the proportion of current assets to total assets increases, debt maturity decreases. This provides some support for the liquidity risk hypothesis. If firms carry more short-term assets, they may become more liquid, reducing their need to consider liquidity risk in determining their debt structure. Moreover, during the financial crisis, firms may switch to longer-term projects because the financial crisis removed short-term opportunities. As the financial crisis created external capital constraints, and assuming firms match the maturity of the short-term investment opportunities with short-term liabilities, investing in

short-term projects is riskier. The firm would face more pressing needs to find either renewed financing or liquidity to fulfill the debt obligations. In addition, short-term financing is costly and uncertain during the crisis, and may leave the firm with two alternatives: to default on its obligations and/or to go through bankruptcy proceedings, or to sell assets to cover the cost of maturing short-term debt. This encourages firms to borrow longer-term debt, increasing the proportion of long-term debt in the debt maturity.

The most notable determinant of debt maturity structure as noted in the regression results was leverage. This variable returned statistically significant, positive coefficients in both the full sample and crisis periods, suggesting that firms believe leverage to be an important factor to evaluate when making choices with respect to debt. This consideration became more apparent during the crisis period, where firms faced with increasing leverage ratios trended even more toward longer term debt. Our expectation that as leverage increased firms tend to trade off to longer term debt maturities was corroborated. This is highly supportive of the liquidity risk hypothesis.

We expected a positive correlation between firm size and debt maturity, and while both the full sample and dummy coefficients are positive and thus, consistent with this hypothesis, the relationship during the crisis period was not significantly different. This leads to the conclusion that while a relationship exists between firm size and debt maturity choices, the crisis did not have a significant effect on this relationship. It does appear that during normal times smaller firms trend toward shorter term debt maturities, which is consistent with the signaling hypothesis.

## **VII. Conclusion**

Based upon our research, the data reflect that the liquidity risk hypothesis is strongly supported during the full sample period, and firms' consideration of liquidity risk changed during the financial crisis for two measures, asset maturity and leverage. The majority of the independent variables tested were shown to be significantly correlated with debt maturity, and the highly significant F-statistic reveals that these variables jointly explain changes in debt maturities. Throughout the sample period, it appears that firms did increase their debt maturities as a result of considering the risks of short-term debt, and the maturity of their assets. We initially expected that in general, the need for signaling the markets to re-price securities would be one factor in firms' debt structure decisions. We can find no support that the use of signaling increased during the crisis period, despite the increase in information asymmetry during this time.

In general, firms appear to base debt structure decisions on factors that support both the liquidity risk and signaling hypotheses. During the crisis, however, two of all determinants of debt maturity support the hypotheses. When firms experienced higher leverage ratios they appeared to make a significant change in behavior regarding their use of long-term debt. This is understandable as firms try to avoid financial distress resulting from high leverage, and one way to moderate this effect is by switching to longer-term maturity debt. In addition, when firms attempted to increase the maturity of

their assets, they turn to longer-term debt, as the liquidity risk hypothesis has predicted. The insignificant quantifiable changes in firms' behavior indicated by other determinants of debt maturity during the crisis may be representative of the magnitude and chaos of the financial crisis. Firms may have been unable to facilitate their desired debt structure decisions due to the volatility, uncertainty and limitations in the markets.<sup>6</sup> Alternatively, the nature of the financial crisis may have caused firms to consider additional, unique factors in making debt maturity decisions. Ideally, it would serve the purpose of this paper well to extend the sample period through 2010 in order to fully evaluate firms' behavior from the onset of the crisis until markets had returned to new normalcy.

#### ENDNOTES

1. Krishnamurthy (2010) provides a description of the malfunction of debt markets during the financial crisis.
2. Other studies that have examined determinants of debt maturity include Barclay and Smith (1995), Guedes and Opler (1996), and Antoniou et al. (2006).
3. We should clarify that since we require all firms in the sample to have complete financial data during the observed years of 2002 - 2009, firms that disappeared due to acquisition are not in the sample. The sample contains a consistent 891 firms in each year of observation.
4. Borrowing is possible for these firms as they may draw down their credit lines or take out new loans. (Ivashina and Scharfstein, 2010).
5. We thank the referee for highlighting factors that are not under the control of firms in relation to debt maturity structure decisions.
6. Ivashina and Scharfstein (2010) report that large borrowers faced a cut in new loans by 47 percent during the financial crisis.

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