Black's Leverage Effect Is Not Due To Leverage*

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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 financial 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 1972 to December 2008, we find that the leverage effect is just as strong if not stronger, implying that the inverse relationship between price and volatility is not driven by financial leverage.

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

JEL Classification: G12

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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 financial leverage. Using the returns of all-equity-financed companies from January 1972 to December 2008, 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 we must look elsewhere for an explanation of this empirical regularity, e.g., 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 his 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:

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

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:

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

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, and quarterly fundamental data from the CRSP/Compustat Merged Database (Fundamentals Quarterly). We select only those stocks with zero total debt for all quarters from January 1961 to December 2008, 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 667 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 2008, which yields a considerably larger sample of 11,504 debt-financed companies. From this universe of debt-financed (DF) companies, we select a smaller subset of 667 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.[3] We then construct the subsets of the AE and DF monthly datasets consisting of continuously traded firms for the 15-year period from January 3, 1994

[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.

[3]In particular, our AE sample contains 123, 109, 154, 188, and 93 companies in size quintiles 1 to 5, respectively.

to December 31, 2008. This time span was chosen as the best compromise to maximize the number of time-series observations (15 years of daily returns) while maintaining a sufficiently representative sample size of companies in the AE and DF sub-samples (23 continuously listed AE firms and 41 continuously listed DF firms).

Finally, for each of the four samples (AE, DF, and their continuously listed sub-samples), we obtain daily returns from the CRSP Daily Database, and to maintain the same start date for the AE and DF companies, we use the later start date of December 18, 1972.

4 Empirical Evidence

We test 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 and 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 and 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 having 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`.

Each of these regression models is estimated on the AE and DF samples from December 18, 1972 to December 31, 2008, and on the continuously listed sub-sample of AE and DF companies from January 3, 1994 to December 31, 2008. In keeping with Black (1976), Christie (1982), and Duffie (1995), we use a 21-day interval to estimate volatilities and returns,[4] 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, we also consider subsets of our datasets consisting of NYSE and AMEX companies only.[5]

[4] We have also used 10-, 40-, and 80-day intervals to check the robustness of our results, and have obtained qualitatively similar patterns. See Tables A.1–A.3 in the Appendix for details.

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

In Tables 1–2, 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 or on NYSE and AMEX only, respectively. For example, according to the top-left panel of Table 1, corresponding to the `BlackLag1` regression specification, the average across 323 firms in the AE dataset of the firm-by-firm "leverage" coefficients λ is -0.71, which is about the same as the average λ of -0.58 for the 449 firms of its DF counterpart.[6] The average t-statistics are relatively low—-1.43 and -1.80 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. 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.

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,[8] the average λ's are somewhat less negative for the AE dataset with respect to their DF counterpart, however this situation is reversed in Table 2, where only NYSE and AMEX firms are considered. In fact, Table 2 shows that for six out of the eight regression specifications, the average λ is more negative for the AE than for the DF companies, and in the remaining two cases, the differences between the AE and DF estimates are not significant (-0.15 and -0.27 for the AE versus -0.21 and -0.37 for the DF datasets, respectively). In other words, the inverse relationship between a firm's return and the resulting volatility change is more pronounced for all-equity-financed firms.

[6] 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).

[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.

[8] 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.

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					**BlackLag2**				
All-Equity Financed	323	α	0.02	0.14	0.17	0.88	0.11	-0.03	0.16	0.19	0.91	0.12
			(0.34)	(2.04)	(2.18)	(4.51)	(0.73)	(-0.63)	(2.13)	(2.22)	(5.15)	(0.89)
		λ	**-5.04**	**-0.60**	**-0.71**	**1.38**	**0.71**	**-5.48**	**-0.41**	**-0.49**	**5.17**	**1.04**
			(-5.88)	(-1.37)	(-1.43)	(1.81)	(1.05)	(-6.95)	(-0.97)	(-0.98)	(3.01)	(1.40)
		Adj. R^2	-2.3%	1.1%	2.1%	19.7%	3.7%	-2.5%	0.4%	1.7%	28.4%	4.2%
Debt Financed	449	α	0.03	0.13	0.15	0.75	0.08	0.01	0.15	0.17	1.16	0.11
			(0.55)	(2.31)	(2.40)	(4.93)	(0.74)	(0.10)	(2.40)	(2.47)	(4.67)	(0.79)
		λ	**-2.74**	**-0.54**	**-0.58**	**1.62**	**0.43**	**-7.98**	**-0.49**	**-0.58**	**3.64**	**0.75**
			(-5.43)	(-1.82)	(-1.80)	(1.50)	(1.12)	(-7.30)	(-1.44)	(-1.51)	(5.45)	(1.45)
		Adj. R^2	-2.5%	2.0%	2.9%	27.6%	3.9%	-2.2%	1.0%	2.9%	32.7%	5.1%
			LogBlackLag1					**LogBlackLag2**				
All-Equity Financed	323	α	-0.08	0.01	0.01	0.19	0.03	-0.16	0.01	0.01	0.12	0.04
			(-1.13)	(0.25)	(0.27)	(2.24)	(0.46)	(-1.86)	(0.17)	(0.15)	(2.30)	(0.55)
		λ	**-5.52**	**-0.61**	**-0.75**	**1.93**	**0.79**	**-3.36**	**-0.35**	**-0.42**	**1.97**	**0.68**
			(-8.28)	(-1.89)	(-2.00)	(2.72)	(1.52)	(-5.17)	(-1.10)	(-1.05)	(2.47)	(1.29)
		Adj. R^2	-2.4%	2.7%	5.2%	40.2%	7.3%	-2.4%	0.5%	1.8%	21.7%	4.0%
Debt Financed	449	α	-0.10	0.01	0.01	0.15	0.02	-0.11	0.01	0.01	0.15	0.03
			(-1.05)	(0.28)	(0.30)	(2.22)	(0.40)	(-1.60)	(0.26)	(0.23)	(1.62)	(0.49)
		λ	**-3.42**	**-0.55**	**-0.59**	**1.93**	**0.50**	**-2.52**	**-0.40**	**-0.45**	**1.97**	**0.46**
			(-7.79)	(-2.30)	(-2.34)	(2.72)	(1.50)	(-7.37)	(-1.50)	(-1.53)	(3.09)	(1.33)
		Adj. R^2	-2.6%	3.9%	5.5%	57.6%	6.4%	-2.3%	1.2%	2.7%	35.0%	4.8%
			ChristieLag1					**ChristieLag2**				
All-Equity Financed	323	α	-0.10	0.00	0.00	0.12	0.03	-0.15	0.00	0.00	0.09	0.04
			(-1.33)	(0.07)	(0.04)	(1.49)	(0.40)	(-1.81)	(0.06)	(0.02)	(1.27)	(0.53)
		λ	**-5.52**	**-0.48**	**-0.61**	**2.01**	**0.80**	**-3.31**	**-0.37**	**-0.44**	**2.09**	**0.68**
			(-7.10)	(-1.42)	(-1.45)	(3.13)	(1.42)	(-5.28)	(-1.11)	(-1.11)	(2.55)	(1.29)
		Adj. R^2	-2.5%	1.3%	3.2%	30.7%	5.4%	-2.5%	0.6%	1.9%	21.4%	4.0%
Debt Financed	449	α	-0.11	0.00	0.00	0.10	0.02	-0.13	0.00	0.00	0.09	0.03
			(-1.33)	(0.03)	(-0.01)	(1.18)	(0.32)	(-1.81)	(0.10)	(0.02)	(1.07)	(0.44)
		λ	**-3.50**	**-0.40**	**-0.46**	**2.01**	**0.50**	**-2.69**	**-0.43**	**-0.47**	**2.09**	**0.47**
			(-6.43)	(-1.62)	(-1.72)	(3.13)	(1.37)	(-7.03)	(-1.59)	(-1.62)	(3.07)	(1.34)
		Adj. R^2	-2.5%	1.8%	3.2%	47.8%	5.0%	-2.3%	1.5%	3.0%	34.1%	5.0%
			DuffeeLag1					**DuffeeLag2**				
All-Equity Financed	323	α	-0.15	0.00	0.00	0.12	0.02	-0.08	0.00	0.00	0.13	0.02
			(-1.30)	(0.11)	(0.12)	(1.75)	(0.40)	(-1.59)	(0.07)	(0.11)	(2.14)	(0.52)
		λ	**-1.85**	**-0.20**	**-0.20**	**1.87**	**0.44**	**-1.91**	**-0.26**	**-0.27**	**1.13**	**0.37**
			(-7.55)	(-1.10)	(-1.02)	(9.14)	(1.91)	(-7.66)	(-1.23)	(-1.24)	(2.83)	(1.50)
		Adj. R^2	-2.4%	1.2%	3.4%	31.2%	6.0%	-2.4%	0.8%	2.5%	28.4%	5.0%
Debt Financed	449	α	-0.07	0.00	0.00	0.16	0.02	-0.10	0.00	0.00	0.10	0.02
			(-0.93)	(0.07)	(0.10)	(1.32)	(0.33)	(-1.68)	(0.11)	(0.14)	(1.40)	(0.47)
		λ	**-1.78**	**-0.22**	**-0.21**	**1.87**	**0.39**	**-2.75**	**-0.32**	**-0.37**	**1.13**	**0.37**
			(-6.42)	(-1.21)	(-1.21)	(9.14)	(1.84)	(-8.61)	(-1.71)	(-1.85)	(5.41)	(1.69)
		Adj. R^2	-2.4%	1.4%	3.1%	41.7%	5.5%	-2.3%	1.8%	4.1%	43.4%	6.6%

Table 1: Summary statistics across all firms in the all-equity-financed (AE) and debt-financed (DF) datasets from December 18, 1972 to December 31, 2008 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	106	α	0.03	0.12	0.13	0.33	0.06	-0.03	0.14	0.15	0.36	0.07
			(0.67)	(2.06)	(2.29)	(4.51)	(0.83)	(-0.63)	(2.18)	(2.38)	(5.15)	(1.10)
		λ	**-3.34**	**-0.77**	**-0.82**	**1.12**	**0.73**	**-5.10**	**-0.51**	**-0.73**	**5.17**	**1.29**
			(-3.87)	(-1.37)	(-1.39)	(1.81)	(1.12)	(-6.95)	(-1.07)	(-1.16)	(3.01)	(1.53)
		Adj. R^2	-2.3%	0.9%	1.8%	19.7%	3.5%	-2.5%	0.5%	1.9%	28.4%	4.4%
Debt Financed	147	α	0.05	0.12	0.13	0.31	0.04	0.02	0.14	0.15	0.42	0.06
			(0.87)	(2.40)	(2.43)	(4.93)	(0.73)	(0.27)	(2.46)	(2.56)	(4.52)	(0.77)
		λ	**-1.55**	**-0.57**	**-0.55**	**1.62**	**0.44**	**-3.70**	**-0.50**	**-0.64**	**0.86**	**0.70**
			(-5.43)	(-1.57)	(-1.74)	(1.49)	(1.24)	(-6.09)	(-1.53)	(-1.58)	(2.84)	(1.49)
		Adj. R^2	-2.0%	1.6%	2.7%	15.1%	3.6%	-1.9%	1.0%	3.1%	31.7%	5.6%
			LogBlackLag1					LogBlackLag2				
All-Equity Financed	106	α	-0.03	0.01	0.02	0.10	0.02	-0.10	0.01	0.01	0.08	0.03
			(-0.40)	(0.32)	(0.35)	(1.58)	(0.35)	(-1.86)	(0.33)	(0.23)	(1.41)	(0.57)
		λ	**-4.94**	**-0.71**	**-0.85**	**1.05**	**0.86**	**-3.36**	**-0.52**	**-0.60**	**1.92**	**0.83**
			(-6.27)	(-1.74)	(-1.81)	(2.24)	(1.54)	(-5.17)	(-1.18)	(-1.18)	(2.47)	(1.33)
		Adj. R^2	-2.4%	2.3%	3.9%	40.2%	6.4%	-2.4%	0.6%	1.7%	15.7%	3.4%
Debt Financed	147	α	-0.04	0.01	0.01	0.08	0.02	-0.09	0.02	0.01	0.08	0.03
			(-0.51)	(0.32)	(0.33)	(1.70)	(0.36)	(-1.08)	(0.39)	(0.34)	(1.29)	(0.47)
		λ	**-2.12**	**-0.58**	**-0.56**	**1.80**	**0.50**	**-2.06**	**-0.40**	**-0.48**	**0.71**	**0.48**
			(-6.25)	(-2.09)	(-2.20)	(2.23)	(1.65)	(-5.26)	(-1.47)	(-1.53)	(1.83)	(1.35)
		Adj. R^2	-2.0%	3.4%	5.0%	27.3%	5.9%	-2.0%	1.1%	2.6%	19.7%	4.5%
			ChristieLag1					ChristieLag2				
All-Equity Financed	106	α	-0.04	0.01	0.01	0.09	0.02	-0.10	0.01	0.00	0.08	0.03
			(-0.72)	(0.20)	(0.18)	(1.34)	(0.33)	(-1.81)	(0.14)	(0.12)	(1.22)	(0.54)
		λ	**-4.83**	**-0.58**	**-0.71**	**1.17**	**0.88**	**-3.31**	**-0.53**	**-0.60**	**1.93**	**0.81**
			(-5.13)	(-1.29)	(-1.37)	(2.79)	(1.49)	(-5.28)	(-1.26)	(-1.24)	(2.48)	(1.34)
		Adj. R^2	-2.3%	1.1%	2.6%	30.7%	5.1%	-2.5%	0.9%	1.8%	16.7%	3.5%
Debt Financed	147	α	-0.06	0.00	0.00	0.03	0.01	-0.10	0.01	0.00	0.07	0.03
			(-0.75)	(0.11)	(0.06)	(0.63)	(0.28)	(-1.10)	(0.27)	(0.16)	(1.07)	(0.42)
		λ	**-1.95**	**-0.46**	**-0.44**	**1.67**	**0.49**	**-2.12**	**-0.45**	**-0.51**	**0.73**	**0.46**
			(-5.12)	(-1.63)	(-1.66)	(2.79)	(1.50)	(-5.50)	(-1.56)	(-1.65)	(1.72)	(1.36)
		Adj. R^2	-2.5%	2.0%	3.1%	21.7%	4.4%	-1.9%	1.3%	2.9%	19.0%	4.5%
			DuffeeLag1					DuffeeLag2				
All-Equity Financed	106	α	-0.04	0.00	0.01	0.08	0.01	-0.03	0.00	0.01	0.07	0.02
			(-0.86)	(0.22)	(0.24)	(1.51)	(0.40)	(-1.59)	(0.15)	(0.22)	(2.14)	(0.60)
		λ	**-1.34**	**-0.17**	**-0.15**	**1.87**	**0.43**	**-1.39**	**-0.26**	**-0.27**	**0.59**	**0.34**
			(-5.45)	(-1.02)	(-1.01)	(9.14)	(2.15)	(-7.66)	(-1.23)	(-1.37)	(2.60)	(1.66)
		Adj. R^2	-2.4%	1.1%	3.4%	31.2%	6.1%	-2.4%	0.8%	2.4%	28.4%	4.6%
Debt Financed	147	α	-0.04	0.00	0.01	0.06	0.01	-0.07	0.01	0.01	0.08	0.02
			(-0.68)	(0.15)	(0.19)	(1.04)	(0.34)	(-0.79)	(0.26)	(0.33)	(1.40)	(0.50)
		λ	**-1.46**	**-0.22**	**-0.21**	**1.87**	**0.39**	**-1.30**	**-0.32**	**-0.37**	**0.22**	**0.32**
			(-6.42)	(-1.31)	(-1.27)	(9.14)	(2.02)	(-7.79)	(-1.81)	(-1.99)	(1.36)	(1.77)
		Adj. R^2	-2.4%	1.6%	3.3%	31.2%	5.8%	-2.1%	1.4%	4.3%	43.4%	6.9%

Table 2: Summary statistics across all NYSE and AMEX firms in the all-equity-financed (AE) and debt-financed (DF) datasets from December 18, 1972 to December 31, 2008 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.

This relationship is supported by the regression results of equal-weighted portfolios of firms in the AE and DF datasets from December 18, 1972 to December 31, 2008 in Table 3, where the estimated λ is more negative for the portfolio of AE firms for each of the eight regression specifications considered.[9]

Dataset	Statistic	BlackLag1	BlackLag2	LogBlackLag1	LogBlackLag2	ChristieLag1	ChristieLag2	DuffeeLag1	DuffeeLag2
		All Exchanges							
All-Equity Financed	α	0.10	0.14	0.01	0.04	0.01	0.03	0.00	0.01
		(3.95)	(5.19)	(0.69)	(1.82)	(0.62)	(1.73)	(0.44)	(2.02)
	λ	**-0.90**	**-2.42**	**-0.60**	**-1.80**	**-0.55**	**-1.79**	**-0.04**	**-0.34**
		(-2.38)	(-5.64)	(-2.07)	(-5.84)	(-1.91)	(-5.83)	(-0.78)	(-6.33)
	Adj. R^2	1.1%	6.7%	0.8%	7.2%	0.6%	7.1%	-0.1%	8.3%
Debt Financed	α	0.09	0.14	0.00	0.03	0.00	0.03	0.00	0.01
		(3.61)	(4.59)	(0.23)	(1.64)	(0.18)	(1.54)	(-0.04)	(1.74)
	λ	**-0.41**	**-2.06**	**-0.10**	**-1.54**	**-0.06**	**-1.52**	**0.05**	**-0.32**
		(-1.28)	(-4.90)	(-0.41)	(-5.77)	(-0.22)	(-5.75)	(1.02)	(-5.87)
	Adj. R^2	0.1%	5.1%	-0.2%	7.0%	-0.2%	6.9%	0.0%	7.2%
		NYSE and AMEX Only							
All-Equity Financed	α	0.10	0.15	0.02	0.04	0.02	0.04	0.00	0.01
		(4.34)	(5.64)	(1.19)	(2.26)	(1.07)	(2.14)	(0.83)	(2.49)
	λ	**-1.67**	**-3.62**	**-1.27**	**-2.57**	**-1.18**	**-2.52**	**-0.12**	**-0.44**
		(-3.62)	(-6.61)	(-3.48)	(-6.47)	(-3.27)	(-6.43)	(-2.07)	(-6.75)
	Adj. R^2	2.7%	9.0%	2.5%	8.7%	2.2%	8.6%	0.8%	9.4%
Debt Financed	α	0.09	0.11	0.01	0.01	0.01	0.01	0.00	0.00
		(3.80)	(4.01)	(0.48)	(0.45)	(0.32)	(0.39)	(0.43)	(0.23)
	λ	**-0.36**	**-0.57**	**-0.48**	**-0.43**	**-0.38**	**-0.43**	**-0.18**	**-0.07**
		(-1.48)	(-2.03)	(-2.44)	(-2.08)	(-1.92)	(-2.08)	(-2.59)	(-1.07)
	Adj. R^2	0.3%	0.7%	1.1%	0.8%	0.6%	0.8%	1.3%	0.0%

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 all firms in the all-equity-financed (AE) and debt-financed (DF) datasets from December 18, 1972 to December 31, 2008. 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) in the top panel and only on NYSE and AMEX in the bottom panel.

[9]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 $t-1$.

In Tables 4–6, we provide some robustness checks on our results by re-running the analysis of Tables 1–3 for subsets of the AE and DF datasets containing only those firms that are continuously traded over a common time period (see Duffee, 1995). And in Tables A.1–A.3 of the Appendix, we replicate the regressions of Table 1 but allow for more or less flexibility in the estimates by focusing on the 10, 40, and 80-day volatility- and return-estimation periods, respectively. All of these results are qualitatively consistent with the patterns from the complete AE and DF samples.

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 often stronger, among a sample of all-equity-financed firms.

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 also support 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 findings 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

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					**BlackLag2**				
All-Equity Financed Continuous Traded	23	α	0.08	0.11	0.12	0.29	0.04	0.10	0.15	0.16	0.26	0.04
			(2.00)	(2.86)	(2.79)	(3.32)	(0.37)	(2.83)	(3.26)	(3.32)	(4.05)	(0.34)
		λ	**-1.64**	**-0.48**	**-0.32**	**1.24**	**0.77**	**-4.22**	**-0.71**	**-0.98**	**0.29**	**0.99**
			(-3.24)	(-0.72)	(-0.77)	(2.36)	(1.62)	(-7.34)	(-1.71)	(-1.71)	(0.65)	(1.72)
		Adj. R^2	-0.5%	1.0%	1.2%	5.1%	1.7%	-0.6%	1.1%	2.3%	23.1%	5.0%
Debt Financed Continuous Traded	41	α	0.07	0.12	0.12	0.22	0.03	0.08	0.14	0.14	0.26	0.03
			(2.05)	(2.89)	(2.84)	(3.77)	(0.35)	(2.30)	(3.06)	(3.07)	(3.77)	(0.35)
		λ	**-1.33**	**-0.49**	**-0.56**	**0.02**	**0.28**	**-1.84**	**-0.59**	**-0.59**	**2.15**	**0.64**
			(-3.62)	(-2.02)	(-1.97)	(0.06)	(0.86)	(-4.82)	(-2.18)	(-1.77)	(7.51)	(1.90)
		Adj. R^2	-0.6%	1.7%	2.0%	6.4%	1.9%	-0.6%	2.3%	2.9%	23.9%	4.2%
			LogBlackLag1					**LogBlackLag2**				
All-Equity Financed Continuous Traded	23	α	-0.01	0.01	0.01	0.04	0.01	0.01	0.02	0.02	0.04	0.01
			(-0.35)	(0.44)	(0.36)	(0.78)	(0.33)	(0.24)	(0.56)	(0.66)	(1.23)	(0.28)
		λ	**-1.47**	**-0.40**	**-0.29**	**1.10**	**0.75**	**-2.57**	**-0.58**	**-0.64**	**0.16**	**0.63**
			(-3.70)	(-1.04)	(-0.84)	(3.07)	(1.96)	(-5.53)	(-1.33)	(-1.43)	(0.61)	(1.42)
		Adj. R^2	-0.6%	0.7%	1.8%	6.7%	2.3%	-0.5%	0.4%	1.5%	14.4%	3.6%
Debt Financed Continuous Traded	41	α	0.00	0.01	0.01	0.03	0.01	0.00	0.02	0.02	0.03	0.01
			(-0.07)	(0.43)	(0.42)	(0.84)	(0.19)	(-0.01)	(0.50)	(0.49)	(1.04)	(0.27)
		λ	**-1.36**	**-0.50**	**-0.53**	**0.24**	**0.29**	**-1.29**	**-0.43**	**-0.49**	**0.42**	**0.37**
			(-4.80)	(-2.41)	(-2.35)	(0.74)	(1.13)	(-5.13)	(-1.81)	(-1.84)	(1.28)	(1.27)
		Adj. R^2	-0.6%	2.7%	3.1%	11.1%	2.8%	-0.6%	1.3%	2.2%	12.6%	2.5%
			ChristieLag1					**ChristieLag2**				
All-Equity Financed Continuous Traded	23	α	-0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.02	0.04	0.01
			(-0.29)	(0.28)	(0.25)	(0.58)	(0.25)	(0.22)	(0.52)	(0.58)	(1.05)	(0.25)
		λ	**-1.36**	**-0.29**	**-0.15**	**1.22**	**0.72**	**-2.50**	**-0.62**	**-0.68**	**0.09**	**0.60**
			(-3.14)	(-0.89)	(-0.45)	(3.49)	(1.87)	(-5.61)	(-1.43)	(-1.55)	(0.32)	(1.41)
		Adj. R^2	-0.6%	0.8%	1.4%	6.0%	1.9%	-0.6%	0.6%	1.7%	14.8%	3.6%
Debt Financed Continuous Traded	41	α	0.00	0.00	0.01	0.01	0.00	-0.01	0.01	0.01	0.03	0.01
			(-0.12)	(0.15)	(0.16)	(0.49)	(0.15)	(-0.14)	(0.33)	(0.31)	(0.91)	(0.24)
		λ	**-1.23**	**-0.33**	**-0.39**	**0.34**	**0.29**	**-1.28**	**-0.43**	**-0.49**	**0.45**	**0.38**
			(-4.14)	(-1.65)	(-1.69)	(1.09)	(1.09)	(-5.17)	(-1.94)	(-1.88)	(2.02)	(1.34)
		Adj. R^2	-0.5%	1.0%	1.7%	8.4%	2.2%	-0.6%	1.7%	2.3%	12.7%	2.6%
			DuffeeLag1					**DuffeeLag2**				
All-Equity Financed Continuous Traded	23	α	0.00	0.01	0.01	0.02	0.01	0.00	0.01	0.01	0.03	0.01
			(-0.37)	(0.43)	(0.49)	(1.44)	(0.47)	(0.22)	(0.90)	(0.98)	(1.91)	(0.51)
		λ	**-1.48**	**-0.11**	**-0.13**	**0.57**	**0.41**	**-2.08**	**-0.36**	**-0.41**	**0.06**	**0.44**
			(-7.83)	(-0.80)	(-0.87)	(4.00)	(2.80)	(-10.06)	(-2.37)	(-2.56)	(0.29)	(2.41)
		Adj. R^2	-0.6%	0.5%	3.4%	25.5%	7.0%	-0.6%	2.5%	5.0%	36.3%	8.5%
Debt Financed Continuous Traded	41	α	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.02	0.01
			(-0.26)	(0.20)	(0.26)	(1.19)	(0.29)	(-0.16)	(0.45)	(0.48)	(1.81)	(0.45)
		λ	**-0.58**	**-0.11**	**-0.14**	**0.39**	**0.21**	**-0.98**	**-0.33**	**-0.31**	**0.95**	**0.31**
			(-4.22)	(-0.89)	(-1.12)	(2.79)	(1.60)	(-6.82)	(-2.39)	(-2.27)	(4.20)	(1.94)
		Adj. R^2	-0.8%	0.3%	1.5%	8.7%	2.6%	-0.6%	2.6%	4.0%	20.6%	4.8%

Table 4: Summary statistics across continuously traded firms in the all-equity-financed (AE) and debt-financed (DF) datasets from January 3, 1994 to December 31, 2008 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 Continuous Traded		α	0.08	0.11	0.11	0.17	0.02	0.10	0.15	0.16	0.22	0.03
			(2.00)	(2.85)	(2.77)	(3.32)	(0.38)	(2.83)	(3.33)	(3.35)	(4.05)	(0.36)
	20	λ	**-1.64**	**-0.53**	**-0.29**	**1.24**	**0.82**	**-4.22**	**-1.00**	**-1.08**	**0.27**	**1.01**
			(-3.24)	(-0.70)	(-0.65)	(2.36)	(1.70)	(-7.34)	(-1.71)	(-1.83)	(0.53)	(1.77)
		Adj. R^2	-0.5%	0.6%	1.2%	5.1%	1.8%	-0.6%	1.1%	2.6%	23.1%	5.4%
Debt Financed Continuous Traded		α	0.07	0.12	0.12	0.16	0.03	0.08	0.14	0.14	0.21	0.03
			(2.39)	(2.77)	(2.81)	(3.29)	(0.25)	(2.65)	(3.21)	(3.25)	(3.77)	(0.28)
	15	λ	**-1.32**	**-0.56**	**-0.58**	**-0.29**	**0.26**	**-1.84**	**-0.97**	**-0.96**	**-0.36**	**0.41**
			(-2.96)	(-1.71)	(-1.78)	(-0.52)	(0.76)	(-3.24)	(-2.79)	(-2.53)	(-1.14)	(0.68)
		Adj. R^2	-0.4%	1.4%	1.5%	4.2%	1.5%	0.2%	3.7%	3.2%	5.1%	1.7%
			LogBlackLag1					**LogBlackLag2**				
All-Equity Financed Continuous Traded		α	-0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.04	0.01
			(-0.35)	(0.47)	(0.34)	(0.78)	(0.34)	(0.24)	(0.65)	(0.69)	(1.23)	(0.28)
	20	λ	**-1.47**	**-0.42**	**-0.25**	**1.10**	**0.79**	**-2.57**	**-0.61**	**-0.70**	**0.12**	**0.64**
			(-3.43)	(-0.90)	(-0.63)	(3.07)	(1.96)	(-5.53)	(-1.33)	(-1.53)	(0.26)	(1.45)
		Adj. R^2	-0.6%	0.5%	1.7%	5.8%	2.1%	-0.5%	0.4%	1.7%	14.4%	3.8%
Debt Financed Continuous Traded		α	0.00	0.01	0.01	0.02	0.00	0.01	0.02	0.02	0.03	0.01
			(0.11)	(0.43)	(0.42)	(0.65)	(0.13)	(0.41)	(0.64)	(0.66)	(1.04)	(0.20)
	15	λ	**-1.36**	**-0.50**	**-0.54**	**0.08**	**0.30**	**-1.29**	**-0.80**	**-0.73**	**-0.29**	**0.30**
			(-3.86)	(-2.20)	(-2.08)	(0.19)	(1.06)	(-3.31)	(-2.44)	(-2.39)	(-1.22)	(0.66)
		Adj. R^2	-0.6%	2.7%	2.4%	7.3%	2.3%	0.3%	2.7%	2.8%	5.4%	1.6%
			ChristieLag1					**ChristieLag2**				
All-Equity Financed Continuous Traded		α	-0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.02	0.04	0.01
			(-0.29)	(0.31)	(0.25)	(0.58)	(0.26)	(0.23)	(0.57)	(0.62)	(1.05)	(0.24)
	20	λ	**-1.36**	**-0.30**	**-0.12**	**1.22**	**0.77**	**-2.50**	**-0.65**	**-0.74**	**0.06**	**0.61**
			(-3.14)	(-0.74)	(-0.30)	(3.49)	(1.93)	(-5.61)	(-1.44)	(-1.66)	(0.14)	(1.45)
		Adj. R^2	-0.6%	0.6%	1.4%	6.0%	2.0%	-0.6%	0.6%	1.9%	14.8%	3.9%
Debt Financed Continuous Traded		α	0.00	0.01	0.01	0.01	0.00	0.00	0.02	0.02	0.03	0.01
			(-0.05)	(0.24)	(0.25)	(0.49)	(0.15)	(0.03)	(0.48)	(0.49)	(0.91)	(0.24)
	15	λ	**-1.23**	**-0.41**	**-0.42**	**0.28**	**0.31**	**-1.28**	**-0.82**	**-0.74**	**-0.31**	**0.29**
			(-3.47)	(-1.75)	(-1.63)	(0.72)	(1.04)	(-3.39)	(-2.47)	(-2.48)	(-1.30)	(0.67)
		Adj. R^2	-0.4%	1.2%	1.5%	5.9%	1.8%	0.4%	2.8%	3.1%	5.6%	1.7%
			DuffeeLag1					**DuffeeLag2**				
All-Equity Financed Continuous Traded		α	0.00	0.01	0.01	0.02	0.01	0.00	0.01	0.01	0.03	0.01
			(-0.37)	(0.56)	(0.53)	(1.44)	(0.49)	(0.24)	(1.06)	(1.08)	(1.91)	(0.48)
	20	λ	**-1.48**	**-0.13**	**-0.14**	**0.57**	**0.44**	**-2.08**	**-0.39**	**-0.45**	**0.04**	**0.45**
			(-7.83)	(-0.81)	(-0.92)	(4.00)	(3.00)	(-10.06)	(-2.64)	(-2.78)	(0.29)	(2.49)
		Adj. R^2	-0.5%	1.1%	3.9%	25.5%	7.3%	-0.6%	3.3%	5.6%	36.3%	8.9%
Debt Financed Continuous Traded		α	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.02	0.01
			(-0.02)	(0.35)	(0.44)	(1.19)	(0.35)	(-0.06)	(0.69)	(0.81)	(1.81)	(0.52)
	15	λ	**-0.58**	**-0.17**	**-0.18**	**0.39**	**0.22**	**-0.98**	**-0.43**	**-0.46**	**-0.14**	**0.23**
			(-3.74)	(-1.22)	(-1.54)	(2.26)	(1.63)	(-5.54)	(-3.23)	(-3.30)	(-1.12)	(1.46)
		Adj. R^2	-0.8%	1.0%	2.1%	6.9%	2.8%	0.1%	5.1%	6.2%	14.4%	4.9%

Table 5: Summary statistics across continuously traded NYSE and AMEX firms in the all-equity-financed (AE) and debt-financed (DF) datasets from January 3, 1994 to December 31, 2008 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
		All Exchanges							
All-Equity Financed Continuous Traded	**α**	0.09	0.19	0.02	0.08	0.02	0.07	0.01	0.02
		(2.73)	(5.30)	(0.89)	(2.61)	(0.85)	(2.56)	(1.73)	(3.90)
	λ	**-1.16**	**-5.44**	**-0.77**	**-3.37**	**-0.73**	**-3.38**	**-0.20**	**-0.77**
		(-1.47)	(-6.57)	(-1.23)	(-5.04)	(-1.20)	(-5.14)	(-2.10)	(-6.92)
	Adj. R^2	0.7%	19.3%	0.3%	12.2%	0.2%	12.6%	1.9%	21.1%
Debt Financed Continuous Traded	**α**	0.09	0.16	0.02	0.06	0.02	0.06	0.01	0.02
		(2.76)	(4.66)	(0.84)	(2.22)	(0.77)	(2.10)	(1.30)	(2.82)
	λ	**-0.80**	**-3.23**	**-0.71**	**-2.36**	**-0.66**	**-2.35**	**-0.20**	**-0.63**
		(-1.66)	(-6.12)	(-1.73)	(-5.46)	(-1.63)	(-5.50)	(-2.44)	(-6.55)
	Adj. R^2	1.0%	17.2%	1.1%	14.1%	0.9%	14.3%	2.7%	19.2%
		NYSE and AMEX Only							
All-Equity Financed Continuous Traded	**α**	0.10	0.21	0.02	0.08	0.02	0.08	0.01	0.02
		(2.77)	(5.68)	(0.72)	(2.70)	(0.68)	(2.62)	(1.61)	(4.13)
	λ	**-1.09**	**-6.51**	**-0.72**	**-4.10**	**-0.67**	**-4.09**	**-0.21**	**-0.93**
		(-1.21)	(-7.26)	(-1.00)	(-5.59)	(-0.95)	(-5.68)	(-1.99)	(-7.76)
	Adj. R^2	0.3%	22.7%	0.0%	14.6%	-0.1%	15.1%	1.7%	25.2%
Debt Financed Continuous Traded	**α**	0.07	0.13	0.02	0.05	0.02	0.05	0.01	0.02
		(2.66)	(4.18)	(0.92)	(2.06)	(0.84)	(1.92)	(1.52)	(2.92)
	λ	**-1.03**	**-3.15**	**-0.87**	**-2.37**	**-0.82**	**-2.35**	**-0.25**	**-0.74**
		(-2.18)	(-5.72)	(-2.19)	(-5.37)	(-2.09)	(-5.43)	(-2.97)	(-7.15)
	Adj. R^2	2.1%	15.3%	2.1%	13.7%	1.9%	14.0%	4.2%	22.2%

Table 6: 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 the continuously traded firms in the all-equity-financed (AE) and debt-financed (DF) datasets from January 3, 1994 to December 31, 2008. 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) in the top panel and on NYSE and AMEX in the bottom panel.

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 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.

[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).

A Appendix

To provide additional robustness checks for our results, we re-run the analysis of Table 1 for 10, 40, and 80-day volatility- and return-estimation windows, and the results are reported in Tables A.1–A.3, respectively. All of these results are qualitatively consistent with the patterns from the complete AE and DF samples.

Dataset	Sample Size	Statistic	Min	Median	Mean	Max	Std	Min	Median	Mean	Max	Std
			BlackLag1					BlackLag2				
		α	0.06	0.19	0.24	2.24	0.16	0.06	0.22	0.26	1.52	0.16
			(0.99)	(2.67)	(2.87)	(6.79)	(1.07)	(0.53)	(2.67)	(2.90)	(7.27)	(1.17)
All-Equity Financed	**504**	λ	**-10.20**	**-0.83**	**-1.02**	**1.50**	**1.05**	**-20.89**	**-0.53**	**-0.62**	**43.71**	**2.58**
			(-5.53)	(-1.44)	(-1.51)	(1.72)	(1.04)	(-6.59)	(-0.85)	(-0.94)	(4.55)	(1.38)
		Adj. R^2	-2.6%	0.7%	1.6%	18.7%	3.1%	-2.6%	0.0%	1.3%	29.7%	3.7%
		α	0.07	0.20	0.22	0.63	0.09	0.07	0.22	0.24	0.74	0.10
			(1.24)	(3.23)	(3.35)	(7.15)	(1.16)	(1.10)	(3.29)	(3.41)	(7.41)	(1.18)
Debt Financed	**573**	λ	**-10.20**	**-0.82**	**-0.88**	**1.04**	**0.67**	**-8.19**	**-0.57**	**-0.68**	**4.61**	**0.93**
			(-5.54)	(-1.84)	(-1.92)	(1.43)	(1.07)	(-5.81)	(-1.17)	(-1.23)	(3.22)	(1.27)
		Adj. R^2	-2.3%	1.4%	1.9%	16.5%	2.6%	-2.4%	0.3%	1.2%	23.2%	2.7%
			LogBlackLag1					LogBlackLag2				
		α	-0.08	0.01	0.01	0.16	0.02	-0.15	0.00	0.00	0.15	0.03
			(-0.86)	(0.18)	(0.20)	(1.83)	(0.36)	(-1.23)	(0.07)	(0.03)	(1.15)	(0.42)
All-Equity Financed	**504**	λ	**-6.87**	**-0.87**	**-1.10**	**2.10**	**1.03**	**-4.22**	**-0.44**	**-0.52**	**4.55**	**0.84**
			(-7.15)	(-2.34)	(-2.35)	(2.47)	(1.55)	(-4.91)	(-0.95)	(-1.01)	(2.53)	(1.26)
		Adj. R^2	-2.2%	3.1%	5.0%	42.8%	6.3%	-2.6%	0.1%	1.2%	19.3%	3.2%
		α	-0.08	0.01	0.01	0.12	0.02	-0.17	0.01	0.00	0.11	0.02
			(-0.66)	(0.21)	(0.23)	(1.83)	(0.31)	(-1.11)	(0.13)	(0.11)	(1.26)	(0.36)
Debt Financed	**573**	λ	**-5.18**	**-0.83**	**-0.92**	**0.86**	**0.63**	**-3.33**	**-0.44**	**-0.48**	**2.19**	**0.54**
			(-7.76)	(-2.81)	(-2.85)	(1.85)	(1.57)	(-5.38)	(-1.25)	(-1.26)	(2.02)	(1.20)
		Adj. R^2	-1.9%	3.4%	5.0%	37.3%	5.6%	-2.3%	0.4%	1.1%	17.7%	2.3%
			ChristieLag1					ChristieLag2				
		α	-0.11	0.00	0.00	0.11	0.02	-0.15	0.00	-0.01	0.15	0.03
			(-0.97)	(0.02)	(0.01)	(1.28)	(0.32)	(-1.37)	(0.01)	(-0.06)	(1.15)	(0.42)
All-Equity Financed	**504**	λ	**-6.80**	**-0.69**	**-0.90**	**2.62**	**1.06**	**-4.27**	**-0.45**	**-0.52**	**4.60**	**0.83**
			(-6.19)	(-1.77)	(-1.76)	(3.37)	(1.47)	(-5.23)	(-1.00)	(-1.04)	(2.63)	(1.27)
		Adj. R^2	-2.6%	1.5%	3.1%	35.8%	5.0%	-2.5%	0.2%	1.2%	20.5%	3.1%
		α	-0.09	0.00	0.00	0.10	0.02	-0.20	0.00	0.00	0.15	0.02
			(-0.94)	(-0.03)	(-0.03)	(0.86)	(0.24)	(-1.36)	(0.02)	(-0.01)	(1.25)	(0.34)
Debt Financed	**573**	λ	**-5.00**	**-0.64**	**-0.74**	**1.15**	**0.64**	**-3.33**	**-0.48**	**-0.51**	**2.31**	**0.54**
			(-6.53)	(-2.20)	(-2.13)	(2.24)	(1.42)	(-5.33)	(-1.33)	(-1.34)	(2.07)	(1.21)
		Adj. R^2	-2.0%	1.9%	3.0%	33.0%	4.2%	-2.3%	0.5%	1.3%	19.7%	2.5%
			DuffeeLag1					DuffeeLag2				
		α	-0.11	0.00	0.00	0.23	0.03	-0.13	0.00	0.00	0.16	0.03
			(-1.05)	(0.05)	(0.09)	(2.09)	(0.34)	(-1.33)	(0.02)	(0.01)	(1.84)	(0.38)
All-Equity Financed	**504**	λ	**-2.83**	**-0.35**	**-0.31**	**3.73**	**0.76**	**-2.47**	**-0.32**	**-0.33**	**1.21**	**0.52**
			(-8.81)	(-1.30)	(-1.23)	(6.98)	(2.22)	(-11.51)	(-1.03)	(-1.14)	(2.91)	(1.67)
		Adj. R^2	-2.6%	1.5%	3.7%	36.2%	6.0%	-2.4%	0.4%	1.9%	30.0%	4.4%
		α	-0.24	0.00	0.00	0.17	0.02	-0.12	0.00	0.00	0.14	0.02
			(-1.03)	(0.02)	(0.05)	(1.14)	(0.28)	(-1.28)	(0.03)	(0.06)	(1.19)	(0.32)
Debt Financed	**573**	λ	**-4.07**	**-0.36**	**-0.35**	**2.02**	**0.64**	**-3.52**	**-0.37**	**-0.43**	**1.63**	**0.50**
			(-8.80)	(-1.58)	(-1.48)	(5.98)	(2.11)	(-9.59)	(-1.51)	(-1.61)	(2.38)	(1.62)
		Adj. R^2	-2.5%	1.5%	3.1%	55.2%	5.5%	-2.2%	0.9%	2.2%	27.9%	4.1%

Table A.1: Summary statistics across all firms in the all-equity-financed (AE) and debt-financed (DF) datasets from December 18, 1972 to December 31, 2008 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 10 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	168	α	0.01	0.11	0.13	0.52	0.08	-0.03	0.13	0.15	0.47	0.09
			(0.12)	(1.82)	(1.85)	(3.55)	(0.65)	(-0.69)	(1.89)	(1.88)	(3.86)	(0.77)
		λ	**-2.86**	**-0.43**	**-0.41**	**12.23**	**1.11**	**-5.10**	**-0.29**	**-0.30**	**11.60**	**1.21**
			(-4.15)	(-1.38)	(-1.35)	(1.32)	(1.13)	(-4.50)	(-0.84)	(-0.89)	(3.07)	(1.39)
		Adj. R^2	-2.6%	1.3%	2.7%	24.9%	4.5%	-2.6%	0.4%	2.4%	24.4%	4.9%
Debt Financed	303	α	0.03	0.10	0.12	0.53	0.07	-0.01	0.12	0.14	0.85	0.10
			(0.47)	(1.85)	(1.90)	(3.83)	(0.59)	(-0.14)	(1.96)	(1.98)	(3.69)	(0.65)
		λ	**-2.25**	**-0.35**	**-0.36**	**12.23**	**0.79**	**-6.50**	**-0.36**	**-0.41**	**11.60**	**0.93**
			(-4.90)	(-1.58)	(-1.65)	(1.25)	(1.11)	(-6.41)	(-1.38)	(-1.39)	(1.97)	(1.39)
		Adj. R^2	-2.6%	2.0%	3.5%	23.3%	5.0%	-2.4%	1.5%	3.3%	34.5%	5.5%
			LogBlackLag1					**LogBlackLag2**				
All-Equity Financed	168	α	-0.05	0.02	0.02	0.18	0.03	-0.11	0.02	0.02	0.17	0.04
			(-0.88)	(0.33)	(0.38)	(2.45)	(0.48)	(-1.62)	(0.26)	(0.27)	(3.00)	(0.65)
		λ	**-3.28**	**-0.38**	**-0.44**	**1.05**	**0.55**	**-2.36**	**-0.27**	**-0.28**	**1.56**	**0.53**
			(-4.93)	(-1.58)	(-1.61)	(1.76)	(1.42)	(-4.20)	(-1.01)	(-0.91)	(2.56)	(1.32)
		Adj. R^2	-2.5%	1.9%	4.5%	29.4%	6.3%	-2.6%	0.6%	2.1%	19.7%	4.4%
Debt Financed	303	α	-0.04	0.02	0.02	0.12	0.02	-0.08	0.02	0.02	0.14	0.03
			(-0.71)	(0.40)	(0.43)	(2.10)	(0.44)	(-1.18)	(0.32)	(0.35)	(2.32)	(0.52)
		λ	**-2.22**	**-0.34**	**-0.37**	**1.05**	**0.32**	**-1.62**	**-0.29**	**-0.33**	**1.01**	**0.36**
			(-6.00)	(-1.86)	(-1.95)	(1.91)	(1.38)	(-5.88)	(-1.33)	(-1.39)	(2.16)	(1.32)
		Adj. R^2	-2.4%	3.2%	5.4%	32.8%	6.9%	-2.6%	1.2%	3.2%	25.7%	5.3%
			ChristieLag1					**ChristieLag2**				
All-Equity Financed	168	α	-0.06	0.00	0.01	0.16	0.02	-0.11	0.01	0.01	0.16	0.03
			(-0.90)	(0.10)	(0.13)	(2.19)	(0.39)	(-1.81)	(0.12)	(0.13)	(1.81)	(0.57)
		λ	**-3.13**	**-0.28**	**-0.33**	**1.15**	**0.54**	**-2.41**	**-0.28**	**-0.29**	**1.60**	**0.53**
			(-4.12)	(-1.11)	(-1.12)	(2.26)	(1.40)	(-4.32)	(-1.05)	(-0.96)	(2.60)	(1.34)
		Adj. R^2	-2.6%	0.9%	2.7%	21.9%	4.9%	-2.6%	0.9%	2.3%	24.0%	4.7%
Debt Financed	303	α	-0.06	0.00	0.00	0.08	0.02	-0.09	0.01	0.01	0.08	0.02
			(-0.84)	(0.11)	(0.09)	(1.06)	(0.32)	(-1.23)	(0.14)	(0.13)	(1.28)	(0.44)
		λ	**-2.17**	**-0.26**	**-0.28**	**1.15**	**0.31**	**-1.58**	**-0.31**	**-0.35**	**1.01**	**0.36**
			(-5.05)	(-1.36)	(-1.38)	(2.28)	(1.26)	(-5.75)	(-1.44)	(-1.47)	(2.18)	(1.33)
		Adj. R^2	-2.6%	1.2%	2.9%	21.1%	5.1%	-2.6%	1.5%	3.4%	28.7%	5.4%
			DuffeeLag1					**DuffeeLag2**				
All-Equity Financed	168	α	-0.05	0.00	0.00	0.07	0.02	-0.05	0.00	0.00	0.08	0.02
			(-0.99)	(0.13)	(0.18)	(2.05)	(0.43)	(-1.26)	(0.13)	(0.19)	(2.31)	(0.59)
		λ	**-1.20**	**-0.12**	**-0.11**	**1.72**	**0.33**	**-1.27**	**-0.20**	**-0.20**	**1.58**	**0.31**
			(-4.61)	(-0.90)	(-0.86)	(4.48)	(1.78)	(-5.93)	(-1.24)	(-1.19)	(2.28)	(1.51)
		Adj. R^2	-2.6%	1.3%	3.5%	30.9%	6.2%	-2.6%	1.4%	3.4%	37.9%	6.4%
Debt Financed	303	α	-0.04	0.00	0.01	0.13	0.02	-0.06	0.01	0.01	0.17	0.02
			(-0.74)	(0.12)	(0.18)	(1.54)	(0.37)	(-1.19)	(0.15)	(0.22)	(2.14)	(0.49)
		λ	**-1.11**	**-0.13**	**-0.13**	**1.72**	**0.27**	**-1.73**	**-0.23**	**-0.24**	**1.58**	**0.28**
			(-6.18)	(-0.94)	(-0.99)	(4.43)	(1.67)	(-6.04)	(-1.62)	(-1.63)	(2.85)	(1.54)
		Adj. R^2	-2.4%	0.8%	3.0%	24.6%	5.5%	-2.5%	2.3%	4.4%	30.7%	6.1%

Table A.2: Summary statistics across all firms in the all-equity-financed (AE) and debt-financed (DF) datasets from December 18, 1972 to December 31, 2008 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 40 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	**48**	**α**	0.00	0.09	0.11	0.31	0.06	0.00	0.12	0.14	0.46	0.09
			(0.12)	(1.65)	(1.68)	(2.70)	(0.54)	(0.04)	(1.81)	(1.81)	(3.50)	(0.74)
		λ	**-0.99**	**-0.27**	**-0.27**	**0.91**	**0.38**	**-1.97**	**-0.28**	**-0.29**	**1.65**	**0.67**
			(-3.44)	(-1.01)	(-1.03)	(1.73)	(1.25)	(-4.37)	(-0.69)	(-0.79)	(1.87)	(1.57)
		Adj. R^2	-2.3%	0.8%	2.6%	20.9%	5.2%	-2.5%	1.3%	2.9%	21.5%	5.4%
Debt Financed	**115**	**α**	0.00	0.08	0.11	0.61	0.09	0.02	0.10	0.14	0.83	0.13
			(0.05)	(1.56)	(1.60)	(3.20)	(0.65)	(0.34)	(1.68)	(1.67)	(3.45)	(0.64)
		λ	**-1.59**	**-0.24**	**-0.24**	**0.71**	**0.31**	**-1.88**	**-0.24**	**-0.29**	**1.14**	**0.45**
			(-4.57)	(-1.24)	(-1.26)	(1.75)	(1.28)	(-4.08)	(-1.23)	(-1.20)	(2.42)	(1.24)
		Adj. R^2	-2.6%	1.3%	3.4%	29.7%	6.0%	-2.6%	1.1%	3.1%	27.4%	5.7%
			LogBlackLag1					**LogBlackLag2**				
All-Equity Financed	**48**	**α**	-0.03	0.03	0.03	0.09	0.02	-0.05	0.03	0.03	0.14	0.04
			(-0.65)	(0.60)	(0.56)	(1.70)	(0.49)	(-0.83)	(0.47)	(0.54)	(2.10)	(0.64)
		λ	**-1.27**	**-0.23**	**-0.28**	**0.86**	**0.42**	**-1.43**	**-0.21**	**-0.25**	**1.09**	**0.46**
			(-4.20)	(-1.03)	(-1.25)	(1.68)	(1.51)	(-3.84)	(-0.76)	(-0.84)	(1.87)	(1.43)
		Adj. R^2	-2.1%	0.9%	4.4%	28.7%	7.5%	-2.5%	0.5%	2.4%	22.4%	5.4%
Debt Financed	**115**	**α**	-0.04	0.03	0.03	0.15	0.03	-0.09	0.02	0.03	0.16	0.04
			(-0.73)	(0.50)	(0.56)	(2.42)	(0.61)	(-0.98)	(0.41)	(0.46)	(2.52)	(0.58)
		λ	**-1.61**	**-0.24**	**-0.22**	**0.61**	**0.28**	**-1.31**	**-0.22**	**-0.23**	**0.41**	**0.27**
			(-5.65)	(-1.42)	(-1.49)	(1.77)	(1.55)	(-3.98)	(-1.27)	(-1.25)	(1.29)	(1.17)
		Adj. R^2	-2.6%	2.2%	5.1%	39.7%	8.3%	-2.6%	1.4%	3.0%	24.5%	5.6%
			ChristieLag1					**ChristieLag2**				
All-Equity Financed	**48**	**α**	-0.03	0.01	0.01	0.06	0.02	-0.04	0.02	0.02	0.09	0.03
			(-0.61)	(0.26)	(0.27)	(1.10)	(0.40)	(-0.86)	(0.41)	(0.40)	(1.62)	(0.57)
		λ	**-1.16**	**-0.16**	**-0.20**	**0.93**	**0.40**	**-1.38**	**-0.21**	**-0.25**	**1.10**	**0.44**
			(-3.91)	(-0.64)	(-0.85)	(2.07)	(1.47)	(-3.79)	(-0.91)	(-0.89)	(1.79)	(1.42)
		Adj. R^2	-2.3%	0.0%	2.9%	25.1%	6.2%	-2.4%	0.8%	2.5%	16.8%	5.1%
Debt Financed	**115**	**α**	-0.06	0.01	0.01	0.12	0.02	-0.12	0.01	0.01	0.09	0.03
			(-0.83)	(0.14)	(0.15)	(1.18)	(0.37)	(-1.47)	(0.14)	(0.15)	(1.24)	(0.47)
		λ	**-1.52**	**-0.16**	**-0.15**	**0.67**	**0.27**	**-1.24**	**-0.25**	**-0.24**	**0.36**	**0.25**
			(-4.39)	(-0.96)	(-0.95)	(2.01)	(1.36)	(-4.78)	(-1.35)	(-1.32)	(1.31)	(1.20)
		Adj. R^2	-2.6%	0.6%	2.6%	28.0%	5.7%	-2.6%	1.5%	3.4%	24.1%	5.7%
			DuffeeLag1					**DuffeeLag2**				
All-Equity Financed	**48**	**α**	-0.02	0.01	0.01	0.06	0.01	-0.03	0.01	0.01	0.10	0.02
			(-0.71)	(0.28)	(0.33)	(1.55)	(0.49)	(-0.82)	(0.38)	(0.49)	(1.79)	(0.65)
		λ	**-0.40**	**-0.05**	**-0.08**	**0.36**	**0.18**	**-0.64**	**-0.13**	**-0.14**	**0.27**	**0.18**
			(-4.94)	(-0.50)	(-0.77)	(2.63)	(1.72)	(-5.04)	(-1.05)	(-1.12)	(1.56)	(1.60)
		Adj. R^2	-2.3%	0.6%	3.7%	25.9%	6.5%	-2.2%	1.5%	3.9%	35.2%	7.1%
Debt Financed	**115**	**α**	-0.03	0.00	0.01	0.06	0.01	-0.06	0.00	0.01	0.10	0.02
			(-0.72)	(0.12)	(0.17)	(1.20)	(0.40)	(-0.95)	(0.13)	(0.21)	(1.78)	(0.48)
		λ	**-1.00**	**-0.07**	**-0.07**	**0.36**	**0.19**	**-0.80**	**-0.14**	**-0.18**	**0.28**	**0.19**
			(-4.84)	(-0.80)	(-0.65)	(3.28)	(1.59)	(-5.04)	(-1.53)	(-1.45)	(1.86)	(1.40)
		Adj. R^2	-2.6%	1.1%	3.1%	32.3%	6.0%	-2.6%	2.7%	4.6%	35.2%	7.1%

Table A.3: Summary statistics across all firms in the all-equity-financed (AE) and debt-financed (DF) datasets from December 18, 1972 to December 31, 2008 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 80 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.

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