Black's Leverage Effect Is Not Due To Leverage

Jasmina Hasanhodzic* **and Andrew W. Lo†**

January 1, 2013

Abstract

One of the most enduring empirical regularities in equity markets is the inverse relationship between stock prices and volatility, first documented by Black (1976) who attributed it to the effects of leverage. As a company's stock price declines, it becomes more highly leveraged given a fixed level of debt outstanding, and this increase in leverage induces a higher equity-return volatility. In a sample of all-equity-financed companies from January 1973 to December 2010, we find that the leverage effect is just as strong if not stronger, implying that the inverse relationship between price and volatility is not based on leverage.

Keywords: Volatility; Leverage Effect; Return/Volatility Relationship; Time-Varying Expected Return; Behavioral Finance.

JEL Classification: G12

*Graduate Student, Boston University Department of Economics, (646) 338–1971 (voice), jah@bu.edu (email).

†Harris & Harris Group Professor, MIT Sloan School of Management, and Chief Investment Strategist, AlphaSimplex Group, (617) 253–0920 (voice), andrew.lo@mit.edu (email).

Contents

1 Introduction

One of the most enduring empirical regularities of equity markets is the fact that stock-return volatility rises after price declines, with larger declines inducing greater volatility spikes. In a seminal paper, Black (1976) provides a compelling explanation for this phenomenon in terms of the firm's financial leverage: a negative return implies a drop in the value of the firm's equity, increasing its leverage which, in turn, leads to higher equity-return volatility. This explanation has been so tightly coupled with the empirical phenomenon that the inverse relation between stock returns and volatility is now commonly known as the "leverage effect". This effect, and the leverage-based explanation, have been empirically confirmed by a number of studies since Black (1976), e.g., Christie (1982), Cheung and Ng (1992), and Duffee (1995) using linear regressions of returns on subsequent changes in volatility for individual stocks and stock portfolios, and arguing that these relationships become stronger as the firms' debt-to-equity ratios increase. However, the validity of the leverage explanation has been called into question more recently by Figlewski and Wang (2000), who document several empirical anomalies associated with it.

In this paper we provide clear evidence that the leverage effect is not due to leverage. Using the returns of all-equity-financed companies from January 1973 to December 2010, and the specifications of Black (1976), Christie (1982), and Duffee (1995), we find just as strong an inverse relationship between returns and the subsequent volatility changes as for their debt-financed counterparts. This finding suggests that the return/volatility relationship is due, instead, to other factors such as time-varying expected returns, endogenous volatility, or path-dependent cognitive risk perceptions.

In Section 2 we provide a review of the literature in which the stock-return/volatility relationship is documented, focusing on a few key regression-based studies that we replicate using the sample of all-equity-financed companies described in Section 3. In Section 4 we present our empirical results, and we conclude in Section 5 with a discussion of some possible interpretations.

2 Literature Review

Black (1976) is widely credited as the originator of the leverage-effect literature. In this pioneering paper, Black uses daily data from 1964 to 1975 of a sample of 30 stocks (mostly Dow Jones Industrials) to study the relationship between volatility changes and returns in individual stocks and the portfolio of those stocks. For each stock, Black constructs 21-day summed returns, and estimates volatility over these intervals with the square root of the sum of squared returns. The portfolio-level equivalents of these estimates, which he calls the "summed market return" and the "market volatility estimate", are obtained by averaging the summed returns and the volatility estimates, respectively, across the sample of stocks. He then defines the "volatility change" as the difference between the volatility estimate of the current and the previous period, divided by the volatility estimate of the previous period, and regresses the volatility change at time $t+1$ on the summed return at time t. His results suggest a strong inverse relationship between the two: a 1% summed-return decline implies a more than 1% volatility increase.

Black (1976) proposes two possible explanations for this relationship. The first explanation, which he terms the "direct causation" effect, refers to the causal relation from stock returns to volatility changes. A drop in the value of the firm's equity will cause a negative return on its stock and will increase the leverage of the stock (i.e., its debt/equity ratio), and this rise in the debt/equity ratio will lead to a rise in the volatility of the stock. A similar effect may arise even if the firm has almost no debt because of the presence of so-called "operating leverage" (fixed costs that cannot be eliminated, at least in the short run, hence when expected revenues fall, profit margins decline as well). The second explanation, which Black (1976) calls the "reverse causation" effect, refers to the causal relationship from volatility changes to stock returns. Changes in tastes and technology lead to an increase in the uncertainty about the payoffs from investments. Because of the increase in expected future volatility, stock prices must fall, so that the expected return from the stock rises to induce investors to continue to hold the stock.

Using a sample of 379 stocks from 1962 to 1978, Christie (1982) estimates the following linear relationship between changes in volatility from one quarter to the next and the return

over the first quarter for each stock:

$$\ln(\frac{\sigma_t}{\sigma_{t-1}}) \quad = \quad \beta_0 \; + \; \theta_S r_{t-1} \; + \; u_t \tag{1}$$

where σ_{t-1} and r_{t-1} are the volatility estimate and return of the stock over quarter $t-1$. He finds the cross-sectional mean elasticity to be -0.23, consistent with the leverage effect, and then derives testable implications of various volatility models and efficient estimation procedures to investigate the implications of risky debt and interest-rate changes on this relationship. He finds significant positive association between equity volatility and financial leverage, but the strength of this association declines with increasing leverage. Christie finds that, contrary to the predictions stemming from the contingent claims literature, the riskless interest rate and financial leverage jointly have a substantial positive impact on the volatility of equity. Finally, he tests the elasticity hypothesis, which says that the observed negative elasticity of equity volatility with respect to the value of equity is, in large measure, attributable to financial leverage. For this purpose he uses the constant elasticity of variance (CEV) model for equity prices, according to which $\sigma_S = \lambda S^{\theta}$, and estimates the linear regression:

$$\ln(\sigma_{S,t}) \quad = \quad \ln(\lambda) \; + \; \theta \ln(S_t) \; + \; u_t \tag{2}$$

where $\sigma_{S,t}$ is the volatility estimated over quarter t, and S_t is the stock price at the beginning of that quarter. He performs two separate tests of the hypothesis that θ_S is a function of financial leverage—one based on leverage quartiles and the other on sub-periods—and finds evidence in support of this hypothesis from both.

Cheung and Ng (1992) examine the inverse relation between future stock volatility and current stock prices using daily returns of 252 NYSE-AMEX stocks with no missing returns from 1962 to 1989, under the assumption of an exponential GARCH model for stock prices (to control for heteroskedasticity and possible serial correlation in their returns). In this model, the conditional variance equation has the logarithm of the lagged stock price on the right-hand side, hence the corresponding coefficient θ is a measure of the leverage effect. Applying the Spearman rank correlation test, the authors find a strong positive correlation

between θ and firm size, and explain this pattern by arguing that the smaller the firm, the higher the debt/equity ratio. Their sub-sample analysis shows that the strength of this relationship changes over time. In particular, conditional variances of stock returns on average have become less sensitive to changes in stock prices over time, which, the authors suggest, may be due to an increase in the firms' liquidity over the sample period.

Duffee (1995) provides a new interpretation for the negative relationship between current stock returns and changes in future stock return volatility at the firm level by arguing that it is mainly due to a positive *contemporaneous* relationship between returns and volatility. In addition to the usual test of leverage effect based on lagged returns, Duffee estimates the following two contemporaneous regressions:

$$\ln(\sigma_t) = \alpha_1 + \lambda_1 r_t + \epsilon_{t,1} \quad (3)$$

$$\ln(\sigma_{t+1}) = \alpha_2 + \lambda_2 r_t + \epsilon_{t+1,2} \quad (4)$$

and observes that the usual lagged stock-return coefficient is simply the difference $\lambda_0 \equiv \lambda_2 - \lambda_1$. Using data for 2,500 firms traded on the AMEX or NYSE from 1977 to 1991 (not necessarily continuously for the entire sample),[1] Duffee finds that for a typical firm, λ_1 is strongly positive, λ_2 is positive at the daily frequency and negative at the monthly frequency, and that regardless of the sign of λ_2, it is the case that $\lambda_1 > \lambda_2$, implying that $\lambda_0 < 0$. Duffee then tests the theory behind the leverage effect, according to which highly leveraged firms should have a stronger negative relation between stock returns and volatility than less highly leveraged firms. Prior to his study, researchers have documented that the inverse relation between period t stock returns and changes in the stock return volatility from period t to period $t+1$ is stronger for firms with larger debt/equity ratios (e.g., Christie, 1982 and Cheung and Ng, 1992), and that this relation is stronger for smaller firms (Cheung and Ng, 1992). Using the Spearman rank correlations between the individual-firm regression coefficients (λ_0, λ_1, and λ_2) and debt/equity ratios and market capitalizations, Duffee obtains the following

[1] It is worth noting that, unlike Black (1976), Christie (1982), and Cheung and Ng (1992) who include only companies that were continuously traded throughout their sample periods, Duffee's (1995) sample is broader, including both continuously traded firms and those that exit the sample, which greatly reduces survivorship bias. He finds that continuously traded firms are, on average, much larger and have lower debt/equity ratios than the typical firm.

three findings: First, the negative relation between λ_0 and the debt/equity ratio found by Christie (1982) and Cheung and Ng (1992) is confirmed only with monthly data for the subset of continuously traded firms. When a larger sample of firms without survivorship bias is used, the correlation between λ_0 and the debt/equity ratio turns positive. Second, highly leveraged firms exhibit stronger negative relations between stock returns and volatility than less highly leveraged firms (the rank correlations between λ_1 and the debt/equity ratio, and λ_2 and the debt/equity ratio, are both negative). And third, because the leverage effect theory has no implications for the strength of the contemporaneous relation between stock returns and volatility, Duffee argues that there is some reason other than the leverage effect that is causing at least part of the correlation between firm debt/equity ratios and the regression coefficients, and determining the negative correlation between the firm debt/equity ratio and λ_1. Furthermore, in accordance with Cheung and Ng (1992), he finds that λ_0 is positively correlated with size, at both monthly and daily frequencies, for all firms as well as the sub-sample of continuously traded firms.

Our results differ from Duffie's in a few important ways. First, Duffee's conclusions apply to the typical firm, whereas ours involve the extreme case of all-equity-financed companies. Second, Duffee's findings are mixed—as discussed above, he finds that the relationship between stock returns and volatility changes is negative for continuously traded firms, but positive for the entire sample of firms—but we find a negative relationship in both continuously traded and all firms in our sample of all-equity financed companies. Moreover, we compare the relationship between stock returns and volatility changes of all-equity-financed companies to that of their debt-financed counterparts, and find that the former is at least as negative as the latter. These results lead us to conclude that rather than being the result of leverage, the inverse relationship between average return and volatility is due to human cognitive perceptions of risk (see Section 5). Although Duffee also suggests that something other than leverage must be causing the correlation between firm debt/equity ratios and the regression coefficients, he is motivated by his consideration of the *contemporaneous* relation between returns and volatility changes for a typical firm, rather than by the *lagged* relation between returns and volatility changes (the traditional "leverage effect" relationship) for all-equity-financed firms and debt-financed firms separately.

Other explanations for the inverse relation between stock volatility and lagged returns

have been proposed, each developing into its own strand of literature. The most prominent of these strands is the time-varying risk premia literature, according to which an increase in return volatility implies an increase in the future required expected return of the stock, hence a decline in the current stock price. In addition, due to the persistent nature of volatility (large realizations of either good or bad news increase both current and future volatility), a feedback loop is created: the increased current volatility raises expected future volatility and, therefore, expected future returns, causing stock prices to fall now. The time-varying risk premia explanation, also known as the volatility feedback effect, has been considered by Pindyck (1984), French, Schwert, and Stambaugh (1987), and Campbell and Hentschel (1992), typically using aggregate market returns within a GARCH framework.

Yet another explanation for the inverse relation between volatility and lagged returns, first proposed by Schwert (1989) involves the apparent asymmetry in the volatility of the macroeconomic variables. Empirical evidence suggests that real variables are more volatile in recessions than expansions, hence, if a recession is expected but not yet realized, i.e., GDP growth is forecasted to be lower in the future, stock prices will fall immediately, followed by higher stock-return volatility when the recession is realized.

Disentangling these effects has proved to be a challenging task. For example, using the data for the portfolios of Nikkei 225 stocks and a conditional CAPM model with a GARCH-in-mean parametrization, Bekaert and Wu (2000) reject the leverage model and find support for the volatility feedback explanation. In contrast, examining the relationship between volatility and past and future returns using the S&P 500 futures high-frequency data, Bollerslev, Litvinova, and Tauchen (2006) find that the correlations between absolute high-frequency returns and current and past high-frequency returns are significantly negative for several days, lending support to the leverage explanation, whereas the reverse cross-correlations are negligible, which is inconsistent with the volatility feedback story.

Using the data for the individual stocks in the S&P 100 index, as well the aggregate index data itself, Figlewski and Wang (2000) document a strong inverse volatility/lagged-return relation associated with negative returns, but also a number of anomalies that cast some doubt on the leverage-based explanation. Specifically, the inverse relation becomes much weaker when positive returns reduce leverage, it is too small with measured leverage for individual firms and too large when implied volatilities are used, and the volatility change

associated with a given change in leverage seems to decay over several months. Most importantly, there is no change in volatility when leverage changes due to a change in outstanding debt or shares, but is observed only with stock-price changes, leading Figlewski and Wang (2000) to propose a new label for the observed inverse volatility/lagged-return relation: the "down-market effect".

3 Data

Our sample consists of daily stock returns from the University of Chicago's Center for Research in Security Prices, quarterly fundamental data from the CRSP/COMPUSTAT Merged Database (Fundamentals Quarterly), and annual accounting data from COMPUSTAT Fundamentals Annual. We select only those stocks with zero total debt for all quarters from January 1961 to December 2010, where total debt is defined as the sum of total long-term debt, debt in current liabilities (short-term debt), and total preferred stock.[2] This filter yields 520 companies, which is our sample of all-equity financed (AE) companies.

We also construct a complementary sample of companies with positive levels of total debt in their capital structure in every quarter from January 1961 to December 2010, which yields a considerably larger sample of 22,782 debt-financed companies. From this universe of debt-financed (DF) companies, we select a smaller subset of 520 companies to match the number of companies in our AE subset. This subset is selected by first sorting the AE companies into size quintiles based on their median market capitalizations during the entire sample period (where quintile breakpoints are computed from the entire CRSP Monthly Master file), and then randomly selecting the same number of DF companies from each size quintile. This procedure yields a matching sample of DF companies with approximately the same size distribution as the AE sample.

Finally, for each of the two samples (AE and DF), we obtain daily returns from the CRSP Daily Database, and to maintain the same start date for the AE and DF companies, we use

[2]We first eliminate observations for which any of the long-term debt, current liabilities, or preferred stock is missing. Note that our definition of total debt differs slightly from Christie's (1982), in which short-term debt is measured by the accounting variable "current liabilities" (Compustat mnemonic LCT). This variable is comprised of four components: accounts payable (AP), current liabilities – other – total (LCO), debt in current liabilities (DLC), and income taxes payable (TXP). Since our filter is intended to separate companies with and without debt in their capital structures, we use DLC as our measure of short-term debt.

the later start date of January 2, 1973.

4 Empirical Evidence

We test for the leverage effect using linear regression models where the dependent and independent variables of the regression are those proposed by Black (1976), Christie (1982), and Duffee (1995); using all three specifications serves as a robustness check on our results. To obtain the dependent and independent variables used in the regression equations, we first split the daily stock-returns data for each firm or for the portfolios of firms into non-overlapping periods of a certain length, and compute the volatility and total returns over those periods. Then, for each firm or portfolio, we regress the change in volatility between the current period and the previous period on the total return over the previous period, and the change in volatility between the current period and two periods ago on the return in the previous period. The latter regression has the advantage of no data in common to both sides of the regression equation at the same time, which, as Black (1976, p. 181) observes, reduces the chance that the coefficient estimates are biased by errors in the volatility estimates. More formally, we estimate the following eight specifications—each a variation of the same linear regression model—where period $t-1$ returns are related to changes in volatility between periods t and $t-1$ in the first four specifications, and to the changes in volatility between periods t and $t-2$ in the four remaining specifications:

1. `BlackLag1` is given by $\frac{\sigma_t - \sigma_{t-1}}{\sigma_{t-1}} = \alpha + \lambda r_{t-1} + \epsilon_t$, where σ_t is the square root of the sum the squared daily simple returns over period t multiplied by the ratio of 252 to the number of days in period t, and r_t is the sum of daily simple returns over that period.

2. `LogBlackLag1` is given by $\ln(\frac{\sigma_t}{\sigma_{t-1}}) = \alpha + \lambda r_{t-1} + \epsilon_t$, where σ_t and r_t are the same as in `BlackLag1`.

3. `ChristieLag1` is given by $\ln(\frac{\sigma_t}{\sigma_{t-1}}) = \alpha + \lambda r_{t-1} + \epsilon_t$, where σ_t is the square root of the sum of squared daily simple returns over the period, and r_t is the sum of daily log-returns over that period.

4. `DuffeeLag1` is given by $\sigma_t - \sigma_{t-1} = \alpha + \lambda r_{t-1} + \epsilon_t$, where σ_t is the square root of the

sum of squared daily log-returns multiplied by the ratio of 252 to the number of days in period t, and r_t is the sum of daily log-returns over that period.

5. `BlackLag2` is given by $\frac{\sigma_t - \sigma_{t-2}}{\sigma_{t-1}} = \alpha + \lambda r_{t-1} + \epsilon_t$, where σ_t and r_t are the same as in `BlackLag1`.

6. `LogBlackLag2` is given by $\ln(\frac{\sigma_t}{\sigma_{t-2}}) = \alpha + \lambda r_{t-1} + \epsilon_t$, where σ_t and r_t are the same as in `BlackLag1`.

7. `ChristieLag2` is given by $\ln(\frac{\sigma_t}{\sigma_{t-2}}) = \alpha + \lambda r_{t-1} + \epsilon_t$, where σ_t and r_t are the same as in `ChristieLag1`.

8. `DuffeeLag2` is given by $\sigma_t - \sigma_{t-2} = \alpha + \lambda r_{t-1} + \epsilon_t$, where σ_t and r_t are the same as in `DuffeeLag1`.

4.1 Financial Leverage

To test whether the leverage effect is due to firms' financial leverage, i.e. the presence of debt in its capital structure, we estimate each of the above regression models on the AE and DF samples from January 2, 1973 to December 31, 2010. In keeping with Black (1976), Christie (1982), and Duffie (1995), we use a 21-day interval to estimate volatilities and returns, and we impose a minimum of 40 daily observations for each regression, hence companies with fewer observations are eliminated from the sample. Our data consist of companies listed on the New York Stock Exchange (NYSE), the American Stock Exchange (AMEX), the NASDAQ Stock Exchange (NASDAQ), and the Archipelago Stock Exchange (ARCA); to be consistent with the above-mentioned literature, in Section A we also consider subsets of our datasets consisting of NYSE and AMEX companies only.[3]

In Table 1 we report the distributional summary statistics of the individual-firm regression estimates and goodness-of-fit statistics from the AE and DF datasets, for firms traded either on all exchanges. For example, according to the top-left panel of Table 1, corresponding to the `BlackLag1` regression specification, the average across 223 firms in the AE dataset of the firm-by-firm "leverage" coefficients λ is -0.51, which is about the same as the average

[3]The filtering is done using the CRSP Header Exchange Code variable, which displays the latest exchange code listed for a specific security.

λ of -0.63 for the 241 firms of its DF counterpart.[4] The average t-statistics are relatively low—-1.26 and -1.74 for the AE and DF datasets, respectively—a finding consistent with Christie (1982), who obtains an average t-statistic of -1.01. The adjusted R^2 statistic tend to be small, around 2% to 5% on average, which is also consistent with Christie (1982), who obtains the average adjusted R^2 of 1%.

Similar results are observed in all of the left-hand-side panels of Table 1, where we regress the change in volatility between the current period and the previous period on the return in the previous period according to the various regressions specifications under consideration. Namely, the average λ's are -0.58 (AE) vs. -0.62 (DF) in `LogBlackLag1`, -0.44 (AE) vs. -0.47 (DF) in `ChristieLag1`, and -0.13 (AE) vs. -0.19 (DF) in `DuffeeLag1`.

For the right-hand-side panels of Table 1, where we regress the change in volatility between the current period and two periods ago on the return in the previous period,[5] the average λ's are somewhat less negative for the AE dataset with respect to their DF counterpart, however the median λ's are still very close for the two datasets. Moreover, Table 2 reveals that the estimated λ for the equal-weighted portfolio of AE firms is virtually indistinguishable from that of the equal-weighted portfolio of DF firms, for each of the eight regression specifications considered: -0.94 (AE) vs. -0.80 (DF) for `BlackLag1`, -1.66 (AE) vs. -2.49 (DF) for `BlackLag2`, -0.81 (AE) vs. -0.63 (DF) for `LogBlackLag1`, -1.32 (AE) vs. -1.84 (DF) for `LogBlackLag2`, -0.77 (AE) vs. -0.58 (DF) for `ChristieLag1`, -1.32 (AE) vs. -1.82 (DF) for `ChristieLag2`, -0.16 (AE) vs. -0.12 (DF) for `DuffeeLag1`, and -0.33 (AE) vs. -0.46 (DF) for `DuffeeLag2`.[6]

Estimation errors aside,[7] we conclude that the inverse relationship between a firm's stock return and the resulting change in volatility cannot be attributed of the firm's financial leverage, since this relationship is virtually identical among AE and DF firms.

[4]Note that the number of firms for each dataset reported in the tables differs from the actual number of firms in each sample due to the minimum number of observations constraint (40 times the period length).

[5]Recall Black's (1976) motivation for this procedure was to mitigate the volatility estimation errors by not allowing any data in common to the dependent and independent variables at the same time.

[6]The equal-weighted portfolio return, $R_{p,t}$, is computed as $R_{p,t} \equiv \sum_{i=1}^{N} R_{i,t}/N$, where $R_{i,t}$ is the total return (including dividends) of company i at time t, and where N is the number of companies that exist at the end of time $t-1$.

[7]Recall that coefficient estimates are biased by errors in the volatility estimates, especially when dependent and independent variables are based on the same data at the same time, as is the case here.

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					**BlackLag2**				
All-Equity Financed		α	0.02	0.13	0.15	0.67	0.10	-0.03	0.14	0.17	0.59	0.10
			(0.34)	(1.83)	(1.96)	(4.68)	(0.69)	(-0.63)	(1.93)	(1.95)	(4.89)	(0.82)
	223	λ	**-2.85**	**-0.49**	**-0.51**	**0.59**	**0.49**	**-4.71**	**-0.38**	**-0.40**	**5.80**	**0.97**
			(-5.88)	(-1.15)	(-1.26)	(1.52)	(1.09)	(-4.16)	(-0.96)	(-0.93)	(3.52)	(1.33)
		Adj. R^2	-2.6%	0.5%	1.8%	19.7%	4.0%	-2.4%	0.4%	1.7%	19.0%	4.0%
Debt Financed		α	0.00	0.12	0.14	0.54	0.07	-0.01	0.14	0.17	0.55	0.09
			(0.06)	(2.23)	(2.32)	(5.01)	(0.81)	(-0.14)	(2.32)	(2.43)	(4.98)	(0.83)
	241	λ	**-3.55**	**-0.55**	**-0.63**	**0.67**	**0.51**	**-14.32**	**-0.50**	**-0.84**	**5.17**	**1.58**
			(-5.64)	(-1.73)	(-1.74)	(1.29)	(1.16)	(-6.04)	(-1.45)	(-1.59)	(3.01)	(1.50)
		Adj. R^2	-2.6%	1.5%	2.7%	26.0%	4.3%	-2.5%	1.1%	2.8%	27.3%	5.1%
			LogBlackLag1					**LogBlackLag2**				
All-Equity Financed		α	-0.08	0.00	0.01	0.12	0.03	-0.14	0.00	0.00	0.11	0.04
			(-1.13)	(0.11)	(0.13)	(2.24)	(0.45)	(-1.86)	(-0.02)	(-0.03)	(2.30)	(0.52)
	223	λ	**-3.06**	**-0.49**	**-0.58**	**0.90**	**0.61**	**-2.56**	**-0.33**	**-0.36**	**3.53**	**0.67**
			(-8.28)	(-1.69)	(-1.78)	(2.02)	(1.62)	(-4.01)	(-1.09)	(-1.03)	(4.03)	(1.35)
		Adj. R^2	-2.5%	2.5%	5.0%	41.6%	7.8%	-2.5%	0.6%	2.1%	20.6%	4.4%
Debt Financed		α	-0.06	0.01	0.01	0.10	0.02	-0.09	0.01	0.01	0.16	0.03
			(-1.05)	(0.25)	(0.25)	(1.54)	(0.38)	(-1.60)	(0.18)	(0.19)	(1.45)	(0.52)
	241	λ	**-3.72**	**-0.53**	**-0.62**	**0.80**	**0.52**	**-5.27**	**-0.40**	**-0.58**	**1.44**	**0.79**
			(-6.66)	(-2.07)	(-2.19)	(1.78)	(1.48)	(-5.70)	(-1.41)	(-1.54)	(2.54)	(1.43)
		Adj. R^2	-2.4%	2.7%	4.9%	35.1%	6.4%	-2.5%	1.0%	2.5%	24.7%	4.6%
			ChristieLag1					**ChristieLag2**				
All-Equity Financed		α	-0.09	0.00	-0.01	0.10	0.03	-0.14	-0.01	-0.01	0.09	0.03
			(-1.33)	(-0.08)	(-0.10)	(0.85)	(0.37)	(-1.81)	(-0.13)	(-0.16)	(1.16)	(0.48)
	223	λ	**-2.85**	**-0.35**	**-0.44**	**1.10**	**0.62**	**-2.46**	**-0.36**	**-0.36**	**3.71**	**0.67**
			(-7.10)	(-1.15)	(-1.21)	(2.77)	(1.47)	(-4.66)	(-1.09)	(-1.06)	(4.05)	(1.34)
		Adj. R^2	-2.6%	1.1%	3.0%	30.7%	5.7%	-2.6%	0.5%	2.1%	17.6%	4.3%
Debt Financed		α	-0.08	0.00	0.00	0.09	0.02	-0.10	0.00	0.00	0.09	0.03
			(-1.08)	(-0.02)	(-0.02)	(1.29)	(0.32)	(-1.81)	(0.01)	(-0.00)	(1.12)	(0.47)
	241	λ	**-3.50**	**-0.41**	**-0.47**	**1.00**	**0.53**	**-5.30**	**-0.42**	**-0.60**	**1.44**	**0.77**
			(-5.09)	(-1.52)	(-1.58)	(4.10)	(1.41)	(-5.65)	(-1.47)	(-1.61)	(2.46)	(1.43)
		Adj. R^2	-2.6%	1.1%	2.7%	22.1%	4.5%	-2.5%	1.2%	2.8%	32.2%	4.9%
			DuffeeLag1					**DuffeeLag2**				
All-Equity Financed		α	-0.07	0.00	0.00	0.11	0.02	-0.06	0.00	0.00	0.13	0.02
			(-0.86)	(-0.05)	(-0.02)	(1.06)	(0.32)	(-1.59)	(-0.07)	(-0.08)	(1.34)	(0.42)
	223	λ	**-1.78**	**-0.16**	**-0.13**	**2.16**	**0.48**	**-1.91**	**-0.24**	**-0.24**	**2.09**	**0.40**
			(-7.55)	(-0.75)	(-0.66)	(5.79)	(1.90)	(-5.74)	(-1.13)	(-1.11)	(6.24)	(1.51)
		Adj. R^2	-2.4%	1.2%	3.3%	34.4%	6.1%	-2.6%	1.0%	2.5%	23.2%	4.9%
Debt Financed		α	-0.06	0.00	0.00	0.21	0.02	-0.07	0.00	0.00	0.21	0.03
			(-0.93)	(-0.00)	(0.04)	(1.54)	(0.34)	(-1.33)	(0.03)	(0.07)	(1.59)	(0.43)
	241	λ	**-1.84**	**-0.17**	**-0.19**	**2.04**	**0.44**	**-1.63**	**-0.31**	**-0.35**	**0.75**	**0.34**
			(-8.03)	(-1.16)	(-1.19)	(10.46)	(2.03)	(-8.78)	(-1.56)	(-1.88)	(2.86)	(1.90)
		Adj. R^2	-2.5%	0.9%	3.4%	31.2%	6.1%	-2.3%	1.7%	4.3%	43.0%	7.7%

Table 1: Summary statistics across all firms in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010 of the estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic, where regressions are estimated firm by firm. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on NYSE, AMEX, NASDAQ, and ARCA, and the number of firms in each dataset is reported as well.

Dataset	Statistic	BlackLag1	BlackLag2	LogBlackLag1	LogBlackLag2	ChristieLag1	ChristieLag2	DuffeeLag1	DuffeeLag2
		All Exchanges							
All-Equity Financed	α	0.08	0.12	0.02	0.03	0.01	0.02	0.00	0.01
		(4.31)	(5.08)	(0.92)	(1.36)	(0.81)	(1.26)	(0.90)	(1.58)
	λ	**-0.94**	**-1.66**	**-0.81**	**-1.32**	**-0.77**	**-1.32**	**-0.16**	**-0.33**
		(-3.48)	(-5.05)	(-3.41)	(-5.00)	(-3.23)	(-4.99)	(-3.62)	(-6.35)
	Adj. R^2	2.4%	5.1%	2.3%	5.0%	2.0%	5.0%	2.6%	8.0%
Debt Financed	α	0.08	0.13	0.01	0.03	0.01	0.03	0.00	0.01
		(3.93)	(5.57)	(0.63)	(1.75)	(0.54)	(1.61)	(0.59)	(2.07)
	λ	**-0.80**	**-2.49**	**-0.63**	**-1.84**	**-0.58**	**-1.82**	**-0.12**	**-0.46**
		(-2.97)	(-7.79)	(-2.71)	(-7.27)	(-2.52)	(-7.24)	(-2.73)	(-9.18)
	Adj. R^2	1.7%	11.6%	1.4%	10.3%	1.2%	10.2%	1.4%	15.5%

Table 2: Estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic for the equal-weighted portfolio of all firms in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on all exchanges (NYSE, AMEX, NASDAQ, and ARCA).

For completeness, in the Appendix Tables A.1–A.2 we repeat the above regression analysis for individual firms and equal-weighted portfolios of firms in AE and DF datasets, but consider only those subsets of firms from the two datasets that are traded on NYSE or AMEX exhanges. Although comparing the intensity of the leverage effect across the corresponding AE and DF panels of these two tables is not entirely fair due to the fact that the filtering out of non-NYSE or AMEX firms has left twice as many firms in the DF than in the AE dataset, the results are qualitatively consistent with the patterns from the complete AE and DF samples.

4.2 Operating Leverage

In this section we study whether the leverage effect observed in all-equity financed sample of firms is driven by operating leverage, as suggested by Black (1976). Recall that the idea behind the operating leverage explanation for the leverage effect is as follows: because of fixed costs, when income falls it does so by less than expenses, hence firm's equity value

falls and its volatility increases. In Tables 3–8 we follow the literature[8] and define operating leverage as the ratio of operating costs to book assets. Operating costs is computed as the sum of Costs of Goods Sold (COGS) and Selling, General and Administrative Expenses (XSGA) items from the COMPUSTAT Fundamentals annual database. Costs of Goods Sold (COGS) item represents all costs directly allocated by the company to production, such as material, labor and overhead. Selling, General and Administrative Expenses (XSGA) item represents all commercial expenses of operation (i.e., expenses not directly related to product production) incurred in the regular course of business pertaining to the securing of operating income. Book assets is measured by the AT (Total Assets) item, which represents the total assets of a company at a point in time. When we combine the annual accounting data with the daily stock returns data, we make sure that the accounting data was available at the time the stock return was observed. Namely, the accounting data for the fiscal year ending in calendar year t-1 is considered to be available as of June of year t. We compute the operating leverage quintiles for the all-equity financed (AE) sample, and sort firms from that sample into those quintiles based on the average operating leverage over their lifetime. We repeat the same procedure for the debt-financed (DF) sample. Although the results for both samples are presented for completeness, in the ensuing discussion we focus on the AE sample, since what we are after is further understanding the drivers of the observed leverage effect in that sample.

In Table 3 we consider equal-weighted portfolios of firms in each operating leverage quintile, from the first (lowest) to the fifth (highest). If the leverage effect in the AE sample were driven by operating leverage, then we would expect the leverage coefficient λ for that sample to be more negative in the higher operating leverage quintiles than in the lower ones. However, Table 3 reveals that in five out of eight regression specifications λ is virtually indistinguishable between the lowest (Q1) than in the highest (Q5) operating leverage quintiles, or somewhat more negative in the lowest one: -1.30 (Q1) vs. -0.99 (Q5) in `BlackLag1` regression specification, -1.36 (Q1) vs. -0.91 (Q5) in `LogBlackLag1`, -0.68 (Q1) vs. -0.67 (Q5) in `LogBlackLag2`, -1.15 (Q1) vs. -0.85 (Q5) in `ChristieLag1`, and -0.68 (Q1) vs. -0.69 (Q5) in `ChristieLag2`. And in two out of three cases where this relationship reverses between quintiles Q1 (lowest) and Q5 (highest), it is still present between quintiles Q2 (sec-

[8]See, for example, Novy-Marx (2011) and Garcia-Feijoo and Jorgensen (2010).

Dataset	Statistic	BlackLag1	BlackLag2	LogBlackLag1	LogBlackLag2	ChristieLag1	ChristieLag2	DuffeeLag1	DuffeeLag2
					OL Q1				
All-Equity Financed	α	0.12	0.13	0.02	0.01	0.01	0.01	0.00	0.00
		(4.75)	(4.18)	(0.99)	(0.36)	(0.69)	(0.29)	(0.35)	(0.10)
	λ	**-1.30**	**-0.64**	**-1.36**	**-0.68**	**-1.15**	**-0.68**	**-0.19**	**-0.10**
		(-3.23)	(-1.29)	(-4.06)	(-1.85)	(-3.41)	(-1.86)	(-1.85)	(-0.99)
	Adj. R^2	2.1%	0.2%	3.4%	0.6%	2.4%	0.6%	0.6%	0.0%
Debt Financed	α	0.13	0.13	0.02	0.02	0.01	0.01	0.00	0.00
		(4.12)	(4.82)	(0.82)	(0.73)	(0.65)	(0.63)	(0.65)	(0.73)
	λ	**-1.33**	**-1.43**	**-1.22**	**-1.08**	**-1.15**	**-1.09**	**-0.26**	**-0.31**
		(-3.20)	(-4.11)	(-4.50)	(-3.91)	(-4.19)	(-3.94)	(-4.21)	(-4.70)
	Adj. R^2	2.0%	3.4%	4.1%	3.1%	3.6%	3.1%	3.6%	4.5%
					OL Q2				
All-Equity Financed	α	0.12	0.14	0.01	0.01	0.01	0.01	0.00	0.00
		(4.10)	(4.33)	(0.50)	(0.52)	(0.24)	(0.34)	(0.15)	(0.38)
	λ	**-0.97**	**-1.20**	**-0.77**	**-0.85**	**-0.57**	**-0.83**	**-0.15**	**-0.36**
		(-3.01)	(-3.46)	(-2.92)	(-3.10)	(-2.17)	(-3.05)	(-1.41)	(-3.34)
	Adj. R^2	2.2%	3.0%	2.1%	2.4%	1.0%	2.3%	0.3%	2.8%
Debt Financed	α	0.09	0.12	0.01	0.02	0.01	0.01	0.00	0.00
		(4.12)	(4.79)	(0.52)	(0.79)	(0.31)	(0.53)	(0.29)	(0.58)
	λ	**-1.02**	**-1.96**	**-0.92**	**-1.49**	**-0.84**	**-1.47**	**-0.24**	**-0.51**
		(-4.48)	(-7.14)	(-4.73)	(-6.91)	(-4.31)	(-6.88)	(-3.97)	(-7.63)
	Adj. R^2	4.2%	10.3%	4.7%	9.7%	3.9%	9.6%	3.3%	11.6%
					OL Q3				
All-Equity Financed	α	0.11	0.13	0.01	0.01	0.01	0.00	0.00	0.00
		(3.65)	(3.85)	(0.39)	(0.26)	(0.26)	(0.21)	(0.27)	(0.21)
	λ	**-0.57**	**-0.54**	**-0.63**	**-0.37**	**-0.57**	**-0.37**	**-0.17**	**-0.12**
		(-1.92)	(-1.63)	(-2.81)	(-1.51)	(-2.54)	(-1.52)	(-2.67)	(-1.75)
	Adj. R^2	0.7%	0.5%	1.9%	0.4%	1.5%	0.4%	1.7%	0.6%
Debt Financed	α	0.07	0.08	0.01	0.01	0.01	0.01	0.00	0.00
		(3.83)	(3.97)	(0.84)	(0.58)	(0.61)	(0.45)	(0.56)	(0.43)
	λ	**-0.95**	**-0.91**	**-0.86**	**-0.71**	**-0.81**	**-0.72**	**-0.24**	**-0.23**
		(-4.74)	(-4.57)	(-5.34)	(-4.19)	(-5.03)	(-4.24)	(-4.92)	(-4.40)
	Adj. R^2	4.6%	4.3%	5.8%	3.6%	5.1%	3.6%	4.9%	3.9%
					OL Q4				
All-Equity Financed	α	0.12	0.15	0.02	0.01	0.01	0.00	0.01	0.00
		(4.10)	(3.98)	(0.83)	(0.22)	(0.41)	(0.05)	(0.44)	(-0.09)
	λ	**-0.60**	**-0.51**	**-0.78**	**-0.48**	**-0.70**	**-0.52**	**-0.34**	**-0.13**
		(-3.11)	(-2.02)	(-4.97)	(-2.65)	(-4.28)	(-2.75)	(-3.91)	(-1.36)
	Adj. R^2	2.4%	0.9%	6.3%	1.7%	4.7%	1.8%	3.9%	0.2%
Debt Financed	α	0.08	0.11	0.01	0.01	0.01	0.01	0.00	0.00
		(4.24)	(4.60)	(0.65)	(0.57)	(0.47)	(0.45)	(0.41)	(0.72)
	λ	**-0.82**	**-1.11**	**-0.68**	**-0.78**	**-0.62**	**-0.78**	**-0.16**	**-0.30**
		(-3.73)	(-4.19)	(-3.43)	(-3.47)	(-3.10)	(-3.45)	(-2.84)	(-4.96)
	Adj. R^2	2.8%	3.6%	2.3%	2.4%	1.9%	2.4%	1.5%	5.0%
					OL Q5				
All-Equity Financed	α	0.13	0.16	0.03	0.02	0.02	0.01	0.01	0.00
		(5.08)	(4.78)	(1.27)	(0.65)	(0.98)	(0.53)	(1.19)	(0.64)
	λ	**-0.99**	**-0.92**	**-0.91**	**-0.67**	**-0.85**	**-0.69**	**-0.32**	**-0.26**
		(-4.21)	(-2.98)	(-4.60)	(-2.98)	(-4.24)	(-3.01)	(-5.12)	(-3.65)
	Adj. R^2	3.6%	1.8%	4.4%	1.8%	3.7%	1.8%	5.4%	2.7%
Debt Financed	α	0.09	0.12	0.03	0.03	0.02	0.02	0.01	0.01
		(4.32)	(4.58)	(1.57)	(1.37)	(1.31)	(1.26)	(1.71)	(1.33)
	λ	**-0.87**	**-1.33**	**-0.99**	**-0.97**	**-0.93**	**-1.00**	**-0.40**	**-0.35**
		(-4.09)	(-4.78)	(-5.52)	(-4.83)	(-5.10)	(-4.90)	(-6.55)	(-5.12)
	Adj. R^2	3.5%	4.8%	6.3%	4.9%	5.4%	5.0%	8.8%	5.5%

Table 3: Estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic for the equal-weighted portfolio of firms from the first (lowest) to the fifth (highest) quintile of operating leverage (defined as operating costs divided by book assets), in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on all exchanges (NYSE, AMEX, NASDAQ, and ARCA).

ond lowest) and Q5 (highest): −1.20 (Q2) vs. −0.92 (Q5) in `BlackLag2` and −0.36 (Q2) vs. −0.26 (Q5) in `DuffieLag2`.

Tables 4–8 summarize the firm-level regression results for operating leverage quintiles Q1–Q5 respectively, and tell the same story as above but on a firm-level basis. As before, these tables reveal that in seven out of eight regression specifications λ is either slightly more pronounced in the lowest (Q1) than in the highest (Q5) operating leverage quintile, or very close between the two: −0.45 (Q1) vs. −0.39 (Q5) in `BlackLag2`, −0.71 (Q1) vs. −0.62 (Q5) in `LogBlackLag1`, −0.34 (Q1) vs. −0.35 (Q5) in `LogBlackLag2`, −0.56 (Q1) vs. −0.50 (Q5) in `ChristieLag1`, −0.35 (Q1) vs. −0.37 (Q5) in `ChristieLag2`, and −0.20 (Q1) vs. −0.26 (Q5) in `DuffieLag1`. And in `DuffieLag2` case where this relationship is reversed between Q1 and Q5, it is still present between quintiles Q2 (−0.31) and Q5 (−0.26).

To test the robustness of the above results, in the Appendix Tables A.3–A.8 we repeat the above analysis but compute operating leverage according to another definition frequently used in the literature,[9] namely as the percent change in earnings divided by the percent change in sales. Earnings are measured by EBIT (Earnings Before Interest and Taxes) item from the COMPUSTAT Fundamental Annual database, which is defined as the sum of Sales - Net (SALE) minus Cost of Goods Sold (COGS) minus Selling, General and Administrative Expense (XSGA) minus Depreciation/Amortization (DP). Sales are measured by the SALE (Net Sales) item from the same database, which represents gross sales (the amount of actual billings to customers for regular sales completed during the period) reduced by cash discounts, trade discounts, and returned sales and allowances for which credit is given to customers, for each operating segment. The rational behind this measure of operating leverage is that as fixed costs go up, the sensitivity of operating income to changes in sales increases, hence risk exposures increase, yielding an increase in the volatility of the firm's equity.

Table A.3 refers to equal-weighted portfolios of firms in each operating leverage quintile, while Tables A.4–A.8 refer to the firm-level analysis. These results paint similar picture as before. Table A.3 reveals that for equal-weighted portfolios of firms by operating leverage quintile, in all eight regression specifications λ is actually more negative in the lowest (Q1)

[9] See, for example, Bowman and Bush (2006), Garrison and Noreen (2003), and Dantas, Medeiros, Lustosa (2006).

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					**BlackLag2**				
All-Equity Financed	34	α	0.04	0.12	0.15	0.37	0.08	0.02	0.15	0.18	0.50	0.11
			(0.84)	(1.73)	(1.89)	(4.08)	(0.76)	(0.33)	(1.75)	(1.85)	(3.69)	(0.82)
		λ	**-3.00**	**-0.46**	**-0.49**	**5.42**	**1.34**	**-4.66**	**-0.28**	**-0.45**	**4.50**	**1.67**
			(-2.25)	(-0.93)	(-0.82)	(1.79)	(0.99)	(-4.14)	(-0.45)	(-0.63)	(1.89)	(1.33)
		Adj. R^2	-2.5%	0.1%	1.2%	9.3%	3.1%	-2.5%	-0.4%	1.6%	20.9%	5.6%
Debt Financed	38	α	0.04	0.11	0.15	0.85	0.13	0.04	0.14	0.16	0.53	0.09
			(0.89)	(2.27)	(2.25)	(3.86)	(0.66)	(0.77)	(2.41)	(2.37)	(3.81)	(0.74)
		λ	**-2.68**	**-0.74**	**-0.92**	**0.25**	**0.73**	**-2.68**	**-0.70**	**-0.63**	**1.00**	**0.83**
			(-3.81)	(-1.57)	(-1.56)	(0.26)	(0.91)	(-5.00)	(-0.88)	(-1.13)	(1.65)	(1.48)
		Adj. R^2	-2.2%	1.0%	1.8%	10.2%	2.8%	-1.5%	0.1%	1.5%	13.3%	3.4%
			LogBlackLag1					**LogBlackLag2**				
All-Equity Financed	34	α	-0.02	0.02	0.02	0.13	0.03	-0.05	0.01	0.01	0.08	0.03
			(-0.57)	(0.31)	(0.32)	(1.29)	(0.41)	(-0.73)	(0.18)	(0.17)	(1.52)	(0.41)
		λ	**-4.18**	**-0.48**	**-0.71**	**0.83**	**1.10**	**-2.79**	**-0.29**	**-0.34**	**2.09**	**0.92**
			(-4.95)	(-1.35)	(-1.16)	(2.21)	(1.48)	(-3.57)	(-0.60)	(-0.60)	(2.75)	(1.26)
		Adj. R^2	-2.5%	1.5%	3.9%	35.4%	7.6%	-2.6%	-0.3%	1.4%	20.7%	5.3%
Debt Financed	38	α	-0.02	0.01	0.01	0.04	0.01	-0.04	0.01	0.01	0.07	0.02
			(-0.35)	(0.24)	(0.25)	(0.87)	(0.25)	(-0.53)	(0.17)	(0.17)	(1.35)	(0.39)
		λ	**-3.94**	**-0.68**	**-0.88**	**0.25**	**0.88**	**-2.49**	**-0.46**	**-0.46**	**0.95**	**0.68**
			(-4.21)	(-1.83)	(-1.85)	(0.96)	(1.23)	(-4.32)	(-0.89)	(-1.07)	(1.08)	(1.41)
		Adj. R^2	-2.1%	1.8%	3.5%	17.9%	4.7%	-1.6%	0.1%	1.3%	10.7%	3.3%
			ChristieLag1					**ChristieLag2**				
All-Equity Financed	34	α	-0.04	0.01	0.01	0.10	0.03	-0.05	0.01	0.01	0.05	0.02
			(-0.62)	(0.19)	(0.18)	(0.99)	(0.36)	(-0.73)	(0.12)	(0.11)	(0.90)	(0.35)
		λ	**-4.26**	**-0.30**	**-0.56**	**0.95**	**1.13**	**-2.92**	**-0.31**	**-0.35**	**2.13**	**0.91**
			(-4.61)	(-0.90)	(-0.78)	(2.58)	(1.44)	(-4.22)	(-0.63)	(-0.63)	(2.68)	(1.27)
		Adj. R^2	-2.3%	0.1%	2.6%	32.1%	6.7%	-2.6%	-0.3%	1.5%	27.2%	5.9%
Debt Financed	38	α	-0.03	0.00	0.00	0.03	0.01	-0.04	0.00	0.00	0.05	0.02
			(-0.55)	(0.05)	(0.07)	(0.81)	(0.23)	(-0.52)	(0.08)	(0.07)	(1.02)	(0.34)
		λ	**-3.85**	**-0.54**	**-0.71**	**0.72**	**0.88**	**-2.47**	**-0.44**	**-0.47**	**0.92**	**0.68**
			(-3.55)	(-1.39)	(-1.32)	(4.67)	(1.45)	(-4.33)	(-1.00)	(-1.08)	(1.01)	(1.35)
		Adj. R^2	-2.1%	1.1%	2.2%	15.5%	3.9%	-1.8%	0.1%	1.3%	10.2%	3.3%
			DuffeeLag1					**DuffeeLag2**				
All-Equity Financed	34	α	-0.04	0.00	0.01	0.06	0.02	-0.04	0.00	0.01	0.08	0.02
			(-0.65)	(0.11)	(0.17)	(0.95)	(0.41)	(-0.52)	(0.05)	(0.10)	(1.03)	(0.34)
		λ	**-1.46**	**-0.09**	**-0.20**	**0.77**	**0.47**	**-1.60**	**-0.04**	**-0.16**	**1.15**	**0.50**
			(-4.93)	(-0.34)	(-0.72)	(3.29)	(1.83)	(-6.99)	(-0.22)	(-0.74)	(3.01)	(1.67)
		Adj. R^2	-2.6%	0.6%	3.7%	27.4%	7.0%	-2.5%	-0.4%	2.4%	51.5%	9.6%
Debt Financed	38	α	-0.01	0.00	0.00	0.02	0.01	-0.01	0.00	0.00	0.06	0.01
			(-0.61)	(0.08)	(0.09)	(0.67)	(0.25)	(-0.40)	(0.11)	(0.13)	(1.19)	(0.33)
		λ	**-1.11**	**-0.22**	**-0.21**	**2.16**	**0.51**	**-0.98**	**-0.19**	**-0.29**	**0.53**	**0.36**
			(-3.88)	(-1.53)	(-1.03)	(10.62)	(2.42)	(-5.66)	(-1.14)	(-1.44)	(1.38)	(1.75)
		Adj. R^2	-2.6%	0.9%	3.6%	31.0%	6.7%	-1.6%	1.0%	3.0%	17.4%	5.3%

Table 4: Summary statistics across firms from the first (lowest) quintile of operating leverage (defined as operating costs divided by book assets) in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010 of the estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic, where regressions are estimated firm by firm. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on NYSE, AMEX, NASDAQ, and ARCA, and the number of firms in each dataset is reported as well.

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					**BlackLag2**				
All-Equity Financed	26	α	0.03	0.11	0.11	0.22	0.04	0.02	0.14	0.12	0.28	0.06
			(0.56)	(1.67)	(1.75)	(3.22)	(0.65)	(0.24)	(1.66)	(1.72)	(3.70)	(0.89)
		λ	**-2.21**	**-0.57**	**-0.66**	**0.14**	**0.57**	**-3.19**	**-0.45**	**-0.60**	**0.82**	**0.94**
			(-3.13)	(-1.25)	(-1.27)	(0.32)	(0.80)	(-3.49)	(-1.15)	(-0.99)	(1.55)	(1.40)
		Adj. R^2	-1.6%	0.9%	1.4%	8.6%	2.5%	-2.5%	0.9%	2.8%	20.3%	5.5%
Debt Financed	46	α	0.03	0.11	0.12	0.24	0.05	0.02	0.13	0.14	0.34	0.07
			(0.43)	(1.77)	(1.80)	(3.14)	(0.60)	(0.26)	(1.84)	(1.84)	(3.30)	(0.65)
		λ	**-2.94**	**-0.55**	**-0.67**	**0.29**	**0.62**	**-2.97**	**-0.69**	**-0.75**	**0.64**	**0.90**
			(-4.00)	(-1.63)	(-1.56)	(1.08)	(1.09)	(-5.15)	(-1.41)	(-1.44)	(1.57)	(1.59)
		Adj. R^2	-2.1%	2.6%	3.1%	13.9%	4.1%	-2.0%	1.5%	4.0%	27.3%	7.3%
			LogBlackLag1					**LogBlackLag2**				
All-Equity Financed	26	α	-0.05	0.00	0.01	0.08	0.03	-0.08	0.00	-0.01	0.07	0.03
			(-0.75)	(0.03)	(0.11)	(1.31)	(0.48)	(-1.04)	(-0.06)	(-0.06)	(1.00)	(0.58)
		λ	**-2.43**	**-0.50**	**-0.65**	**0.08**	**0.56**	**-1.92**	**-0.37**	**-0.50**	**0.49**	**0.62**
			(-4.23)	(-1.55)	(-1.55)	(0.23)	(1.10)	(-3.49)	(-1.02)	(-1.04)	(1.18)	(1.20)
		Adj. R^2	-1.7%	1.6%	2.8%	15.2%	4.1%	-2.6%	0.5%	2.1%	20.3%	5.2%
Debt Financed	46	α	-0.05	0.01	0.00	0.09	0.02	-0.07	0.00	0.00	0.07	0.03
			(-0.87)	(0.11)	(0.11)	(1.35)	(0.39)	(-1.19)	(0.01)	(0.01)	(1.02)	(0.50)
		λ	**-2.77**	**-0.57**	**-0.67**	**0.38**	**0.65**	**-3.10**	**-0.45**	**-0.54**	**0.50**	**0.66**
			(-5.14)	(-2.05)	(-1.89)	(1.76)	(1.43)	(-6.24)	(-1.38)	(-1.37)	(1.38)	(1.57)
		Adj. R^2	-2.2%	4.7%	5.1%	21.0%	5.4%	-2.3%	1.2%	3.5%	24.7%	6.3%
			ChristieLag1					**ChristieLag2**				
All-Equity Financed	26	α	-0.05	-0.01	-0.01	0.03	0.02	-0.08	-0.01	-0.01	0.05	0.03
			(-0.90)	(-0.11)	(-0.07)	(0.63)	(0.41)	(-1.24)	(-0.13)	(-0.17)	(0.82)	(0.58)
		λ	**-2.28**	**-0.35**	**-0.48**	**0.20**	**0.52**	**-1.91**	**-0.38**	**-0.51**	**0.51**	**0.62**
			(-3.35)	(-1.06)	(-1.07)	(0.84)	(0.94)	(-3.45)	(-1.07)	(-1.06)	(1.23)	(1.20)
		Adj. R^2	-2.3%	0.2%	0.9%	9.8%	2.8%	-2.6%	0.7%	2.1%	19.9%	5.1%
Debt Financed	46	α	-0.05	0.00	0.00	0.07	0.02	-0.09	-0.01	-0.01	0.06	0.03
			(-0.81)	(-0.07)	(-0.06)	(1.10)	(0.38)	(-1.18)	(-0.11)	(-0.10)	(0.81)	(0.50)
		λ	**-2.64**	**-0.47**	**-0.56**	**0.43**	**0.66**	**-3.10**	**-0.45**	**-0.55**	**0.49**	**0.66**
			(-4.81)	(-1.66)	(-1.45)	(2.38)	(1.45)	(-6.21)	(-1.40)	(-1.40)	(1.37)	(1.57)
		Adj. R^2	-2.3%	2.9%	3.4%	19.3%	4.6%	-2.3%	1.2%	3.7%	24.4%	6.5%
			DuffeeLag1					**DuffeeLag2**				
All-Equity Financed	26	α	-0.04	0.00	0.00	0.03	0.01	-0.04	0.00	-0.01	0.03	0.02
			(-0.82)	(-0.07)	(-0.03)	(0.63)	(0.36)	(-1.22)	(-0.08)	(-0.11)	(0.85)	(0.52)
		λ	**-0.76**	**-0.21**	**-0.16**	**0.75**	**0.31**	**-1.19**	**-0.31**	**-0.31**	**0.31**	**0.36**
			(-2.97)	(-0.70)	(-0.66)	(3.36)	(1.37)	(-4.11)	(-1.29)	(-1.30)	(1.40)	(1.43)
		Adj. R^2	-2.5%	-0.5%	1.4%	11.4%	3.8%	-2.6%	0.9%	3.6%	26.5%	7.3%
Debt Financed	46	α	-0.03	0.00	0.00	0.06	0.02	-0.05	0.00	0.00	0.05	0.02
			(-0.75)	(-0.03)	(0.02)	(1.43)	(0.39)	(-1.04)	(-0.05)	(-0.03)	(1.19)	(0.47)
		λ	**-1.26**	**-0.30**	**-0.20**	**1.10**	**0.41**	**-1.39**	**-0.31**	**-0.29**	**0.87**	**0.44**
			(-4.61)	(-1.45)	(-1.17)	(4.91)	(1.98)	(-7.42)	(-1.50)	(-1.56)	(2.22)	(2.08)
		Adj. R^2	-1.9%	1.9%	4.4%	25.1%	6.0%	-2.3%	2.7%	5.8%	51.0%	10.0%

Table 5: Summary statistics across firms from the second quintile of operating leverage (defined as operating costs divided by book assets) in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010 of the estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic, where regressions are estimated firm by firm. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on NYSE, AMEX, NASDAQ, and ARCA, and the number of firms in each dataset is reported as well.

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					**BlackLag2**				
All-Equity Financed	30	α	0.05	0.13	0.14	0.36	0.07	0.06	0.13	0.15	0.44	0.08
			(0.96)	(1.85)	(1.69)	(2.37)	(0.37)	(0.88)	(1.62)	(1.69)	(2.72)	(0.44)
		λ	**-4.96**	**-0.59**	**-0.68**	**1.72**	**1.00**	**-6.13**	**-0.65**	**-0.78**	**0.78**	**1.32**
			(-2.81)	(-1.23)	(-1.19)	(0.98)	(0.85)	(-3.99)	(-1.63)	(-1.14)	(2.01)	(1.32)
		Adj. R^2	-1.8%	1.0%	2.1%	14.7%	3.6%	-2.3%	2.6%	3.1%	16.2%	4.7%
Debt Financed	35	α	0.03	0.12	0.13	0.36	0.07	0.06	0.13	0.14	0.30	0.06
			(1.07)	(1.83)	(1.94)	(3.72)	(0.56)	(0.77)	(1.98)	(1.92)	(3.03)	(0.54)
		λ	**-2.00**	**-0.56**	**-0.56**	**0.01**	**0.41**	**-1.89**	**-0.46**	**-0.58**	**0.48**	**0.58**
			(-4.46)	(-1.07)	(-1.46)	(0.01)	(1.22)	(-4.17)	(-1.19)	(-1.31)	(0.81)	(1.27)
		Adj. R^2	-2.0%	0.2%	2.2%	15.9%	5.0%	-2.4%	0.7%	1.9%	11.3%	3.7%
			LogBlackLag1					**LogBlackLag2**				
All-Equity Financed	30	α	-0.05	0.00	0.01	0.06	0.02	-0.07	0.00	0.00	0.06	0.03
			(-0.61)	(0.10)	(0.06)	(0.67)	(0.32)	(-0.94)	(-0.04)	(-0.07)	(0.80)	(0.43)
		λ	**-5.00**	**-0.62**	**-0.72**	**1.08**	**0.97**	**-4.81**	**-0.53**	**-0.64**	**0.58**	**0.99**
			(-3.74)	(-1.30)	(-1.50)	(0.99)	(1.03)	(-3.53)	(-1.64)	(-1.18)	(1.20)	(1.15)
		Adj. R^2	-1.5%	1.1%	4.0%	18.8%	6.1%	-2.3%	2.2%	2.8%	13.0%	4.6%
Debt Financed	35	α	-0.03	0.01	0.01	0.06	0.02	-0.08	0.01	0.00	0.07	0.02
			(-0.31)	(0.13)	(0.18)	(1.29)	(0.32)	(-0.83)	(0.09)	(0.06)	(1.21)	(0.37)
		λ	**-1.76**	**-0.45**	**-0.57**	**-0.04**	**0.38**	**-2.04**	**-0.37**	**-0.43**	**0.67**	**0.53**
			(-5.51)	(-1.19)	(-1.79)	(-0.16)	(1.46)	(-3.65)	(-1.02)	(-1.19)	(0.74)	(1.23)
		Adj. R^2	-1.8%	0.6%	3.9%	24.0%	7.4%	-2.3%	0.0%	1.6%	10.4%	3.4%
			ChristieLag1					**ChristieLag2**				
All-Equity Financed	30	α	-0.06	0.00	0.00	0.04	0.02	-0.10	-0.01	-0.01	0.04	0.03
			(-0.77)	(-0.05)	(-0.09)	(0.40)	(0.32)	(-1.14)	(-0.21)	(-0.20)	(0.61)	(0.43)
		λ	**-4.85**	**-0.38**	**-0.55**	**1.29**	**0.98**	**-4.78**	**-0.51**	**-0.64**	**0.55**	**0.99**
			(-3.27)	(-0.82)	(-1.05)	(1.19)	(1.01)	(-3.48)	(-1.62)	(-1.18)	(1.27)	(1.15)
		Adj. R^2	-1.6%	-0.5%	2.1%	16.8%	4.8%	-2.3%	2.3%	2.8%	12.6%	4.5%
Debt Financed	35	α	-0.04	0.00	0.00	0.04	0.01	-0.08	0.00	0.00	0.05	0.02
			(-0.69)	(0.03)	(-0.01)	(0.43)	(0.24)	(-0.93)	(0.00)	(-0.06)	(0.65)	(0.34)
		λ	**-1.63**	**-0.41**	**-0.45**	**0.18**	**0.40**	**-2.02**	**-0.38**	**-0.44**	**0.63**	**0.53**
			(-4.99)	(-0.89)	(-1.40)	(0.30)	(1.37)	(-3.73)	(-1.14)	(-1.22)	(0.69)	(1.24)
		Adj. R^2	-2.5%	-0.2%	2.4%	19.3%	5.9%	-2.3%	0.3%	1.7%	11.4%	3.5%
			DuffeeLag1					**DuffeeLag2**				
All-Equity Financed	30	α	-0.02	0.00	0.00	0.03	0.01	-0.05	0.00	-0.01	0.03	0.02
			(-0.48)	(-0.08)	(-0.06)	(0.83)	(0.29)	(-0.74)	(-0.14)	(-0.16)	(0.74)	(0.39)
		λ	**-1.23**	**-0.13**	**-0.17**	**0.78**	**0.42**	**-1.35**	**-0.27**	**-0.35**	**0.37**	**0.43**
			(-3.83)	(-0.54)	(-0.61)	(2.27)	(1.43)	(-5.49)	(-1.52)	(-1.25)	(1.49)	(1.51)
		Adj. R^2	-2.6%	-0.3%	2.1%	21.8%	5.9%	-2.1%	1.6%	4.2%	27.4%	6.8%
Debt Financed	35	α	-0.02	0.00	0.00	0.19	0.03	-0.03	0.00	0.00	0.17	0.03
			(-0.71)	(0.05)	(0.01)	(1.03)	(0.28)	(-0.83)	(0.01)	(0.00)	(1.28)	(0.37)
		λ	**-0.87**	**-0.07**	**-0.15**	**0.57**	**0.32**	**-0.85**	**-0.25**	**-0.23**	**0.22**	**0.26**
			(-5.35)	(-0.42)	(-0.96)	(1.56)	(1.67)	(-4.80)	(-1.17)	(-1.38)	(0.83)	(1.45)
		Adj. R^2	-2.6%	-0.5%	2.4%	21.7%	6.5%	-2.3%	0.5%	2.5%	18.1%	5.0%

Table 6: Summary statistics across firms from the third quintile of operating leverage (defined as operating costs divided by book assets) in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010 of the estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic, where regressions are estimated firm by firm. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on NYSE, AMEX, NASDAQ, and ARCA, and the number of firms in each dataset is reported as well.

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					**BlackLag2**				
All-Equity Financed	32	α	0.05	0.11	0.12	0.30	0.06	0.02	0.10	0.13	0.30	0.07
			(0.78)	(1.48)	(1.50)	(2.41)	(0.38)	(0.33)	(1.40)	(1.39)	(2.30)	(0.47)
		λ	**-1.70**	**-0.56**	**-0.54**	**0.66**	**0.39**	**-1.82**	**-0.41**	**-0.42**	**1.13**	**0.59**
			(-3.04)	(-1.45)	(-1.35)	(1.14)	(0.91)	(-3.15)	(-1.09)	(-1.00)	(2.10)	(1.19)
		Adj. R^2	-2.6%	1.6%	2.6%	12.6%	4.0%	-2.6%	0.4%	2.5%	13.5%	5.0%
Debt Financed	42	α	0.05	0.12	0.14	0.38	0.07	0.04	0.13	0.15	0.42	0.09
			(0.80)	(1.90)	(1.99)	(4.09)	(0.67)	(0.64)	(1.87)	(1.88)	(3.93)	(0.71)
		λ	**-4.37**	**-0.54**	**-0.73**	**0.00**	**0.72**	**-1.84**	**-0.40**	**-0.39**	**1.06**	**0.66**
			(-3.44)	(-1.46)	(-1.43)	(-0.00)	(0.80)	(-4.54)	(-0.93)	(-0.90)	(1.73)	(1.27)
		Adj. R^2	-2.3%	1.4%	1.8%	12.1%	3.1%	-2.0%	0.3%	1.6%	11.7%	3.5%
			LogBlackLag1					**LogBlackLag2**				
All-Equity Financed	32	α	-0.04	-0.01	0.00	0.04	0.02	-0.11	-0.02	-0.01	0.05	0.04
			(-0.54)	(-0.09)	(-0.03)	(0.79)	(0.31)	(-1.13)	(-0.29)	(-0.17)	(0.92)	(0.50)
		λ	**-2.31**	**-0.57**	**-0.60**	**0.66**	**0.53**	**-1.24**	**-0.38**	**-0.39**	**0.63**	**0.45**
			(-4.43)	(-1.56)	(-1.69)	(1.49)	(1.30)	(-3.20)	(-1.03)	(-1.10)	(1.35)	(1.16)
		Adj. R^2	-2.1%	2.2%	5.0%	21.2%	6.6%	-2.4%	0.9%	2.5%	13.9%	4.9%
Debt Financed	42	α	-0.02	0.01	0.01	0.08	0.02	-0.04	0.00	0.00	0.08	0.03
			(-0.36)	(0.18)	(0.21)	(0.86)	(0.29)	(-0.83)	(-0.04)	(-0.01)	(1.47)	(0.43)
		λ	**-3.44**	**-0.52**	**-0.69**	**-0.05**	**0.62**	**-1.32**	**-0.30**	**-0.30**	**0.63**	**0.49**
			(-4.74)	(-1.68)	(-1.72)	(-0.10)	(1.04)	(-4.01)	(-0.92)	(-0.85)	(1.84)	(1.18)
		Adj. R^2	-2.5%	2.2%	3.3%	24.0%	4.9%	-2.2%	-0.1%	1.3%	9.5%	3.3%
			ChristieLag1					**ChristieLag2**				
All-Equity Financed	32	α	-0.07	-0.01	-0.02	0.03	0.02	-0.14	-0.02	-0.02	0.05	0.04
			(-0.84)	(-0.23)	(-0.23)	(0.56)	(0.33)	(-1.41)	(-0.37)	(-0.31)	(0.89)	(0.48)
		λ	**-2.22**	**-0.39**	**-0.47**	**0.72**	**0.54**	**-1.28**	**-0.43**	**-0.40**	**0.63**	**0.45**
			(-3.68)	(-1.20)	(-1.28)	(1.74)	(1.20)	(-3.20)	(-1.08)	(-1.11)	(1.35)	(1.15)
		Adj. R^2	-2.4%	1.3%	2.9%	16.6%	5.2%	-2.4%	0.9%	2.5%	14.0%	4.8%
Debt Financed	42	α	-0.06	0.00	0.00	0.08	0.02	-0.05	-0.01	-0.01	0.05	0.02
			(-1.13)	(0.04)	(0.05)	(0.75)	(0.35)	(-0.81)	(-0.14)	(-0.13)	(0.85)	(0.38)
		λ	**-3.37**	**-0.41**	**-0.55**	**0.39**	**0.64**	**-1.27**	**-0.30**	**-0.30**	**0.65**	**0.47**
			(-4.12)	(-1.43)	(-1.32)	(0.65)	(1.05)	(-4.01)	(-0.93)	(-0.88)	(1.89)	(1.19)
		Adj. R^2	-2.5%	1.1%	1.9%	19.0%	4.0%	-2.2%	-0.1%	1.4%	9.7%	3.4%
			DuffeeLag1					**DuffeeLag2**				
All-Equity Financed	32	α	-0.03	-0.01	-0.01	0.02	0.01	-0.03	-0.01	-0.01	0.03	0.02
			(-0.61)	(-0.15)	(-0.14)	(0.59)	(0.24)	(-0.83)	(-0.27)	(-0.21)	(0.98)	(0.39)
		λ	**-1.03**	**-0.20**	**-0.21**	**0.75**	**0.34**	**-0.84**	**-0.30**	**-0.31**	**0.26**	**0.28**
			(-3.83)	(-0.92)	(-0.94)	(3.65)	(1.44)	(-3.69)	(-1.10)	(-1.27)	(1.01)	(1.22)
		Adj. R^2	-2.4%	-0.2%	2.6%	22.9%	6.2%	-2.6%	0.5%	3.4%	22.3%	6.9%
Debt Financed	42	α	-0.07	0.00	0.00	0.06	0.02	-0.04	0.00	0.00	0.05	0.01
			(-1.29)	(0.05)	(0.05)	(0.88)	(0.37)	(-0.90)	(-0.09)	(-0.09)	(0.77)	(0.35)
		λ	**-1.18**	**-0.17**	**-0.17**	**0.62**	**0.32**	**-0.97**	**-0.18**	**-0.26**	**0.36**	**0.32**
			(-4.57)	(-0.99)	(-1.03)	(2.55)	(1.43)	(-4.56)	(-1.09)	(-1.18)	(1.90)	(1.39)
		Adj. R^2	-2.3%	0.5%	2.3%	22.6%	5.0%	-2.3%	0.5%	2.8%	17.0%	5.2%

Table 7: Summary statistics across firms from the fourth quintile of operating leverage (defined as operating costs divided by book assets) in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010 of the estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic, where regressions are estimated firm by firm. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on NYSE, AMEX, NASDAQ, and ARCA, and the number of firms in each dataset is reported as well.

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					**BlackLag2**				
All-Equity Financed	31	α	0.02	0.13	0.15	0.54	0.10	-0.03	0.14	0.16	0.46	0.10
			(0.31)	(1.80)	(1.93)	(4.26)	(0.78)	(-0.45)	(1.80)	(1.76)	(3.25)	(0.72)
		λ	**-1.68**	**-0.56**	**-0.59**	**0.15**	**0.42**	**-1.95**	**-0.44**	**-0.39**	**1.25**	**0.59**
			(-4.74)	(-1.28)	(-1.64)	(0.25)	(1.36)	(-4.15)	(-1.14)	(-0.97)	(1.61)	(1.25)
		Adj. R^2	-2.5%	0.9%	4.7%	29.3%	8.3%	-2.5%	0.9%	2.2%	27.0%	5.5%
Debt Financed	29	α	0.06	0.11	0.14	0.45	0.08	0.05	0.13	0.16	0.52	0.09
			(1.28)	(2.44)	(2.43)	(4.14)	(0.84)	(0.81)	(2.36)	(2.47)	(4.43)	(0.82)
		λ	**-1.50**	**-0.58**	**-0.55**	**0.07**	**0.38**	**-1.49**	**-0.45**	**-0.49**	**0.36**	**0.40**
			(-4.25)	(-1.69)	(-1.90)	(0.11)	(1.29)	(-3.98)	(-1.52)	(-1.49)	(0.82)	(1.25)
		Adj. R^2	-2.2%	2.0%	2.6%	10.1%	3.2%	-1.9%	1.3%	1.5%	8.7%	2.5%
			LogBlackLag1					**LogBlackLag2**				
All-Equity Financed	31	α	-0.05	0.02	0.02	0.16	0.03	-0.14	0.00	0.01	0.13	0.04
			(-0.80)	(0.23)	(0.32)	(1.98)	(0.52)	(-1.57)	(0.05)	(0.08)	(1.37)	(0.53)
		λ	**-2.25**	**-0.63**	**-0.62**	**0.14**	**0.52**	**-1.52**	**-0.39**	**-0.35**	**0.26**	**0.36**
			(-5.11)	(-1.61)	(-1.90)	(0.36)	(1.54)	(-3.85)	(-1.08)	(-0.98)	(0.87)	(1.01)
		Adj. R^2	-2.6%	3.3%	6.5%	36.3%	10.0%	-2.5%	0.2%	1.5%	23.9%	5.0%
Debt Financed	29	α	-0.02	0.01	0.01	0.05	0.02	-0.05	0.01	0.01	0.09	0.03
			(-0.28)	(0.22)	(0.32)	(1.32)	(0.38)	(-0.69)	(0.21)	(0.22)	(1.04)	(0.49)
		λ	**-3.21**	**-0.54**	**-0.63**	**0.15**	**0.60**	**-1.70**	**-0.39**	**-0.41**	**0.17**	**0.34**
			(-6.33)	(-2.12)	(-2.47)	(0.29)	(1.70)	(-4.09)	(-1.29)	(-1.50)	(0.59)	(1.15)
		Adj. R^2	-2.3%	4.0%	5.6%	43.4%	8.5%	-1.8%	1.2%	1.5%	9.7%	2.8%
			ChristieLag1					**ChristieLag2**				
All-Equity Financed	31	α	-0.06	0.00	0.00	0.03	0.02	-0.14	-0.01	0.00	0.06	0.03
			(-0.93)	(-0.04)	(-0.01)	(0.63)	(0.33)	(-1.58)	(-0.10)	(-0.05)	(0.67)	(0.45)
		λ	**-2.00**	**-0.48**	**-0.50**	**0.30**	**0.50**	**-1.53**	**-0.40**	**-0.37**	**0.25**	**0.37**
			(-4.50)	(-1.23)	(-1.43)	(0.82)	(1.40)	(-3.86)	(-1.15)	(-1.02)	(0.86)	(1.06)
		Adj. R^2	-2.6%	1.0%	4.2%	30.4%	7.7%	-2.6%	0.4%	1.7%	24.0%	5.3%
Debt Financed	29	α	-0.03	0.00	0.00	0.02	0.01	-0.08	0.00	0.00	0.07	0.03
			(-0.51)	(0.07)	(0.02)	(0.68)	(0.28)	(-0.91)	(0.08)	(0.03)	(0.80)	(0.43)
		λ	**-3.45**	**-0.49**	**-0.53**	**0.35**	**0.66**	**-2.00**	**-0.37**	**-0.43**	**0.17**	**0.38**
			(-5.22)	(-1.70)	(-1.92)	(0.68)	(1.55)	(-4.41)	(-1.32)	(-1.53)	(0.61)	(1.15)
		Adj. R^2	-2.3%	1.9%	3.6%	34.0%	6.8%	-1.5%	0.8%	1.6%	11.2%	2.9%
			DuffeeLag1					**DuffeeLag2**				
All-Equity Financed	31	α	-0.07	0.00	0.00	0.04	0.02	-0.04	0.00	0.00	0.08	0.02
			(-0.66)	(-0.03)	(0.03)	(0.70)	(0.31)	(-1.11)	(-0.03)	(-0.01)	(0.69)	(0.38)
		λ	**-1.55**	**-0.14**	**-0.26**	**0.71**	**0.44**	**-1.30**	**-0.24**	**-0.26**	**0.23**	**0.32**
			(-5.02)	(-0.60)	(-1.11)	(2.32)	(1.73)	(-3.98)	(-1.15)	(-1.08)	(0.70)	(1.10)
		Adj. R^2	-2.3%	0.2%	4.4%	35.5%	8.8%	-2.6%	0.6%	2.1%	25.2%	5.7%
Debt Financed	29	α	-0.04	0.00	0.00	0.06	0.02	-0.02	0.00	0.00	0.10	0.02
			(-0.74)	(0.01)	(0.07)	(0.75)	(0.31)	(-0.54)	(0.03)	(0.07)	(1.20)	(0.39)
		λ	**-2.07**	**-0.26**	**-0.28**	**0.72**	**0.48**	**-0.94**	**-0.28**	**-0.33**	**0.10**	**0.24**
			(-6.00)	(-1.58)	(-1.64)	(2.31)	(2.09)	(-6.83)	(-1.49)	(-1.88)	(0.84)	(1.52)
		Adj. R^2	-2.3%	2.0%	4.5%	30.0%	7.3%	-1.5%	2.3%	3.0%	23.7%	5.4%

Table 8: Summary statistics across firms from the fifth (highest) quintile of operating leverage (defined as operating costs divided by book assets) in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010 of the estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic, where regressions are estimated firm by firm. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on NYSE, AMEX, NASDAQ, and ARCA, and the number of firms in each dataset is reported as well.

than in the highest (Q5) operating leverage quintile, in some cases even turning positive in the highest quintile: −0.96 (Q1) vs. −0.52 (Q5) in `BlackLag1`, −0.90 (Q1) vs. 0.54 (Q5) in `BlackLag2`, −0.81 (Q1) vs. −0.48 (Q5) in `LogBlackLag1`, −0.44 (Q1) vs. 0.22 (Q5) in `LogBlackLag2`, −0.60 (Q1) vs. −0.37 (Q5) in `ChristieLag1`, −0.43 (Q1) vs. 0.22 (Q5) in `ChristieLag2`, −0.26 (Q1) vs. −0.01 (Q5) in `DuffieLag1`, and −0.19 (Q1) vs. 0.21 (Q5) in `DuffieLag2`.

Results in Tables A.4–A.8, which summarize the firm-level regression results for operating leverage quintiles Q1–Q5 respectively, are a bit less striking, though they still do not suggest that operating leverage could be a driver behind the observed leverage effect in the all-equity financed sample of firms. Although in all eight specifications λ is more negative in the highest (Q5) than in the lowest (Q1) operating leverage quintile, in most cases the leverage effect in the second lowest (Q2) or third lowest (Q3) operating leverage quintile is comparable to or more pronounced than that in the highest (Q5) quintile: −0.51 (Q2) vs. −0.57 (Q5) in `BlackLag1`, −0.50 (Q3) vs. −0.41 (Q5) in `BlackLag2`, −0.59 (Q2) vs. −0.67 (Q5) in `LogBlackLag1`, −0.42 (Q3) vs. −0.40 (Q5) in `LogBlackLag2`, −0.43 (Q2) vs. −0.54 (Q5) in `ChristieLag1`, −0.45 (Q3) vs. −0.42 (Q5) in `ChristieLag2`, −0.14 (Q3) vs. −0.22 (Q5) in `DuffieLag1`, and −0.25 (Q3) vs. −0.31 (Q5) in `DuffieLag2`.

We conclude that the inverse relationship between a firm's stock return and the resulting change in volatility observed in the all-equity financed sample is not driven by operating leverage.

5 Conclusion

The inverse relationship between equity returns and subsequent volatility changes is one of the most well-established empirical regularities in stock-market data. Long considered to be the result of leverage, the so-called leverage effect is, in fact, not due to leverage. Our results show that this inverse relationship is at least as strong, and sometimes stronger, among a sample of all-equity-financed firms, and that in that sample it cannot be explained by operating leverage.

Our analysis does not provide a clear-cut alternative to the leverage explanation. By ruling out leverage as the source of the return/volatility relationship, our results may be

interpreted as supportive of the time-varying expected return hypothesis of Pindyck (1984), French, Schwert, and Stambaugh (1987), and Campbell and Hentschel (1992). Our findings provide support for the recent volatility-feedback model of Danielsson, Shin, and Zigrand (2009), in which asset-market volatility is endogenously determined in equilibrium by a combination of leverage constraints, feedback effects, and market conditions.

However, our results are also consistent with a behavioral interpretation in which investors' behavior is shaped by their recent experiences, altering their perceptions of risk and, consequently, giving rise to changes in their demand for risky assets. Such biased perceptions of risk have been modeled by Gennaioli and Shleifer (2010), in which individuals make judgments by recalling past experiences and scenarios that are the most representative of the current situation, and combining these experiences with current information. Such judgments will be biased not only because the representative scenarios that come to mind depend on the situation being evaluated, but also because the scenarios that first come to mind tend to be stereotypical ones. In our context, the first memories that come to mind of an investor who has experienced significant financial loss is despair; as a result, emotions take hold, prompting the investor to quickly reverse his positions, rather than continuing with a given investment policy.

The view that our recent experiences can have substantial effects on our future behavior is also backed by Lleras, Kawahara, and Levinthal (2009).[10] In their research, Lleras and his co-authors show that memories of past experiences affect the kinds of information we pay attention to today. In particular, they compare the effects on the attention system of externally-attributed rewards and penalties to the memory-driven effects that arise when subjects repeatedly perform a task, and find that in both cases the attention system is affected in analogous ways. This leads them to conclude that memories are tainted (positively or negatively) by implicit assessments of our past performance.

Additional support for a behavioral interpretation of the leverage effect may be found in some recent experimental evidence (Hens and Steude, 2009) in which 24 students were asked to trade artificial securities with each other using an electronic trading system, and the

[10]See also Lleras' ongoing research as described in his APS Revolutionary Science 22nd Annual Convention invited talk "The Hidden Value In Memories: Equivalent Effects of Memory and External Rewards on Attention System" (May 2010).

returns generated by these trades were negatively correlated with changes in future volatility estimates. Clearly in this experimental context, neither leverage nor time-varying expected returns can explain the inverse return/volatility relationship.

To distinguish among these competing explanations, further empirical and experimental analysis—with more explicit models of investor behavior and market equilibrium—is required. We hope to pursue these extensions in future research.

A Appendix

A.1 Financial Leverage

To provide additional robustness checks for our results, in the Appendix Tables A.1–A.2 we re-run the analysis of Tables 1–2 for individual firms and equal-weighted portfolios of firms, respectively, but consider only those subsets of firms in the AE and DF datasets that are traded on NYSE or AMEX exchanges. These results are qualitatively consistent with the patterns from the complete AE and DF samples, but should be interpreted with caution due to uneven sample sizes of the two datasets (there are twice as many DF firms in the NYSE/AMEX subsamples).

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					BlackLag2				
All-Equity Financed	53	α	0.03	0.13	0.14	0.43	0.07	-0.03	0.15	0.15	0.38	0.07
			(0.67)	(1.96)	(2.07)	(4.68)	(0.84)	(-0.63)	(1.94)	(2.10)	(4.89)	(1.09)
		λ	**-2.85**	**-0.51**	**-0.55**	**0.59**	**0.64**	**-4.29**	**-0.27**	**-0.37**	**5.80**	**1.39**
			(-3.87)	(-0.92)	(-1.08)	(1.02)	(1.06)	(-4.16)	(-0.54)	(-0.70)	(3.52)	(1.42)
		Adj. R^2	-2.1%	0.1%	1.4%	19.7%	3.9%	-2.3%	-0.2%	1.1%	16.0%	3.8%
Debt Financed	100	α	0.03	0.11	0.13	0.39	0.06	0.02	0.14	0.16	0.53	0.09
			(0.81)	(2.22)	(2.31)	(5.01)	(0.80)	(0.56)	(2.34)	(2.50)	(4.98)	(0.89)
		λ	**-3.55**	**-0.56**	**-0.71**	**0.61**	**0.60**	**-14.32**	**-0.70**	**-1.37**	**5.17**	**2.28**
			(-5.64)	(-1.70)	(-1.70)	(0.86)	(1.21)	(-6.04)	(-2.02)	(-2.03)	(3.01)	(1.81)
		Adj. R^2	-2.6%	1.3%	2.4%	26.0%	4.5%	-2.2%	2.9%	4.4%	27.3%	6.2%
			LogBlackLag1					LogBlackLag2				
All-Equity Financed	53	α	-0.04	0.01	0.01	0.06	0.02	-0.10	0.01	0.00	0.05	0.03
			(-0.63)	(0.21)	(0.22)	(1.44)	(0.38)	(-1.86)	(0.08)	(0.06)	(0.99)	(0.49)
		λ	**-2.75**	**-0.51**	**-0.57**	**0.75**	**0.72**	**-2.56**	**-0.26**	**-0.32**	**3.53**	**0.88**
			(-6.27)	(-1.46)	(-1.45)	(2.02)	(1.60)	(-3.33)	(-0.70)	(-0.73)	(4.03)	(1.36)
		Adj. R^2	-2.2%	1.8%	3.8%	40.2%	6.8%	-2.4%	-0.1%	0.9%	15.8%	3.4%
Debt Financed	100	α	-0.03	0.01	0.01	0.10	0.02	-0.09	0.01	0.01	0.11	0.03
			(-0.48)	(0.27)	(0.27)	(1.38)	(0.33)	(-1.08)	(0.27)	(0.28)	(1.45)	(0.51)
		λ	**-3.14**	**-0.51**	**-0.66**	**0.80**	**0.58**	**-5.27**	**-0.57**	**-0.87**	**1.44**	**1.06**
			(-6.66)	(-1.96)	(-2.05)	(0.80)	(1.43)	(-5.70)	(-1.94)	(-1.96)	(2.54)	(1.69)
		Adj. R^2	-2.3%	1.9%	4.0%	29.0%	5.8%	-2.1%	2.1%	3.9%	20.3%	5.4%
			ChristieLag1					ChristieLag2				
All-Equity Financed	53	α	-0.04	0.00	0.00	0.04	0.02	-0.10	0.00	0.00	0.04	0.03
			(-0.73)	(0.05)	(0.04)	(0.85)	(0.31)	(-1.81)	(0.07)	(-0.01)	(0.80)	(0.43)
		λ	**-2.70**	**-0.36**	**-0.43**	**0.87**	**0.73**	**-2.46**	**-0.29**	**-0.31**	**3.71**	**0.87**
			(-5.13)	(-1.15)	(-0.96)	(2.77)	(1.48)	(-3.32)	(-0.72)	(-0.76)	(4.05)	(1.36)
		Adj. R^2	-2.2%	0.7%	2.3%	30.7%	5.1%	-2.4%	-0.1%	1.0%	16.0%	3.4%
Debt Financed	100	α	-0.05	0.00	0.00	0.09	0.02	-0.10	0.00	0.00	0.09	0.03
			(-0.86)	(0.06)	(0.07)	(1.29)	(0.30)	(-1.09)	(0.05)	(0.11)	(1.12)	(0.45)
		λ	**-2.98**	**-0.39**	**-0.52**	**1.00**	**0.60**	**-5.30**	**-0.58**	**-0.87**	**1.44**	**1.04**
			(-5.09)	(-1.31)	(-1.52)	(4.10)	(1.42)	(-5.65)	(-1.91)	(-1.99)	(2.46)	(1.70)
		Adj. R^2	-2.4%	0.6%	2.3%	20.6%	4.3%	-2.0%	2.3%	4.1%	32.2%	5.9%
			DuffeeLag1					DuffeeLag2				
All-Equity Financed	53	α	-0.04	0.00	0.00	0.07	0.01	-0.02	0.00	0.00	0.03	0.01
			(-0.74)	(0.05)	(0.04)	(0.80)	(0.34)	(-1.59)	(0.09)	(0.01)	(0.73)	(0.39)
		λ	**-1.34**	**-0.10**	**-0.11**	**2.16**	**0.50**	**-1.39**	**-0.16**	**-0.18**	**1.51**	**0.39**
			(-4.51)	(-0.75)	(-0.64)	(5.79)	(1.96)	(-4.35)	(-0.70)	(-0.95)	(3.54)	(1.53)
		Adj. R^2	-2.2%	1.0%	3.2%	34.4%	6.5%	-2.6%	0.3%	1.6%	12.8%	3.6%
Debt Financed	100	α	-0.06	0.00	0.00	0.16	0.02	-0.06	0.00	0.01	0.21	0.03
			(-0.73)	(0.05)	(0.09)	(1.54)	(0.34)	(-0.82)	(0.09)	(0.16)	(1.39)	(0.42)
		λ	**-1.21**	**-0.16**	**-0.16**	**2.04**	**0.45**	**-1.63**	**-0.38**	**-0.38**	**0.75**	**0.39**
			(-8.03)	(-0.98)	(-1.22)	(10.46)	(2.27)	(-8.78)	(-1.81)	(-2.32)	(2.86)	(2.32)
		Adj. R^2	-2.1%	0.5%	3.6%	31.2%	7.1%	-2.2%	3.0%	6.2%	43.0%	9.6%

Table A.1: Summary statistics across all NYSE and AMEX firms in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010 of the estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic, where regressions are estimated firm by firm. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. The number of firms in each dataset is reported as well.

Dataset	Statistic	BlackLag1	BlackLag2	LogBlackLag1	LogBlackLag2	ChristieLag1	ChristieLag2	DuffeeLag1	DuffeeLag2
		NYSE and AMEX Only							
All-Equity Financed	α	0.10	0.11	0.02	0.02	0.02	0.01	0.00	0.00
		(4.49)	(4.54)	(1.05)	(0.76)	(0.89)	(0.71)	(0.89)	(0.96)
	λ	**-1.02**	**-1.02**	**-1.07**	**-0.83**	**-0.99**	**-0.84**	**-0.21**	**-0.25**
		(-2.78)	(-2.45)	(-3.45)	(-2.46)	(-3.17)	(-2.49)	(-3.17)	(-3.47)
	Adj. R^2	1.5%	1.1%	2.3%	1.1%	2.0%	1.1%	2.0%	2.4%
Debt Financed	α	0.07	0.12	0.01	0.03	0.01	0.02	0.00	0.01
		(4.02)	(5.33)	(0.77)	(1.59)	(0.64)	(1.42)	(0.83)	(2.05)
	λ	**-0.90**	**-2.26**	**-0.80**	**-1.78**	**-0.75**	**-1.77**	**-0.21**	**-0.56**
		(-3.61)	(-7.64)	(-3.70)	(-7.51)	(-3.46)	(-7.51)	(-4.27)	(-10.38)
	Adj. R^2	2.6%	11.2%	2.7%	10.9%	2.4%	10.9%	3.7%	19.1%

Table A.2: Estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic for the equal-weighted portfolio of all firms in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on NYSE and AMEX exchanges only.

A.2 Operating Leverage

To test the robustness of the results in Section 4.2 computed using the Novy-Marx (2011) definition of operating leverage, in the Appendix Tables A.3–A.8 we replicate the analysis of Tables 3–8, but compute operating leverage according to another commonly used definition, namely as the percent change in earnings divided by the percent change in sales. Table A.3 refers to equal-weighted portfolios of firms in each operating leverage quintile, while Tables A.4–A.8 refer to the firm-level analysis. Qualitatively the patters observed in these tables are in line with those observed in Tables 3–8; see Section 4.2 for further discussion.

Dataset	Statistic	BlackLag1	BlackLag2	LogBlackLag1	LogBlackLag2	ChristieLag1	ChristieLag2	DuffeeLag1	DuffeeLag2
					OL Q1				
All-Equity Financed	α	0.12	0.13	0.01	0.00	0.00	-0.01	0.00	0.00
		(3.86)	(3.58)	(0.49)	(-0.09)	(0.11)	(-0.22)	(0.12)	(-0.18)
	λ	**-0.96**	**-0.90**	**-0.81**	**-0.44**	**-0.60**	**-0.43**	**-0.26**	**-0.19**
		(-3.41)	(-2.70)	(-3.50)	(-1.75)	(-2.54)	(-1.69)	(-2.09)	(-1.48)
	Adj. R^2	3.4%	2.1%	3.6%	0.7%	1.8%	0.6%	1.1%	0.4%
Debt Financed	α	0.11	0.13	0.02	0.00	0.01	0.00	0.01	0.00
		(4.09)	(3.95)	(0.84)	(0.20)	(0.61)	(0.14)	(0.85)	(0.27)
	λ	**-0.90**	**-0.68**	**-0.83**	**-0.33**	**-0.76**	**-0.34**	**-0.30**	**-0.14**
		(-3.26)	(-1.99)	(-4.14)	(-1.47)	(-3.74)	(-1.47)	(-4.94)	(-2.02)
	Adj. R^2	2.2%	0.7%	3.6%	0.3%	2.9%	0.3%	5.1%	0.7%
					OL Q2				
All-Equity Financed	α	0.14	0.17	0.02	0.01	0.02	0.01	0.01	0.00
		(3.76)	(3.50)	(0.86)	(0.25)	(0.60)	(0.19)	(0.69)	(0.35)
	λ	**-0.98**	**-0.17**	**-0.98**	**-0.34**	**-0.92**	**-0.35**	**-0.32**	**-0.19**
		(-2.84)	(-0.38)	(-4.35)	(-1.28)	(-4.02)	(-1.31)	(-4.40)	(-2.22)
	Adj. R^2	2.0%	-0.3%	5.0%	0.2%	4.3%	0.2%	5.1%	1.1%
Debt Financed	α	0.08	0.11	0.01	0.02	0.01	0.01	0.00	0.00
		(4.21)	(4.50)	(0.82)	(0.83)	(0.62)	(0.69)	(0.53)	(0.74)
	λ	**-0.91**	**-1.11**	**-0.91**	**-0.96**	**-0.85**	**-0.97**	**-0.19**	**-0.28**
		(-3.89)	(-3.73)	(-4.38)	(-4.03)	(-4.09)	(-4.05)	(-3.44)	(-4.28)
	Adj. R^2	3.2%	3.0%	4.1%	3.5%	3.6%	3.5%	2.5%	3.9%
					OL Q3				
All-Equity Financed	α	0.13	0.17	0.02	0.02	0.02	0.02	0.01	0.01
		(4.54)	(4.50)	(1.09)	(0.96)	(0.82)	(0.85)	(0.98)	(0.85)
	λ	**-1.29**	**-1.55**	**-1.13**	**-1.13**	**-1.04**	**-1.20**	**-0.38**	**-0.38**
		(-3.36)	(-3.04)	(-3.96)	(-3.43)	(-3.51)	(-3.54)	(-4.19)	(-3.60)
	Adj. R^2	2.4%	1.9%	3.4%	2.5%	2.6%	2.6%	3.8%	2.7%
Debt Financed	α	0.09	0.13	0.01	0.02	0.01	0.01	0.00	0.01
		(4.30)	(4.98)	(0.79)	(0.91)	(0.54)	(0.70)	(0.61)	(0.82)
	λ	**-1.09**	**-1.64**	**-1.00**	**-1.35**	**-0.92**	**-1.35**	**-0.32**	**-0.47**
		(-4.48)	(-5.68)	(-4.89)	(-5.72)	(-4.47)	(-5.72)	(-5.01)	(-6.52)
	Adj. R^2	4.2%	6.7%	5.0%	6.8%	4.2%	6.8%	5.2%	8.7%
					OL Q4				
All-Equity Financed	α	0.11	0.13	0.02	0.01	0.01	0.00	0.00	0.00
		(3.99)	(4.18)	(0.89)	(0.23)	(0.64)	(0.18)	(0.68)	(-0.05)
	λ	**-0.94**	**-0.77**	**-1.16**	**-0.60**	**-1.07**	**-0.65**	**-0.36**	**-0.08**
		(-2.84)	(-2.07)	(-4.71)	(-2.11)	(-4.21)	(-2.21)	(-4.38)	(-0.90)
	Adj. R^2	1.7%	0.8%	4.9%	0.8%	3.9%	0.9%	4.2%	0.0%
Debt Financed	α	0.09	0.10	0.01	0.01	0.01	0.01	0.00	0.00
		(4.13)	(4.11)	(0.54)	(0.42)	(0.37)	(0.31)	(0.28)	(0.32)
	λ	**-1.03**	**-0.89**	**-0.88**	**-0.82**	**-0.81**	**-0.83**	**-0.23**	**-0.27**
		(-3.84)	(-2.94)	(-3.87)	(-3.32)	(-3.57)	(-3.35)	(-3.98)	(-4.15)
	Adj. R^2	3.0%	1.7%	3.1%	2.2%	2.6%	2.3%	3.3%	3.6%
					OL Q5				
All-Equity Financed	α	0.14	0.14	0.01	-0.01	0.01	-0.01	0.00	0.00
		(3.02)	(2.99)	(0.43)	(-0.28)	(0.23)	(-0.24)	(-0.03)	(-0.45)
	λ	**-0.52**	**0.54**	**-0.48**	**0.22**	**-0.37**	**0.22**	**-0.01**	**0.21**
		(-1.33)	(1.34)	(-2.16)	(0.83)	(-1.64)	(0.85)	(-0.06)	(2.15)
	Adj. R^2	0.2%	0.2%	1.1%	-0.1%	0.5%	-0.1%	-0.3%	1.1%
Debt Financed	α	0.11	0.13	0.02	0.01	0.01	0.00	0.00	0.00
		(3.86)	(4.36)	(0.84)	(0.31)	(0.54)	(0.20)	(0.50)	(-0.06)
	λ	**-0.63**	**-0.87**	**-0.89**	**-0.60**	**-0.77**	**-0.61**	**-0.29**	**-0.17**
		(-2.25)	(-3.07)	(-4.34)	(-2.68)	(-3.73)	(-2.67)	(-3.71)	(-1.99)
	Adj. R^2	1.0%	2.0%	4.2%	1.5%	3.0%	1.5%	3.0%	0.7%

Table A.3: Estimated regression coefficients, associated t-statistics (in parentheses), and the adjusted R^2 for the equal-weighted portfolio of firms from the first (lowest) to the fifth (highest) quintile of operating leverage (defined as change in earnings divided by change in sales), in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on all exchanges (NYSE, AMEX, NASDAQ, and ARCA).

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					BlackLag2				
All-Equity Financed		α	0.03	0.13	0.15	0.52	0.09	0.02	0.14	0.16	0.52	0.11
			(0.72)	(1.84)	(1.96)	(4.60)	(0.75)	(0.54)	(1.82)	(1.85)	(4.34)	(0.80)
	40	λ	**-1.62**	**-0.35**	**-0.36**	**0.50**	**0.37**	**-1.79**	**-0.43**	**-0.27**	**2.97**	**0.81**
			(-3.73)	(-0.88)	(-1.09)	(0.80)	(1.05)	(-3.76)	(-1.14)	(-0.97)	(2.28)	(1.33)
		Adj. R^2	-2.3%	-0.2%	0.8%	9.6%	2.7%	-2.4%	0.9%	1.8%	18.5%	4.0%
Debt Financed		α	0.06	0.12	0.15	0.39	0.07	0.07	0.14	0.18	0.46	0.09
			(1.22)	(2.15)	(2.33)	(5.01)	(0.85)	(1.20)	(2.31)	(2.37)	(4.98)	(0.71)
	43	λ	**-3.55**	**-0.61**	**-0.66**	**0.67**	**0.62**	**-4.18**	**-0.48**	**-0.60**	**0.69**	**0.76**
			(-5.64)	(-1.85)	(-1.99)	(1.29)	(1.36)	(-4.18)	(-1.44)	(-1.46)	(1.25)	(1.20)
		Adj. R^2	-2.3%	2.8%	3.8%	14.4%	4.7%	-2.2%	1.5%	2.1%	21.3%	3.9%
			LogBlackLag1					LogBlackLag2				
All-Equity Financed		α	-0.05	0.00	0.00	0.06	0.03	-0.11	-0.01	-0.01	0.08	0.04
			(-0.84)	(0.01)	(0.04)	(1.01)	(0.46)	(-1.41)	(-0.10)	(-0.18)	(1.07)	(0.55)
	40	λ	**-1.88**	**-0.41**	**-0.42**	**0.90**	**0.48**	**-1.37**	**-0.39**	**-0.28**	**1.65**	**0.56**
			(-7.60)	(-1.47)	(-1.62)	(1.77)	(1.76)	(-4.01)	(-1.31)	(-1.18)	(3.50)	(1.48)
		Adj. R^2	-2.1%	2.0%	3.2%	34.0%	6.4%	-2.3%	1.2%	2.5%	17.0%	4.5%
Debt Financed		α	-0.06	0.01	0.01	0.08	0.03	-0.07	0.00	0.01	0.11	0.04
			(-0.67)	(0.26)	(0.27)	(1.54)	(0.45)	(-0.80)	(0.09)	(0.16)	(1.12)	(0.53)
	43	λ	**-3.14**	**-0.51**	**-0.63**	**0.51**	**0.57**	**-2.01**	**-0.39**	**-0.44**	**0.30**	**0.44**
			(-6.66)	(-2.33)	(-2.55)	(1.35)	(1.70)	(-4.31)	(-1.47)	(-1.44)	(1.15)	(1.17)
		Adj. R^2	-2.3%	4.9%	6.5%	23.4%	6.9%	-1.6%	1.5%	2.3%	20.3%	4.1%
			ChristieLag1					ChristieLag2				
All-Equity Financed		α	-0.06	-0.01	-0.01	0.06	0.03	-0.12	-0.01	-0.02	0.09	0.04
			(-0.89)	(-0.13)	(-0.14)	(0.74)	(0.41)	(-1.57)	(-0.23)	(-0.31)	(1.16)	(0.57)
	40	λ	**-1.79**	**-0.29**	**-0.27**	**1.10**	**0.49**	**-1.36**	**-0.39**	**-0.29**	**1.94**	**0.58**
			(-4.43)	(-0.95)	(-1.03)	(2.28)	(1.51)	(-3.56)	(-1.42)	(-1.19)	(3.91)	(1.45)
		Adj. R^2	-1.9%	0.4%	1.7%	14.5%	3.7%	-2.2%	1.5%	2.5%	16.8%	4.2%
Debt Financed		α	-0.08	0.00	-0.01	0.06	0.02	-0.10	0.00	0.00	0.09	0.03
			(-0.94)	(-0.11)	(-0.10)	(0.72)	(0.30)	(-1.12)	(-0.14)	(-0.08)	(0.91)	(0.44)
	43	λ	**-2.90**	**-0.41**	**-0.50**	**0.64**	**0.56**	**-2.21**	**-0.41**	**-0.47**	**0.30**	**0.46**
			(-5.09)	(-1.67)	(-1.86)	(1.75)	(1.53)	(-4.40)	(-1.58)	(-1.53)	(1.14)	(1.19)
		Adj. R^2	-2.2%	2.6%	3.5%	16.2%	4.7%	-1.5%	1.9%	2.6%	22.3%	4.4%
			DuffeeLag1					DuffeeLag2				
All-Equity Financed		α	-0.02	0.00	0.00	0.11	0.02	-0.05	-0.01	0.00	0.13	0.03
			(-0.59)	(-0.06)	(-0.02)	(1.06)	(0.36)	(-0.96)	(-0.20)	(-0.19)	(1.34)	(0.45)
	40	λ	**-1.05**	**-0.11**	**-0.03**	**1.00**	**0.42**	**-0.89**	**-0.25**	**-0.20**	**2.09**	**0.45**
			(-5.06)	(-0.47)	(-0.42)	(3.95)	(1.96)	(-4.15)	(-1.36)	(-1.19)	(6.24)	(1.75)
		Adj. R^2	-1.9%	1.3%	2.7%	14.5%	4.1%	-2.0%	1.7%	3.2%	23.2%	6.0%
Debt Financed		α	-0.03	0.00	0.00	0.08	0.02	-0.07	0.00	0.00	0.21	0.04
			(-0.67)	(-0.03)	(-0.01)	(0.84)	(0.28)	(-0.71)	(-0.12)	(0.01)	(1.23)	(0.38)
	43	λ	**-1.37**	**-0.22**	**-0.24**	**0.68**	**0.45**	**-1.29**	**-0.31**	**-0.36**	**0.22**	**0.32**
			(-6.82)	(-1.52)	(-1.34)	(3.23)	(2.12)	(-6.18)	(-1.56)	(-1.71)	(1.09)	(1.59)
		Adj. R^2	-2.1%	2.0%	3.9%	31.2%	6.6%	-1.9%	1.9%	3.6%	37.8%	6.7%

Table A.4: Summary statistics across firms from the first (lowest) quintile of operating leverage (defined as change in earnings divided by change in sales) in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010 of the estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic, where regressions are estimated firm by firm. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on NYSE, AMEX, NASDAQ, and ARCA, and the number of firms in each dataset is reported as well.

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					BlackLag2				
All-Equity Financed	39	α	0.02	0.13	0.17	0.62	0.12	-0.01	0.15	0.19	0.59	0.13
			(0.34)	(1.83)	(1.83)	(2.71)	(0.51)	(-0.13)	(1.94)	(1.87)	(3.15)	(0.60)
		λ	**-1.61**	**-0.42**	**-0.51**	**0.00**	**0.39**	**-2.18**	**-0.25**	**-0.33**	**1.16**	**0.69**
			(-2.97)	(-1.09)	(-1.17)	(0.00)	(0.78)	(-4.03)	(-0.74)	(-0.77)	(1.12)	(1.18)
		Adj. R^2	-2.6%	0.3%	1.0%	10.0%	2.8%	-2.4%	-0.5%	0.9%	19.0%	4.1%
Debt Financed	44	α	0.03	0.14	0.15	0.29	0.06	0.01	0.17	0.16	0.31	0.07
			(0.55)	(2.05)	(2.11)	(4.29)	(0.71)	(0.10)	(2.19)	(2.23)	(3.64)	(0.71)
		λ	**-2.92**	**-0.51**	**-0.60**	**0.03**	**0.49**	**-3.25**	**-0.31**	**-0.39**	**5.17**	**1.12**
			(-3.69)	(-1.66)	(-1.57)	(0.07)	(0.95)	(-4.46)	(-1.09)	(-1.25)	(3.01)	(1.47)
		Adj. R^2	-2.5%	1.7%	2.3%	20.4%	4.2%	-2.5%	0.4%	2.2%	23.9%	5.3%
			LogBlackLag1					LogBlackLag2				
All-Equity Financed	39	α	-0.08	0.00	0.01	0.08	0.03	-0.14	0.01	0.00	0.11	0.04
			(-1.13)	(0.08)	(0.09)	(1.05)	(0.43)	(-1.79)	(0.08)	(0.01)	(0.97)	(0.49)
		λ	**-2.24**	**-0.48**	**-0.59**	**0.04**	**0.49**	**-1.94**	**-0.22**	**-0.32**	**0.41**	**0.49**
			(-3.45)	(-1.59)	(-1.66)	(0.14)	(1.06)	(-3.93)	(-0.59)	(-0.89)	(1.28)	(1.19)
		Adj. R^2	-2.5%	1.8%	4.0%	21.4%	6.0%	-2.5%	-0.6%	1.5%	20.6%	5.1%
Debt Financed	44	α	-0.05	0.01	0.01	0.06	0.02	-0.08	0.00	0.01	0.11	0.03
			(-1.05)	(0.27)	(0.19)	(0.78)	(0.33)	(-1.60)	(0.10)	(0.12)	(1.36)	(0.52)
		λ	**-3.72**	**-0.53**	**-0.65**	**0.15**	**0.60**	**-2.92**	**-0.25**	**-0.40**	**1.44**	**0.68**
			(-5.44)	(-2.28)	(-2.11)	(0.51)	(1.28)	(-4.55)	(-0.98)	(-1.28)	(1.43)	(1.44)
		Adj. R^2	-1.8%	3.2%	4.9%	22.0%	5.9%	-2.5%	0.1%	2.0%	24.7%	5.3%
			ChristieLag1					ChristieLag2				
All-Equity Financed	39	α	-0.09	0.00	-0.01	0.06	0.03	-0.14	-0.01	-0.01	0.08	0.04
			(-1.19)	(-0.04)	(-0.11)	(0.85)	(0.39)	(-1.79)	(-0.09)	(-0.10)	(0.89)	(0.49)
		λ	**-1.98**	**-0.31**	**-0.43**	**0.63**	**0.51**	**-1.96**	**-0.22**	**-0.32**	**0.36**	**0.48**
			(-3.15)	(-0.94)	(-1.12)	(1.56)	(1.09)	(-3.91)	(-0.86)	(-0.92)	(0.72)	(1.14)
		Adj. R^2	-2.6%	0.0%	2.1%	18.6%	4.5%	-2.5%	-0.6%	1.4%	17.6%	4.9%
Debt Financed	44	α	-0.06	0.00	0.00	0.03	0.02	-0.09	0.00	0.00	0.09	0.03
			(-1.08)	(-0.04)	(-0.07)	(0.42)	(0.33)	(-1.81)	(-0.05)	(-0.05)	(1.11)	(0.51)
		λ	**-3.50**	**-0.38**	**-0.47**	**0.37**	**0.60**	**-2.89**	**-0.28**	**-0.42**	**1.44**	**0.68**
			(-4.20)	(-1.68)	(-1.47)	(1.29)	(1.21)	(-4.49)	(-1.18)	(-1.35)	(1.43)	(1.43)
		Adj. R^2	-2.4%	1.1%	2.4%	16.1%	4.4%	-2.5%	0.8%	2.3%	24.2%	5.2%
			DuffeeLag1					DuffeeLag2				
All-Equity Financed	39	α	-0.07	0.00	0.00	0.05	0.02	-0.06	0.00	0.00	0.10	0.03
			(-0.65)	(-0.04)	(-0.04)	(0.68)	(0.31)	(-1.25)	(-0.03)	(-0.06)	(0.73)	(0.41)
		λ	**-1.49**	**-0.14**	**-0.11**	**1.22**	**0.46**	**-0.95**	**-0.17**	**-0.24**	**0.31**	**0.31**
			(-3.81)	(-0.37)	(-0.52)	(2.69)	(1.56)	(-5.61)	(-0.93)	(-1.02)	(1.01)	(1.31)
		Adj. R^2	-2.4%	1.0%	2.2%	16.7%	4.7%	-2.1%	-0.1%	1.9%	21.7%	5.5%
Debt Financed	44	α	-0.06	0.00	0.00	0.11	0.03	-0.06	0.00	0.01	0.14	0.04
			(-0.73)	(-0.01)	(0.03)	(1.01)	(0.34)	(-1.22)	(0.00)	(0.06)	(1.59)	(0.44)
		λ	**-0.87**	**-0.14**	**-0.21**	**0.53**	**0.37**	**-0.93**	**-0.30**	**-0.31**	**0.59**	**0.32**
			(-8.03)	(-0.85)	(-1.13)	(2.91)	(1.87)	(-7.92)	(-1.31)	(-1.53)	(2.43)	(1.84)
		Adj. R^2	-2.5%	-0.1%	2.8%	28.8%	6.0%	-2.1%	0.8%	3.4%	29.1%	7.1%

Table A.5: Summary statistics across firms from the second quintile of operating leverage (defined as change in earnings divided by change in sales) in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010 of the estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic, where regressions are estimated firm by firm. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on NYSE, AMEX, NASDAQ, and ARCA, and the number of firms in each dataset is reported as well.

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					BlackLag2				
All-Equity Financed	37	α	0.04	0.12	0.15	0.67	0.11	0.00	0.14	0.15	0.46	0.10
			(0.67)	(1.91)	(2.04)	(4.46)	(0.78)	(0.04)	(2.08)	(2.14)	(4.89)	(1.02)
		λ	**-1.36**	**-0.50**	**-0.42**	**0.59**	**0.50**	**-1.55**	**-0.42**	**-0.50**	**0.35**	**0.51**
			(-2.88)	(-1.04)	(-0.94)	(1.02)	(1.04)	(-3.70)	(-0.96)	(-1.03)	(0.78)	(1.03)
		Adj. R^2	-2.2%	0.1%	1.1%	9.8%	2.6%	-2.3%	0.0%	0.7%	7.9%	2.5%
Debt Financed	43	α	0.05	0.12	0.13	0.39	0.07	0.03	0.13	0.16	0.43	0.08
			(1.18)	(2.23)	(2.37)	(4.50)	(0.74)	(0.63)	(2.38)	(2.48)	(4.32)	(0.78)
		λ	**-2.84**	**-0.52**	**-0.68**	**-0.11**	**0.49**	**-2.28**	**-0.62**	**-0.63**	**0.96**	**0.63**
			(-4.20)	(-2.08)	(-1.97)	(-0.27)	(0.97)	(-5.61)	(-1.62)	(-1.88)	(1.14)	(1.67)
		Adj. R^2	-2.4%	1.9%	3.5%	19.0%	4.5%	-2.0%	1.5%	3.7%	23.0%	6.0%
			LogBlackLag1					LogBlackLag2				
All-Equity Financed	37	α	-0.05	0.00	0.00	0.06	0.02	-0.10	0.00	0.00	0.07	0.03
			(-0.84)	(0.03)	(0.07)	(0.91)	(0.39)	(-1.18)	(-0.01)	(-0.02)	(0.86)	(0.49)
		λ	**-2.73**	**-0.52**	**-0.51**	**0.75**	**0.76**	**-1.70**	**-0.33**	**-0.42**	**0.27**	**0.47**
			(-6.56)	(-1.38)	(-1.39)	(2.02)	(1.78)	(-3.93)	(-0.71)	(-1.06)	(0.66)	(1.13)
		Adj. R^2	-2.2%	1.4%	4.6%	41.6%	8.8%	-2.4%	-0.1%	1.2%	19.7%	4.1%
Debt Financed	43	α	-0.02	0.01	0.02	0.10	0.02	-0.03	0.01	0.02	0.09	0.03
			(-0.45)	(0.37)	(0.36)	(1.38)	(0.35)	(-0.81)	(0.24)	(0.28)	(1.45)	(0.48)
		λ	**-2.38**	**-0.55**	**-0.65**	**-0.13**	**0.45**	**-2.31**	**-0.45**	**-0.49**	**0.57**	**0.51**
			(-4.66)	(-2.27)	(-2.33)	(-0.38)	(1.14)	(-5.42)	(-1.49)	(-1.70)	(1.17)	(1.48)
		Adj. R^2	-2.2%	3.4%	5.5%	32.0%	7.0%	-1.5%	1.0%	2.9%	17.6%	4.7%
			ChristieLag1					ChristieLag2				
All-Equity Financed	37	α	-0.06	0.00	-0.01	0.05	0.02	-0.10	0.00	-0.01	0.06	0.03
			(-1.00)	(-0.06)	(-0.09)	(0.65)	(0.35)	(-1.25)	(-0.06)	(-0.12)	(0.80)	(0.44)
		λ	**-2.44**	**-0.32**	**-0.38**	**0.94**	**0.76**	**-1.68**	**-0.35**	**-0.45**	**0.25**	**0.50**
			(-4.81)	(-1.04)	(-0.89)	(2.63)	(1.64)	(-3.65)	(-0.89)	(-1.09)	(0.64)	(1.13)
		Adj. R^2	-2.1%	0.7%	3.2%	27.3%	6.4%	-2.4%	-0.1%	1.3%	14.9%	4.0%
Debt Financed	43	α	-0.03	0.00	0.00	0.09	0.02	-0.04	0.00	0.01	0.05	0.02
			(-0.59)	(0.10)	(0.09)	(1.29)	(0.35)	(-1.05)	(0.08)	(0.07)	(1.06)	(0.42)
		λ	**-2.34**	**-0.46**	**-0.52**	**0.21**	**0.47**	**-2.29**	**-0.49**	**-0.51**	**0.59**	**0.50**
			(-3.74)	(-1.87)	(-1.76)	(0.49)	(1.12)	(-5.36)	(-1.50)	(-1.79)	(1.17)	(1.49)
		Adj. R^2	-2.6%	1.4%	3.3%	22.1%	5.0%	-1.4%	1.3%	3.2%	18.3%	5.0%
			DuffeeLag1					DuffeeLag2				
All-Equity Financed	37	α	-0.03	0.00	0.00	0.04	0.01	-0.04	0.00	0.00	0.04	0.02
			(-0.74)	(-0.07)	(-0.06)	(0.91)	(0.33)	(-1.00)	(-0.02)	(-0.04)	(0.74)	(0.39)
		λ	**-1.78**	**-0.08**	**-0.14**	**1.12**	**0.58**	**-1.23**	**-0.24**	**-0.25**	**0.26**	**0.30**
			(-4.71)	(-0.52)	(-0.45)	(4.57)	(2.21)	(-4.35)	(-1.42)	(-1.17)	(0.78)	(1.26)
		Adj. R^2	-2.2%	1.2%	4.4%	33.0%	7.6%	-2.2%	0.7%	1.5%	10.1%	3.1%
Debt Financed	43	α	-0.03	0.00	0.00	0.05	0.02	-0.03	0.00	0.01	0.05	0.02
			(-0.52)	(0.07)	(0.15)	(1.54)	(0.38)	(-1.08)	(0.14)	(0.17)	(1.30)	(0.44)
		λ	**-1.10**	**-0.19**	**-0.23**	**1.78**	**0.44**	**-1.35**	**-0.30**	**-0.41**	**0.35**	**0.35**
			(-4.96)	(-1.51)	(-1.51)	(2.61)	(1.61)	(-8.78)	(-1.74)	(-2.39)	(1.69)	(2.30)
		Adj. R^2	-1.8%	1.1%	4.0%	26.2%	6.3%	-2.2%	2.3%	6.3%	43.0%	10.9%

Table A.6: Summary statistics across firms from the third quintile of operating leverage (defined as change in earnings divided by change in sales) in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010 of the estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic, where regressions are estimated firm by firm. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on NYSE, AMEX, NASDAQ, and ARCA, and the number of firms in each dataset is reported as well.

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					BlackLag2				
All-Equity Financed	40	α	0.03	0.13	0.14	0.43	0.07	-0.03	0.14	0.15	0.38	0.09
			(0.67)	(1.75)	(1.97)	(4.68)	(0.79)	(-0.63)	(1.90)	(1.95)	(4.88)	(0.99)
		λ	**-2.85**	**-0.54**	**-0.66**	**-0.05**	**0.57**	**-4.22**	**-0.54**	**-0.48**	**5.80**	**1.35**
			(-5.88)	(-1.05)	(-1.33)	(-0.08)	(1.10)	(-4.16)	(-1.15)	(-1.12)	(3.52)	(1.49)
		Adj. R^2	-1.9%	0.1%	1.9%	19.6%	4.1%	-2.3%	1.1%	2.5%	16.0%	4.5%
Debt Financed	42	α	0.00	0.12	0.12	0.24	0.05	-0.01	0.14	0.14	0.33	0.06
			(0.06)	(2.43)	(2.32)	(4.45)	(0.91)	(-0.14)	(2.31)	(2.40)	(4.50)	(0.97)
		λ	**-2.18**	**-0.43**	**-0.48**	**0.36**	**0.45**	**-5.10**	**-0.42**	**-0.58**	**0.84**	**0.93**
			(-4.94)	(-1.30)	(-1.54)	(0.81)	(1.30)	(-5.97)	(-1.46)	(-1.45)	(2.29)	(1.57)
		Adj. R^2	-2.4%	0.6%	1.7%	12.8%	3.3%	-2.0%	1.0%	2.4%	13.9%	4.0%
			LogBlackLag1					LogBlackLag2				
All-Equity Financed	40	α	-0.04	0.00	0.01	0.05	0.02	-0.10	0.00	0.00	0.05	0.03
			(-0.45)	(0.09)	(0.18)	(1.44)	(0.41)	(-1.86)	(-0.02)	(-0.02)	(0.99)	(0.51)
		λ	**-2.75**	**-0.59**	**-0.74**	**0.09**	**0.62**	**-1.75**	**-0.53**	**-0.45**	**3.53**	**0.91**
			(-8.28)	(-1.89)	(-1.82)	(0.23)	(1.50)	(-3.33)	(-1.53)	(-1.24)	(4.03)	(1.47)
		Adj. R^2	-1.7%	3.0%	4.6%	32.9%	6.7%	-2.1%	2.0%	3.2%	16.9%	4.9%
Debt Financed	42	α	-0.04	0.01	0.00	0.06	0.02	-0.07	0.00	0.00	0.04	0.02
			(-0.84)	(0.13)	(0.12)	(1.11)	(0.37)	(-1.21)	(0.08)	(0.03)	(0.84)	(0.41)
		λ	**-2.08**	**-0.43**	**-0.45**	**0.62**	**0.43**	**-3.36**	**-0.32**	**-0.47**	**0.69**	**0.67**
			(-5.25)	(-1.58)	(-1.84)	(1.78)	(1.68)	(-5.61)	(-1.41)	(-1.42)	(2.54)	(1.54)
		Adj. R^2	-2.4%	1.2%	3.2%	26.4%	5.4%	-2.0%	1.3%	2.4%	13.8%	4.0%
			ChristieLag1					ChristieLag2				
All-Equity Financed	40	α	-0.06	0.00	-0.01	0.04	0.02	-0.10	-0.01	-0.01	0.03	0.03
			(-0.76)	(-0.10)	(-0.05)	(0.85)	(0.33)	(-1.81)	(-0.11)	(-0.16)	(0.44)	(0.44)
		λ	**-2.70**	**-0.46**	**-0.59**	**0.24**	**0.64**	**-1.54**	**-0.52**	**-0.43**	**3.71**	**0.91**
			(-7.10)	(-1.43)	(-1.34)	(0.65)	(1.34)	(-3.32)	(-1.40)	(-1.24)	(4.05)	(1.45)
		Adj. R^2	-1.8%	1.1%	2.6%	26.4%	5.1%	-2.0%	2.3%	3.1%	16.0%	4.6%
Debt Financed	42	α	-0.06	0.00	0.00	0.02	0.01	-0.08	0.00	-0.01	0.03	0.02
			(-0.99)	(-0.05)	(-0.08)	(0.88)	(0.32)	(-1.36)	(-0.00)	(-0.11)	(0.67)	(0.42)
		λ	**-1.92**	**-0.30**	**-0.31**	**0.72**	**0.45**	**-3.25**	**-0.33**	**-0.46**	**0.70**	**0.64**
			(-4.80)	(-1.00)	(-1.23)	(4.10)	(1.78)	(-5.65)	(-1.41)	(-1.41)	(2.46)	(1.50)
		Adj. R^2	-2.0%	0.4%	2.0%	18.2%	4.0%	-2.0%	1.2%	2.4%	13.4%	3.9%
			DuffeeLag1					DuffeeLag2				
All-Equity Financed	40	α	-0.02	0.00	0.00	0.03	0.01	-0.02	0.00	0.00	0.04	0.01
			(-0.64)	(-0.04)	(0.01)	(0.80)	(0.30)	(-1.59)	(-0.05)	(-0.06)	(0.60)	(0.41)
		λ	**-1.09**	**-0.20**	**-0.17**	**0.75**	**0.31**	**-1.39**	**-0.31**	**-0.28**	**1.51**	**0.43**
			(-7.55)	(-0.99)	(-0.89)	(3.38)	(1.70)	(-3.83)	(-1.73)	(-1.32)	(3.54)	(1.47)
		Adj. R^2	-2.2%	1.0%	2.1%	28.9%	5.3%	-2.1%	2.5%	3.0%	12.4%	3.9%
Debt Financed	42	α	-0.05	0.00	0.00	0.01	0.01	-0.07	0.00	0.00	0.02	0.01
			(-0.93)	(-0.03)	(-0.04)	(1.00)	(0.29)	(-1.33)	(0.01)	(-0.04)	(0.88)	(0.37)
		λ	**-0.88**	**-0.12**	**-0.06**	**2.04**	**0.46**	**-0.82**	**-0.27**	**-0.27**	**0.75**	**0.31**
			(-5.29)	(-0.83)	(-0.71)	(10.46)	(2.77)	(-7.09)	(-1.51)	(-1.76)	(2.86)	(1.93)
		Adj. R^2	-2.0%	0.3%	3.5%	28.8%	6.8%	-1.4%	1.6%	4.0%	21.5%	6.0%

Table A.7: Summary statistics across firms from the fourth quintile of operating leverage (defined as change in earnings divided by change in sales) in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010 of the estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic, where regressions are estimated firm by firm. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on NYSE, AMEX, NASDAQ, and ARCA, and the number of firms in each dataset is reported as well.

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					**BlackLag2**				
All-Equity Financed		α	0.03	0.13	0.14	0.39	0.07	0.01	0.13	0.15	0.30	0.06
			(0.80)	(2.05)	(2.09)	(3.74)	(0.61)	(0.22)	(2.07)	(2.04)	(3.98)	(0.67)
	40	λ	**-2.14**	**-0.51**	**-0.57**	**0.54**	**0.45**	**-2.40**	**-0.43**	**-0.41**	**0.85**	**0.57**
			(-4.00)	(-1.75)	(-1.80)	(1.45)	(1.19)	(-3.85)	(-1.38)	(-1.11)	(2.14)	(1.35)
		Adj. R^2	-2.2%	2.6%	4.0%	19.7%	5.1%	-1.7%	1.6%	2.4%	9.3%	3.1%
Debt Financed		α	0.06	0.13	0.16	0.54	0.09	0.06	0.14	0.19	0.55	0.12
			(1.06)	(2.27)	(2.52)	(4.87)	(0.85)	(1.20)	(2.43)	(2.54)	(4.89)	(0.85)
	43	λ	**-2.16**	**-0.65**	**-0.69**	**-0.18**	**0.38**	**-2.18**	**-0.46**	**-0.52**	**0.17**	**0.49**
			(-4.95)	(-1.89)	(-2.05)	(-0.67)	(1.06)	(-4.41)	(-1.25)	(-1.36)	(0.92)	(1.24)
		Adj. R^2	-1.2%	1.8%	3.4%	26.0%	4.9%	-2.4%	0.7%	2.0%	27.3%	5.3%
			LogBlackLag1					**LogBlackLag2**				
All-Equity Financed		α	-0.05	0.01	0.01	0.09	0.03	-0.11	0.00	0.00	0.11	0.03
			(-0.98)	(0.18)	(0.24)	(2.24)	(0.56)	(-1.51)	(-0.04)	(0.02)	(2.30)	(0.57)
	40	λ	**-2.55**	**-0.57**	**-0.67**	**0.60**	**0.58**	**-1.59**	**-0.40**	**-0.40**	**0.59**	**0.46**
			(-6.27)	(-2.42)	(-2.48)	(1.91)	(1.65)	(-3.75)	(-1.49)	(-1.26)	(1.88)	(1.39)
		Adj. R^2	-2.4%	6.2%	8.2%	40.2%	9.8%	-1.7%	2.2%	2.9%	10.6%	3.8%
Debt Financed		α	-0.03	0.01	0.01	0.07	0.02	-0.05	0.01	0.01	0.16	0.03
			(-0.36)	(0.32)	(0.30)	(1.20)	(0.36)	(-0.68)	(0.17)	(0.15)	(1.45)	(0.46)
	43	λ	**-3.10**	**-0.64**	**-0.71**	**-0.14**	**0.47**	**-1.15**	**-0.38**	**-0.38**	**0.18**	**0.31**
			(-6.23)	(-2.54)	(-2.73)	(-0.44)	(1.33)	(-4.07)	(-1.26)	(-1.32)	(1.20)	(1.17)
		Adj. R^2	-1.2%	4.4%	6.5%	35.1%	7.3%	-1.8%	0.6%	1.7%	17.5%	3.9%
			ChristieLag1					**ChristieLag2**				
All-Equity Financed		α	-0.08	-0.01	-0.01	0.02	0.02	-0.13	-0.01	-0.01	0.06	0.03
			(-1.33)	(-0.14)	(-0.16)	(0.56)	(0.36)	(-1.78)	(-0.27)	(-0.21)	(0.82)	(0.45)
	40	λ	**-2.45**	**-0.42**	**-0.54**	**0.67**	**0.59**	**-1.72**	**-0.43**	**-0.42**	**0.61**	**0.48**
			(-5.13)	(-1.84)	(-1.80)	(2.23)	(1.52)	(-4.66)	(-1.58)	(-1.31)	(2.26)	(1.45)
		Adj. R^2	-1.9%	3.7%	5.0%	30.7%	7.4%	-1.7%	2.4%	3.2%	16.0%	4.1%
Debt Financed		α	-0.04	0.00	0.00	0.05	0.02	-0.06	0.00	0.00	0.07	0.02
			(-0.74)	(-0.03)	(-0.03)	(0.60)	(0.30)	(-0.80)	(-0.08)	(-0.04)	(0.90)	(0.36)
	43	λ	**-2.98**	**-0.52**	**-0.57**	**0.10**	**0.49**	**-1.41**	**-0.37**	**-0.42**	**0.18**	**0.35**
			(-4.99)	(-1.80)	(-1.99)	(0.36)	(1.23)	(-4.93)	(-1.35)	(-1.43)	(1.23)	(1.27)
		Adj. R^2	-2.2%	2.2%	3.5%	20.6%	4.9%	-1.7%	0.5%	2.4%	32.2%	5.7%
			DuffeeLag1					**DuffeeLag2**				
All-Equity Financed		α	-0.06	0.00	0.00	0.03	0.02	-0.06	0.00	0.00	0.08	0.02
			(-0.86)	(-0.08)	(-0.07)	(0.52)	(0.29)	(-1.48)	(-0.15)	(-0.13)	(0.96)	(0.37)
	40	λ	**-1.34**	**-0.22**	**-0.22**	**0.78**	**0.46**	**-1.91**	**-0.31**	**-0.31**	**0.86**	**0.43**
			(-4.51)	(-1.16)	(-1.09)	(3.51)	(1.92)	(-5.74)	(-1.30)	(-1.31)	(2.65)	(1.60)
		Adj. R^2	-1.8%	2.4%	4.1%	25.4%	6.3%	-2.1%	1.6%	3.3%	22.6%	5.1%
Debt Financed		α	-0.04	0.00	0.00	0.21	0.03	-0.04	0.00	0.00	0.16	0.03
			(-0.56)	(-0.04)	(0.02)	(1.11)	(0.32)	(-0.92)	(-0.04)	(0.00)	(0.83)	(0.35)
	43	λ	**-1.84**	**-0.25**	**-0.27**	**1.35**	**0.47**	**-1.63**	**-0.29**	**-0.33**	**0.29**	**0.37**
			(-5.78)	(-1.38)	(-1.57)	(3.36)	(1.81)	(-6.03)	(-1.70)	(-1.59)	(1.99)	(1.58)
		Adj. R^2	-2.2%	1.6%	3.9%	27.3%	6.1%	-1.7%	0.9%	3.5%	41.9%	7.3%

Table A.8: Summary statistics across firms from the fifth (highest) quintile of operating leverage (defined as change in earnings divided by change in sales) in the all-equity-financed (AE) and debt-financed (DF) datasets from January 2, 1973 to December 31, 2010 of the estimated regression coefficients, their associated t-statistics (reported in parentheses), and the adjusted R^2 goodness-of-fit statistic, where regressions are estimated firm by firm. The period length for estimating returns and volatilities is 21 days. The dependent and independent variables of the regression equation are defined according to all eight specifications considered, and a minimum of 40 observations are required for each regression. Firms are traded on NYSE, AMEX, NASDAQ, and ARCA, and the number of firms in each dataset is reported as well.

References

Bekaert, G. and G. Wu, 2000, "Asymmetric Volatility and Risk in Equity Markets", *Review of Financial Studies* 13, 1–42.

Black, F., 1976, "Studies of Stock Price Volatility Changes", *Proceedings of the Business and Economics Section of the American Statistical Association* , 177–181.

Bollerslev, T., J. Litvinova, and G. Tauchen, 2006, "Leverage and Volatility Feedback Effects in High-Frequency Data", *Journal of Financial Econometrics* 4, 353–384.

Bowman, R. and S. Bush, 2006, "Using Comparable Companies to Estimate the Betas of Private Companies", *Journal of Applied Finance* Fall/Winter, 71–81.

Campbell, J. and L. Hentschel, 1992, "Non News is good news: An asymmetric model of changing volatility in stock returns", *Journal of Financial Economics* 31, 281–318.

Cheung, Y.-W. and L. Ng, 1992, "Stock Price Dynamics and Firm Size: An Empirical Investigation", *Journal of Finance* XLVII, 1985–1997.

Christie, A., 1982, "The Stochastic Behavior of Common Stock Variances: Value, leverage, and Interest Rate Effects", *Journal of Financial Economics* 10, 407–432.

Danielsson, J., H. S. Shin, and J.-P. Zigrand, 2009, "Risk Appetite and Endogenous Risk", Technical report, FRB of Cleveland/NBER Research Conference on Quantifying Systemic Risk.

Dantas, J. A., O. R. Medeiros, and P. R. B. Lustosa, 2006, "The Impact of the Degree of Operating Leverage on Stock Returns: An Empirical Study in the Brazilian Market", *Revista de Contabilidade e Financas* 41.

Duffee, G., 1995, "Stock Returns and Volatility: A Firm Level Analysis", *Journal of Financial Economics* 37, 399–420.

Figlewski, S. and X. Wang, 2000, "Is the "Leverage Effect" a Leverage Effect?", Technical report, NYU Stern School of Business and City University of Hong Kong.

French, K., W. Schwert, and R. Stambaugh, 1987, "Expected Stock Returns and Volatility", *Journal of Financial Economics* 19, 3–29.

Garcia-Feijoo, L. and R. Jorgensen, 2010, "Can Operating Leverage Be the Cause of the Value Premium?", *Financial Management* 39, 1127–1154.

Garrison, R. H. and E. Noreen, 2003, *Managerial Accounting*, New York: Irwin McGraw-Hill.

Gennaioli, N. and A. Shleifer, 2009, "What Comes to Mind", Technical report, NBER Working Paper No. w15084.

Hens, T. and S. C. Steude, 2009, "The Leverage Effect Without Leverage", *Finance Research Letters* 6, 83–94.

Lleras, A., J. Kawahara, and B. R. Levinthal, 2009, "Past Rejections Lead to Future Misses: Selection-Related Inhibition Produces Blink-Like Misses of Future (Easily Detectable) Events", *Journal of Vision* 9, 1–12.

Novy-Marx, R., 2011, "Operating Leverage", *Review of Finance* 15, 103–134.

Pindyck, R., 1984, "Risk, Inflation, and the Stock Market", *American Economic Review* 74, 335–351.

Schwert, W., 1989, "Why Does Stock Market Volatility Change Over Time?", *Journal of Finance* XLIV, 1115–1153.