Market-Based Measures of Financing Constraints*

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Abstract

We use data from exchange-traded options to identify market expectations about firm risks relevant for financing constraint. Forward-looking estimates of these risks impounded into option prices predict changes in firm capital structure better than the accounting-based measures traditionally used. We hypothesize that this is because market prices reflect new information at a higher frequency than accounting filings do. Consistent with this hypothesis, options data from the month before the past quarter's accounting data release are as informative about the current quarter's financial constraint as those recorded contemporaneously with the accounting data. We use these new market-based risk indicators to create a measure of financing constraint. This measure generates an abnormal buy-and-hold return of 9.5% over one year for a trading strategy based on buying unconstrained firms and selling constrained firms.

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1 Introduction

Early literature on capital structure has relied primarily on the assumption that firms have unlimited access to financing and firms choose their capital structure based on their own demand for investment and relative costs of capital. Subsequently, literature on financing constraints emerged that examines the impact restrictions to access of funds necessary for growth have on firm value and investment decisions. Given the unobservable nature of financing constraints, the definition and measurement of financing constraints is crucial to understanding its risks. Much of the literature define financing constraints as frictions that cause the cost of internal capital to differ nonproportionally with the cost of external capital and rely on firm characteristics gathered from financial statements to proxy for these frictions. Accounting-based measures have achieved success in measuring a firm's ability to changes its capital structure (e.g, Whited and Wu, 2006; Hadlock and Pierce, 2010). However, these measures capture information that reflect past decisions and are infrequently updated, generally restricted to quarterly filings of a snapshot of the firm's books.

In this paper, we study the effectiveness of using market data to explain the firm's ability to change its capital structure. We examine the flexibility of a firm's capital structure using market expectations about firm risk estimated from equity options. We propose four new options-based measures that capture different dimensions of risk in the firm: 1) the implied volatility spread between the implied volatility extrapolated from long maturity call options and realized volatility from historical returns that captures forward-looking risk expectations against historical risks, 2) the implied volatility spread between the volatilities implied in short maturity calls and short maturity puts that captures risk expectations on performance direction of the stock, 3) the spread between the implied volatilities of long maturity and short maturity call options that captures risk expectations on horizon of the stock, and 4) the implied volatility spread between out-of-the-money puts and in-the-money puts that captures risk expectations on the recovery of the stock or left-tail "crash" risk. We find that all four measures explain net levering behavior of firms in directions consistent with theory - the riskier the firm the less likely the firm is to lever up - with the implied volatility spread between OTM puts and ITM puts having the strongest and most robust effect.

We show that a model with our market-based measures of risk expectations explain net levering up behavior of firms better than a model using only traditional accounting-based measures of financing constraints. In addition, when considering a model that includes both accounting-based and market-based measures with common controls, close to all of the explanatory power comes from the market-based measures. After including realized volatility as a control, the significance of accounting-based measure disappears, though the significance of our options-based measures remain. Using net levering up behavior as our dependant variable allows us to examine the impact of accounting and market based measures on the magnitude of capital structure decisions within a firm. For robustness, we also examine whether a firm levers up or not by running a logit model using our option-based measure. Based on our analysis, we propose a new financing constraint index using our market-based measures. We sort our measure for financing constraint into three equal bins. A buy-and-hold strategy of buying the least constrained tercile and selling the most constrained tercile based on our index nets an abnormal return of 9.5% over the next year using our market-based index for financing constraints compared to a net return of 1.8% and 3.7% using the Whited and Wu (2006) and Hadlock and Pierce (2010) indices respectively.

Our results establish the usefulness of market data on capital structure decisions, providing new market-based measures for financing constraint, and demonstrating abnormal returns generated by a buy-and-hold strategy using our measures for financing constraint. The predictive power of our market-based measures of financial constraint establish a promising connection between market expectations and capital structure decisions. This is particularly relevant in the wake of the financial crisis as investors and regulators re-evaluate the timeliness of book-based measures of firm risk such as bank capital ratios and consider market-based alternatives. Additionally, our approach allows us to study the specific risk channel that impacts financing behavior rather than rely on firm proxies. Specifically, and not surprisingly, we find that firms with high tail risk face the highest financing constraints. Furthermore, using market-based measures allows us to bypass the issue of measuring financial constraint using limited and low-frequency data due to real time availability and updating of market data. The ability to infer useful information about firm decision making from market variables is directly useful for estimating firm financing constraint. It is also more broadly suggestive of additional potential applications for the use market data in estimating firm characteristics previously treated only with book-based measures.

This paper adds to the literature on the role of using market-based measures in corporate finance by connecting two strands of research: the informational content of option prices about firm risk and performance and the understanding and measurement of financing constraints. Previous studies have widely documented that option prices can be used to elicit investor expectations about future performance of the underlying asset (e.g. Bakshi, Cao and Chen, 1997; Ait-Sahalia, Wang and Yared, 2001; Liu, Pan and Wang, 2005; Broadie, Chernov and Johannes, 2007, Cremers and Weinbaum, 2010). Surprisingly, these methods have seen very few applications to significant corporate events, in which ex-ante market expectations should be a valuable signal. To the best of our knowledge, there have been only two such applications: mergers and acquisitions (Subramanian, 2004; Barraclough, Robinson, Smith and Whaley, 2013; Borochin, 2013), and earnings announcements (Dubinsky and Johannes, 2005). We use findings from the option pricing literature to derive and apply market-based measures of firm risk to the problem of identifying financing-constrained firms.

The rest of the paper proceeds as follows. Section 2 discusses the previous literature on financing constraints and the informativeness of options data on firm performance and potential informativeness about financial constraint. In section 3, we describe our data and define our market-based financial constraint measures. Next, we present our findings on the effectiveness of using these market-based measures in forecasting changes in firm capital structure in section 4. Section 5 measures the abnormal returns accruing to portfolios of constrained and unconstrained firms based on various measures. Finally, section 6 concludes.

2 Literature Review

2.1 Existing Measures of Financing Constraints

Financing constraints have been studied extensively in the literature. In a frictionless world, the firm's financing decisions are independent of its investment decisions. However, when frictions exist that create discontinuities between external and internal cost of capital, firms may face limited access to funds that force them to forego otherwise positive NPV projects. The capital markets' perceptions of firm risk can impact the degree of access the firm has to external sources of capital for positive NPV projects, and therefore the firm's ability to create value. Estimating the effects of these frictions on firm performance leads to the tough task of defining and measuring financing constraints.

The seminal work of Fazzari, Hubbard, and Petersen (1988) defines a firm to be financially constrained if its investment is highly sensitive to its cash flows. Kaplan and Zingales (1997) refute the connection between financing constraints and investment to cash flow sensitivity by examining firm characteristics after collecting financial statements and classifying firms into constrainedness groups. Lamont, Polk and Saa-Requejo (2001) generalize the Kaplan and Zingales (1997) approach and create an index of financing constraints based on firm characteristics such as cash flow, Tobin's Q, leverage ratio, dividends ratio, and cash holdings. Almeida, Campello, and Weisbach (2004) moves away from the investment to cash flow sensitivity by studying the relationship between cash to cash flow sensitivity and argues that a financially constrained firm is more likely to save cash out of cash flows as it expects to be restricted from external financing. Almeida and Campello (2007) revive the investment to cash flow sensitivity measure by including a tangibility multiplier that accounts for the tangibility of assets on the balance sheet. Whited and Wu (2006) use a structural model approach to examine financing constraints by estimating a constrained firm optimization problem to test the impact of financing constraints on stock returns. They parameterize financing constraints with a set of observed firm characteristics such as cash flow, dividend paying status, leverage ratio, firm size, sales growth, and industry sales growth. More recently, Hadlock and Pierce (2010) accumulates these various measures and test their validity to capture financing constraints. They conclude that firm age and size are the best proxies for financing constraints.

In this paper, we rely on the Whited and Wu (2006) index and Hadlock and Pierce (2010) size-age index for our accounting-based measures for financing constraints. We propose a market-based measure for financing constraint and evaluate the additional informativeness of these measures in predicting leverage decisions and financing constraints above that obtainable from the accounting-based measures. Specifically, we take advantage of the information contained in exchange-traded options to infer market beliefs about firm risk as it relates to changes in firm leverage and investment.

2.2 Market-Based Measures of Financing Constraint

There exists a substantial literature on the informational content of options regarding expected future performance of the underlying asset. Option prices have been successfully used to estimate informative risk-neutral distributions of the underlying and generate predictors of its future performance (e.g. Ait-Sahalia, Wang and Yared, 2001; Denis and Mayhew, 2002; Han, 2008; Cremers and Weinbaum, 2010). Bollen and Whaley (2004) propose a price pressure mechanism by which investor beliefs about firm risk and performance become reflected in option prices and implied volatilities across option moneyness and type. This sentiment is expressed as excess demand for the derivatives that reflect their beliefs and investment needs. This framework has been corroborated and extended by Garleanu, Pedersen and Poteshman (2009), Cremers and Weinbaum (2010) and Friesen, Zhang and

Zorn (2012). The common theme in these earlier works is that investor demand pressure impounds useful information about the expected performance of the underlying into option prices. Investors with optimistic (pessimistic) expectations will buy calls (puts), increasing the price and implied volatility of certain option contracts, as well as changing the implied risk-neutral distribution. Despite informativeness about future performance, options data have seen very limited applications outside of asset pricing. In corporate finance applications, they have been used to predict the likelihood of takeovers (Subramanian, 2004; Barraclough, Robinson, Smith and Whaley, 2013; Borochin, 2013), and to measure uncertainty about the firm around earnings announcements (Dubinsky and Johannes, 2005). We add to this literature by using option-based risk measures to forecast changes in firm leverage.

We apply and extend earlier findings about the reflection of investor expectations in option prices by focusing on their relation to firm risks related to increases in firm leverage. The literature suggests that option implied volatilities reflect investor sentiment about the expected level of risk in the underlying, which should have implications for leverage. We take differences in implied volatilities across several dimensions to isolate risks we hypothesize to be relevant to leverage: changes in overall risk, directional (upside or downside) risk, the term structure of risk, and left-tail "crash" risks.

Goyal and Saretto (2009) demonstrate that option implied volatilities deviate from historical levels based on investor beliefs about firm risk. They find evidence consistent with the Barberis and Huang (2001) hypothesis of investor overreaction: investors expect firms that have realized losses to be riskier in the future than firms that have realized gains. Interestingly, Goyal and Saretto (2009) do not find that implied volatility is a significant predictor of future volatility. We take an agnostic position on whether the deviation of implied volatility from the historical level is an overreaction or a rational expectation of firm risk on the part of investors, and focus on this difference as an indicator of perceptions about changes in the riskiness of firms. Thus, the difference between implied and historical volatility is a relevant measure of firm risk.

Cremers and Weinbaum (2010) find that differences in the implied volatilities of puts and calls contain informative investor beliefs about future firm performance. The authors hypothesize that differences in call and put implied volatilities arise due to price pressure (Bollen and Whaley, 2004; Garleanu, Pedersen and Poteshman, 2009) from informed investors (Eesley, O'Hara and Srinivas, 1998) who buy a call option or sell a put option if performance is expected to be positive, and buy a put or sell a call if it is to be negative. This price pressure causes the implied volatilities of call options to exceed those of puts for firms whose investors have optimistic outlooks, and the opposite for those whose investors are pessimistic. This gap in implied volatilities is therefore an indicator of the direction of risk for the firm, which is our second measure of risk relevant to firm leverage. Following a similar argument, investors who expect long-term (short-term) performance to be positive will invest in long-term (short-term) calls. As such, we use changes in the term structure of implied volatility to estimate changes in the term structure of risk, since capital structure may only affect investor expectations at longer maturities. This gives us a third measure for firm risk.

The price pressure argument suggests that the shape of the implied volatility functions reflects excess demand for certain types of options. The most common example of this is the implied volatility "smile" in index options, which Bollen and Whaley (2004) find is due to demand pressure on out of the money put options as a form of insurance. This demand-based explanation is separate from the stochastic volatility explanations of the slope of the implied volatility functions (Bakshi, Cao and Chen, 1997; Bates, 2000; Ait-Sahalia, Wang and Yared, 2001; Liu, Pan and Wang, 2005; Broadie, Chernov and Johannes, 2007). The two explanations are related, however, in the sense that a negative slope in the implied volatility function is indicative of the possibility of a crash. While remaining agnostic about the source of the implied volatility smile, we consider its presence in single-stock options as a sign of left-tail "crash" risk. This interpretation is consistent with both strands of the literature summarized above, whether the negative slope in the implied volatility function is due to excess demand for insurance puts against this risk, or to expectations of price drops due to stochastic volatility in the underlying stock. We therefore look at the slope of the implied volatility functions of put options on single stock firms as our fourth measure of firm risk relevant to the leverage decision.

3 Data and Methods

3.1 Options Measures

We use daily single-stock option data from OptionMetrics, which covers all exchange-traded puts and calls and reports closing bid and ask prices and implied volatilities from 1996 onward. We aggregate the daily implied volatility data into quarterly averages by option type, maturity, and moneyness to match the frequency of our accounting data. As motivated in the previous section, implied volatility reflects the level of risk associated with the underlying asset of an option contract for specific values of option type, maturity, and moneyness. To isolate risks associated with these dimensions, we take differences in average monthly or quarterly implied volatilities by firm across each dimension. From these differences we propose our four option-based measures of firm risk relevant to financial constraint. We construct four firm-specific implied volatility difference variables that capture expectations about risks that we hypothesize to be relevant to a firm's ability to change its leverage. Each variable is calculated for all firms i and quarter t.

Our first variable is the difference between the average implied volatility of long-term calls over the quarter and the historical volatility over the year, measuring changes in (perceived) overall riskiness of a firm:

$$IVspread_{hist,i,t} = IV_{c,long,i,t} - RealizedVolatility_{i,t} \quad (1)$$

Goyal and Saretto (2009) find evidence that the difference between the current implied volatility and the historical annual volatility reflect changes in investor perceptions about firm risk. A perceived increase in the expected riskiness of a firm, regardless of whether it is accurate, may be sufficient to limit its ability to increase leverage. $RealizedVolatility_{i,t}$, the historical volatility for the preceding year, is a measure of the historical risk level of the firm and therefore should be relevant to leverage decisions by itself. We therefore include it as a control variable in our full specification. However, a positive difference between implied and realized volatilities suggests that the firm is perceived to be riskier than before. As such we hypothesize that a positive difference between implied and realized volatilities negatively affects a firm's ability to lever up.

Our second variable is the difference between short-term, and therefore most liquid, call and put implied volatilities, reflecting expectations about the direction of firm performance:

$$IVspread_{cp,i,t} = IV_{c,short,i,t} - IV_{p,short,i,t} \tag{2}$$

This measure draws on the work of Cremers and Weinbaum (2010), who find that differences in call and put implied volatilities are a predictor of future firm performance. According to the price pressure hypothesis of option pricing, net buying pressure raises implied volatilities of options, and net selling pressure lowers it. This causes the gap between calls and puts to act as a barometer of investor sentiment about the firm. Investor optimism about future performance will result in higher implied volatilities of calls relative to puts, and vice versa for investor pessimism. Regardless of whether expected firm performance is realized, the expectation alone may affect a firm's ability to obtain funds.[1] That is, we hypothesize that a positive difference between the implied volatility of calls and puts positively affects a firm's ability to lever up.

Our next variable is the difference in average implied volatilities between long and short

[1] Cremers and Weinbaum (2010) do find significant abnormal performance in firms classified using their measure of difference in call and put implied volatilities.

maturity calls, representing horizon or maturity risk:

$$IVspread_{mat,i,t} = IV_{c,long,i,t} - IV_{c,short,i,t} \quad (3)$$

We define long maturity calls as those expiring in more than 200 days, and short maturity calls as those expiring in less than 40 days. For each firm i in each quarter t, we average implied volatilities for the two maturity categories, $IV_{c,long,i,t}$ and $IV_{c,short,i,t}$ respectively. The difference of the average volatilities $IVspread_{mat,i,t}$ provides a meaningful way to compare expected maturity risk across firms. If $IVspread_{mat,i,t}$ is positive, the firm is expected to be riskier in the long term than in the short, negatively affecting its ability to increase leverage.

Finally, our last measure is the difference in average implied volatilities between out-of-the-money (OTM) and in-the-money (ITM) puts, capturing left-tail or “crash” risk:

$$IVspread_{mon,i,t} = IV_{p,OTM,i,t} - IV_{p,ITM,i,t} \quad (4)$$

We define moneyness as the ratio of the spot price to the strike price. Out-of-the-money calls as those with moneyness less than 0.8 and in-the-money puts as those with moneyness greater than 1.2. Whether a negatively sloped implied volatility function is due to excess insurance demand for OTM put options (Bollen and Whaley, 2004; Garleanu Pedersen and Poteshman, 2009) or stochastic volatility (e.g. Bakshi, Cao and Chen, 1997; Ait-Sahalia, Wang and Yared, 2001; Liu, Pan and Wang, 2005; Broadie, Chernov and Johannes, 2007), in both cases it points to investor beliefs about crashes: the more negative the slope, the bigger the crash.[2] For each firm i in each quarter t, we average put implied volatilities for the two maturity categories, $IV_{p,OTM,i,t}$ and $IV_{p,ITM,i,t}$ respectively. The difference of the average volatilities $IVspread_{mon,i,t}$ provides an indicator of expectations about firm risk. If $IVspread_{mon,i,t}$ is positive, the out of the money puts are more valuable than ones in

[2] A persistently negative implied volatility function is observed in index options, but not in single-stock options. However, this only makes its (occasional) presence in single-stock options all the more informative.

the money, indicating market concern about left-tail "crash" risk and therefore negatively affecting the firm's ability to increase leverage.

3.2 Accounting Based Financing Constraint Measures

We use two existing measures for financing constraints that have gained recent popularity in the literature: the Whited and Wu (2006) index and the Hadlock and Pierce (2010) size-age index. These measures rely on using firm characteristics to proxy for financing constraint risks.

Whited and Wu (2006), following on the theoretical framework of Whited (1992), solve a firm value optimization problem where the firm is subject to a financing constraint. The Lagrange multiplier on the financing constraint captures the sensitivity of the firm to such a constraint. The authors parameterize the Lagrange multiplier using firm characteristics and estimate its coefficients using generalized method of moments approach. The resulting measure provides an index for financing constraint:

$$\begin{aligned} \mathrm{WW}_{i,t} = \; & -0.091 \times \mathrm{CF}_{i,t} - 0.062 \times \mathrm{DDIV}_{i,t} + 0.021 \times \mathrm{LTD}_{i,t} - 0.044 \times \mathrm{SIZE}_{i,t} \\ & +0.102 \times \mathrm{ISG}_{i,t} - 0.035 \times \mathrm{SG}_{i,t}, \end{aligned} \tag{5}$$

where CF is cashflows over total assets, DDIV is an indicator for a dividend-paying firm, LTD is long-term debt over total assets, SIZE is the natural log of book assets, ISG is the sales growth in the firm's 3-digit SIC industry, and SG is the firm's one quarter sales growth all taken from quarterly accounting filings. The WW index is positively correlated with financial constraint.

The second measure, suggested by Hadlock and Pierce (2010), is a more parsimonious index based on firm size and age. Hadlock and Pierce (2010) collect information self-reported by firms in their annual reports to classify firms into five groups: not financially constrained (NFC), likely not financially constrained (LNFC), potentially financially constrained (PFC), likely financially constrained (LFC), and financially constrained (FC). Using ordered logit analysis, the authors examine the ability of various firm characteristics to predict the financing constraint status of firms. They find that a model using firm size and age have significant power for explaining financing constraint classifications. The resulting index is defined as:

$$\text{HPSA}_{i,t} = -0.737 \times \text{FirmSize}_{i,t} + 0.043 \times \text{FirmSize}_{i,t}^2 - 0.040 \times \text{FirmAge}_{i,t}, \tag{6}$$

where FirmSize is the log of book assets (adjusted for inflation using 2004 dollars following Hadlock and Pierce (2010)) and replaced with log($4.5billion) if the actual value is greater, and FirmAge is the number of years the firm has been on Compustat with a non-missing stock price and replaced with 37 if the actual age is greater. The HP index is positively correlated with financial constraint.

3.3 Models of Financial Constraint

Our main dependent variable is the net levering up behavior of the firm, defined as net debt issuances minus net equity issuances as a fraction of total assets:

$$\text{NLEVR}_{i,t} = \frac{D_{iss,i,t} - D_{red,i,t} - E_{iss,i,t} + E_{red,i,t}}{TA_{i,t}} \tag{7}$$

where $D_{iss,i,t}$ is the long-term debt issuance for firm i over quarter t, $D_{red,i,t}$ is the long-term debt reduction, $E_{iss,i,t}$ is the equity issuance, and $E_{red,i,t}$ is the equity reduction. This variable captures the increases in leverage for a firm in a quarter.

This gives us our baseline model to examine how various financing constraint and risk measures explain levering up behavior of firms:

$$\text{NLEVR}_{i,t} = \alpha + \beta_1 FC_{i,t-1} + \varepsilon_{i,t} \tag{8}$$

where $FC_{i,t-1}$ reflects our various financing constraint variables for firm i in quarter $t-1$ (lagged one quarter). We examine individually and altogether our four options-based measures, $IVspread_{hist}$, $IVspread_{cp}$, $IVspread_{mat}$, and $IVspread_{mon}$, and two accounting-based measures, WW and $HPSA$. Of the option-based experimental variables that we hypothesize to be relevant to financial constraint, previous studies suggest that $IVspread_{hist}$, $IVspread_{mat}$, and $IVspread_{mon}$, should be negatively correlated with changes in firm leverage since we hypothesize them to be increasing in overall risk, maturity risk, and tail risk, respectively. $IVspread_{cp}$ should be positively correlated with firm leverage since we hypothesize it to be increasing in upside expectations. To obtain the previous quarter's market-based variables, we calculate averages of the 3-, 4-, and 5-month lags of the market-based option and historical volatility variables at monthly frequency.[3] Of the two accounting based measures, both WW and $HPSA$ should be negatively correlated with changes in leverage since they both derived to be increasing in financing constraints. This model is estimated with two-way clustered standard errors by firm and quarter as in Thompson (2009) and Petersen (2009).

It is important to note that our options-based measures reflect differences in implied volatilities (or difference between implied and realized volatility as in the case of $IVspread_{hist}$). As such, when estimating equation (8) using our options-based measures, we also include the corresponding right-side variable that is being differenced away. For example, when estimating equation (8) using $IVspread_{hist}$, we also include $RealizedVolatility$ in the estimation, when using $IVspread_{cp}$, we also include $IV_{p,short}$, and so on.

Since factors other than financing constraints can impact the net levering behavior of firms, we also include a set of control variables that may explain $NLEVR$ to arrive at our

[3] We cannot use 2-, 1-, or 0-month lags of option data in estimating the model because we want to establish a predictive relationship between market data and leverage. This precludes the use of the current quarter's price data since firm leverage may have changed at any point during the current quarter. However, contemporaneous option data may be used in applications.

full model:

$$\begin{aligned}\text{NLEVR}_{i,t} =&\alpha + \beta_1 FC_{i,t-1} + \beta_2 RealizedVolatility_{i,t-1} + \beta_3 lnTA_{i,t-1} + \beta_4 BTM_{i,t-1}\\&+ \beta_5 Zscore_{i,t-1} + \beta_6 IndLTDR_{i,t-1} + \beta_7 CredSpread_{t-1} + \varepsilon_{i,t}\end{aligned} \tag{9}$$

where $lnTA$ is firm size measured by the natural log of total assets, BTM is the ratio of book equity to market equity, $Zscore$ is the Altman's (1976) Z-score that measures the financial health of a firm, $IndLTDR$ is the firm's 3-digit SIC industry long-term debt ratio, and $CredSpread$ is the credit spread between Moody's Baa bonds and Moody's Aaa bonds. Previous literature in capital structure suggests that large, value, not in financial distress have higher leverage ratios. Furthermore, Frank and Goyal (2009) and Leary and Roberts (2011) suggest that industry leverage plays a large role in a firm's chosen capital structure. Finally, the credit spread reflects the current macroeconomic environment and, as such, the availability of funds in the economy. Again, all explanatory variables are lagged one quarter and the model is estimated with standard errors clustered by firm and by quarter.

The above analysis uses a continuous measure of net levering up behavior, $NLEVR$. For robustness, we also define a dummy variable for any increase in leverage as

$$\text{NLEVD}_{i,t} = 1 \text{ if } \text{NLEVR}_{i,t} > 0, 0 \text{ otherwise} \tag{10}$$

While $NLEVR$ allows us to study whether our various financing constraint measures can explain the magnitude of capital structure changes, using $NLEVD$ allows us to test whether our measures have power in explaining the levering up decision. We use a logistic model to examine the impact of financing constraints on $NLEVD$:

$$\begin{aligned}\text{NLEVD}_{i,t} =&\alpha + \beta_1 FC_{i,t-1} + \beta_2 RealizedVolatility_{i,t-1} + \beta_3 lnTA_{i,t-1} + \beta_4 BTM_{i,t-1}\\&+ \beta_5 Zscore_{i,t-1} + \beta_6 IndLTDR_{i,t-1} + \beta_7 CredSpread_{t-1} + \varepsilon_{i,t}\end{aligned} \tag{11}$$

The predicted value of the logistic regression's link function gives us the propensity score on

$(0, 1)$ on whether the firm is likely to lever up.

3.4 Financial Statement, Macro Environment and Returns Data

We use quarterly data to construct the two accounting-based financing constraint indices, dependent variable ($NLEVR$), and controls discussed above. We obtain corporate financial statement data from Standard & Poor's Compustat North American quarterly database from 1996 to 2012 and Moody's Baa and Aaa rates from the Federal Reserve Board historical interest rate website. We chain all dollar amounts to 2000 dollars using CPI to adjust for inflation (with the exception of HPSA, which is chained to 2004 dollars, as described in section 3.2). We remove any firms with negative book asset value, market equity, book equity, capital stock, sales, dividends, debt, and inventory. Such firms have either unreliable Compustat data or are likely to be distressed or severely unprofitable. Although distressed and unprofitable firms are likely to be restricted from obtaining additional funds, financially constrained firms need not be distressed or unprofitable in general. In addition, we delete observations in which book assets or sales growth over the quarter is greater than 1 or less than -1 and remove firms worth less than $5 million in 2000 dollars in book value or market value to remove observations that have abnormally large or sensitive changes due to acquisitions or small asset bases. Next, we remove outliers defined as firm-quarter observations that are in the first and 99th percentile tails for all relevant variables used in our analysis. We also remove all firms in the financial and insurance, utilities, and public administration industries because they tend to be heavily regulated.

Our returns data comes from the daily and monthly CRSP database from 1995 to 2012. We measure realized volatility on the first of each month using a one-year backward-looking window of daily returns. We annualize the resulting standard deviation to obtain the realized volatility for the preceding year $RealizedVolatility_{i,t}$. This is an input into $IVspread_{hist,i,t}$, our measure of the perception of change in firm risk. It is also a control for the historical level of firm risk as a determinant of leverage. We also compute buy-and-hold abnormal returns for portfolios of financially constrained and unconstrained firms by computing and compounding abnormal monthly returns.

Finally, requiring the resulting sample to contain at least one non-missing financing constraint measure gives us a sample of 4,449 firms spanning over 100,971 firm-quarter observations between 1996 to 2012. In addition, in order to compare across estimations, we restrict our sample to those with non-missing observations for all financing constraint measures, giving us a sample of 3,779 firms spanning 57,097 firm-quarter observations. Table I provides the summary statistics for all relevant variables for both samples. Table II provides the pairwise correlation between all relevant variables. Only correlations significant at the 10% level or better are reported. It is worthwhile to note that the pairwise correlation between the Whited and Wu (2006) index and the Hadloack and Pierce (2010) size-age index is 66.5%, given the inclusion of firm size in both indices. Furthermore, the pairwise correlations between the four implied volatility spreads are all under 11.0%, suggesting that all four measures contain unique information. Finally, while the IV spread measures are largely uncorrelated, the implied volatility levels (rows (10) through (14) in Table II) are are highly correlated amongst themselves and with realized volatility, with correlations ranging from 68.7% to 81.5%.

4 Main Results

4.1 Baseline Model

Table III presents the results for our baseline specification without any control variables, as in equation (8). We regress the net levering up behavior of firms as a ratio to total book assets, $NLEVR$, on the two accounting-based financing constraint measures and four options-based measures discussed above individually and altogether. Columns (1) and (2) report the coefficients on the Whited and Wu (2006) and Hadlock and Pierce (2010) size-age indices for financing constraints, respectively. The higher the index, the more constrained the firm. As expected, we observe less levering up behavior when firms are more constrained. Columns (3) through (6) report the coefficients for our four implied volatility spreads and their corresponding right-side levels in the spread. For example, in the specification in column (3), we use $IVspread_{hist}$, the difference between the implied volatility for long-term calls and historical volatility. The corresponding baseline level is the historical volatility, which is also included in the specification. Similarly, column (4) reports the coefficients on $IVspread_{cp}$ and $IV_{p,short}$. We expect the coefficients on all volatility level variables to be negative. Indeed, the results confirm that the riskier the firm, the less likely they will engage in levering up behavior. Based on existing literature on the risks associated with the different implied volatility spreads, we expect the coefficients on $IVspread_{hist}$, $IVspread_{mat}$, and $IVspread_{mon}$ to be negative in columns (3), (5), and (6), respectively, and find corroborating results. However, the coefficient on $IVspread_{cp}$ in column (4) is negative. This is opposite to previous literature which suggest the greater the spread between calls and puts, the better the expectations of the future for the firm by investors. It is worthwhile to note that the adjusted R^2 is higher for the option-based measures in columns (3) through (6) than for the accounting based measures in columns (1) and (2).

Column (7) of Table III reports the results for including all measures into one specification. As mentioned above, the correlation between all the implied volatility level variables are highly correlated, causing multi-collinearity concerns when combined into one model. To alleviate this issue, we use $RealizedVolatilty$ in place of all implied volatility level variables to control for the overall risk level of the firm. As before, both WW and HPSA are negative and significant. Additionally, $IVspread_{hist}$, $IVspread_{mat}$, and $IVspread_{mon}$ are also negative and significant. However, in the presence of other measures, $IVspread_{cp}$ becomes positive and insignificant. Furthermore, the adjusted R^2 for this model is higher than including each of the measures independently. The specifications in columns (8) and (9) splits the analysis into using accounting based measures only (WW and HPSA) and using market-based measures only (implied volatility spreads, and realized volatility), respectively.

Though the results are similar to that reported under column (7), the high adjusted R^2 in column (7) is driven primarily by the market-based measures. Only using market-based measures increases the adjusted R^2 by 37.0% over only using accounting-based measures.

4.2 With Controls

Table IV repeats the analysis in Table III with the inclusion of common control variables. Firm-specific controls include firm size, book-to-market ratio to capture investment and growth opportunities, and Altman's Z-score to capture firm's financial health. Frank and Goyal (2009) find that a firm's long-term debt ratio is largely determined by its industry's long-term debt ratio and Leary and Roberts (2011) find that firms tend to mimic the industry leverage ratio. We include the 3-digit SIC industry long-term debt ratio to control for industry influences. Finally, we control for the economy-wide environment by including the credit spread, measured by the difference between Moody's Baa and Moody's Aaa rates. In general, the coefficients on the control variables are consistent with existing literature on financial constraints and capital structure. Large, value, financially healthy firms are typically less financially constrained and our results indicate they engage in larger net levering behavior. Furthermore, with the inclusion of control variables the adjusted R^2 of the models increase by more than 2%.

With the inclusion of control variables, the coefficient on WW in column (1) is no longer significant. This suggests that the control variables absorb the usefulness of WW in explaining net levering up behavior of firms. Although, HPSA is still negative and significant in column (2), the magnitude of the coefficient has decreased by 84%. However, the inclusion of control variables has little effect on the significance and direction of the option-based measures in columns (3) through (6). Indeed, all volatility level measures remain negative and highly significant. The coefficients on $IVspread_{hist}$, $IVspread_{mat}$, and $IVspread_{mon}$, in columns (3), (5), and (6) respectively, are negative and significant at the 1% levels. The coefficient on $IVspread_{cp}$, in column (4), is still negative, though now only significant at the 5% level. However, when including all measures into one model as in column (7) or all market-based measures into one model as in column (9), the coefficient on $IVspread_{cp}$ becomes positive and significant at the 10% level, consistent with our hypothesis, while the coefficient on $IVspread_{mat}$, though negative, becomes insignificant. Similar to the results observed in Table III, the specification with only market-based measures in column (9) has more explanatory power than the specification with both accounting-based measures in column (8). Indeed, the adjusted R^2 using only market-based measures in column (9) is 4.57%, driving the fit of the full model in column (7) which has an adjusted R^2 of 4.58%. Furthermore, when including both accounting-based measures and market-based measures in the full model, both WW and $HPSA$ become slightly positive and lose their significance.

In Table V, we also include $RealizedVolatility$ in all specifications. This controls for the historical level of firm risk and isolates any revisions in expected volatility against the current level. When we include $RealizedVolatility$ as a control, the coefficient on WW becomes positive and significant in column (1), counter to its previous results and opposite to the expected effect of financing constraints on net levering up behavior. Likewise, the coefficient on HPSA is slightly positive and no longer significant. These findings are consistent with the interpretation that Realized Volatility absorbs the financing constraint risk component in WW and $HPSA$. Among our four option-based measures, $IVspread_{hist}$ in column (3) and $IVspread_{mon}$ in column (6) retain their significance. Though the coefficient on $IVspread_{mat}$ in column (5) is negative, it is no longer significant. It is worthwhile to note that with the inclusion of Realized Volatility in the specification, the coefficient on $IVspread_{cp,i,t}$ is now positive, albeit insignificant. This is consistent with the existing literature on the call-put implied volatility spread. In our full specification in column (7), both WW and $HPSA$ are positive, though neither are significant. Columns (7) and (9) of Table V are identical to those in Table IV and are included for completeness and for comparison. However, in a model with both WW and $HPSA$ and controls that include $RealizedVolatility$, as in column (8), neither the WW index nor $HPSA$ has any explanatory power on the net levering up behavior of firms.

4.3 Monthly Market-based Measures

The preceding analysis suggests that market-based measures contain information relevant to capital structure decisions in excess of that obtainable from accounting based measures. Taken to the extreme, the results from columns (7) and (8) of Table V imply that there is no value in using WW and $HPSA$ as financing constraint measures in the presence of market-based measures in explaining net levering up behavior. Tables III to V use the average implied volatility measures over the past quarter, i.e., the average implied volatility spread from five months ago to three months ago. We take the average for two reasons. First, to improve the number of observations in our sample to include firms that may not have data for all three months in the past quarter and second, to smooth any kinks in the options data. However in taking the average, we lose one of the key features of using market based data - the more frequent availability of data. For robustness, in Table VI, we restrict our sample to firms with options data in all three months in the past quarter and rerun columns (7), (8), (9) from the previous tables using monthly option averages instead of quarterly.[4] This reduces our sample to 21,187 firm-quarter observations. If market-based measures indeed contain useful information about financing constraint, we should see that options data at monthly frequency retains explanatory power on net levering up behavior.

Column (1) presents the results for this subsample using WW and $HPSA$ with controls but excluding $RealizedVolatility$. Although the coefficients on both WW and $HPSA$ are negative, they are insignificant. There are two interpretations for this finding. First, as before, the controls absorb any explanatory power in these measures as both indices use similar proxies such as firm size and industry leverage. Second, there is a sample selection bias in that firms that have options data available for all three months in the past quarter may

[4]We require all three months' data to be present to enable a meaningful comparison of the quality of fit across months.

be the more liquid and less constrained firms to start with and therefore these two financing constraint measures are non-binding in this sample. Although the second interpretation may be worrisome, it is important to emphasize that the concept of financing constraint may be interpreted in two ways: binary (constrained versus unconstrained) or continuous (more or less constrained, closer or further from being constrained). Here, we study the latter interpretation. Therefore, although it is possible this super-restricted sample contains mostly unconstrained firms, our analysis can still speak to how close firms are to being constrained.

Columns (2) and (3) of Table VI use the fifth lag of monthly market-based measures, i.e., the end of the first month in the past quarter. This is the month immediately following the release of accounting data from two quarters ago. The results are similar to those observed in the quarterly data. However, only $IVspread_{hist}$ and $IVspread_{mon}$ are significant at the 5% and 1% levels, respectively in both columns, and the models have adjusted R^2's of 4.15%. Columns (4) and (5) use the fourth lag of monthly market-based measures, i.e., the second month in the past quarter. Though the market has not received any new accounting information, the options data advanced by one month and we should expect stronger findings if this fresher data is more informative. Indeed, we see that the significance for $IVspread_{hist}$ has improved to 1% and the adjusted R^2 has improved slightly to 4.21% in column (4) and 4.22% in column (5). Furthermore, in column (5), $IVspread_{cp}$ is positive and significant at 10%, as expected. Finally, columns (6) and (7) use the third lag of monthly market-based measures, i.e., the last month in the past quarter. This coincides with a release of new accounting information from one quarter ago. The results here look very similar to those using the fourth lag, though slightly weaker, e.g., $IVspread_{cp}$ loses significance. We hypothesize that the new information content in the third lag of market-based measures correlates more with those in the new accounting information, losing some of the uniqueness of its informative power to the accounting information. It is reassuring that using the fourth lag of market-based measures provides results as strong or stronger than the most current information, since this data contains updated market information without corresponding updates to accounting information. These findings highlight the information advantage of using market-based measures.

5 A Market-Based Index of Financing Constraint

The results from section 4 suggest that there is value in using market-based measures to study financing constraints and financing behavior of firms. In this section, we propose a new measure for financing constraints that uses market-based information. There are three key advantages to this measure over existing, accounting-based measures. First, practically, options and returns information are updated at a much higher frequency than book-based measures. Second, market-based measures reflect investor and market attitudes and expectations regarding firm risks and therefore are forward-looking. Third, a feature distinctive to using options data, having various types of options associated with one underlying asset allows us to examine various risk dimensions pulled from the implied volatilities of these options, such as horizon risk or tail risk. This allows us to examine specific risks that may explain corporate behavior, specifically in this paper, net levering up behavior and financing constraints, rather than rely on book values of firm characteristics to proxy for these risks. In other words, rather than rely on firm size as a catch-all measure for various risks firms are exposed to, we can specifically measure horizon risk and tail risk and compare their individual impacts.

Tables III to V use restricted samples in order to compare the fit across different specifications. In creating our index, we the estimated coefficients using the unrestricted, full sample described in Panel A of Table I. Columns (1), (2), and (3) of Table VII presents the results for a specification using only accounting-based measures, market-based measures, and both accounting and market-based measures, respectively.[5] The results are similar to

[5]Column (3) of Table VII is identical to column (7) of Table IV and is included only for completeness and comparison.

those discussed above. We take the negative of the coefficients from column (2) of Table VII to create our market-based financing constraint index:

$$\begin{aligned} FCMkt_{i,t} = & 0.0119 * IVspread_{hist,i,t} - 0.0067 * IVspread_{cp,i,t} \\ & + 0.0089 * IVspread_{mon,i,t} + 0.0226 * RealizedVolatility_{i,t} \\ & - 0.0022 * LnTA_{i,t} - 0.0044 * BTM_{i,t} - 0.0060 * Zscore_{i,t} \end{aligned} \tag{12}$$

where $IVspread_{hist}$ is the difference between the implied volatility of long-term calls and realized volatility, $IVspread_{cp}$ is the difference between the implied volatility of short-term calls and short-term puts, $IVspread_{mon}$ is the difference between the implied volatility of out-of-the-money puts and in-the-money puts, $RealizedVolatility$ is the realized volatility of the underlying asset over the past year, $LnTA$ is the natural log of total assets, BTM is the ratio of book equity to market equity, and $Zscore$ is the Altman (1979) Z-score.

5.1 Propensity to Lever Up

As mentioned above, financing constraints can be interpreted in two ways: binary (constrained versus unconstrained) or continuous (more or less constrained, closer or further from being constrained). In the preceding analysis, we use $NLEVR$ as our dependent variable to derive our market-based index for financing constraints in equation (12). This captures not only the direction but also the magnitude that various financing constraint and risk measures have on the net levering up behavior of the firm. For robustness, we create a binary, dummy variable, $NLEVD$, that takes the value of 1 for firms that increases net leverage in a particular quarter[6] and 0 otherwise.

Columns (4), (5), and (6) of Table VII presents the results using this dummy variable for net levering up as the dependent variable in a localistic model, as detailed in equation (11). The control variables have the same direction of effect on the binary leverage decision

[6] We continue to use the definition of net leverage from the preceding analysis.

that they did in the continuous case, but with varying significance. Interestingly, both industry long-term debt ratio and credit spread become significant with signs consistent with previous literature. Namely, firms in 3-digit SIC industries with higher long-term debt ratios are more likely to lever up as well as during better economies as reflected by a lower credit rating spread. In a model using only accounting-based measures, as in column (4), both WW and $HPSA$ are negative and significant, even in the presence of controls where previously they lost significance or changed signs. In a model using only market-based measures, as in column (5), only $IVspread_{mon}$ is statistically significant among the four $IVspread$ measures. However, $RealizedVolatility$ is strongly negative and significant. In a model with both accounting-based measures and market-based measures, while both WW and $HPSA$ are still negative, only WW retains its significance. However, $IVspread_{mon}$ and $RealizedVolatility$ are both negative and strongly significant. These results suggest that the accounting-based measures for financing constraints are informative in inferring the general direction of capital structure behavior (i.e., whether a firm levers up or not) rather than how much a firm levers up. Furthermore, among the four $IVspread$ variables proposed in section 2, $IVspread_{mon}$ is the only consistently significant one, suggesting that tail risk is the most informative in explaining net levering up behavior both in direction and magnitude. Historical risk levels, captured by $RealizedVolatility$, are similarly important for both. The predicted value of this logistic regression provides us with a probability, $P(LeverUp)$, on whether the firm is likely to lever up. $1 - P(LeverUP)$ then provides us with another market-based measure for financing constraints, $P(FinConstr)$.

5.2 Evidence of Measuring Financing Constraints

Armed with two potential market-based measures for financing constraints, an index based on equation (12) and $P(FinConstr)$, we explore whether these two measures can identify firms commonly believed to be financially constrained, or their associated characteristics. To do this, in each quarter we sort firms based on $FCMkt$ into three equal-sized bins: LOW, MED, and HIGH. The LOW bin reflects firms with values of $FCMkt$ falling in the bottom tercile in any given quarter, i.e., firms with larger net levering up behavior and are more likely to be unconstrained. The HIGH bin reflects firms with values of $FCMkt$ ranking in the top tercile in any given quarter, i.e., firm with less net levering up behavior and are more likely to be constrained. We repeat this procedure to create LOW, MED, and HIGH bins based on $P(FinConstr)$.

Table VIII compares firms in the LOW and HIGH bins for firm characteristics commonly associated with being financially constrained. The first three columns use $FCMkt$, based on regression analysis using $NLEVR$ and the last three columns use $P(FinConstr)$, based on logistic regression analysis using $NLEVD$. Means are reported in the table and tested to see if they are statistically different from each other. As evidenced in the table, firms ranking HIGH in both market-based measures are smaller, growth firms with low Altman Z-scores and cash flows. These firms also have lower leverage ratios and higher cash holdings, consistent with the cash-to-cashflow sensitivity theory of Almeida, Campello, and Weisbach (2004). Furthermore, these firms are less likely to be dividend-paying firms, have credit ratings, or if they do, have investment-grade ratings, and positive correlations with both WW and $HPSA$. These results suggest that $FCMkt$ and $P(FinConstr)$ appear to be measuring financing constraints and identifying firms with characteristics associated with being constrained.

Finally, we examine and compare the explanatory power of various financing constraint measures on observed investment behavior of firms. Table IX repeats the previous analysis using accounting-based and market-based measures to explain the ratio of capital expenditure to total assets, a proxy for investment behavior. As we expect firms to engage in levering up behavior in order to fund investment, we expect the results on investment behavior to be similar to those on financing behavior. Indeed, firms with high WW in the previous quarter, have lower investment, as evidenced by the negative coefficient on WW in column (1). However, in column (2), the coefficient on $HPSA$ is positive and significant, contrary to expectations. This result is driven by the fact that $HPSA$ is based on firm size and age only. As such, these firms are likely to be in the growth stage of their development and have low total assets. In other words, their capital expenditure may be low, but their total asset denominator is much lower, resulting in a high capital expenditure to total asset ratio. Using our market-based measures, we confirm that $IVspread_{mat}$ and $IVspread_{mon}$ indeed affect investment behavior negatively and significantly in columns (5) and (6), respectively, consistent with our results based on financing behavior. However, the coefficient on $IVspread_{hist}$ is positive in column (3) and the coefficient on $IVspread_{cp}$ is negative in column (4), contrary to expectations. Furthermore, $RealizedVolatility$ does not seem to play a significant role in any specification with the exception of columns (3) and (7), where it plays the counterpart to $IVspread_{hist}$. Though there are distinctive differences between the investment and financing behaviors of the firm, our market-based measures of tail and horizon risks perform as at least well as the existing accounting based measures for financing constraints in explaining investment behavior.

5.3 Buy-and-hold Strategy

Since the previous results seem consistent with an ability to identify firms that have financing constraints, and therefore an impaired ability to create value, we explore the usefulness of our market-based measures in generating abnormal returns from a buy-and-hold strategy. We return to our LOW, MED, HIGH terciles for $FCMkt$ and $P(FinConstr)$. In each quarter we also sort firms based on WW and $HPSA$ into their respective LOW, MED, and HIGH terciles. Finally, for validity and robustness, we randomly assign firms in each quarter to another set of terciles. This gives us five terciles based on: A) $FCMkt$, B) $P(FinConstr)$, C) WW, D) $HPSA$, and E) *Random*. For the first four measures, LOW represent firms with low financing constraints and HIGH captures firms with high financing constraints. For *Random*, there should be no statistical difference between each bin by construction.

We follow a buy-and-hold strategy by compounding abnormal returns over 12 months.

Abnormal returns are calculated as actual returns net of expected returns based on the coefficients obtained from the Carhart (1997) 4-factor model using a 60-month rolling window. We expect financially unconstrained firms, firms in the LOW bins, to generate higher abnormal returns than financially constrained firms, firms in the HIGH bins for both our two market-based measures and the two accounting-based measures. The returns are plotted in Figure 1.

Panel A of Figure 1 plots the LOW, MED, HIGH, and LOW-HIGH buy-and-hold returns out 12 months based on $FCMkt$. Not surprisingly, LOW (HIGH) offers the highest (lowest) buy-and-hold returns, reaching 1.7% (-3.3%) by month six and 4.3% (-5.1%) by month 12. The LOW-HIGH portfolio generates a buy-and-hold return of 9.5% by month 12. In other words, buying a portfolio with LOW $FCMkt$ firms and shorting a portfolio of HIGH $FCMkt$ generates almost a 10% return over one year. Panel B displays the LOW, MED, HIGH, and LOW-HIGH buy-and-hold returns based on $P(FinConstr)$. Similar to the results for $FCMkt$, LOW (HIGH) offers the highest (lowest) returns, with a buy-and-hold strategy on the LOW-HIGH portfolio generating a 5.0% by month 6 and a 7.6% return by the end of a year. Panel C graphs the LOW, MED, HIGH, and LOW-HIGH returns based on the WW sort. Though the results are similar, with LOW (HIGH) portfolio generating the highest (lowest) abnormal returns, the magnitude is much smaller. The LOW-HIGH portfolio only generates 1.3% over 6 months and 1.8% over a year. Panel D presents the LOW, MED, HIGH, and LOW-HIGH buy-and-hold returns using $HPSA$. Although the buy-and-hold returns on LOW-HIGH portfolio is higher than WW, it is still meager compared to $FCMkt$ and $P(FinConstr)$, generating 1.9% by month 6 and 3.7% by month 12. Finally, and reassuringly, the buy-and-hold returns for the LOW-HIGH portfolio based on a random assignment, plotted in Panel E, is basically 0.0% over the entire year. This indicates that a market-based index for financing constraints generates substantial buy-and-hold returns that accounting-based measures of financing constraints do not.

6 Conclusion

We provide new evidence connecting market-based measures of firm risk to firm leverage decisions. We recover investor expectations about risks relevant to financing constraint from option prices, and demonstrate their predictive power for changes in firm leverage. Our results demonstrate that these market-based measures capture information that is not contained in established accounting-based measures.

Option implied volatility spreads that capture investor perceptions of left-tail "crash" risk, changes of firm riskiness, maturity risk, and upside potential have significant predictive power for future leverage changes at the firm. Furthermore, accounting-based measures of financial constraint lose their power once these market-based measures, including historical volatility, are taken into account. A buy-and-hold trading strategy on the market-based index of financing constraint significantly outperforms those on established accounting-based indices. The 12-month abnormal return on buying a portfolio of firms identified as least financially constrained by the market-based index while shorting the portfolio identified as most constrained is 9.5%, significantly outperforming similar accounting-based strategies.

These findings provide promising insight into the linkages between market-based estimates of investor expectations outside the firm and managerial decision-making within it. The present application of estimating unobservable financing constraints is just one case of a potentially large set of connections between investor expectations and firm operations, as well as frictions that moderate these connections. One such promising friction is the strength of firm corporate governance as the mechanism connecting the expectations of outsider shareholders to the incentives of insider decision-makers.

References

Ait-Sahalia, Y., Y. Wang, and F. Yared, 2001, Do Options Markets Correctly Price the Probabilities of Movement of the Underying Asset?, *Journal of Econometrics*, 102, 67-110

Almeida, H., and M. Campello, 2007, Financial Constraints, Asset Tangibility, and Corporate Investment, *Review of Financial Studies*, 20, 1429-1460.

Almeida, H., M. Campello, and M. Weisbach, 2004, The Cash Flow Sensitivity of Cash, *Journal of Finance*, 59, 1777-1804.

Altman, E., 1968, Financial Ratios, Discriminant Analysis, and the Prediction of Corporate Bankruptcy, *Journal of Finance*, 23, 589-609.

Bakshi, G., C. Cao, and Z. Chen, 1997, Empirical Performance of Alternative Option Pricing Models, *Journal of Finance*, 52, 2003-2049.

Barberis, N., and M. Huang, 2001, Mental Accounting, Loss Aversion, and Individual Stock Returns, *Journal of Finance*, 56, 1247-1292.

Barraclough, K., D. Robinson, T. Smith, and R. Whaley, 2013, Using option prices to infer overpayments and synergies in M&A transactions, *Review of Financial Studies*, 26, 695-722.

Bates, D., 2000, Post-'87 crash fears in the S&P 500 futures options market, *Journal of Econometrics*, 94, 181-238.

Borochin, P., 2013, When Does A Merger Create Value? Using Option Prices to Elicit Market Beliefs, Financial Management, *forthcoming*.

Bollen, N., and R. Whaley, 2004, Does Net Buying Pressure Affect the Shape of Implied Volatility Functions?, *Journal of Finance*, 59, 711-753.

Broadie, M., M. Chernov and M. Johannes, 2007, Model Specification and Risk Premia: Evidence from Futures Options, *Journal of Finance*, 62, 1453-1490.

1944-1979.

Cremers, M., and D. Weinbaum, 2010, Deviations from Put-Call Parity and Stock Return Predictability, *Journal of Financial and Quantitative Analysis*, 45, 335-367.

Dennis, P., and S. Mayhew, 2002, Risk-neutral skewness: Evidence from stock options, *Journal of Financial and Quantitative Analysis*, 37, 471-493.

Dubinsky, A., and M. Johannes, 2006, Fundamental uncertainty, earnings announcements, and equity prices, *Columbia University working paper.*

Easley, D., M. O'Hara and P. Srinivas, 1998, Option Volume and Stock Prices: Evidence on Where Informed Traders Trade, *Journal of Finance*, 53, 431-465.

Faulkender, M. and M.A. Petersen, 2006, Does the Source of Capital Affect Capital Structure?, *Review of Financial Studies*, 19, 45-75.

Fazzari, S.M., R.G. Hubbard, and B.C. Petersen, 1988, Financing Constraints and Corporate Investment, *Brookings Papers on Economic Activity*, 1, 141-195.

Friesen, G., Y. Zhang and T. Zorn, 2012, Heterogeneous Beliefs and Risk-Neutral Skewness, *Journal of Financial And Quantitative Analysis*, 47, 851-872.

Gamba, A. and A.J. Triantis, 2008, The Value of Financial Flexibility, *Journal of Finance*, 63, 5, 2263-2296.

Garleanu, N., L. Pedersen, and A. Poteshman, 2009, Demand-Based Option Pricing, *Review of Financial Studies*, 22, 4259-4299.

Goyal, A., and A. Saretto, 2009, Cross-Section of Option Returns and Volatility, *Journal of Financial Economics*, 94, 310-326.

Hadlock, C.J., and J.R. Pierce, 2010, New Evidence on Measuring Financial Constraints: Moving Beyond the KZ Index, *Review of Financial Studies*, 23, 1909-1940.

Han, B., 2008, Investor Sentiment and Option Prices, *Review of Financial Studies*, 21, 387-414.

Kaplan, S. and L. Zingales, 1997, Do Financing Constraints Explain Why Investment is Correlated with Cash Flow?, *Quarterly Journal of Economics*, 112, 169-215.

Lamont, O., C. Polk, and J. Sa-Requejo, 2001, Financial Constraints and Stock Returns,*Review of Financial Studies*, 14, 529-554.

Liu, J., J. Pan and T. Wang, 2005, An Equilibrium Model of Rare-Event Premia and Its Implication for Option Smirks, *Review of Financial Studies*, 18, 131-164.

Petersen, M.A., 2009, Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches, *Review of Financial Studies*, 22, 435-480.

Subramanian, A., 2004, Option pricing on stocks in mergers and acquisitions, *Journal of Finance*, 59, 795-829.

Stein, J., 1997, Internal Capital Markets and the Competition for Corporate Resources, *Journal of Finance*, 52, 1, 111-133.

Thompson, S.B., 2009, Simple Formulas for Standard Errors that Cluster by Both Firm and Time, *working paper*, Arrowstreet Capital.

Whited, T., and G. Wu, 2006, Financial Constraints Risk, *Review of Financial Studies*, 19, 531-559.

Table I: Sample statistics of common firm characteristics, financing constraints measures, and option measures. Credit Spread is the difference between Moody's Baa and Moody's Aaa rates. Investments / TA is the ratio of capital expenditures to total book assets for a firm. Net Levering Up / TA is the net levering up behavior of the firm, defined as long-term debt issuance net of long-term debt reductions minus equity issuance net of equity reductions, as a ratio to total book assets. WW is the Whited and Wu (2006) index for financing constraints and HPSA is the Hadlock and Pierce (2010) size-age index for financing constraints. Panel A presents the summary statistics for the full sample and panel B presents the summary statistics for the sample restricted to those with non-missing observations for all relevant variables.

Panel A: Full Sample								
	No. Obs	Mean	Std Dev	1%	25%	50%	75%	99%
Total Assets ($ millions)	100971	4310.4	15930.9	32.2	282.5	802.4	2497.9	65730.0
Total Market Capitalization ($ millions)	100971	4938.6	17809.4	60.2	390.7	975.5	2822.6	80618.1
Log Total Assets	100971	6.702	1.619	3.411	5.548	6.589	7.712	10.927
Book-to-Market Ratio	100971	0.507	0.400	0.063	0.247	0.408	0.644	2.080
Altman's Zscore	93783	0.529	1.414	-5.904	0.248	0.790	1.269	2.259
SIC3 Industry Long-term Debt / TA	100971	0.198	0.099	0.043	0.126	0.168	0.252	0.524
Credit Spread	100971	1.054	0.475	0.550	0.780	0.920	1.240	3.380
Investments / TA	97746	0.016	0.023	0.000	0.005	0.010	0.020	0.108
Net Levering Up / TA	97254	-0.003	0.061	-0.304	-0.009	-0.001	0.008	0.148
Net Levering Up > 0	98319	0.362	0.481	0.000	0.000	0.000	1.000	1.000
WW	90624	-0.312	0.091	-0.520	-0.376	-0.307	-0.248	-0.101
HPSA	100971	-3.492	0.558	-4.636	-3.812	-3.423	-3.116	-2.347
Realized Volatility	100968	0.544	0.273	0.172	0.355	0.485	0.669	1.436
Implied Vol: Long Calls	71955	0.495	0.219	0.171	0.337	0.449	0.608	1.180
Implied Vol: Short Calls	93064	0.565	0.236	0.214	0.400	0.519	0.679	1.328
Implied Vol: Short Puts	89558	0.592	0.245	0.232	0.424	0.541	0.705	1.411
Implied Vol: OTM Puts	84170	0.628	0.225	0.279	0.472	0.586	0.738	1.356
Implied Vol: ITM Puts	67793	0.627	0.265	0.238	0.437	0.573	0.759	1.475
Long Call Implied Vol-Realized Vol Diff	71952	-0.046	0.160	-0.538	-0.100	-0.024	0.029	0.307
Short Call-Short Put Implied Vol Diff	88774	-0.029	0.113	-0.393	-0.061	-0.018	0.014	0.228
Long Call-Short Call Implied Vol Diff	68274	-0.079	0.109	-0.420	-0.122	-0.064	-0.019	0.131
OTM Put-ITM Implied Vol Diff	58482	0.052	0.150	-0.440	-0.005	0.065	0.126	0.384
Panel B: Restricted Sample								
	No. Obs	Mean	Std Dev	1%	25%	50%	75%	99%
Total Assets ($ millions)	57097	3788.4	9870.0	40.8	325.3	933.4	2975.1	44212.0
Total Market Capitalization ($ millions)	57097	4830.7	14769.5	73.3	453.1	1124.6	3349.8	66297.0
Log Total Assets	57097	6.829	1.557	3.689	5.685	6.723	7.868	10.519
Book-to-Market Ratio	57097	0.512	0.398	0.067	0.251	0.412	0.653	2.049
Altman's Zscore	53441	0.593	1.292	-4.904	0.278	0.816	1.287	2.272
SIC3 Industry Long-term Debt / TA	57097	0.194	0.099	0.041	0.124	0.161	0.243	0.527
Credit Spread	57097	1.113	0.516	0.550	0.810	0.980	1.250	3.380
Investments / TA	56756	0.016	0.021	0.000	0.005	0.010	0.020	0.105
Net Levering Up / TA	57097	-0.001	0.053	-0.222	-0.008	-0.001	0.008	0.146
Net Levering Up > 0	57097	0.355	0.479	0.000	0.000	0.000	1.000	1.000
WW	57097	-0.317	0.092	-0.525	-0.381	-0.310	-0.252	-0.107
HPSA	57097	-3.523	0.539	-4.636	-3.832	-3.461	-3.154	-2.451
Realized Volatility	57097	0.567	0.264	0.191	0.384	0.511	0.689	1.421
Implied Vol: Long Calls	57097	0.513	0.195	0.208	0.372	0.474	0.617	1.126
Implied Vol: Short Calls	57097	0.600	0.220	0.254	0.446	0.559	0.708	1.314
Implied Vol: Short Puts	57097	0.625	0.231	0.268	0.464	0.579	0.737	1.388
Implied Vol: OTM Puts	57097	0.641	0.211	0.299	0.495	0.605	0.747	1.309
Implied Vol: ITM Puts	57097	0.591	0.232	0.240	0.426	0.546	0.709	1.335
Long Call Implied Vol-Realized Vol Diff	57097	-0.055	0.154	-0.533	-0.110	-0.029	0.028	0.242
Short Call-Short Put Implied Vol Diff	57097	-0.025	0.071	-0.253	-0.046	-0.017	0.004	0.130
Long Call-Short Call Implied Vol Diff	57097	-0.089	0.092	-0.388	-0.128	-0.077	-0.036	0.088
OTM Put-ITM Implied Vol Diff	57097	0.052	0.141	-0.410	-0.001	0.065	0.122	0.361

Table II: Pairwise correlation matrix of capital structure, financing constraint, and option measures. Net Levering Up / TA is the net levering up behavior of the firm, defined as long-term debt issuance net of long-term debt reductions minus equity issuance net of equity reductions, as a ratio to total book assets. Credit Rating Spread is the difference between Moody's Baa and Moody's Aaa rates. WW is the Whited and Wu (2006) index for financing constraints and HPSA is the Hadlock and Pierce (2010) size-age index for financing constraints. Only correlations significant at the 10% level or better are reported.

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Net Levering Up / TA						
(2) Log Total Assets	0.1275					
(3) Book-to-Market Ratio	0.0173	0.1077				
(4) Altman's Zscore	0.1300	0.2382	0.0128			
(5) SIC3 Industry Long-term Debt / TA	0.0366	0.2332	0.1751			
(6) Credit Spread	0.0154	0.0886	0.2040	0.0000	0.0928	
(7) WW	-0.1256	-0.8773	-0.0799	-0.2632	-0.2333	-0.1068
(8) HPSA	-0.1130	-0.6822	-0.1146	-0.3023	-0.1642	-0.1203
(9) Realized Volatility	-0.1406	-0.4254	0.1278	-0.2502	-0.1170	0.0855
(10) Implied Vol: Long Calls	-0.1345	-0.4789	0.2080	-0.3097	-0.1248	0.1583
(11) Implied Vol: Short Calls	-0.1012	-0.4071	0.1354	-0.2083	-0.1115	0.1336
(12) Implied Vol: Short Puts	-0.0973	-0.3868	0.1228	-0.1912	-0.0883	0.1635
(13) Implied Vol: OTM Puts	-0.1250	-0.4246	0.1640	-0.2384	-0.0744	0.2316
(14) Implied Vol: ITM Puts	-0.1051	-0.4542	0.1953	-0.2508	-0.0634	0.0939
(15) Long Call Implied Vol-Realized Vol Diff	0.0788	0.0934	0.0581	0.0000	0.0288	0.0257
(16) Short Call-Short Put Implied Vol Diff	0.0000		0.0000	0.0000	-0.0404	-0.0778
(17) Long Call-Short Call Implied Vol Diff	-0.0123	0.0127	-0.0092	-0.0734	0.0000	-0.1060
(18) OTM Put-ITM Implied Vol Diff	-0.0208	0.0911	-0.0122	0.0000	0.0208	0.1733

	(7)	(8)	(9)	(10)	(11)	(12)
(8) HPSA	0.6648					
(9) Realized Volatility	0.4270	0.4313				
(10) Implied Vol: Long Calls	0.4786	0.4663	0.8154			
(11) Implied Vol: Short Calls	0.4059	0.3978	0.7292	0.8853		
(12) Implied Vol: Short Puts	0.3794	0.3789	0.7030	0.8492	0.9119	
(13) Implied Vol: OTM Puts	0.4157	0.3989	0.7387	0.8835	0.8639	0.8933
(14) Implied Vol: ITM Puts	0.4366	0.4388	0.6870	0.8404	0.8050	0.8529
(15) Long Call Implied Vol-Realized Vol Diff	-0.0924	-0.1156	-0.6208	-0.0523	-0.1316	-0.1453
(16) Short Call-Short Put Implied Vol Diff	0.0000		-0.0351	-0.0275	0.0800	-0.3361
(17) Long Call-Short Call Implied Vol Diff		-0.0182	-0.1033	-0.0529	-0.5111	-0.4241
(18) OTM Put-ITM Implied Vol Diff	-0.0758	-0.0969	-0.0095	-0.0233	-0.0270	-0.0807

	(13)	(14)	(15)	(16)	(17)
(14) Implied Vol: ITM Puts	0.8137				
(15) Long Call Implied Vol-Realized Vol Diff	-0.1571	-0.1077			
(16) Short Call-Short Put Implied Vol Diff	-0.1960	-0.2593	0.0427		
(17) Long Call-Short Call Implied Vol Diff	-0.2822	-0.2663	0.1088	-0.1696	
(18) OTM Put-ITM Implied Vol Diff	0.1490	-0.4535	-0.0154	0.1612	0.0264

Table III: Results from the estimation of equation (8) without control variables using the restricted sample. The dependent variable is Net Levering Up / TA, the net levering up behavior of the firm, defined as long-term debt issuance net of long-term debt reductions minus equity issuance net of equity reductions, as a ratio to total book assets. WW is the Whited and Wu (2006) index for financing constraints and HPSA is the Hadlock and Pierce (2010) size-age index for financing constraints. $IV spread_{hist}$ measures the difference between the implied volatility on long-term call options and the realized, historical volatility for the firm. Realized volatility is the average historical volatility of the firm's returns over the past year. $IV spread_{cp}$ is the difference between the implied volatility of short-term call options and the short-term put options for a firm. $IV_{p,short}$ is the implied volatility of the long-term put options. $IV spread_{mat}$ measures the difference between long-term call options and short-term call options. $IV_{c,short}$ is the implied volatility of the short-term call options. $IV spread_{mon}$ measures the difference between out-of-the-money and in-the-money put options. $IV_{p,ITM}$ is the implied volatility of the in-the-money put options. All explanatory variables are lagged one quarter. All market-based measures reflect the average of the three months in the past quarter. Standard errors are reported in the parentheses and clustered by both firm and year-quarter as in Thompson (2009) and Petersen (2009). Significance at the 10% level is indicated by *, 5% level by **, and 1% level by ***.

	Net Levering Up / TA								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
WW	-0.0726 ***						-0.0258 ***	-0.0458 ***	
	(0.0054)						(0.0058)	(0.0058)	
HPSA		-0.0120 ***					-0.0037 ***	-0.0069 ***	
		(0.0009)					(0.0009)	(0.0010)	
$IV spread_{hist}$			-0.0272 ***				-0.0180 ***		-0.0277 ***
			(0.0038)				(0.0036)		(0.0037)
$IV spread_{cp}$				-0.0204 ***			0.0057		0.0049
				(0.0040)			(0.0038)		(0.0040)
$IV spread_{mat}$					-0.0472 ***		-0.0088 ***		-0.0100 ***
					(0.0040)		(0.0036)		(0.0037)
$IV spread_{mon}$						-0.0323 ***	-0.0087 ***		-0.0068 ***
						(0.0031)	(0.0022)		(0.0022)
Realized Volatility			-0.0401 ***				-0.0297 ***		-0.0406 ***
			(0.0027)				(0.0028)		(0.0025)
$IV_{p,short}$				-0.0323 ***					
				(0.0028)					
$IV_{c,short}$					-0.0416 ***				
					(0.0026)				
$IV_{p,ITM}$						-0.0373 ***			
						(0.0027)			
Constant	-0.0239 ***	-0.0433 ***	0.0204 ***	0.0188 ***	0.0199 ***	0.0229 ***	-0.0065	-0.0397 ***	0.0202 ***
	(0.0020)	(0.0034)	(0.0014)	(0.0017)	(0.0015)	(0.0017)	(0.0042)	(0.0032)	(0.0014)
No. Obs.	57097	57097	57097	57097	57097	57097	57097	57097	57097
Adjusted R^2	0.0156	0.0149	0.0246	0.0182	0.0233	0.0220	0.0291	0.0184	0.0252

Table IV: Results from the estimation of equation (9) with control variables using the restricted sample. The dependent variable is Net Levering Up / TA, the net levering up behavior of the firm, defined as long-term debt issuance net of long-term debt reductions minus equity issuance net of equity reductions, as a ratio to total book assets. WW is the Whited and Wu (2006) index for financing constraints and HPSA is the Hadlock and Pierce (2010) size-age index for financing constraints. $IV spread_{hist}$ measures the difference between the implied volatility on long-term call options and the realized, historical volatility for the firm. Realized volatility is the average historical volatility of the firm's returns over the past year. $IV spread_{cp}$ is the difference between the implied volatility of short-term call options and the short-term put options for a firm. $IV_{p,short}$ is the implied volatility of the long-term put options. $IV spread_{mat}$ measures the difference between long-term call options and short-term call options. $IV_{c,short}$ is the implied volatility of the short-term call options. $IV spread_{mon}$ measures the difference between out-of-the-money and in-the-money put options. $IV_{p,ITM}$ is the implied volatility of the in-the-money put options. All explanatory variables are lagged one quarter. All market-based measures reflect the average of the three months in the past quarter. Standard errors are reported in the parentheses and clustered by both firm and year-quarter as in Thompson (2009) and Petersen (2009). Significance at the 10% level is indicated by *, 5% level by **, and 1% level by ***.

	Net Levering Up / TA								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
WW	-0.0004						0.0104	0.0022	
	(0.0084)						(0.0074)	(0.0086)	
HPSA		-0.0019 **					0.0006	-0.0019 **	
		(0.0008)					(0.0008)	(0.0008)	
$IV spread_{hist}$			-0.0099 ***				-0.0109 ***		-0.0103 ***
			(0.0039)				(0.0039)		(0.0039)
$IV spread_{cp}$				-0.0084 **			0.0061 *		0.0061 *
				(0.0038)			(0.0034)		(0.0034)
$IV spread_{mat}$					-0.0227 ***		-0.0017		-0.0018
					(0.0041)		(0.0034)		(0.0034)
$IV spread_{mon}$						-0.0232 ***	-0.0081 ***		-0.0081 ***
						(0.0026)	(0.0021)		(0.0021)
Realized Volatility			-0.0218 ***				-0.0226 ***		-0.0219 ***
			(0.0028)				(0.0028)		(0.0028)
$IV_{p,short}$				-0.0176 ***					
				(0.0024)					
$IV_{c,short}$					-0.0233 ***				
					(0.0028)				
$IV_{p,ITM}$						-0.0217 ***			
						(0.0024)			
Log Total Assets	0.0034 ***	0.0030 ***	0.0021 ***	0.0023 ***	0.0021 ***	0.0021 ***	0.0027 ***	0.0031 ***	0.0021 ***
	(0.0005)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0004)	(0.0005)	(0.0003)
Book-to-Market Ratio	0.0019 *	0.0017	0.0039 ***	0.0035 ***	0.0040 ***	0.0037 ***	0.0037 ***	0.0017	0.0037 ***
	(0.0011)	(0.0011)	(0.0010)	(0.0011)	(0.0010)	(0.0010)	(0.0010)	(0.0011)	(0.0010)
Altman's Zscore	0.0063 ***	0.0062 ***	0.0056 ***	0.0059 ***	0.0056 ***	0.0058 ***	0.0057 ***	0.0062 ***	0.0056 ***
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
SIC3 Industry Long-term Debt / TA	0.0040	0.0039	0.0004	0.0018	0.0005	0.0021	0.0007	0.0040	0.0003
	(0.0036)	(0.0036)	(0.0033)	(0.0035)	(0.0035)	(0.0034)	(0.0033)	(0.0037)	(0.0033)
Credit Rating Spread	-0.0020 *	-0.0021 *	-0.0012	-0.0006	-0.0010	0.0000	-0.0007	-0.0021 *	-0.0008
	(0.0011)	(0.0012)	(0.0011)	(0.0014)	(0.0012)	(0.0012)	(0.0010)	(0.0012)	(0.0010)
Constant	-0.0280 ***	-0.0314 ***	-0.0072 **	-0.0110 ***	-0.0076 **	-0.0072 **	-0.0061	-0.0316 ***	-0.0074 **
	(0.0024)	(0.0029)	(0.0035)	(0.0035)	(0.0036)	(0.0035)	(0.0039)	(0.0030)	(0.0035)
No. Obs.	53441	53441	53441	53441	53441	53441	53441	53441	53441
Adjusted R^2	0.0392	0.0394	0.0453	0.0432	0.0442	0.0448	0.0458	0.0394	0.0457

Table V: Results from the estimation of equation (9) with realized volatility and control variables using the restricted sample. The dependent variable is Net Levering Up / TA, the net levering up behavior of the firm, defined as long-term debt issuance net of long-term debt reductions minus equity issuance net of equity reductions, as a ratio to total book assets. WW is the Whited and Wu (2006) index for financing constraints and HPSA is the Hadlock and Pierce (2010) size-age index for financing constraints. $IV spread_{hist}$ measures the difference between the implied volatility on long-term call options and the realized, historical volatility for the firm. Realized volatility is the average historical volatility of the firm's returns over the past year. $IV spread_{cp}$ is the difference between the implied volatility of short-term call options and the short-term put options for a firm. $IV_{p,short}$ is the implied volatility of the long-term put options. $IV spread_{mat}$ measures the difference between long-term call options and short-term call options. $IV_{c,short}$ is the implied volatility of the short-term call options. $IV spread_{mon}$ measures the difference between out-of-the-money and in-the-money put options. $IV_{p,ITM}$ is the implied volatility of the in-the-money put options. All explanatory variables are lagged one quarter. All market-based measures reflect the average of the three months in the past quarter. Standard errors are reported in the parentheses and clustered by both firm and year-quarter as in Thompson (2009) and Petersen (2009). Significance at the 10% level is indicated by *, 5% level by **, and 1% level by ***.

	Net Levering Up / TA								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
WW	0.0090						0.0104	0.0087	
	(0.0073)						(0.0074)	(0.0075)	
HPSA		0.0004					0.0006	0.0003	
		(0.0008)					(0.0008)	(0.0008)	
$IV spread_{hist}$			-0.0099 ***				-0.0109 ***		-0.0103 ***
			(0.0039)				(0.0039)		(0.0039)
$IV spread_{cp}$				0.0042			0.0061 *		0.0061 *
				(0.0033)			(0.0034)		(0.0034)
$IV spread_{mat}$					-0.0026		-0.0017		-0.0018
					(0.0033)		(0.0034)		(0.0034)
$IV spread_{mon}$						-0.0075 ***	-0.0081 ***		-0.0081 ***
						(0.0021)	(0.0021)		(0.0021)
Realized Volatility	-0.0172 ***	-0.0172 ***	-0.0218 ***	-0.0170 ***	-0.0171 ***	-0.0170 ***	-0.0226 ***	-0.0173 ***	0.0021 ***
	(0.0021)	(0.0020)	(0.0028)	(0.0020)	(0.0020)	(0.0020)	(0.0028)	(0.0020)	(0.0003)
Log Total Assets	0.0027 ***	0.0024 ***	0.0021 ***	0.0023 ***	0.0023 ***	0.0024 ***	0.0027 ***	0.0028 ***	-0.0219 ***
	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0028)
Book-to-Market Ratio	0.0034 ***	0.0034 ***	0.0039 ***	0.0034 ***	0.0034 ***	0.0032 ***	0.0037 ***	0.0034 ***	0.0037 ***
	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
Altman's Zscore	0.0058 ***	0.0058 ***	0.0056 ***	0.0058 ***	0.0058 ***	0.0058 ***	0.0057 ***	0.0058 ***	0.0056 ***
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
SIC3 Industry Long-term Debt / TA	0.0013	0.0010	0.0004	0.0012	0.0010	0.0008	0.0007	0.0013	0.0003
	(0.0033)	(0.0033)	(0.0033)	(0.0033)	(0.0033)	(0.0033)	(0.0033)	(0.0033)	(0.0033)
Credit Rating Spread	-0.0014	-0.0014	-0.0012	-0.0014	-0.0016 *	-0.0011	-0.0007	-0.0014	-0.0008
	(0.0009)	(0.0010)	(0.0011)	(0.0010)	(0.0009)	(0.0009)	(0.0010)	(0.0009)	(0.0010)
Constant	-0.0109 ***	-0.0098 ***	-0.0072 **	-0.0107 ***	-0.0108 ***	-0.0110 ***	-0.0061	-0.0103 ***	-0.0074 **
	(0.0031)	(0.0035)	(0.0035)	(0.0031)	(0.0031)	(0.0031)	(0.0039)	(0.0034)	(0.0035)
No. Obs.	53441	53441	53441	53441	53441	53441	53441	53441	53441
Adjusted R^2	0.045	0.0449	0.0453	0.0449	0.0449	0.0453	0.0458	0.0449	0.0457

Table VI: Results from the estimation of equation (9) examining monthly market-based measures in the past quarter. The dependent variable is Net Levering Up / TA, the net levering up behavior of the firm, defined as long-term debt issuance net of long-term debt reductions minus equity issuance net of equity reductions, as a ratio to total book assets. WW is the Whited and Wu (2006) index for financing constraints and HPSA is the Hadlock and Pierce (2010) size-age index for financing constraints. $IVspread_{hist}$ measures the difference between the implied volatility on long-term call options and the realized, historical volatility for the firm. Realized volatility is the average historical volatility of the firm's returns over the past year. $IVspread_{cp}$ is the difference between the implied volatility of short-term call options and the short-term put options for a firm. $IV_{p,short}$ is the implied volatility of the long-term put options. $IVspread_{mat}$ measures the difference between long-term call options and short-term call options. $IV_{c,short}$ is the implied volatility of the short-term call options. $IVspread_{mon}$ measures the difference between out-of-the-money and in-the-money put options. $IV_{p,ITM}$ is the implied volatility of the in-the-money put options. All explanatory variables are lagged one quarter. Column (1) presents the results for WW and $HPSA$ in the super restricted sample (sample restricted to firms having options data in all three months of the past quarter). Columns (2) and (3) uses market-based measures lagged five months (i.e., first month in the past quarter). Columns (4) and (5) uses market-based measures lagged four months (i.e., second month in the past quarter). Columns (6) and (7) uses market-based measures lagged three months (i.e., last month in the past quarter). Standard errors are reported in the parentheses and clustered by both firm and year-quarter as in Thompson (2009) and Petersen (2009). Significance at the 10% level is indicated by *, 5% level by **, and 1% level by ***.

	Net Levering Up / TA						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
WW	-0.0021		0.0045		0.0063		0.0060
	(0.0112)		(0.0100)		(0.0100)		(0.0101)
HPSA	-0.0010		0.0012		0.0013		0.0013
	(0.0013)		(0.0012)		(0.0012)		(0.0012)
$IVspread_{hist}$		-0.0089 **	-0.0097 **	-0.0151 ***	-0.0161 ***	-0.0138 ***	-0.0146 ***
		(0.0044)	(0.0044)	(0.0044)	(0.0045)	(0.0047)	(0.0047)
$IVspread_{cp}$		0.0124	0.0124	0.0128	0.0131 *	0.0066	0.0068
		(0.0076)	(0.0076)	(0.0079)	(0.0078)	(0.0060)	(0.0060)
$IVspread_{mat}$		-0.0017	-0.0016	0.0023	0.0025	0.0025	0.0028
		(0.0043)	(0.0042)	(0.0043)	(0.0043)	(0.0036)	(0.0036)
$IVspread_{mon}$		-0.0146 ***	-0.0144 ***	-0.0170 ***	-0.0168 ***	-0.0129 ***	-0.0127 ***
		(0.0034)	(0.0033)	(0.0037)	(0.0036)	(0.0036)	(0.0036)
Realized Volatility		-0.0204 ***	-0.0212 ***	-0.0231 ***	-0.0241 ***	-0.0227 ***	-0.0236 ***
		(0.0035)	(0.0035)	(0.0033)	(0.0034)	(0.0034)	(0.0035)
Log Total Assets	0.0027 ***	0.0018 ***	0.0022 ***	0.0017 ***	0.0022 ***	0.0017 ***	0.0022 ***
	(0.0006)	(0.0004)	(0.0006)	(0.0004)	(0.0006)	(0.0004)	(0.0006)
Book-to-Market Ratio	-0.0012	0.0007	0.0008	0.0006	0.0008	0.0005	0.0007
	(0.0015)	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)
Altman's Zscore	0.0056 ***	0.0051 ***	0.0052 ***	0.0050 ***	0.0051 ***	0.0051 ***	0.0051 ***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
SIC3 Industry Long-term Debt / TA	-0.0026	-0.0035	-0.0034	-0.0034	-0.0032	-0.0040	-0.0039
	(0.0052)	(0.0050)	(0.0050)	(0.0051)	(0.0051)	(0.0050)	(0.0050)
Credit Rating Spread	-0.0020 *	0.0000	0.0001	0.0001	0.0002	-0.0005	-0.0004
	(0.0012)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0010)	(0.0010)
Constant	-0.0235 ***	-0.0031	-0.0001	-0.0007	0.0028	-0.0003	0.0029
	(0.0039)	(0.0044)	(0.0052)	(0.0043)	(0.0052)	(0.0044)	(0.0052)
No. Obs.	21187	21187	21187	21187	21187	21187	21187
Adjusted R^2	0.0342	0.0415	0.0415	0.0421	0.0422	0.0420	0.0420

Table VII: Results from the estimation of equation (9) and equation (11) using the full sample. Columns (1), (2), and (3) use $NLEVR$ as the dependent variable in an OLS framework and columns (4), (5), and (6) use $NLEVD$ as the dependent variable in a logistic model. $NLEVR$, or Net Levering Up / TA, is the net levering up behavior of the firm, defined as long-term debt issuance net of long-term debt reductions minus equity issuance net of equity reductions, as a ratio to total book assets. $NLEVD$ is a dummy that equals 1 when $NLEVR > 0$ and 0 otherwise. WW is the Whited and Wu (2006) index for financing constraints and HPSA is the Hadlock and Pierce (2010) size-age index for financing constraints. $IVspread_{hist}$ measures the difference between the implied volatility on long-term call options and the realized, historical volatility for the firm. $IVspread_{cp}$ is the difference between the implied volatility of long-term call options and the long-term put options for a firm. $IVspread_{mat}$ measures the difference between long-term call options and short-term call options. $IVspread_{mon}$ measures the difference between out of the money and at the money put options. Realized volatility is the average historical volatility of the firm's returns over the past year. All explanatory variables are lagged at one quarter. All market-based measures reflect the average of the three months in the past quarter. Standard errors are reported in the parentheses and clustered by both firm and year-quarter as in Thompson (2009) and Petersen (2009). Significance at the 10% level is indicated by *, 5% level by **, and 1% level by ***.

	Net Levering Up / TA			1 = Net Levering Up > 0, 0 = otherwise		
	(1)	(2)	(3)	(4)	(5)	(6)
WW	0.0088		0.0104	-1.2317 ***		-0.9051 ***
	(0.0076)		(0.0074)	(0.3661)		(0.3620)
HPSA	-0.0026 ***		0.0006	-0.1352 ***		-0.0252
	(0.0007)		(0.0008)	(0.0408)		(0.0462)
$IVspread_{hist}$		-0.0119 ***	-0.0109 ***		0.1116	0.2232
		(0.0037)	(0.0039)		(0.1504)	(0.1514)
$IVspread_{cp}$		0.0067 **	0.0061 *		-0.0562	-0.0265
		(0.0034)	(0.0034)		(0.1505)	(0.1622)
$IVspread_{mat}$		-0.0027	-0.0017		-0.2371	-0.2194
		(0.0033)	(0.0034)		(0.1495)	(0.1504)
$IVspread_{mon}$		-0.0089 ***	-0.0081 ***		-0.4957 ***	-0.5105 ***
		(0.0021)	(0.0021)		(0.0998)	(0.1027)
Realized Volatility		-0.0226 ***	-0.0226 ***		-1.1842 ***	-1.1214 ***
		(0.0029)	(0.0028)		(0.1212)	(0.1213)
Log Total Assets	0.0037 ***	0.0022 ***	0.0027 ***	0.1695 ***	0.2121 ***	0.1567 ***
	(0.0004)	(0.0003)	(0.0004)	(0.0225)	(0.0147)	(0.0244)
Book-to-Market Ratio	0.0032 ***	0.0044 ***	0.0037 ***	-0.0340	0.0327	0.0272
	(0.0010)	(0.0010)	(0.0010)	(0.0475)	(0.0501)	(0.0515)
Altman's Zscore	0.0059 ***	0.0060 ***	0.0057 ***	0.1726 ***	0.1520 ***	0.1486 ***
	(0.0005)	(0.0006)	(0.0006)	(0.0223)	(0.0268)	(0.0257)
SIC3 Industry Long-term Debt / TA	0.0042	-0.0009	0.0007	0.9690 ***	0.6986 ***	0.7534 ***
	(0.0032)	(0.0033)	(0.0033)	(0.2120)	(0.2128)	(0.2135)
Credit Rating Spread	-0.0022 *	-0.0006	-0.0007	-0.2558 ***	-0.1176 **	-0.1401 ***
	(0.0013)	(0.0010)	(0.0010)	(0.0810)	(0.0518)	(0.0580)
Constant	-0.0362 ***	-0.0084 ***	-0.0061	-2.6072 ***	-1.5234 ***	-1.5300 ***
	(0.0031)	(0.0035)	(0.0039)	(0.1311)	(0.1472)	(0.1868)
No. Obs.	80041	58236	53441	80828	58795	53950
Adjusted R^2	0.0397	0.0505	0.0458	0.0445	0.0619	0.0583

Table VIII: Summary statistics of common firm characteristics associated with constrained firms. Using the coefficients estimated from columns (2) and (5) in Table VII, we create market-based indices to measure net levering up behavior. The negative of these measures creates our financing constraint indices. We sort each measure into three equal bins each year-quarter. LOW tercile reflects the firms that are less financially constrained and HIGH reflects the firms that are more financially constrained. Means in each tercile are reported below and tested to see if they are statistically different from each other. Significance at the 10% level is indicated by *, 5% level by **, and 1% level by ***.

	Net Levering Up / TA			Net Levering Up Dummy		
	LOW	HIGH		LOW	HIGH	
Total Assets ($ millions)	11489.3	714.9	***	12094.2	390.7	***
Total Market Capitalization ($ millions)	14224.7	950.6	***	14475.5	623.7	***
Log Total Assets	8.0682	5.5885	***	8.3365	5.2916	***
Book-to-Market Ratio	0.5294	0.4494	***	0.5001	0.4941	***
Altman's Zscore	1.1681	-0.3612	***	0.9510	-0.2973	***
Total Debt / TA	0.1987	0.1529	***	0.2467	0.1121	***
Long-term Debt / TA	0.1685	0.1304	***	0.2149	0.0907	***
Cash / TA	0.1441	0.3592	***	0.1203	0.3816	***
Cash Flow / TA	0.0277	-0.0113	***	0.0264	-0.0129	***
Pays Dividend = 1	0.6169	0.1235	***	0.6313	0.1108	***
Has Long-term Debt Credit Rating	0.6119	0.1495	***	0.7188	0.0801	***
Has Investment Grade Long-term Debt	0.4665	0.0025	***	0.4901	0.0002	***
WW	-0.3832	-0.2494	***	-0.3952	-0.2357	***
HPSA	-3.8947	-3.1357	***	-3.9005	-3.0751	***

Table IX: Results from the estimation of investment behavior with control variables using the restricted sample. The dependent variable is Capital Expenditure / TA, measuring the investment behavior of the firm. WW is the Whited and Wu (2006) index for financing constraints and HPSA is the Hadlock and Pierce (2010) size-age index for financing constraints. $IV spread_{hist}$ measures the difference between the implied volatility on long-term call options and the realized, historical volatility for the firm. Realized volatility is the average historical volatility of the firm's returns over the past year. $IV spread_{cp}$ is the difference between the implied volatility of short-term call options and the short-term put options for a firm. $IV_{p,short}$ is the implied volatility of the long-term put options. $IV spread_{mat}$ measures the difference between long-term call options and short-term call options. $IV_{c,short}$ is the implied volatility of the short-term call options. $IV spread_{mon}$ measures the difference between out-of-the-money and in-the-money put options. $IV_{p,ITM}$ is the implied volatility of the in-the-money put options. All explanatory variables are lagged one quarter. All market-based measures reflect the average of the three months in the past quarter. Standard errors are reported in the parentheses and clustered by both firm and year-quarter as in Thompson (2009) and Petersen (2009). Significance at the 10% level is indicated by *, 5% level by **, and 1% level by ***.

	Capital Expenditure / TA								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
WW	-0.0126 **						-0.0172 ***	-0.0164 ***	
	(0.0055)						(0.0051)	(0.0055)	
HPSA		0.0029 ***					0.0028 ***	0.0032 ***	
		(0.0009)					(0.0009)	(0.0009)	
$IV spread_{hist}$			0.0099 ***				0.0089 ***		0.0097 ***
			(0.0019)				(0.0018)		(0.0018)
$IV spread_{cp}$				-0.0053 ***			-0.0054 ***		-0.0060 ***
				(0.0021)			(0.0020)		(0.0020)
$IV spread_{mat}$					-0.0078 ***		-0.0078 ***		-0.0079 ***
					(0.0020)		(0.0019)		(0.0020)
$IV spread_{mon}$						-0.0043 ***	-0.0032 ***		-0.0034 ***
						(0.0011)	(0.0010)		(0.0010)
Realized Volatility	0.0013	0.0000	0.0059 ***	0.0010	0.0008	0.0011	0.0044 ***	0.0003	0.0002
	(0.0011)	(0.0011)	(0.0016)	(0.0011)	(0.0011)	(0.0011)	(0.0016)	(0.0011)	(0.0002)
Log Total Assets	-0.0007 **	0.0005 *	0.0002	-0.0001	-0.0001	-0.0001	-0.0001	-0.0003	0.0054 ***
	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0004)	(0.0016)
Book-to-Market Ratio	-0.0048 ***	-0.0045 ***	-0.0053 ***	-0.0048 ***	-0.0048 ***	-0.0049 ***	-0.0049 ***	-0.0044 ***	-0.0053 ***
	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Altman's Zscore	0.0006 ***	0.0008 ***	0.0008 ***	0.0007 ***	0.0006 ***	0.0007 ***	0.0008 ***	0.0008 ***	0.0007 ***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
SIC3 Industry Long-term Debt / TA	0.0393 ***	0.0397 ***	0.0403 ***	0.0396 ***	0.0396 ***	0.0396 ***	0.0393 ***	0.0392 ***	0.0399 ***
	(0.0036)	(0.0036)	(0.0036)	(0.0036)	(0.0036)	(0.0036)	(0.0035)	(0.0036)	(0.0036)
Credit Rating Spread	-0.0032 ***	-0.0029 ***	-0.0034 ***	-0.0032 ***	-0.0034 ***	-0.0029 ***	-0.0034 ***	-0.0030 ***	-0.0035 ***
	(0.0007)	(0.0007)	(0.0006)	(0.0007)	(0.0007)	(0.0007)	(0.0005)	(0.0007)	(0.0005)
Constant	0.0144 ***	0.0207 ***	0.0106 ***	0.0142 ***	0.0139 ***	0.0140 ***	0.0171 ***	0.0216 ***	0.0103 ***
	(0.0020)	(0.0026)	(0.0022)	(0.0020)	(0.0019)	(0.0020)	(0.0028)	(0.0026)	(0.0022)
No. Obs.	53656	53656	53656	53656	53656	53656	53656	53656	53656
Adjusted R^2	0.0397	0.0417	0.0414	0.0393	0.0401	0.0398	0.0464	0.0428	0.0433

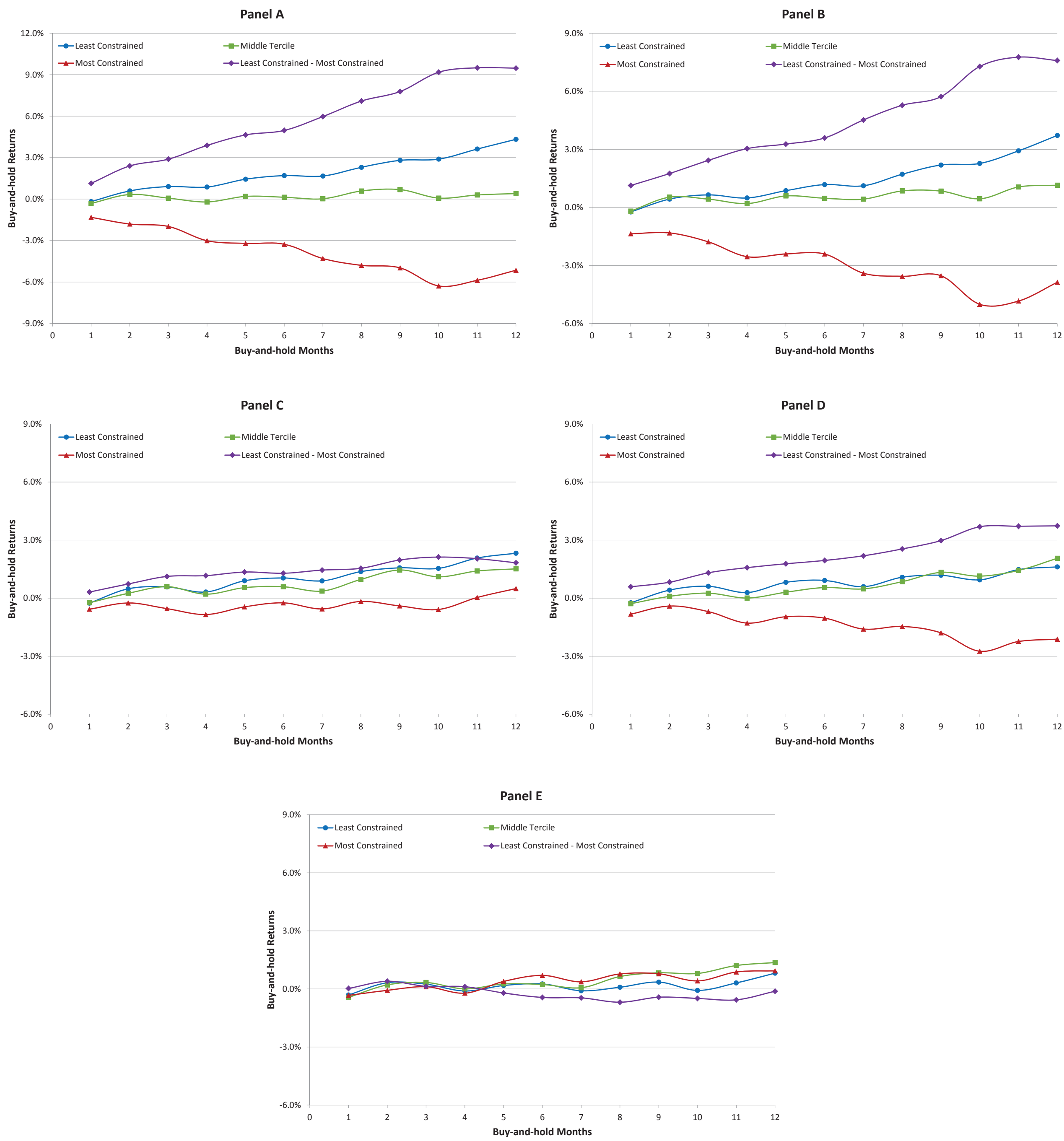

Figure 1: Buy-and-hold portfolios based on financing constraint measures. Panel A displays the cumulative returns from a buy-and-hold strategy out one year for our market-based measure, $FCMkt$, as defined in equation (12) using the coefficients from column (2) in Table VII. Panel B presents the returns for our market-based measure, $P(FinConstr)$, based on a logistic regression as explained in section 5.1 using the coefficients from column (5) in Table VII. Panels C and D graph the buy-and-hold returns using WW and $HPSA$, respectively. Finally, Panel E, plots the buy-and-hold returns based on randomly assigning firms into LOW, MED, HIGH terciles.