Capital structure and financial flexibility: Expectations of future shocks*

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Abstract

We test one of the main predictions of the financial flexibility paradigm, that expectations about future firm-specific investment shocks affect the firm's leverage. We extract the expectations of small and large future shocks from the market prices of equity options. We find that leverage decreases in anticipation of an increase in both types of future shocks and the relation is statistically significant even when we control for standard determinants of leverage and the firm's probability of default. Expectations for future shocks explain more variation of the leverage than standard determinants of leverage do and they affect more the small and financially constrained firms. Our results are not subject to an endogeneity bias and they confirm De Angelo et al. (2011) model's predictions and the evidence that managers seek for financial flexibility.

JEL classifications: G13; G30; G32

Keywords: Capital structure; Financial flexibility; Options; Risk-neutral volatility; Risk-neutral kurtosis

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1. Introduction

There is indirect evidence and theoretical support in the context of the financial flexibility paradigm that expectations of a firm's manager about future changes in the firm's investment opportunity set play a key role in determining the firm's capital structure. Financial flexibility is defined as the firm's ability to take advantage of (cope with) a positive (negative) shock in its investment opportunity set. Survey studies by Graham and Harvey (2001), Bancel and Mitoo (2004) and Brounen et al. (2006) document that U.S. and European Chief Financial Officers set the firm's financing policy so as to primarily maintain the firm's financial flexibility. DeAngelo et al. (2011) derive theoretically one of the main predictions of the financial flexibility paradigm, that is the firm's leverage is inversely related to the expectations about future shocks to the firm's investment opportunity set. This is because in the case where an investment shock is expected, the firm acts *proactively* and it decreases its leverage to preserve a greater debt capacity today to meet its *future* expected borrowing.[1] De Angelo et al. (2016) document that proactive deleveraging is the norm among firms.

Being motivated by the above evidence and theory, we explore whether manager's expectations for future investment shocks affect firm's current leverage. We measure the expectations for future "small" (diffusive) and "large" (jumps) investment shocks by extracting the stock returns risk-neutral volatility and risk-neutral kurtosis, respectively, from the market prices of a cross-section of liquid equity options.[2] Options prices are forward-looking and hence they provide a natural venue to proxy market expectations. We use the Bakshi et al. (2003) model-free formulae to calculate risk-neutral volatility and risk-neutral kurtosis for all firms that belong to any of the S&P LargeCap 500, S&P

[1] DeAngelo et al. (2011) show that debt is the least costly source of capital for a firm when a realized shock dictates financing. Debt has a tax advantage and it is also subject to lower adverse selection costs relative to equity. Furthermore, stockpiling cash is also costly because it creates agency costs that lower the firm value.

[2] Gorbenko and Strebulaev (2010) develop a dynamic trade-off capital structure model where both types of shocks affect the firm's capital structure

MidCap 400 and S&P SmallCap 600 indices and which they have available accounting data as well as reliable equity option data. Then, we use panel data regressions to estimate the effect of the two risk-neutral moments (RNMs) on the firms’ leverage ratios in accordance with the empirical capital structure literature (e.g., Korajczyk and Levy, 2003, Frank and Goyal, 2009). Given that RNMs may also be affected by leverage, we address concerns on the effect of endogeneity by providing further evidence using a set of instruments for RNMs dictated by previous literature (e.g., Taylor et al., 2009, Hansis et al., 2010). We also explore whether the documented relation between RNMs and leverage is consistent with a financial distress rather than a financial flexibility explanation; an increase (decrease) in RNMs may be a manifestation of an increase (decrease) in the firm’s probability of default and thus managers decrease (increase) leverage. Finally, we explore the relative impact of RNMs on leverage across constrained and unconstrained groups of firms, as DeAngelo’s model predicts that constrained firms have a greater need for financial flexibility.

One point is in order regarding the validity of the implicit assumption which underlies our approach to proxy firm's managers’ expectations with stock investor's expectations for future shocks to stock prices. In line with Andres et al. (2014), we assume that the firm managers who set leverage, also participate as investors in the stock market where these risk-neutral moments (RNMs) are extracted from. This is a plausible assumption because managers own considerable parts of their companies' shares (Fahlenbrach and Stulz, 2009, Holderness, 2009) as they often receive stocks and stock options as part of their compensation scheme (Frydman and Saks, 2010). In addition, there is empirical evidence that managers tend to trade in their own firms' stock (Lakonishok and Lee, 2001, Jeng et al., 2003).

We find that expectations for diffusive shocks and jumps are inversely related to the firm's leverage. Specifically, an increase (decrease) in risk-neutral volatility and risk-neutral kurtosis decreases (increases) leverage. These findings hold over and above of standard controls for the firm’s leverage, they are not subject to an endogeneity bias and they are in accordance with DeAngelo et al.

(2011) model's predictions. In the case where managers expect a shock, they decrease the firm's leverage. They do so to increase the reserves of untapped borrowing power of the firm so that the firm can access the debt markets and address its funding needs if the shock is realized. The RNMs retain their significance and sign even when we control for the firm's probability of default. This confirms that the documented effect of RNMs on the capital structure cannot be explained by a probability of default story and it renders further support to the financial flexibility explanation.

Our analysis provides further support to the above evidence. The variance decomposition reveals that the expectations for the future shocks account for a significant fraction of the leverage variation controlling for other standard determinants of firm’s leverage (18.3% to 43.1% across alternative model specifications). Moreover, a comparison of our model which explains leverage in terms of the two RNMs and standard determinants of leverage versus the previously employed models which exclude the two RNMs reveals that the inclusion of RNMs increases R^2 significantly, from 11.3% to 27.2% across alternative model specifications. Interestingly, we find that firms’ managers set the current quarter’s leverage ratio by also taking into account expectations for longer horizons’ shocks, i.e. shocks expected to be realized at times beyond the period (quarter) over which they will reset their leverage. This is again in accordance with DeAngelo et al. (2011) who show theoretically that in the case where managers believe that shocks are serially correlated, they take into account expectations for longer horizon shocks when making financing decisions.

We also find that the leverage of the more financially constrained firms is more sensitive to expectations for shocks, as expected under the financial flexibility paradigm. The greater the risk that a firm will not be able to respond to a future shock by accessing capital markets, the greater the debt capacity it needs to preserve today and thus the lower the leverage. Finally, we find that results are robust to potential effects from macroeconomic fluctuations, the financial crisis of 2008, the firm’s ownership structure, CEO attributes, location (physical, and the jurisdiction of incorporation), and R&D intensity. In sum, our results confirm the theoretical predictions of DeAngelo et al. (2011) and the results of Graham and Harvey (2001), Bancel and Mitoo (2004) and Brounen et al. (2006) surveys which find that managers seek for financial flexibility when they set the firm's leverage ratio.

Our paper contributes to two strands of literature. First, our findings contribute to the growing literature which explores the implications of financial flexibility for capital structure decisions. The financial flexibility paradigm has two testable implications related to capital structure decisions (DeAngelo et al., 2011). The first is that new investments are mostly financed with debt; a number of papers have empirically confirmed this prediction (Marchica and Mura, 2010, Denis and McKeon, 2012, DeAngelo and Roll 2014, Hess and Immenkötter, 2014, Ferrando et al., 2017). The second is that firms decrease leverage when future small or large investment shocks are expected in order to preserve a greater debt capacity today to meet their future expected borrowing. In this paper, we test the latter implication.[3] Our paper complements Byoun (2011, 2016) who tests the implications of the financial flexibility paradigm by exploring the financing choices of firms conditional on their future growth opportunities and financing needs that these would require. To this end, he uses a number of accounting variables to proxy the firm's future growth opportunities. We proxy expectations for future shocks in the firm's investment opportunity set, which can be viewed as future growth opportunities for the firm. Indirectly, we also proxy expectations for future financing needs, given that the firm will

[3] There is a concurrent study by Borochin and Yang (BY, 2017) who explore the effect of equity options-implied information on leverage. However, there is an important difference between BY and our study. Our study explores one of the main implications of the financial flexibility paradigm, that in the case where an investment shock is expected, the firm acts proactively and it decreases its leverage to preserve a greater debt capacity today to meet its future expected borrowing. To test this implication, we use the risk-neutral volatility and risk-neutral kurtosis of stock returns to capture expectations about small and large investment shocks, respectively. Then, we convert stock return volatility to asset volatility to control for the "leverage effect" on volatility (Christie, 1982). This transformation enables us to test the theory. On the contrary, BY use stock return option-based measures without controlling for the "leverage effect" on stock returns volatility measure. The two studies also differ in other respects, too. We use pure option-based measures of expectations of future shocks which are forward-looking measures by construction whereas BY use measures such as the variance risk premium which is partly forward looking because it also contains information from past data (i.e. the one required to estimate the physical volatility which is part of the variance risk premium). In addition, we test whether our results are subject to endogeneity, whereas BY do not.

decide to exploit these opportunities, should they realize. Different from these two papers though, our study uses forward-looking market-based variables to proxy the firm's future growth opportunities. Grullon et al., (2012) and Ai and Kiku (2016) find that market-based volatility measures of future corporate growth provide contain more information about the firm's future investment opportunities compared to conventional accounting-based measures. However, these are historical measures of volatility which may reflect a financial distress rather than an expectations effect on leverage.[4]

Second, our approach to use RNMs to measure managers' expectations about shocks to future investment contributes to the extensive literature which views market option prices as a market-based estimate of investors' expectations to address a number of questions in finance for policy questions, asset management and asset pricing, risk management, stock selection and portfolio choice purposes (e.g., Bates, 1991, Kostakis et al., 2011, Faccini et al., 2018, Hiraki and Skiadopoulos, 2019, and Jackwerth, 2004, Christoffersen et al., 2012, Giamouridis and Skiadopoulos, 2012, Bali et al., 2016 for reviews). Two remarks are in order at this point. First, we acknowledge that the RNMs represent the expectations of a risk-neutral investor. Nevertheless, the RNMs are related to the moments of the physical distribution; the risk-neutral distribution is the product of the pricing kernel times the physical distribution. Therefore, RNMs convey information about the expectations of market participants. Second, we do not claim that RNMs forecast realized shocks accurately. However, this is not a concern for the purposes of our study. We employ RNMs simply as a forward-looking measure extracted from market prices to proxy market participants' expectations for future shocks.

[4] There is also another strand of literature, which explores how corporate cash management policies are affected when firms seek for financial flexibility. Firms have an incentive to build cash reserves in order to be able to fund future investment opportunities, without having to resort to costly external finance. This precautionary motive will be a positive function of the firm's need for external funds (e.g., firms with more volatile cash flows) and the cost of external funds. There is a special issue in the Journal of Corporate Finance (Denis, 2011) on this topic, i.e. the implications of financial flexibility on corporate cash management policies. Different to this strand of literature, our paper explores the implications of financial flexibility for capital structure decisions.

The remainder of the paper is structured as follows. Section 2 describes the sample construction. Section 3 presents the method for calculating the risk-neutral moments. In Section 4 we present the baseline empirical analysis and robustness tests. In Section 5 we explore whether the effects of expectations on leverage prevail once the firm's probability of default is taken into account. In Section 6 we explore the effect of expectations on leverage once we take financial constraints into account and Section 7 concludes.

2. Datasets

We collect quarterly firm-level accounting data and daily equity options data from Compustat North America and OptionMetrics Ivy DB database, respectively. Data span 1996:Q1 to 2017:Q4, as data on equity options are available from 1996 onwards. We match firm-level data from the two databases using eight-digit CUSIP numbers. Our sample consists of all firms that belong to any of the S&P LargeCap 500, S&P MidCap 400 and S&P SmallCap 600 indices and have available accounting and equity option data.[5] We choose to confine the sample to firms belonging to these benchmark indices because the equity options written on the stocks of these firms are the most liquid among the universe of U.S. traded equity options (for a similar sample choice in the corporate finance literature dictated by the liquidity of the derivatives' market, see Saretto and Tookes, 2013).

We filter accounting data in line with the previous literature. We exclude financial firms (SIC codes 6000-6999) and utilities (SIC codes 4900-4949), because their capital structure is significantly affected by regulatory factors. Furthermore, we only use firm-quarters in which firms have non-missing data for any of the variables of interest. Moreover, we exclude firm-quarters with firms having

[5] At any point in time, participation in these indices is mutually exclusive. That is, a firm cannot belong to more than one index at the same time.

non-positive book assets, book equity or market equity and negative debt or total liabilities. To avoid the effect of misreported data and outliers, we winsorize all final variables at the 1st and the 99th percentiles. Once we have applied filters, our sample consists of 817 firms. Over our sample period, 264 of these firms were became inactive, either because they defaulted, were delisted or merged with other companies. This ensures that our dataset includes both the firms that were successful and survived as well as the firms that failed. Hence our results are not biased towards successful companies.

Regarding the equity options data, we use the daily implied volatilities provided by Ivy DB for each traded contract (source: Option price files). These are calculated by the Cox, Ross, and Rubinstein (1979) model based on the midpoint of bid and ask option prices ; individual equity options are American style. We filter the options' data to remove any noise in the corresponding implied volatilities. We only consider out-of-the-money (OTM) and at-the-money options with time-to-maturity of at least 5 days. We also discard options with zero open interest, zero bid price, and premiums below 3/8 $. In addition, we retain only option contracts that do not violate Merton's (1973) no-arbitrage conditions for American options and have implied volatilities less than 100%. As a proxy for the risk-free rate, we use the zero curves provided by IvyDB. IvyDB provides continuously compounded zero rates which have been constructed based on the term structure of U.S. LIBOR rates (ranging from one week up to twelve months), as well as on the settlement prices of the Chicago Mercantile (CME) Eurodollar futures. We interpolate linearly across the two closest available maturities to obtain the rate for maturities beyond the provided ones. We also obtain data on expected dividend payments over the life of each option contract and their timing from IvyDB.

For some firms the fiscal ear does not coincide with the calendar year, so we need to collect monthly instead of quarterly data on other variables to accommodate for this. Then variables are synchronized based on the last month of each fiscal quarter, e.g. the value of an accounting variable for the fiscal quarter that ends on May will be matched with the value of a monthly variable for May. We obtain monthly data on the number of analysts following a firm, monthly data on the analysts' forecasts (mean forecast and standard deviation of forecasts) regarding the earnings per share from the Institutional Brokers' Estimate System (I/B/E/S) and daily data on the trading volume of stocks and equity options per firm from Compustat North America and OptionMetrics Ivy DB database, respectively. We also obtain daily data on the put/call ratio from OptionMetrics Ivy DB database.

We obtain annual data on CEO attributes and managerial ownership from ExecuCopm database and quarterly data on institutional ownership from Thomson-Reuters 13F database. We convert the annual frequency to quarterly by setting the value of a variable for each quarter within a year equal to the value of the variable for that particular year. Finally, we obtain monthly data on equity market return from CRSP and quarterly data on the aggregate nonfinancial corporate profit growth and GDP growth from the Federal Reserve Board and Federal Reserve Bank of St. Louis websites, respectively.

3. Calculation of risk-neutral moments

We extract the risk-neutral volatility and risk-neutral kurtosis from market option prices using the model-free methodology suggested by Bakshi et al. (2003, BKM hereafter).

3.1. BKM method: Description

Let $S(t)$ be the price of the underlying asset at time t adjusted by the present values of dividends, $R(t,\tau) \equiv \ln\left[S\left(t+\tau\right)\right] - \ln\left[S\left(t\right)\right]$ the τ-period log- return and r the continuously compounded risk-free rate computed at time t which corresponds to horizon τ. The computed at time t model-free risk-neutral volatility ($IV(t,\tau)$) and kurtosis ($KURT(t,\tau)$) of the log-returns distribution with horizon τ are given by:

$$IV(t,\tau) = \sqrt{E_t^Q\left\{R(t,\tau)^2\right\} - \mu(t,\tau)^2} = \sqrt{V(t,\tau)e^{r\tau} - \mu(t,\tau)^2} \qquad (1)$$

$$KURT(t,\tau)=\frac{E_t^Q\left\{(R(t,\tau)-E_t^Q\left[R(t,\tau)\right])^4\right\}}{\left\{E_t^Q(R(t,\tau)-E_t^Q\left[R(t,\tau)\right])^2\right\}^2}$$

$$=\frac{e^{r\tau}X(t,\tau)-4\mu(t,\tau)e^{r\tau}W(t,\tau)+6e^{r\tau}\mu(t,\tau)^2V(t,\tau)-3\mu(t,\tau)^4}{\left[e^{r\tau}V(t,\tau)-\mu(t,\tau)^2\right]^2} \qquad (2)$$

where $V(t, \tau)$, $W(t,\tau)$ and $X(t,\tau)$ are the fair values of three artificial contracts (volatility, cubic and quartic contract) defined as:

$$V(t,\tau)\equiv E_t^Q\left\{e^{-r\tau}R(t,\tau)^2\right\},\ W(t,\tau)\equiv E_t^Q\left\{e^{-r\tau}R(t,\tau)^3\right\},\ X(t,\tau)\equiv E_t^Q\left\{e^{-r\tau}R(t,\tau)^4\right\} \qquad (3)$$

and $\mu(t, \tau)$ is the mean of the log return for period τ defined as:

$$\mu(t,\tau)\equiv E_t^Q\left\{ln\left[\frac{S(t+\tau)}{S(t)}\right]\right\}\approx e^{r\tau}-1-\frac{e^{r\tau}}{2}V(t,\tau)-\frac{e^{r\tau}}{6}W(t,\tau)-\frac{e^{r\tau}}{24}X(t,\tau) \qquad (4)$$

The prices of the three contracts can be computed as a linear combination of out-of-the-money call and put options:

$$V(t,\tau)=+\int_{S(t)}^{\infty}\frac{2\left(1-ln\left[\frac{K}{S(t)}\right]\right)}{K^2}C\left(t,\tau;K\right)dK\quad\int_{0}^{S(t)}\frac{2\left(1+ln\left[\frac{S(t)}{K}\right]\right)}{K^2}P\left(t,\tau;K\right)dK \qquad (5)$$

$$W(t,\tau)=-\int_{S(t)}^{\infty}\frac{6\,ln\left[\frac{K}{S(t)}\right]-3\left(ln\left[\frac{K}{S(t)}\right]\right)^2}{K^2}C\left(t,\tau;K\right)dK\quad\int_{0}^{S(t)}\frac{6\,ln\left[\frac{S(t)}{K}\right]+3\left(ln\left[\frac{S(t)}{K}\right]\right)^2}{K^2}P\left(t,\tau;K\right)dK \qquad (6)$$

$$X(t,\tau)=\int_{S(t)}^{\infty}\frac{12\left(ln\left[\frac{K}{S(t)}\right]\right)^2-4\left(ln\left[\frac{K}{S(t)}\right]\right)^3}{K^2}C\left(t,\tau;K\right)dK$$

$$+\int_{0}^{S(t)}\frac{12\left(ln\left[\frac{S(t)}{K}\right]\right)^2+4\left(ln\left[\frac{S(t)}{K}\right]\right)^3}{K^2}P\left(t,\tau;K\right)dK \qquad (7)$$

where $C(t,\tau;K)$ and $P(t,\tau;K)$ are the call and put prices with strike price K and time to maturity τ.

3.2. BKM method: Implementation

To compute the two RNMs [equations (1) and (2)]The implementation of equations (5), (6), and (7) requires a continuum of OTM call and OTM put options across strikes. However, market option quotes are available only for a bounded finite range of discrete strike prices. This will incur a bias in the calculation of RNMs (Dennis and Mayhew, 2002, and Jiang and Tian, 2005). In addition, we need to extract constant maturity RNNs to eliminate the effect of the shrinking time to maturity on the RNMs as time goes by.

To address both issues, once we apply the data filters described in Section 2 to any given date, we extract the expirations for which at least two OTM puts and two OTM calls are traded. We discard maturities that do not satisfy this requirement. We also discard any maturity for which there is no data on at least one call option with delta smaller than 0.25 and one put option with delta larger than 0.75. We do this to ensure that the computed RNMs reflect a wide range of option strike prices. Then, we fit a Hermite cubic spline through the implied volatilities for each available maturity as a function of moneyness (defined as the ratio of the underlying price to the strike price). We evaluate this spline at an equally spaced moneyness grid of 1000 points with minimum moneyness 0.01 and maximum moneyness 3. This yields for each maturity 1000 pairs of moneyness and implied volatilities (for a similar approach, see Rehman and Vilkov, 2012, Chang et al., 2013, Neumann and Skiadopoulos, 2013). For each one of these 1,000 moneyness levels, we fit a cubic spline in the maturity dimension and evaluate it at the target maturity; we calculate the RNMs on a daily level for fixed maturities 3, 6 and 12 months. For moneyness levels below (above) the smallest (largest) available moneyness level in the market, we extrapolate the implied volatility of the lowest (highest) available strike price horizontally. If the target expiration is below the smallest available traded expiration, a constant maturity implied volatility curve is not constructed to avoid any noise from extrapolation in the time to maturity dimension.

Finally, we convert the moneyness grid and the corresponding constant maturity implied volatilities to the associated strike and option prices via the Black and Scholes (1973) model.[6] To account for any dividends expected to be paid over the life of the constant maturity option, we adjust the underlying price by the present value of the expected dividends (for a similar approach, see e.g., Dumas et al., 1998). Then, we compute the constant maturity moments [equations (1), (2), and (3)] by evaluating the integrals in formulae (6), (7), and (8) using trapezoidal approximation.

In line with Bakshi et al. (2003) and Conrad et al. (2013), we average the daily RNM over the period of interest (quarter) to diminish the effect of any outliers in risk-neutral moments that may still be present on a daily level. The application of the filtering constraints to the options' data, delivers a different sample size for the RNMs across the different horizons. As a result, the sample size of the firms' panel which is matched with the RNMs differs across the different horizons. The use of 3-month, 6-month and 12-month option prices yields 26,327 28,521 and 18,023 firm-quarter observations, respectively.

[6] The use of the Black-Scholes (1973) model to convert implied volatilities to option prices does not introduce a bias even though we use American options. This is because we use only short maturity (less than six months), out-of-the money options which have a very small early exercise premium (see Barone-Adesi and Whaley, 1987, for an extensive analysis of these points).

4. Leverage and expectations about future shocks

4.1. Empirical specification

To explore the effects of expectations about future shocks on leverage, we run the following fixed-effects panel regression:

$$L_{i,t} = a_i + \beta RNM_{i,t,\tau} + \gamma FL_{i,t} + \varepsilon_{i,t} \quad (8)$$

Equation (8) describes the leverage ratio $\left(L_{i,t}\right)$ of the i^{th} firm measured at quarter t as a function of the vector of RNMs $\left(RNM_{i,t,\tau}\right)$ implied by τ-maturity equity options of firm i measured at time t; the vector includes the risk-neutral volatility and kurtosis for each firm. RNMs are concurrent to the leverage ratio, as current expectations of future investment shocks affect contemporaneous leverage decisions. In equation (8), we also include firm fixed effects a_i and a vector of standard firm-level $\left(FL_{i,t}\right)$ determinants of leverage proposed by the previous literature. Firm fixed effects (a_i) incorporate any unobserved firm-specific time invariant effects. The inclusion of firm fixed effects is required given that previous literature on firm leverage models (Lemmon et al. 2008) concludes that a substantial part of leverage variation is driven by firm-specific time invariant effects which are not captured by previously identified determinants.

We measure leverage by book (i.e., accounting) and market values, separately, since there is no consensus in the previous literature on which one of the two measures of leverage is better (e.g., Huang and Ritter, 2009). The former is measured as book debt divided by total assets and the latter as book debt divided by the sum of the market value of equity and book debt at time t. We convert stock returns risk-neutral volatility to asset risk-neutral volatility to control for the "leverage effect" on volatility (Christie, 1982), which states that when stock prices decrease (increase), firms become more (less) levered, raising (lowering) the volatility of stock returns.[7] In line with Welch (2004), Faulkender and Petersen (2006) and Frank and Goyal (2009), we perform the conversion from the stock return to the asset value metric by multiplying the equity volatility with the equity-to-asset ratio of the firm.[8] In the case of the risk-neutral kurtosis, there is no need to perform a conversion because kurtosis is invariant to linear transformations. Hence, the risk-neutral kurtosis of stock returns equals the risk-neutral kurtosis of asset returns.

The set of firm-level variables $\left(FL_{i,t}\right)$ controls for the effect of agency costs, asymmetric information, default risk and tax shield variability on leverage. Following Flannery and Rangan (2006), Hovakimian and Li (2011) and Faulkender at el. (2012), we use the following set of firm-level variables:

- **INDUSTRY**: Industry median leverage. Within any quarter, it is defined as the median leverage ratio among all firms of the industry (defined by two-digit SIC codes) that the firm belongs to. The industry median leverage proxies industry factors that affect leverage, such as business risk and regulation, and is expected to have a positive effect on the firm’s leverage
- **MB**: Market-to-book ratio of assets. It is calculated as the sum of book liabilities and market value of equity divided by book assets. It proxies a firm's growth opportunities. Firms with

[7] We checked whether this transformation may have an effect on the results of our subsequent analysis. To this end, we repeated the subsequent analysis without applying this transformation. The results were affected, as the relation between risk-neutral volatility turns from negative to positive. However, this could be the result of the “leverage effect”. A decrease in the firm’s stock rice would increase at the same time the firm’s leverage ratio and the stock return volatility, creating a positive relation between the two variables. By converting to asset volatility, we control for this effect.

[8] In line with Welch (2004), Faulkender and Petersen (2006) and Frank and Goyal (2009), we switch from the stock returns metric to the asset metric by assuming that the variance of debt equals zero. Schaefer and Strebulaev (2008, Table 7, page 10) find that the asset volatility is the same regardless of whether one assumes zero debt volatility or she estimates debt volatility using investment grade bonds. They use the Fixed Income Securities Database; unfortunately we have no access to this database to verify their results. However, 97.9% of the firms with rated debt in our sample also issue investment grade bonds.

high growth potential are more concerned about the debt overhang problem and thus they are expected to have lower leverage.[9]

- **ASSETS**: Natural log of book assets expressed in 2009 U.S. dollars as a measure of firm size. Large firms are considered to have lower default risk and investors possess more information about them. Therefore, they are considered to have higher debt capacity and hence a greater leverage.
- **PROF**: Profitability calculated as earnings before interest, taxes, depreciation and amortization divided by the book value of assets. More profitable firms are expected to be less levered because the availability of internally generated funds reduces the need to resort to costly debt financing. Furthermore, retained earnings may mechanically reduce the firm's book leverage ratio.
- **TANG**: Tangibility, calculated as net property, plant and equipment divided by book assets. Tangibility proxies collateral. Firms operating mostly with fixed assets are expected to have a greater leverage because they have a greater debt capacity, given that fixed assets have a high liquidation value in case of default.
- **DEP**: Depreciation expenses, calculated as depreciation and amortization divided by book assets. Depreciation expenses proxy for non-debt tax shields. The greater the depreciation expenses of a firm, the less the need for interest expenses to reduce taxable income, and thus the lower the leverage ratio
- **SELL**: Selling expenses, calculated as selling, general and administrative expenses divided by sales. Selling expenses proxy the degree of uniqueness of the firm, i.e., how easily replaceable are the assets of the firm by the assets of another firm. Specialized assets have a lower expected

[9] According to the debt overhang problem, the greater the leverage of a firm, the greater the probability that it will forgo positive net present value projects. This happens because the share of the firm's future proceeds received by current creditors increases with leverage, leaving little or no incentive to equity holders or new creditors to finance a new profitable investment.

liquidation value. Thus, firms with highly specialized assets are expected to have a lower debt capacity.

Table 1 reports the sample summary statistics. Three samples are formed based on the respective RNMs three horizons (3, 6 and 12-months) under scrutiny. The size of each sample is determined by the availability of RNMs and of accounting data used to construct the measures of leverage and the set of control variables $\left(FL_{i,t}\right)$. As expected, book leverage ratios are on average higher than market leverage ratios, given that the book value of equity is usually lower than the market value for equity.

4.2. Results and discussion

We use RNMs extracted for three different time horizons 3, 6 and 12 months. We use three different time horizons to examine whether expectations for longer horizon shocks may also matter for leverage determination. Firms' managers may set the current quarter's leverage by taking into account expectations for longer horizons shocks, too. DeAngelo et al. (2011) show that this is the case when managers believe that shocks are serially correlated. .

First, we perform a preliminary assessment of the relation between leverage and RNMs by sorting firms in two high and low volatility (kurtosis) groups. At any given date and for any given time horizon, we trace the median value for risk-neutral volatility (kurtosis) across all firm-quarters in our panel. Then, we sort firms with RNMs greater (smaller) than the media in the high (low) group. De Angelo (2011) model predicts that firms which belong in the low risk-neutral volatility and kurtosis groups should have higher leverage ratios than the firms which belong in the high RNMs groups.

Columns (1) and (2) [(4) and (5)] of Table 2 present the average and median values for leverage across the two volatility (kurtosis) groups. Consistent with the predictions of De Angelo (2011) model that expectations for future shocks decrease leverage, both the average and the median leverage ratios of the low-volatility group are greater than these of the high-volatility group. This holds for both market and book leverage. In the case of kurtosis, the results are mixed, as neither book nor market leverage are consistently higher in one of two groups across all time horizons. These results are based on univariate sorts and they do not control for other variables which may affect leverage.

Next, to provide a deeper understanding of the relation between leverage and the expectations for future shocks, we assess the relation between leverage and RNMs by means of panel regressions. We estimate two alternative specifications of equation (8) for each time horizon, for the cases where we use market and book leverage as a dependent variable, respectively. In line with Petersen (2009), we conduct statistical inference by using Cameron et al. (2011) and Thompson (2011) standard errors clustered by firm. Table 3, reports the results for the cases where managers take into account expectations for shocks over the next three (columns (1) and (2)), six (columns (3) and (4)) and twelve-month (columns (5) and (6)) period, when leverage is measured by market and book leverage, respectively.

In line with previous capital structure papers (Huang and Ritter, 2009, Hovakimian and Li, 2012), Table 3 reports the *within-firm* adjusted R^2 defined to be the explained variation of leverage that is attributable to all explanatory variables but the firm fixed effects (i.e. the firm specific constant). Given that firm fixed effects can artificially inflate the conventional adjusted R^2 (Lemmon et al., 2008), the *within-firm* adjusted R^2 provides a more accurate estimate for the explanatory power of RNMs and other control variables compared to the estimate provided by the conventional adjusted R^2. To obtain the within-firm R^2, we time-demean the data and estimate the following equation:

$$L_{i,t} - \overline{L}_i = \beta(RNM_{i,t,\tau} - \overline{RNM}_{i,\tau}) + \gamma(FL_{i,t} - \overline{FL}_i) + (\varepsilon_{i,t} - \overline{\varepsilon}_i) \quad (9)$$

Where $\overline{L}_i$ is the time series average leverage of the i^{th} firm. The estimation of equation (9), known as within estimation, yields the same estimates for slope coefficients (β, γ) as the estimation of equation (8). The within-firm R^2 is the adjusted R^2 obtained from the estimation of equation (9)

Three remarks are in order regarding our findings. First, we can see that expectations for future shocks are significant even when we control for well-known determinants of leverage. The coefficients for the risk-neutral volatility and risk-neutral kurtosis are negative and statistically significant in all specifications and time horizons. These findings are consistent with the predictions of the DeAngelo et al. (2011) model. The reported significance suggests that expectations about future shocks affect the way that managers set their leverage today. In addition, the fact that both the risk-neutral variance and kurtosis are significant suggests that managers are concerned about both the variation of ("normal", also termed "diffusive") future shocks as well as about the occurrence of extreme shocks. The negative coefficient of the two RNMs suggest that managers decrease leverage in the case where they expect that the variation of shocks will increase and /or more extreme shocks are likely to happen.[10] Second, the fact that changes in the six and twelve month risk-neutral volatility and kurtosis also affect leverage indicates that managers may set the current quarter leverage ratio by taking into account expectations for longer horizons shocks, i.e. shocks to be realized at times beyond the next quarter, too

Third, we can see that all control variables but depreciation expenses have the expected sign, albeit some of them are not significant across all specifications and time-horizons. The empirical evidence on the effect of depreciation expenses on leverage is mixed. Hovakimian and Li (2011) find a positive whereas Faulkender and Rangan (2006) find a negative relation.

[10] Welch (2004) finds that part of the variation in market leverage ratios is mechanical in the sense that it is due to changes in the market value of the firm's equity. He argues that once the change in the market value of the firm's equity is accounted for, some of the previously identified leverage determinants become statistically insignificant. In unreported tests, we re-run all market leverage regressions augmented with the firm's stock quarterly return. We find that the results on the significance and effect of RNMs to firm's leverage do not change.

4.3. Expectations of future shocks versus standard determinants of leverage

We assess the importance of expectations about future shocks relative to that of the determinants suggested by the previous literature. To this end, we examine the contribution of the two RNMs to the goodness of fit of the model described by equation (8) (full model) relative to the goodness of fit obtained from employing a nested version of equation (8) which uses only the traditional leverage determinants. The second to last and the last rows of Table 3 report the within-firm adjusted R^2 of the full and nested versions of equation (8), respectively. The within-firm adjusted R^2 in the three-month specification increases by 10.1% (17%) in the case of the market (book) leverage when we include the two RNMs in the specifications. The within-firm adjusted R^2 increases by 16% (20.6%) and 21.3% (21.4%) when we consider market (book) leverage for the three-month and twelve-month cases, respectively.

Due to space limitations, in the remaining of the paper, we will only report results for the case where we examine the relation between leverage and the six-month RNMs, and we will be discussing results for the three- and twelve- month RNMs. We select to report results for the six-month horizon because it yields the greatest number of observations among the three horizons.

Next, we conduct a variance decomposition of leverage to determine the fraction of explained variation of the dependent variable that is attributable to the RNMs. Following Lemmon et al. (2008), we employ the framework of analysis of covariance (ANCOVA). For each model specification, we calculate the *partial Type III explained sum of squares* of each explanatory variable. This is calculated as follows. For each explanatory variable, we estimate equation (9) after excluding the particular variable. Next, we obtain the explained sum of squares (ESS) defined as the sum of the squares of the deviations of the fitted leverage values from the mean leverage value of this regression. The difference between the ESS of this model and the ESS of the model that includes the particular variable is the partial Type III ESS for the particular variable. It expresses the explained variation of the dependent variable that is attributable to the particular explanatory variable once all other explanatory variables have been taken into account. The sum of the partial Type III ESS of all explanatory variables in the model equals the ESS of the model that includes all variables.

Panel A of Table 4 reports the variance decomposition results for the specifications which include the 6-month RNMs. Columns (1) and (2) correspond to the specifications that include market and book leverage, respectively. In each column, the entry for a particular variable is calculated as the ratio of the partial Type III ESS of that variable over the sum of the partial Type III ESS of all explanatory variables in the model. Thus, every column adds to 100%. Hence, each entry expresses the percentage of the within-firm adjusted R^2 that is attributable to a particular explanatory variable. Entries in columns (1) and (2) show that the risk-neutral volatility captures 19% and 27.8% of leverage variation in the market and book leverage specifications, respectively. Most importantly, risk-neutral volatility has greater explanatory power – in terms of explained leverage variation – compared to all other determinants, with the exception of industry median leverage. This is consistent with the findings of Lemmon et al. (2008), who document that the industry median leverage is the most influential identified leverage determinant. The results are similar in the 3-month and 12-month specifications where risk-neutral volatility captures 14% to 25% and 24.6% to 26.2% of the leverage explained variation, respectively. Risk-neutral kurtosis accounts for a relatively smaller fraction of leverage variation, ranging from 0.6% to 18.5% depending on the specification and the time horizon of the RNMs. In sum, the RNMs account for 18.3% to 43.1% of leverage variation, depending on the specification and the time horizon of the RNMs. For each individual specification, the RNMs have a greater explanatory power – in terms of explained leverage variation – compared to all other determinants, with the exception of industry median leverage.

Panel B of Table 4 reports the economic significance of the estimated coefficients in equation (8). Columns (3) and (4) correspond to the specifications that include market and book leverage, respectively. From an economic perspective, our calculations show that a one standard deviation increase in risk-neutral volatility decreases market (book) leverage by 3.1% (3.1%) and a one standard deviation increase in risk-neutral kurtosis decreases market (book) leverage by 2% (0.9%). Risk-neutral volatility outperforms all other determinants but industry median leverage, while kurtosis outperforms half of the other determinants. This effect is similar regardless of the horizon under scrutiny (results are available upon request).

4.4. Are results subject to an endogeneity bias?

In the previous subsections, we regressed leverage on the RNMs by controlling for a set of common determinants of leverage. However, an endogeneity issue may arise; the firm's leverage may also affect the RNMs (e.g., Taylor et al., 2009, Hansis et al., 2010). To check whether our results are subject to an endogeneity bias, we perform a two stage least squares (TSLS) instrumental variable estimation. We choose instruments that proxy the heterogeneity of investors' beliefs and market sentiment, and are uncorrelated with leverage. Hansis et al. (2010) findings imply that the heterogeneity of analysts' beliefs affects risk-neutral volatility and risk-neutral kurtosis. In addition, the heterogeneity of beliefs (Shefrin, 2001, Buraschi and Jiltsov, 2006, Friesen et al., 2012) and market sentiment (Han, 2008, Lemmon and Ni, 2011) are related to the slope of the implied volatility curve and hence they are related to the risk-neutral kurtosis. Hence, we fix a menu of five instruments for the two RNMs. These are the stock's trading volume, the option/stock trading volume ratio, the number of analysts following the firm, the dispersion of analysts' forecasts and the put/call ratio. In line with previous literature (Taylor 2009, Hansis et al., 2010), we consider the first four variables as measures of investors' heterogeneity of beliefs (a greater value for each one of these variables is taken to manifest greater information asymmetries) and we use the put/call ratio as a measure of sentiment.

For any given firm, we calculate the stocks (options) trading volume as the log of the daily average over a quarter of the number of traded stocks (option contracts). The number of analysts is the monthly average over a quarter of the number of analysts following a firm, i.e. analysts that report estimates for the next annual earnings announcement. The dispersion of analysts' forecasts is the monthly average over the quarter of the standard deviation of analysts' earnings per share forecasts for a firm for the next annual earnings announcement divided by the absolute value of the mean estimate. The put/call ratio is the daily average over a quarter of the ratio of the trading volume of firm-specific put options to call options.

We check the validity of our instruments and conduct the TSLS estimation as follows. First, for any given horizon, we check the relevance condition for this menu of instruments and determine which instruments to use. We take a general to specific approach by considering all possible combinations of instruments and we retain the variables that satisfy the relevance condition as instruments; we examine combinations because the number of instruments has to be at least equal to the number of endogenous regressors for the purposes of testing, hence in our case at least two. We use Sanderson-Windmeijer (2016) to test the relevance condition. This tests whether any given candidate instrument is correlated with each one of the two potentially endogenous RNMs. We define the optimal set of instruments to be the one which satisfies the relevance condition. The exclusivity condition in TSLS estimation can only be tested if the number of instruments exceeds the number of potentially endogenous variables. Hence, if the chosen set of instruments consists of more than two instruments, we also check whether it satisfies the exclusivity criterion, using Hansen's *J*-statistic. This tests whether any given instrument is uncorrelated with the error term in equation (8). Once we decide on the suitability of instruments, we perform the TSLS estimation to check whether the coefficients of the instrumented RNMs retain the negative sign and significance as the coefficients of RNMs do. In case they do not, then this would imply that the previously reported findings are subject to an endogeneity bias.

Table 5 reports results from the TSLS estimation for the case where we examine the six-month RNMs. The optimal set of instruments for the six-month horizon consists of the dispersion of analysts' forecasts and the stocks trading volume We can see that there is a negative and statistically significant relation between leverage and the RNM instruments for both the book and market leverage specifications. Regarding the results for the other two horizons, the results are similar. Most importantly, there is a negative and statistically significant relation between leverage and RNMs for the specifications in both horizons. The optimal set of instruments for the three- month horizon is the options/stocks trading volume ratio (O/S), the put/call ratio, and the stocks trading volume, whereas for the twelve month horizon is the dispersion of analysts' forecasts, the stocks trading volume and the number of analysts. The relevance criterion is satisfied for both the market and book leverage specifications for the twelve-month horizon and the book leverage specification for the three-month horizon. In sum, in 5 out of 6 specifications (book and leverage specifications across the three RNMs horizons) RNMs retain their sign and satisfy the instrumental variable estimation criteria. Therefore, the relation between leverage and RNMs documented in Section 4 is not subject to an endogeneity bias.

4.5. Further robustness tests

We conduct a number of further robustness checks. We test whether the documented effect of RNMs prevails its significance when we account for (i) the firm's research and development (R&D) expenses, location (physical, and the jurisdiction of incorporation), ownership structure, CEO attributes, and macroeconomic fluctuations, (ii) the number of stock exchanges, on which each firm's shares are traded, (iii) the effect of the global financial crisis of 2008, and (iv) the liquidity of the options dataset we use to construct the RNMs.[11]

[11] Another potential concern is whether the growing presence of High Frequency Data affects our results. We have computed risk-neutral moments (RNMs) over any given quarter by first computing daily RNMs (obtained from end-of-say option prices) and then averaging over the quarter. Therefore, we have not used any high frequency option data and therefore we do not expect our estimates of RNMs to have been affected by high frequency trading (HFT). HFT is a program trading platform that uses powerful computers to transact a large number of orders at fractions of a second. Of course, intra-day, the presence of HFT may affect option prices, however this is unlikely to occur at the very end of the

Regarding (i), we include the following control variables in equation (8). Following Flannery and Rangan (2006), Hovakimian and Li (2011) and Faulkender at el. (2012), we replace selling expenses with (1) R&D expenses divided by sales after setting missing values to zero, and (2) a dummy variable that takes the value of one if the firm does not report R&D expenses and zero otherwise. Similar to the rational for using selling expenses, R&D expenses proxy the degree of uniqueness of the firm, i.e., how easy it is to replace the assets of the firm by the assets of another firm. Specialized assets have a lower expected liquidation value. Thus, firms with highly specialized assets are expected to have a lower debt capacity.

We also include regional fixed effects in equation (8) to control for each firm's headquarters location and the location, in which each firm is legally registered. We use the eight regions that the U.S. Bureau of Economic Analysis (BEA) has defined.[12] Gao et al (2011) find that the leverage ratio of US firms is affected by the location of their headquarters. The financing policy of a firm could be affected by several factors related to location such as state laws on corporate takeover and payout restrictions, local credit market conditions, local investor preferences, local cultural characteristics and social interactions between managers of different firms.

We use two variables to control for two respective features of the structure of ownership, that is institutional and managerial ownership. Moh'd et al (1998) and Grennan et al (2017) find that institutional ownership has a negative effect on the leverage ratio of firms because institutional investors use their monitoring power on firm's managers to prevent them from raising the firm's leverage ratio excessively. Moh'd et al (1998) and Chen and Steiner (1999) find that there is a negative

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trading day (see for instance Kapetanios, Neumann and Skiadopoulos, 2015 for an analysis of the 24-hour CME options market and Kirilenko et al., 2017, for evidence on the flash crash for the stock market).

[12] According to the definition of BEA, these regions are a set of geographic areas that are aggregations of the states. The regional classifications are based on the homogeneity of the states in terms of economic characteristics, such as the industrial composition of the labor force, and in terms of demographic, social, and cultural characteristics. BEA groups all 50 states and the District of Columbia into eight distinct regions.

relation between a firm's level of managerial ownership and leverage. Higher managerial ownership in a firm aligns the manager's own interests with those of the shareholders and thus managers are more concerned with bankruptcy risks. To control for the level of institutional ownership in firms, for any given firm and quarter, we calculate the ratio of the number of shares held by institutional investors to the total number of shares outstanding and use this as a control variable in equation (8). To control for the level of managerial ownership in firms, for any given firm and quarter, we calculate the percentage of total shares outstanding owned by the firm's executives (top managers and directors), including options that are exercisable or will become exercisable within 60 days and use this as a control variable in equation (8).

Certain CEO attributes could also have an effect on the financing policy of a firm. We include two variables in equation (8) to control for CEO gender and age; one dummy variable that takes the value of 1 if the CEO is male and 0 if the CEO is female and one variable measuring CEO age. Graham et al. (2013) and Facio et al. (2016) find that firms led by a male CEO have a higher leverage ratio compared to firms led by a female CEO. Furthermore, Bertrand and Schoar (2003) argue that older CEOs are more risk-averse and are expected to use less debt financing compared to younger CEOs.

Regarding the impact of macroeconomic fluctuations on corporate leverage, Korajczyk and Levy (2003) and Leary (2009) find that leverage is countercyclical for financially unconstrained firms and procyclical for financially constrained firms in U.S. Halling et al. (2016) find that leverage is pro-cyclical in common law countries including U.S. We include three market-level variables in equation (8) to control for the effect of macroeconomic fluctuations on leverage. Following Leary (2009), we use the one-year real aggregate domestic nonfinancial corporate profit growth, the one-year real stock market return and the one-year real GDP growth.

Table 6 reports the results from estimating equation (8) with the aforementioned variables. Panel A (B) reports the results for the specifications with market (book) leverage. Columns (1) to (6) report the results of the specifications that include variables for R&D expenses, headquarters location fixed effects, jurisdiction of incorporation fixed effects, ownership structure, CEO attributes and macroeconomic fluctuations, respectively. Columns (7) reports the results of the specification that includes headquarters location fixed effects and all other variables and (8) jurisdiction of incorporation fixed effects and all other variables. We find that the coefficients for the risk-neutral volatility and risk-neutral kurtosis remain negative and statistically across all specifications. Results are similar for the specifications that include 3-month and 12-month constant maturity RNMs with the exception of the 3-month risk-neutral kurtosis in the book leverage specification.

Regarding (ii), we also test whether our finding that an increase in RNMs decreases leverage holds across firms that are cross listed. We identify the stock exchanges, on which each firm's shares trade, from Worldscope database, as Compustat does not provide such information. We match firm-level data from the two databases using eight-digit CUSIP numbers. We estimate equation (8) using only the firms in our sample that are identified as cross listed, i.e. 329 out of the 798 firms, for which 6-month RNMs are available. We find that the RNMs prevail their significance and sign. Results are similar for the specifications that include 3-month and 12-month constant maturity RNMs.

Regarding (iii), we control for the potential effect of the financial crisis of 2008 on firms' leverage. Kahle and and Stulz (2013) report that the financial crisis had a different impact on debt and equity capital markets; during the financial crisis, the average cumulative decrease in net equity issuance was more than twice the average decrease in net debt issuance compared to pre-crisis levels. This differential impact could have affected the leverage ratio of firms. We include a time dummy variable that takes the value of 1 from the third quarter of 2007 until the fourth quarter of 2010 in equation (8) to control for the effect of the crisis on corporate leverage. We find that the RNMs prevail their significance and sign. Results are similar for the specifications that include 3-month and 12-month constant maturity RNMs.

Finally, we examine whether the results are robust across subsets of our original option dataset employed to extract RNMs. To this end, we segregate options data in deciles by using their liquidity as a sorting criterion. The informational content of option prices in the lower option liquidity decile may be lower than that of options in the higher liquidity decile. In this case, RNMs extracted from the lower liquidity decile will be a poorer proxy of managers' expectations about future shocks. We use the options trading volume to measure options' liquidity. For any given firm, we calculate the options trading volume as the daily average over a quarter of the number of traded option contracts. Next, we sort options in liquidity deciles and estimate equation (8) for each decile (results are available upon request). Table 7 reports the results. We can see that the coefficient for risk-neutral volatility retains its sign and significance across all deciles, across all RNMs horizons and across both regression specifications (market leverage and book leverage). The coefficient for risk-neutral kurtosis in the market leverage specification also retains its significance in all cases. The coefficient for risk-neutral kurtosis in the book leverage specification retains its sign and significance in most of the cases. As an additional robustness test, we also segregate the data by quartiles and estimate equation (8) for each quarter. The results are similar to the ones obtained from the analysis on the liquidity deciles (results are available upon request). In sum, the results indicate that our findings on the significance and effect of RNMs to leverage are robust across different option liquidity groups. This is not surprising given that the employed option dataset consists of highly liquid options and hence the informational content of option prices is expected to be high even for the low option liquidity groups.

5. What do RNMs reflect? Financial flexibility versus financial distress

As we discussed, our findings on the effect of market expectations on the firms' leverage is in accordance with the DeAngelo (2011) model's predictions regarding financial flexibility as a determinant of corporate financial policy. Alternatively, one could argue that the reported effect of

RNMs on leverage reflects a financial distress rather than a financial flexibility effect.. The static trade-off theory implies that the optimal leverage ratio of a firm is inversely related to the probability of default of the firm. An increase in RNMs, i.e. a higher volatility and/or higher kurtosis, might reflect that the firm's probability of default increases and thus managers decrease leverage. We explore this alternative explanation by including a measure of probability of default on the right-hand side of equation (8). We use three alternative measures to proxy the probability of default.

Regarding the first measure, we construct a measure for corporate default probability, using the results from Campbell, et al. (2011) [13]. Campbell et al. (2011) model the probability of default of a firm as a function of observable accounting and market-based variables. They use monthly firm failure event data to construct a dummy variable that takes the value of 1 if the firm fails in the following month and 0 if the firm remains active. Next, they regress this dummy variable on certain accounting and market-based variables to test whether a firm's default can be predicted by these variables. We use the estimated coefficients from this regression to construct an index, which we call the $CHS\_M_{i,t}$ index. This index measures the probability that a firm will default over the next month as a function of the variables. The higher the value of the index, the higher the probability of default, because the dummy variable used by Campbell, Hilscher and Szilagyet al. (2011) takes the value of 1 if the firms fails and 0 if it remains active. We calculate $CHS\_M_{i,t}$ index as follows:

$$CHS\_M_{i,t} = -8.63 - 29 \times \overline{NIMTA}_{i,t} + 3.51 \times TLMTA_{i,t} - 2.49 \times CASHMTA_{i,t} - 8.02 \times \overline{EXRET}_{i,t} + 1.69 \times SIGMA_{i,t} + 0.138 \times RSIZE_{i,t} + 0.05 \times MB - 0.974 \times PRICE_{i,t} \qquad (10)$$

Equation (10) describes the construction of the $CHS\_M_{i,t}$ index for the i^{th} firm in quarter t, where $\overline{NIMTA}_{i,t}$ denotes the average ratio of net income to market value of assets over the last four quarters,

[13] We selected this model, because Campbell et al (2011) document that it outperforms other leading alternative models such as these of Shumway (2001), Chava and Jarrow (2004) and Distance-to-Default models in terms of forecasting the probability of default accurately.

i.e. the period spanning quarter *t-3* to quarter *t*, $TLMTA_{i,t}$ denotes the ratio of total liabilities to market value of assets, $CASHMTA_{i,t}$ denotes the ratio of cash and short-term investments to market value of assets, $\overline{EXRET}_{i,t}$ denotes the stock's average excess return relative to the S&P 500 index return over the last 12 months, i.e. the period spanning month *t-11* to month *t*, $SIGMA_{i,t}$ denotes the annualized stock return standard deviation over the previous 3 months, $RSIZE_{i,t}$ denotes the firm's equity capitalization relative to that of the S&P 500 index, $MB_{i,t}$ denotes the equity market-to-book ratio, and $PRICE_{i,t}$ denotes the log of the stock price. The market value of assets is the sum of the firm's total liabilities and market value of equity.

Campbell et al (2011) also model the probability that a firm will default in the following 12 months, as opposed to the model in equation (10) which predicts the firm's probability of default over the following month. They construct a dummy variable that takes the value of 1 if the firm fails in the following 12 months and 0 if the firm remains active and then regress this variable on the aforementioned variables. We use the estimated coefficients from this regression to construct the $CHS\_Y_{i,t}$ index, which measures the probability that a firm will default over the next 12 months as a function of the variables used:

$$CHS\_Y_{i,t} = -8.87 - 20.12 \times \overline{NIMTA}_{i,t} + 1.60 \times TLMTA_{i,t} - 2.27 \times CASHMTA_{i,t} - 7.88 \times \overline{EXRET}_{i,t} + 1.55 \times SIGMA_{i,t} - 0.005 \times RSIZE_{i,t} + 0.07 \times MB - 0.09 \times PRICE_{i,t} \quad (11)$$

As a second proxy of the firm's probability of default, in line with Graham (2000), we use Altman's (1968) *Z*-score as modified by Mac-Kie Mason (1990, modified Altman's *Z*-score):

$$Z_{i,t} = \frac{3.3 \times EBIT_{i,t} + Sales_{i,t} + 1.4 \times RE_{i,t} + 1.2 \times WC_{i,t}}{TA_{i,t}} \quad (12)$$

Equation (12) describes the modified Altman's *Z*-score for the i^{th} firm in quarter *t*, where *EBIT*: Earnings before Interest and Taxes, *Sales*: Total sales, *RE*: Retained Earnings, and *TA*: Total Assets. The lower the *Z*-score, the greater is the probability that the firm will default.

The third measure we use to proxy financial distress risk is cash-flow volatility. Higher cash flow volatility is expected to increase the probability of default. Leary and Roberts (2005) and Lemmon et al. (2008) have looked at the relation between leverage and cash-flow volatility. We use the standard deviation of the first difference in the firm's historical operating profits ($EBITDA_{i,t}$ – $EBITDA_{i,t-1}$) divided by the mean of total assets to measure cash flow volatility. Following Mac-Kie Mason (1990), for each quarter *t* we use the last ten observations, i.e., the period spanning quarter *t-9* to quarter *t* to calculate both the standard deviation of the operating profits and the mean of the total assets. In case data are missing, we require at least six quarters of non-missing data.

Table 8 reports the results from estimating equation (8) where we include each one of the aforementioned measures for probability of default, separately. Columns (1) to (4), (5) and (6), and (7) and (8) report the results from estimating the specifications which include the CHS_M and CHS_Y indices, the Altman’s Z-score, and cash-flow volatility, respectively. We find that the RNMs prevail their significance and sign across all specifications even once we control for the alternative measures for probability of default. Results are similar for the specifications that include 3-month and 12-month constant maturity RNMs but the 3-month risk-neutral kurtosis in the book leverage specification that includes CHS_Y or Altman’s z-score (results are available upon request (results are available upon request).

Overall, our results indicate that RNMs explain a part of leverage variation which cannot be explained by any of the three alternative employed measures for the probability of default. Simply put, RNMs provide explanatory power over and above the default probability measures. This indicates that our finding that an increase in RNMs decreases leverage cannot be explained under a probability of default perspective.

5. The effect of expectations of shocks and financial constraints

In this Section, we examine further the effect of expectations for future shocks to the firm's leverage when we classify firms according to their ability to obtain external finance to fund their activities. An implication of DeAngelo et al. (2011) model is that the greater the risk that a firm will not be able to respond to a future shock by accessing capital markets, the more the debt capacity it needs to preserve today and thus the lower the leverage today. Hence, the effect of the expectations for shocks on leverage is expected to be stronger for the financially constrained firms. To test this implication, we distinguish the financially constrained from the financially unconstrained firms in our sample. Then, we run a regression of an augmented version of equation (8). We augment the panel regression in equation (8) by interacting all variables with a dummy $D_{i,t}$ that takes the value of one if the firm is identified as constrained and zero if the firm is identified as unconstrained:

$$L_{i,t} = a_i + \varphi_i D_{i,t} + \beta RNM_{i,t,\tau} + \zeta D_{i,t} RNM_{i,t,\tau} + \gamma FL_{i,t} + \eta D_{i,t} FL_{i,t} + \varepsilon_{i,t} \qquad (13)$$

In this specification, the coefficient vectors α_i, β and γ represent the effect of firm fixed effects, risk-neutral moments $(RNM_{i,t})$, firm-level factors $(FL_{i,t})$, respectively, on leverage for the group of unconstrained firms. Vectors φ_i, ζ and η represent the differences between the coefficients for the group of constrained firms and the group of unconstrained firms. The theory is validated if the estimated coefficients for volatility and kurtosis for the unconstrained firms (vector β) and the interaction coefficients (vector ζ) have a negative sign. This would imply that the impact of shocks on leverage is stronger in absolute terms for the constrained firms as predicted by the theory

We use three alternative classification criteria employed by the previous literature to ensure that our results are not sensitive to the choice of the classification criterion. In particular, we classify firms according to firm size, the existence of a credit rating, and the financial constraints index developed by Kaplan and Zingales (1997).

In line with Hahn and Lee (2009), Campello and Chen (2010) and Hovakimian (2011), we classify firms into the constrained and unconstrained groups by using the firm size as a sorting criterion. Small firms are considered to have a more limited access to capital markets due to lower collateral availability and higher asymmetric information problems (Gertler and Gilchrist, 1994). For any given time horizon, we trace the median firm size across all firm-quarters in our panel; we measure size as the real (i.e. deflated) market value of assets calculated as the book value of liabilities plus the market value of equity. We classify a firm as small (big) if the market value of its real assets is lower (higher) than the sample median.

Columns (1) and (2) in Table 8 report the results from estimating equation (13) using the firm size variable. The horizon of RNMs is 6-month. For brevity, we report results only for risk-neutral volatility and kurtosis (coefficient vector β) and their interaction terms (coefficient vector ζ). Given that the estimated coefficients for volatility and kurtosis in the large-firm group are negative, the negative sign of the interaction coefficients indicates that the impact of shocks on leverage is stronger in absolute terms for the small firms as predicted by the theory. In the specifications which include the 3-month RNMs, the coefficient of the one out four interaction variables (volatility and kurtosis, book and market leverage) is negative and statistically significant. In the specifications which include the 12-month RNMs, all four interaction dummy coefficients are negative and statistical significant.

Next, in line with Hahn and Lee (2009) and Hovakimian (2011), the second criterion we adopt to classify firms in the financially unconstrained and constrained group is whether a firm has a commercial paper rating or not, respectively. Rated firms are considered to be less opaque to investors because they are evaluated by rating agencies and thus they can access capital markets easier (Calomiris, Himmelberg, and Wachtel, 1994). Within any given quarter, we classify a firm as unconstrained if it has a commercial paper rating. In addition, we classify a firm as unconstrained if it does not have a commercial paper rating, yet it has zero debt.[14] The remaining firms are classified as financially constrained. We obtain Standard & Poor's rating data downloaded from Compustat; under this classification, firms are characterized as unconstrained in 43.5% of total firm-quarter observations and they are characterized as constrained in the remaining 56.5% of total observations. Interestingly, the vast majority of the ratings in the sample are investment-grade. In particular, 97.9% of the ratings are investment-grade, ranging from grade A1 to grade A3, and 2.1% are speculative-grade, ranging from grade B1 to grade B3. This ensures that the firm rating in our sample is a meaningful criterion to distinguish between constrained and unconstrained firms; if rated firms had received a poor rating, then it would be have been debatable whether they are constrained or unconstrained.

Columns (3) and (4) in Table 8 reports results for risk-neutral volatility and kurtosis (coefficient vector β) and their interaction terms (coefficient vector ζ) for the specifications that include the 6-month RNMs. The coefficients for the RNMs are negative in the unconstrained group. The coefficients for the interaction dummy variables for risk-neutral volatility and kurtosis are negative and significant across both specifications. Again, this is in line with DeAngelo et al. (2011)

[14] There is no consensus on whether firms that have zero debt in their balance sheet and yet they do not have a credit rating should be classified as constrained or unconstrained. For instance, Hovakimian (2011) classifies them as unconstrained, Campello and Chen (2010) classify them as constrained and Hahn and Lee (2009) excludes them from the sample. One may argue that the absence of debt in their balance sheet combined with the lack of a credit rating indicates that these firms are completely rationed by private and public debt markets and therefore they should be categorised as financially constrained. Alternatively, one may argue that these firms have chosen to finance themselves solely with equity and thus they are not interested in issuing debt, either private or public. In this case, the absence of credit rating is a matter of choice rather than credit rationing. So, classifying them as constrained would not be accurate. We report results for the case where we classify firms with zero debt and no credit rating as financially unconstrained. Yet our results are robust to interpreting them as financially constrained or excluding them from our sample.

predictions. In the specifications which include the 3-month and RNMs, the coefficients of the two out four interaction variables (volatility and kurtosis, book and market leverage) is negative and statistically significant. In the specifications which include the 12-month RNMs, all four interaction dummy coefficients are negative and statistical significant.

Finally, in line with Campello and Chen (2010) and Hovakimian (2011), the third criterion we adopt to classify firms is the Kaplan and Zingales (1997) index as this was first applied by Lamont et al. (2001), i.e.

$$KZ_{i,t} = -1.002 \times \left(CF_{i,t}/FA_{i,t}\right) + 0.283 \times MB_{i,t} + 3.139 \times \left(D_{i,t}/TC_{i,t}\right) \\ -39.368 \times \left(DIV_{i,t}/FA_{i,t}\right) - 1.315 \times \left(CASH_{i,t}/FA_{i,t}\right) \qquad (14)$$

where $KZ_{i,t}$ denotes the value of the Kaplan and Zingales index, $CF_{i,t}$ denotes net cash flows, $FA_{i,t}$ denotes fixed assets, $MB_{i,t}$ denotes the market-to-book ratio, $TC_{i,t}$ denotes the sum of debt and equity book values, $DIV_{i,t}$ denotes dividends and $CASH_{i,t}$ denotes cash holdings for the i^{th} firm in quarter *t*.

Kaplan and Zingales (1997) obtain the left hand side of equation (14) using hand-collected qualitative information from the annual reports that firms file with the Securities and Exchange Commission (SEC) to classify firms in discrete categories according to the severity of the financial constraints they face. Then, they construct an ordinal variable (1 for unconstrained, 2 for likely unconstrained, 3 for unclassified, 4 for likely constrained and 5 for undoubtedly constrained) based on this classification. Next, they regress this ordinal variable on certain accounting variables to test whether the degree of financial constraints that a firm faces is related to these variables. Lamont et al. (2001) use the estimated coefficients from this regression to construct the $KZ_{i,t}$ index which measures the severity of financial constraints as a function of the accounting variables that Kaplan and Zingales used. The greater the value of the index, the more constrained a firm is considered to be because higher values of the ordinal variable used by Kaplan and Zingales indicate more severe constraints.

For any given RNM time horizon, we trace the median *KZ* index value across all firms-quarters in our panel. Within any given quarter, we classify a firm as constrained (unconstrained) if the *KZ* index value is greater (less) than the median index value.

Columns (5) and (6) in Table 8 report results for the effect of risk-neutral volatility and kurtosis (coefficient vector β) and their interaction terms (coefficient vector ζ) for the specifications that include the 6-month RNMs. The coefficients for the RNMs are negative for the financially unconstrained group. Moreover, the coefficients for the interaction dummy variables for risk-neutral volatility and kurtosis are negative and significant across both specifications. These results corroborate the findings obtained in the case where the firm size or the existence of a credit rating was used as a criterion to classify firms as constrained and unconstrained. In the specifications which include the 3-month and RNMs, the coefficients of the three out four interaction variables (volatility and kurtosis, book and market leverage) is negative and statistically significant. In the specifications which include the 12-month RNMs, all four interaction dummy coefficients are negative and statistical significant.

6. Conclusions

We test one of the main implications of the financial flexibility theory, that is whether the expectations of a firm's manager about future shocks on the firm's investment opportunity set are inversely related to firm’s leverage. We proxy the expectations for future shocks by the risk-neutral volatility and risk-neutral kurtosis computed from equity options, respectively; the two risk-neutral moments (RNMs) are forward-looking and hence they constitute a natural choice to capture expectations about the variability of “normal” and large shocks, respectively . We extract the two RNMs from a cross-section of liquid equity options over different time horizons. We find that expectations for both small and large shocks matter and decrease the firm's leverage. This effect is stronger for the small and the financially constrained firms as predicted by the theory. Furthermore, expectations for future shocks account for the determination of the firm's leverage even once we control for the traditional determinants of the firm's leverage. In addition, we find that these expectations account for most of the leverage’s variability. These results hold also for expectations spanning time horizons which extend beyond the quarter over which managers set the firm leverage.

Our results have four implications. First, managers set the leverage to prevail over the current period at a lower level when they expect a future shock. This is consistent with the empirical evidence that managers look for financial flexibility, i.e. they maintain low leverage today to preserve the ability to borrow when a future shock dictates a financing need. It is also in accordance with the DeAngelo et al. (2011) model's predictions. Second, managers set leverage by taking into account expectations for both small and large future shocks. Third, expectations about future shocks constitute have a stronger impact on capital structure decisions compared to the effect of the standard leverage determinants proposed by the previous literature, with the exception of industry median leverage. Fourth, managers are concerned not only about shocks to be realized over the quarter that leverage is set but they are also concerned for shocks to be realized at times beyond that. In sum, the results of our study confirm one of the main implications of the financial flexibility paradigm and suggest that the two employed RNMs should be included in models which explain the way that firm’s leverage is set.

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Table 1: Sample Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max	Obs
Panel A: Sample for 3-month RNMs					
ML	0.159	0.153	0.000	0.701	26,327
BL	0.213	0.162	0.000	0.688	26,327
INDUSTRY (ML)	0.150	0.102	0.000	0.916	26,327
INDUSTRY (BL)	0.203	0.106	0.000	0.914	26,327
MB	2.489	1.639	0.844	9.715	26,327
ASSETS	8.424	1.483	5.134	12.053	26,327
PROF	0.043	0.026	-0.028	0.126	26,327
TANG	0.269	0.219	0.016	0.880	26,327
SELL	0.239	0.164	0.013	0.779	26,327
DEP	0.011	0.006	0.002	0.033	26,327
VOL3	0.178	0.081	0.060	0.432	26,327
KURT3	3.775	1.197	2.803	10.676	26,327
Panel B: Sample for 6-month RNMs					
ML	0.168	0.158	0.000	0.701	28,521
BL	0.219	0.163	0.000	0.688	28,521
INDUSTRY (ML)	0.152	0.103	0.000	0.949	28,521
INDUSTRY (BL)	0.204	0.106	0.000	0.914	28,521
MB	2.397	1.556	0.844	9.715	28,521
ASSETS	8.523	1.453	5.134	12.053	28,521
PROF	0.042	0.025	-0.028	0.126	28,521
TANG	0.273	0.219	0.016	0.880	28,521
SELL	0.239	0.164	0.013	0.779	28,521
DEP	0.011	0.006	0.002	0.033	28,521
VOL6	0.238	0.104	0.085	0.582	28,521
KURT6	3.563	0.870	2.303	7.612	28,521

Table 1 (cont'd): Sample Descriptive Statistics

Panel C: Sample for 12-month RNMs

ML	0.180	0.163	0.000	0.701	18,023
BL	0.231	0.163	0.000	0.688	18,023
INDUSTRY (ML)	0.155	0.104	0.000	0.949	18,023
INDUSTRY (BL)	0.206	0.104	0.000	0.914	18,023
MB	2.332	1.501	0.844	9.715	18,023
ASSETS	9.114	1.320	5.134	12.053	18,023
PROF	0.041	0.025	-0.028	0.126	18,023
TANG	0.287	0.223	0.016	0.880	18,023
SELL	0.243	0.167	0.013	0.779	18,023
DEP	0.011	0.006	0.002	0.033	18,023
VOL12	0.319	0.126	0.116	0.720	18,023
KURT12	3.440	0.973	1.780	7.605	18,023

Entries report summary statistics for all variables used in equation (8).. Three samples are formed based on the respective risk-neutral moments' three horizons (3, 6 and 12-months) under scrutiny. The size of each sample is determined by the availability of RNMs and accounting data used to construct the variables for leverage measures and leverage determinants.. BL is book leverage, i.e. book debt divided by book assets. ML is market leverage, i.e. book debt divided by the sum of market equity and book debt. INDUSTRY is the median leverage of the industry (defined by two-digit SIC codes) that the firm belongs to. MB is the sum of book liabilities plus market value of equity divided by book assets. ASSETS is the natural log of book assets expressed in 2009 US dollars. DEP is depreciation and amortization divided by book assets. PROF is earnings before interest, taxes, depreciation and amortization divided by book assets. TANG is net property, plant and equipment divided by book assets. SELL is selling, general and administrative expenses divided by sales. VOL3 (VOL6) (VOL12) is the daily average over a quarter of firm-specific stock return volatility extracted from 90-days (180-days) (360-days) option prices. KURT3 (KURT6) (KURT12) is the daily average over a quarter of firm-specific stock return kurtosis extracted from 90-days (180-days) (360-days) option prices. Sample period is 1996:Q1 to 2017:Q4.

Table 2. Summary statistics of leverage ratios across high and low risk-neutral volatility and kurtosis groups

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Sample for 3-month RNMs					
	Low risk-neutral volatility subset	High risk-neutral volatility subset	Difference (*p*-value)	Low risk-neutral kurtosis subset	High risk-neutral-kurtosis subset	Difference (*p*-value)
ML						
Mean	0.220	0.099	0.00	0.160	0.158	0.27
Median	0.183	0.058	0.00	0.107	0.131	0.00
N	13,163	13,163		13,163	13,163	
BL						
Mean	0.280	0.146	0.00	0.195	0.230	0.00
Median	0.266	0.122	0.00	0.182	0.221	0.00
N	13,163	13,163		13,163	13,163	
	Panel B: Sample for 6-month RNMs					
	Low risk-neutral volatility subset	High risk-neutral volatility subset	Difference (*p*-value)	Low risk-neutral kurtosis subset	High risk-neutral-kurtosis subset	Difference (*p*-value)
ML						
Mean	0.231	0.104	0.00	0.173	0.163	0.00
Median	0.192	0.065	0.00	0.119	0.136	0.00
N	14,260	14,260		14,261	14,260	
BL						
Mean	0.290	0.148	0.00	0.203	0.235	0.00
Median	0.274	0.127	0.00	0.190	0.224	0.00
N	14,260	14,260		14,260	14,260	
	Panel C: Sample for 12-month RNMs					
	Low risk-neutral volatility subset	High risk-neutral volatility subset	Difference (*p*-value)	Low risk-neutral kurtosis subset	High risk-neutral-kurtosis subset	Difference (p-value)
ML						
Mean	0.243	0.117	0.00	0.200	0.160	0.00
Median	0.200	0.081	0.00	0.143	0.136	0.00
N	9,011	9,011		9,011	9,011	
BL						
Mean	0.298	0.163	0.00	0.222	0.238	0.00
Median	0.277	0.150	0.00	0.208	0.225	0.00
N	9,011	9,011		9,011	9,011	

Entries report the summary statistics of leverage ratios across two groups of firms sorted on the magnitude of risk-neutral volatility and kurtosis, separately. For any given time horizon, we trace the median value for risk-neutral volatility (kurtosis) across all firm-quarters in the panel. Then, we sort firms with RNMs greater (smaller) than the median in the high (low) group. Columns (1) and (2) [(4) and (5)] present the average and median values for leverage across the two volatility (kurtosis) groups. BL is book leverage, i.e. book debt divided by book assets. ML is market leverage, i.e. book debt divided by the sum of market equity and book debt. N is the number of firm-quarter observations. Risk-neutral volatility (kurtosis) for the 3-, 6- and 12-month horizon is the daily average over a quarter of firm-specific stock return volatility (kurtosis) extracted option prices with maturities 3-, 6- and 12-months. The test for mean (median) comparison is a t-test (Wilcoxon rank-sum test). Sample period is 1996:Q1 to 2017:Q4.

Table 3. Effect of Risk-neutral moments to leverage

	3-month RNMs		6-month RNMs		12-month RNMs	
	(1) ML	(2) BL	(3) ML	(4) BL	(5) ML	(6) BL
INDUSTRY	0.564*** (16.32)	0.544*** (14.59)	0.603*** (18.28)	0.570*** (15.54)	0.630*** (17.67)	0.631*** (14.38)
MB	-0.012*** (-8.26)	-0.006*** (-3.21)	-0.011*** (-7.62)	-0.005*** (-2.61)	-0.011*** (-5.79)	-0.004** (-2.00)
ASSETS	0.007* (1.70)	-0.003 (-0.56)	0.012*** (2.91)	-0.001 (-0.19)	0.008 (1.56)	-0.007 (-1.14)
PROF	-0.935*** (-11.31)	-0.730*** (-7.32)	-0.924*** (-11.40)	-0.672*** (-6.79)	-0.877*** (-9.53)	-0.492*** (-4.63)
TANG	0.073** (2.23)	0.002 (0.06)	0.044 (1.32)	-0.027 (-0.71)	-0.018 (-0.47)	-0.101** (-2.46)
SELL	-0.107*** (-3.20)	-0.090** (-2.22)	-0.089*** (-2.76)	-0.063 (-1.62)	-0.084** (-2.52)	-0.031 (-0.79)
DEP	1.397*** (2.73)	1.620** (2.53)	1.600*** (3.13)	1.535** (2.37)	1.728*** (2.91)	1.261* (1.71)
VOL3	-0.290*** (-10.79)	-0.347*** (-9.76)				
KURT3	-0.008*** (-7.74)	-0.003** (-2.01)				
VOL6			-0.298*** (-13.59)	-0.301*** (-11.01)		
KURT6			-0.023*** (-11.14)	-0.010*** (-4.63)		
VOL12					-0.335*** (-12.62)	-0.269*** (-10.23)
VOL12					-0.032*** (-9.50)	-0.014*** (-4.84)
N	26,327	26,327	28,521	28,521	18,023	18,023
Adj. R^2	0.335	0.200	0.363	0.204	0.436	0.234
Adj. R^2 without RNMs	0.301	0.166	0.305	0.162	0.343	0.184

Entries report the results from estimating alternative specifications of equation (8). All equations are estimated via OLS with firm fixed effects. Sample period is 1996:Q1 to 2017:Q4. BL is book leverage, i.e. book debt divided by book assets. ML is market leverage, i.e. book debt divided by the sum of market equity and book debt. INDUSTRY is the median leverage of the industry (defined by two-digit SIC codes) that the firm belongs to. MB is the sum of book liabilities plus market value of equity divided by book assets. ASSETS is the natural log of book assets expressed in 2009 US dollars. DEP is depreciation and amortization divided by book assets. PROF is earnings before interest, taxes, depreciation and amortization divided by book assets. TANG is net property, plant and equipment divided by book assets. SELL is selling, general and administrative expenses divided by sales. VOL3 (VOL6) (VOL12) / KURT3 (KURT6) (KURT12) is the daily average over a quarter of firm-specific stock return volatility/kurtosis extracted from options with maturities 90-, 180-, and 360-days. *N* is the number of firm-quarters. Adj. R^2 is the within adj. R^2. *Adj.* R^2 *without RNMs* is the within Adj, R^2 we get from estimating the specifications of equation (8) after excluding the RNMs. The reported *t*-statistics reflect standard errors (White standard errors clustered by firm) robust to heteroscedasticity and to residual dependence within firms. Numbers in parentheses are *t*-statistics. ***, ** and * indicate 1%, 5% and 10% statistical significance levels, respectively.

Table 4. Leverage determinants versus Risk-neutral moments: 6-month horizon

	Panel A: Variance decomposition		Panel B: Economic significance	
	(1) ML	(2) BL	(3) ML	(4) BL
INDUSTRY	51.2%	58.3%	6.2%	6.0%
MB	5.3%	1.5%	-1.7%	-0.8%
ASSETS	1.2%	0.0%	1.7%	-0.1%
PROF	9.6%	7.4%	-2.3%	-1.7%
TANG	0.2%	0.1%	1.0%	-0.6%
SELL	0.8%	0.6%	-1.5%	-1.0%
DEP	0.9%	1.2%	1.0%	0.9%
VOL6	19.0%	27.8%	-3.1%	-3.1%
KURT6	11.7%	3.0%	-2.0%	-0.9%
N	28,521	28,521	28,521	28,521
Adj. R^2	0.363	0.204	0.363	0.204

Entries in Panel A express the percentage of the within-firm adjusted R^2 that is attributable to each explanatory variable in the regressions reported in columns (3) and (4) of Table 3. In each column, the entry for a particular variable is calculated as the ratio of the partial Type III explained sum of squares (henceforth ESS) of that variable over the sum of the partial Type III ESS of all explanatory variables in the model. Thus, every column adds to 100%. The partial Type III ESS are calculated as follows. For each explanatory variable, we estimate equation (9) after excluding the particular variable and calculate the explained sum of squares (henceforth ESS). The difference between the ESS of this model and the ESS of the model that includes the particular variable is the partial Type III ESS for the particular variable. Entries in Panel B express the change in leverage ratio caused by one standard deviation increase in each of the explanatory variables in equation (8), according to the coefficients reported in columns (3) and (4) of Table 3. BL is book leverage, i.e. book debt divided by book assets. ML is market leverage, i.e. book debt divided by the sum of market equity and book debt. INDUSTRY is the median leverage of the industry (defined by two-digit SIC codes) that the firm belongs to. MB is the sum of book liabilities plus market value of equity divided by book assets. ASSETS is the natural log of book assets expressed in 2009 US dollars. DEP is depreciation and amortization divided by book assets. PROF is earnings before interest, taxes, depreciation and amortization divided by book assets. TANG is net property, plant and equipment divided by book assets. SELL is selling, general and administrative expenses divided by sales. VOL6 (KURT6) is the daily average over a quarter of firm-specific stock return volatility (kurtosis) extracted from option prices with 180-days-to-maturity. *N* is the number of firm-quarters.

Table 5. Leverage determinants versus Risk-neutral moments: IV regressions

	ML	BL
INDUSTRY	1.185***	1.032***
	(3.7)	(4.77)
MB	0.088**	0.035*
	(2.12)	(1.96)
ASSETS	0.200***	0.080**
	(2.66)	(2.27)
PROF	-0.123	-0.319
	(-0.23)	(-1.21)
TANG	-0.610*	-0.308**
	(-1.79)	(-2.13)
SELL	0.291	0.063
	(1.22)	(0.58)
DEP	3.565	2.632**
	(1.27)	(1.98)
VOL6	-4.498**	-1.969**
	(-2.42)	(-2.43)
KURT6	-0.690***	-0.294**
	(-2.59)	(-2.37)
Instruments	ANALYST_DISP	ANALYST_DISP
	TV_STOCKS	TV_STOCKS
SW Chi-square statistic (VOL6)	4.463	4.873
p-value	0.035	0.027
SW F-statistic (VOL6)	4.455	4.864
p-value	0.035	0.028
SW Chi-square statistic (KURT6)	4.538	4.980
p-value	0.033	0.026
SW F-statistic (KURT6)	4.531	4.971
p-value	0.034	0.026
N	23,367	23,367

Entries report the results from estimating alternative specifications of equation (8) via two-stage least squares. The endogenous variables are VOL6 (KURT6) is the daily average over a quarter of firm-specific stock return volatility (kurtosis) extracted from 180-days option prices. The excluded instruments are ANALYST_DISP and TV_STOCKS. ANALYST_DISP is the monthly average over the quarter of the standard deviation of analysts' EPS forecasts for the next annual earnings announcement divided by absolute value of the mean estimate. TV_STOCKS is the log of the daily average over a quarter of the number of traded firm-specific stocks. Entries also report chi-squared and *F*-statistics for the Sanderson-Windmeijer (2016) under identification and weak identification tests, respectively, of individual endogenous regressors. A rejection of the null for the under specification test indicates that the particular endogenous regressor in question is identified, i.e. that instruments are correlated with the endogenous regressor. A rejection of the null for the weak specification test indicates that instruments are sufficiently correlated with the particular endogenous regressor in question. Sample period is 1996:Q1 to 2017:Q4. BL is book leverage, i.e. book debt divided by book assets. ML is market leverage, i.e. book debt divided by the sum of market equity and book debt. INDUSTRY is the median leverage of the industry (defined by two-digit SIC codes) that the firm belongs to. MB is the sum of book liabilities plus market value of equity divided by book assets. ASSETS is the natural log of book assets expressed in 2009 US dollars. DEP is depreciation and amortization divided by book assets. PROF is earnings before interest, taxes, depreciation and amortization divided by book assets. TANG is net property, plant and equipment divided by book assets. SELL is selling, general and administrative expenses divided by sales. *N* is the number of firm-quarters. The reported *t*-statistics reflect standard errors (White standard errors clustered by firm) robust to heteroscedasticity and to residual dependence within firms. Numbers in parentheses are *t*-statistics. ***, ** and * indicate 1%, 5% and 10% statistical significance levels, respectively.

Table 6. Leverage determinants and Risk-neutral moments: Robustness checks

	(1) ML	(2) ML	(3) ML	(4) ML	(5) ML	(6) ML	(7) ML	(8) ML
Panel A: Specifications of equation (8) including market leverage								
INDUSTRY	0.606***	0.603***	0.605***	0.604***	0.549***	0.560***	0.446***	0.441***
	(18.51)	(18.33)	(18.45)	(18.52)	(11.72)	(16.79)	(9.78)	(9.77)
MB	-0.011***	-0.012***	-0.011***	-0.011***	-0.027***	-0.010***	-0.022***	-0.023***
	(-7.75)	(-7.89)	(-7.82)	(-7.47)	(-6.96)	(-6.32)	(-6.01)	(-6.05)
ASSETS	0.013***	0.012***	0.013***	0.015***	0.040***	0.010**	0.039***	0.038***
	(3.16)	(2.99)	(3.18)	(3.40)	(4.08)	(2.28)	(3.82)	(3.76)
PROF	-0.851***	-0.852***	-0.852***	-0.811***	-0.617***	-0.870***	-0.642***	-0.650***
	(-13.36)	(-13.30)	(-13.29)	(-12.83)	(-7.65)	(-13.48)	(-7.99)	(-8.11)
TANG	0.041	0.035	0.041	0.028	0.077	0.046	0.039	0.059
	(1.23)	(1.04)	(1.24)	(0.83)	(1.29)	(1.39)	(0.70)	(1.00)
RD	-0.176***	-0.168***	-0.166***	-0.178***	-0.151***	-0.195***	-0.176***	-0.178***
	(-4.60)	(-4.45)	(-4.39)	(-4.52)	(-3.26)	(-5.02)	(-3.67)	(-3.70)
RD_D	-0.003	-0.003	-0.003	-0.005	-0.002	-0.004	-0.005	-0.006
	(-0.73)	(-0.63)	(-0.59)	(-1.03)	(-0.31)	(-0.91)	(-0.95)	(-1.11)
DEP	1.552***	1.502***	1.523***	1.733***	0.441	1.650***	0.788	0.681
	(3.13)	(3.02)	(3.07)	(3.44)	(0.64)	(3.36)	(1.19)	(1.02)
VOL6	-0.299***	-0.295***	-0.300***	-0.296***	-0.243***	-0.379***	-0.484***	-0.490***
	(-13.71)	(-13.48)	(-13.66)	(-13.32)	(-7.68)	(-15.32)	(-11.82)	(-11.91)
KURT6	-0.023***	-0.022***	-0.023***	-0.022***	-0.015***	-0.021***	-0.012***	-0.012***
	(-11.40)	(-11.21)	(-11.33)	(-10.94)	(-8.39)	(-10.79)	(-7.56)	(-7.61)
AGE_CEO				-0.000			-0.000	-0.000
				(-1.42)			(-0.63)	(-0.78)
GENDER_CEO				-0.029**			0.010	0.010
				(-2.06)			(0.56)	(0.56)
INST_OWN					-0.118***		-0.115***	-0.113***
					(-3.50)		(-3.33)	(-3.31)
MAN_OWN					0.001		0.000	0.000
					(0.55)		(0.25)	(0.31)
CRSP						-0.057***	-0.107***	-0.108***
						(-10.27)	(-12.38)	(-12.56)
PROFITS						-0.004	0.039***	0.039***
						(-1.22)	(5.84)	(5.76)
GDP						-0.115	-0.598***	-0.588***
						(-1.46)	(-6.58)	(-6.37)
PHYS_LOC FE	NO	YES	NO	NO	NO	NO	YES	NO
JUR_LOC FE	NO	NO	YES	NO	NO	NO	NO	YES
N	28521	28134	28331	26887	12338	28521	12205	12286
Adj, R2	0.364	0.362	0.365	0.364	0.372	0.377	0.417	0.416

Table 6. Leverage determinants and risk-neutral moments: Robustness checks (cont'd)

	(1) BL	(2) BL	(3) BL	(4) BL	(5) BL	(6) BL	(7) BL	(8) BL
Panel B: Specifications of equation (8) including market leverage								
INDUSTRY	0.572***	0.574***	0.572***	0.567***	0.506***	0.537***	0.449***	0.450***
	(15.55)	(15.51)	(15.54)	(15.09)	(10.35)	(14.45)	(9.08)	(9.10)
MB	-0.005***	-0.005***	-0.005***	-0.005***	-0.009**	-0.005**	-0.006*	-0.006*
	(-2.71)	(-2.76)	(-2.72)	(-2.79)	(-2.57)	(-2.32)	(-1.67)	(-1.77)
ASSETS	-0.000	-0.001	-0.001	-0.001	0.036***	-0.003	0.033***	0.032***
	(-0.06)	(-0.17)	(-0.15)	(-0.11)	(3.10)	(-0.57)	(2.78)	(2.74)
PROF	-0.606***	-0.604***	-0.611***	-0.596***	-0.489***	-0.604***	-0.491***	-0.501***
	(-7.63)	(-7.57)	(-7.62)	(-7.68)	(-6.35)	(-7.60)	(-6.42)	(-6.60)
TANG	-0.028	-0.027	-0.029	-0.042	-0.046	-0.029	-0.076	-0.066
	(-0.75)	(-0.69)	(-0.75)	(-1.06)	(-0.73)	(-0.77)	(-1.23)	(-1.08)
RD	-0.092*	-0.085	-0.081	-0.094*	-0.082	-0.103**	-0.096*	-0.095*
	(-1.77)	(-1.64)	(-1.57)	(-1.78)	(-1.64)	(-2.00)	(-1.93)	(-1.92)
RD_D	0.004	0.005	0.005	0.002	0.000	0.004	-0.002	-0.003
	(0.89)	(0.97)	(1.01)	(0.34)	(0.03)	(0.71)	(-0.54)	(-0.64)
DEP	1.489**	1.391**	1.391**	1.647**	0.622	1.423**	0.786	0.743
	(2.32)	(2.17)	(2.19)	(2.56)	(0.82)	(2.25)	(1.05)	(0.99)
VOL6	-0.301***	-0.300***	-0.302***	-0.303***	-0.252***	-0.365***	-0.420***	-0.423***
	(-11.04)	(-10.89)	(-11.05)	(-11.53)	(-8.31)	(-11.48)	(-10.40)	(-10.52)
KURT6	-0.010***	-0.009***	-0.009***	-0.009***	-0.006***	-0.008***	-0.004**	-0.004**
	(-4.71)	(-4.59)	(-4.67)	(-4.71)	(-3.31)	(-3.93)	(-2.21)	(-2.25)
AGE_CEO				0.000			0.000	0.000
				(0.69)			(0.38)	(0.34)
GENDER_CEO				-0.004			0.029	0.029
				(-0.31)			(1.33)	(1.32)
INST_OWN					-0.034		-0.040	-0.039
					(-1.20)		(-1.36)	(-1.32)
MAN_OWN					0.001		0.000	0.000
					(1.06)		(0.53)	(0.54)
CRSP						-0.049***	-0.071***	-0.072***
						(-8.57)	(-8.82)	(-8.91)
PROFITS						-0.020***	0.012*	0.012*
						(-5.31)	(1.93)	(1.92)
GDP						0.155*	-0.264***	-0.258***
						(1.70)	(-3.18)	(-3.12)
PHYS_LOC FE	NO	YES	NO	NO	NO	NO	YES	NO
JUR_LOC FE	NO	NO	YES	NO	NO	NO	NO	YES
N	28521	28134	28331	26887	12338	28521	12205	12286
Adj, R2	0.204	0.204	0.205	0.206	0.233	0.213	0.254	0.255

Entries report the results from estimating alternative specifications of equation (8). All equations are estimated via OLS with firm fixed effects. Sample period is 1996:Q1 to 2017:Q4. BL is book leverage, i.e. book debt divided by book assets. ML is market leverage, i.e. book debt divided by the sum of market equity and book debt. INDUSTRY is the median leverage of the industry (defined by two-digit SIC codes) that the firm belongs to. MB is the sum of book liabilities plus market value of equity divided by book assets. ASSETS is the natural log of book assets expressed in 2009 US dollars. DEP is depreciation and amortization divided by book assets. PROF is earnings before interest, taxes, depreciation and amortization divided by book assets. TANG is net property, plant and equipment divided by book assets. SELL is selling, general and administrative expenses divided by sales. VOL6 (KURT6) is the daily average over a quarter of firm-specific stock return volatility (kurtosis) extracted from 180-days option prices. AGE_CEO is the age of the CEO. GENDER_CEO is a dummy variable that takes the value of one if the CEO is male and zero if the CEO is female. INST_OWN is the ratio of the number of shares held by institutional investors to the total number of shares outstanding. MAN_OWN is the percentage of total shares outstanding owned by the firm's executives (top managers and directors), including options that are exercisable or will become exercisable within 60 days. CRSP is the one-year real stock market return. PROFITS is the one-year real aggregate domestic nonfinancial corporate profit growth. GDP is and the one-year real GDP growth. PHYS_LOC_FE are fixed effects for corporate headquarters location. JUR_LOC_FE are fixed effects for the geographic region, where companies are legally registered. *N* is the number of firm-quarters. Adj. R^2 is the within adj. R^2. The reported *t*-statistics reflect standard errors (White standard errors clustered by firm) robust to heteroscedasticity and to residual dependence within firms. Numbers in parentheses are *t*-statistics. ***, ** and * indicate 1%, 5% and 10% statistical significance levels, respectively.

Table 7: Leverage determinants and risk-neutral moments: Liquidity deciles

Panel A: Specifications with market leverage

	(1) ML	(2) ML	(3) ML	(4) ML	(5) ML	(6) ML	(7) ML	(8) ML	(9) ML	(10) ML
VOL6	-0.221***	-0.218***	-0.248***	-0.250***	-0.311***	-0.217***	-0.300***	-0.275***	-0.257***	-0.298***
	(-5.31)	(-5.74)	(-5.53)	(-5.52)	(-7.06)	(-5.54)	(-6.67)	(-5.61)	(-4.85)	(-5.95)
KURT6	-0.010***	-0.014***	-0.018***	-0.021***	-0.028***	-0.027***	-0.042***	-0.035***	-0.016***	-0.020***
	(-5.03)	(-5.77)	(-5.18)	(-4.27)	(-6.12)	(-6.67)	(-6.95)	(-5.32)	(-3.09)	(-4.84)
N	2761	2728	2722	2744	2762	2758	2781	2797	2788	2821
r2	0.261	0.308	0.322	0.361	0.400	0.389	0.386	0.442	0.497	0.454

Panel B: Specifications with book leverage

	(1) ML	(2) ML	(3) ML	(4) ML	(5) ML	(6) ML	(7) ML	(8) ML	(9) ML	(10) ML
VOL6	-0.304***	-0.255***	-0.229***	-0.236***	-0.291***	-0.210***	-0.281***	-0.213***	-0.237***	-0.270***
	(-5.66)	(-5.49)	(-3.60)	(-3.83)	(-5.50)	(-4.06)	(-5.07)	(-3.29)	(-4.43)	(-4.94)
KURT6	-0.006***	-0.009**	-0.006	-0.005	-0.007*	-0.010**	-0.018***	-0.013***	0.001	-0.012**
	(-2.89)	(-2.43)	(-1.35)	(-1.03)	(-1.75)	(-2.03)	(-3.88)	(-2.81)	(0.17)	(-2.49)
N	2761	2728	2722	2744	2762	2758	2781	2797	2788	2821
Adj. R^2	0.162	0.201	0.188	0.171	0.211	0.168	0.220	0.224	0.352	0.308

Entries report the results from estimating alternative specifications of equation (8) including 6-month RNMs across liquidity deciles. . For brevity, we report results only for risk-neutral volatility and kurtosis. We use the options' trading volume to measure option liquidity. For any given firm, we calculate the options' trading volume as the daily average over a quarter of the number of traded option contracts. Next, we sort options in liquidity deciles and estimate equation (8) for each decile. All equations are estimated by OLS with firm fixed effects. Sample period is 1996:Q1 to 2017:Q4. VOL6 (KURT6) is the daily average over a quarter of firm-specific stock return volatility (kurtosis) extracted from180-days option prices. *N* is the number of firm-quarters. Adj. R^2 is the within adj. R^2. The reported *t*-statistics reflect standard errors (White standard errors clustered by firm) robust to heteroscedasticity and to residual dependence within firms. Numbers in parentheses are t-statistics. ***, ** and * indicate 1%, 5% and 10% statistical significance levels, respectively.

Table 8. Leverage determinants and risk-neutral moments: Probability of Default

	(1) ML	(2) BL	(3) ML	(4) BL	(5) ML	(6) BL	(7) ML	(8) BL
INDUSTRY	0.394***	0.500***	0.473***	0.526***	0.606***	0.518***	0.602***	0.580***
	(15.45)	(13.89)	(16.76)	(14.38)	(18.91)	(13.56)	(18.14)	(16.02)
MB	-0.004***	0	-0.006***	-0.002	-0.014***	-0.004**	-0.012***	-0.005**
	(-3.73)	(-0.18)	(-5.10)	(-1.00)	(-7.79)	(-2.11)	(-7.57)	(-2.56)
ASSETS	0.003	-0.005	0.010**	-0.001	0.012**	-0.003	0.013***	0
	(0.84)	(-1.09)	(2.56)	(-0.28)	-2.58	(-0.48)	-2.91	(0.02)
PROF	-0.443***	-0.422***	-0.647***	-0.543***	-0.466***	0.061	-0.923***	-0.658***
	(-6.88)	(-4.45)	(-9.15)	(-5.63)	(-5.14)	-0.51	(-10.97)	(-6.58)
TANG	-0.026	-0.077**	-0.014	-0.066*	0.064*	-0.014	0.047	-0.026
	(-0.99)	(-2.13)	(-0.49)	(-1.77)	-1.96	(-0.37)	(1.36)	(-0.70)
SELL	-0.077***	-0.055	-0.086***	-0.062	-0.090**	-0.06	-0.092***	-0.063
	(-2.95)	(-1.47)	(-2.98)	(-1.61)	(-2.46)	(-1.41)	(-2.73)	(-1.56)
DEP	0.228	0.859	0.689	1.119*	1.244**	0.949	1.558***	1.524**
	(0.55)	(1.37)	(1.5)	(1.74)	-2.23	-1.34	(2.92)	(2.27)
VOL6	-0.367***	-0.337***	-0.357***	-0.326***	-0.293***	-0.279***	-0.306***	-0.305***
	(-19.82)	(-12.82)	(-17.57)	(-12.26)	(-13.15)	(-10.73)	(-13.83)	(-11.51)
KURT6	-0.012***	-0.004**	-0.016***	-0.006***	-0.020***	-0.005**	-0.022***	-0.010***
	(-8.84)	(-2.26)	(-9.85)	(-3.29)	(-10.04)	(-2.51)	(-10.87)	(-4.66)
CHS_M	0.051***	0.025***						
	(35.12)	(16.39)						
			0.045***	0.021***				
CHS_Y			(28.39)	(12.83)				
ALT					-0.066***	-0.097***		
					(-11.86)	(-11.31)		
CFLOW							0.371*	0.381*
							(1.89)	(1.9)
N	28,035	28,035	28,035	28,035	24,435	24,435	27,361	27,361
Adj, R2	0.538	0.243	0.462	0.222	0.43	0.29	0.369	0.209

Entries report the results from estimating alternative specifications of equation (8). All equations are estimated via OLS with firm fixed effects. Sample period is 1996:Q1 to 2017:Q4. BL is book leverage, i.e. book debt divided by book assets. ML is market leverage, i.e. book debt divided by the sum of market equity and book debt. INDUSTRY is the median leverage of the industry (defined by two-digit SIC codes) that the firm belongs to. MB is the sum of book liabilities plus market value of equity divided by book assets. ASSETS is the natural log of book assets expressed in 2009 US dollars. DEP is depreciation and amortization divided by book assets. PROF is earnings before interest, taxes, depreciation and amortization divided by book assets. TANG is net property, plant and equipment divided by book assets. RD is R&D expenses divided by sales after setting missing values to zero. RD_D is a dummy variable that takes the value of one if the firm does not report R&D expenses and zero otherwise. VOL6 (KURT6) is the daily average over a quarter of firm-specific stock return volatility (kurtosis) extracted from 180-days option prices. $CHS\_M_{i,t} = -8.63 - 29 \times \overline{NIMTA}_{i,t} + 3.51 \times TLMTA_{i,t} - 2.49 \times CASHMTA_{i,t} - 8.02 \times \overline{EXRET}_{i,t} + 1.69 \times SIGMA_{i,t} + 0.138 \times RSIZE_{i,t} + 0.05 \times MB - 0.974 \times PRICE_{i,t}$ and $CHS\_Y_{i,t} = -8.87 - 20.12 \times \overline{NIMTA}_{i,t} + 1.60 \times TLMTA_{i,t} - 2.27 \times CASHMTA_{i,t} - 7.88 \times \overline{EXRET}_{i,t} + 1.55 \times SIGMA_{i,t} - 0.005 \times RSIZE_{i,t} + 0.07 \times MB - 0.09 \times PRICE_{i,t}$ where (NIMTA)¯_(i,t) denotes the average ratio of net income to market value of assets over the last four quarters, i.e. the period spanning quarter t-3 to quarter t, TLMTAi,t denotes the ratio of total liabilities to market value of assets, CASHMTAi,t denotes the ratio of cash and short-term investments to market value of assets, (EXRET)¯_(i,t) denotes the stock's average excess return relative to the S&P 500 index return over the last 12 months, i.e. . the period spanning month t-11 to month t, SIGMAi,t denotes the annualized stock return standard deviation over the previous 3 months, RSIZEi,t denotes the firm's equity capitalization relative to that of the S&P 500 index, MBi,t denotes the equity market-to-book ratio, and PRICEi,t denotes the log of the stock price. The market value of assets is the sum of the firm's total liabilities and market value of equity. ALT is Altman's Z-score. CFLOW is the standard deviation of the first difference in the firm's historical operating profits (EBITDAi,t – EBITDAi,t-1) divided by the mean of total assets to measure cash flow volatility. *N* is the number of firm-quarters. Adj. R^2 is the within adj. R^2. The reported *t*-statistics reflect standard errors (White standard errors clustered by firm) robust to heteroscedasticity and to residual dependence within firms. Numbers in parentheses are *t*-statistics. ***, ** and * indicate 1%, 5% and 10% statistical significance levels, respectively.

Table 9. The effect of risk-neutral moments on leverage across financially constrained and unconstrained firms separately

	(1)	(2)	(3)	(4)	(5)	(6)
	ML	BL	ML	BL	ML	BL
VOL6	-0.201***	-0.224***				
	(-7.41)	(-6.87)				
KURT6	-0.014***	-0.002				
	(-6.08)	(-0.63)				
VOL6*D_SMALL	-0.139***	-0.095**				
	(-3.67)	(-2.04)				
KURT6* D_SMALL	-0.017***	-0.017***				
	(-4.46)	(-4.68)				
VOL6			-0.132***	-0.213***		
			(-6.40)	(-5.47)		
KURT6			-0.009***	-0.004*		
			(-6.06)	(-1.70)		
VOL6*D_CONSTR			-0.332***	-0.158***		
			(-8.98)	(-3.37)		
KURT6* D_CONSTR			-0.025***	-0.010***		
			(-7.07)	(-3.12)		
VOL6					-0.095***	-0.050*
					(-3.43)	(-1.94)
KURT6					-0.157***	-0.131***
					(-3.82)	(-3.25)
VOL6*D_KZ					-0.006**	-0.002
					(-2.01)	(-0.64)
KURT6* D_KZ					-0.035***	-0.012*
					(-5.68)	(-1.81)
N	28,521	28,521	28,408	28,408	27,609	27,609
Firms	0.363	0.203	0.406	0.209	0.376	0.197

Entries report results from estimating three alternative versions of equation (13): $L_{i,t} = a_i + \varphi_i D_{i,t} + \beta RNM_{i,t,\tau} + \zeta D_{i,t} RNM_{i,t,\tau} + \gamma FL_{i,t} + \eta D_{i,t} FL_{i,t} + \varepsilon_{i,t}$ In each of our three subsamples, i.e. the subsamples corresponding to 3- 6- and 12-month RNMs, $D_{i,t}$ is a dummy variable that, within any given quarter, takes the value of one if the firm is identified as financially constrained and 0 unconstrained. Coefficient vectors α, β and γ represent the effect of firm fixed effects, risk-neutral moments $(RNM_{i,t})$ and firm-level $(FL_{i,t})$ factors, respectively, on leverage for the unconstrained group of firms. That is, if we estimated equation (8) using only the firm-quarters that belong to the unconstrained group, we would have obtained these estimates. Vectors φ, ζ and η represent the differences between the coefficients for the unconstrained-firm and the constrained-firm group. That is, if we estimated equation (8) using only the firm-quarters that belong to the constrained group, we would have obtained coefficients $\alpha+\varphi$, $\beta+\zeta$ and $\gamma+\eta$ for fixed effects, risk-neutral moments and firm-level factors, respectively. For brevity, we report results only for risk-neutral volatility and kurtosis (coefficient vector β) and their interaction terms (coefficient vector ζ). Entries in columns (1) and (2) report results from estimating a specification of equation (13) including $D_{i,t}^{small}$, which is a dummy variable that, within any given quarter, takes the value of one if the value of the firm's real market value of assets (calculated as the book value of liabilities plus the market value of equity) is lower than the subsample median and zero otherwise. Entries in columns (3) and (4) report results from estimating a specification of equation (13) including, $D_{i,t}^{constr}$, which is a dummy variable that takes the value of zero if a firm has a commercial paper rating or has not a commercial paper rating but has zero debt, and one otherwise. Entries in columns (5) and (6) report results from estimating a specification of equation (13) including, $D_{i,t}^{KZ}$, which is a dummy variable that takes the value of one if the value of the KZ index is greater than the subsample median KZ index, and zero otherwise. The KZ index (Kaplan and Zingales, 1997; Lammont et al. 2001) proxies for the level of financial constraints faced by a firm and is calculated as KZ = -1.002*(cash_flow/fixed_assets) + 0.283*market_to_book + 3.139*(debt/total capital) - 39.368*(dividends/fixed_assets) - 1.315*(cash/fixed_assets). Sample period is 1996:Q1 to 2017:Q4. BL is book leverage, i.e. book debt divided by book assets. ML is market leverage, i.e. book debt divided by the sum of market equity and book debt. VOL6 (KURT6) is the daily average over a quarter of firm-specific stock return volatility (kurtosis) extracted from 180-days option prices. The reported *t*-statistics reflect standard errors (White standard errors clustered by firm) robust to heteroscedasticity and to residual dependence within firms. Numbers in parentheses are *t*-statistics. ***, ** and * indicate 1%, 5% and 10% statistical significance levels, respectively.