Leverage- and Cash-Based Tests of Risk and Reward With Improved Identification

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Abstract

Leverage offers not only its own directional implications for both risk and reward, but also facilitates superior tests of risk-reward theories: Leverage can change with and without corporate intervention, sometimes even discontinuously. In better-identified contexts, it is more difficult to blame omitted factors, contamination, information, or corporate responses. The evidence suggests that *changes* in leverage increase volatility but decrease average returns. These effects appear in the large panel of U.S. stock returns, survive progressively better empirical identification, and even hold in equity issuing and dividend payment quasi-experiments.

Keywords: Leverage, Risk, Reward, Quasi-Experiments, Behavioral Finance.

JEL Codes: G12 G31 G32 G35

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The central paradigm of perfect-market macro-finance is built around the fact that investors earn more reward when they take on more risk. Yet, this has been remarkably difficult to test. There is no academic agreement about the relevant risk factors, even for models that posit that optimizing investors are themselves aware of them. Moreover, unidentified contaminants, such as simultaneously released news, corporate responses, or simply measurement error, often render empirical test inferences disputable. Nevertheless, the academic faith in this fundamental risk-reward tradeoff is so strong that these problems have shifted the burden of proof further *in favor of* risk-reward models: There are now a wide range of empirical correlations that would have originally and naively raised doubts about the paradigm, but which are nowadays viewed as no longer necessarily inconsistent. Empirical rejections of specific versions of the risk-reward theory are more likely to motivate dismissal of the risk metric than dismissal of the risk-reward tradeoff.

Yet, the paradigm offers one near-universal element that surprisingly has received only modest *empirical* investigation—leverage. Leverage offers clear predictions. Ceteris paribus, every risky asset should become riskier with more leverage. This prediction should hold for priced and non-priced risk. In turn, leverage should amplify any model-predicted expected return differences to the risk-free rate. These leverage-risk-reward implications are even more basic than equilibrium factor models. They should apply regardless of the deeper risk factors and even if investors are unable to diversify. Gomes and Schmid (2010) characterize them as fundamental insights of rational asset pricing:

> Increases in financial leverage directly increase the risk of the cash flows to equity holders and thus raise the required rate of return on equity. This remarkably simple idea has proved extremely powerful and has been used by countless researchers and practitioners to examine returns and measure the cost of capital across and [sometimes] within firms with varying capital structures.

However, the few papers that had investigated leverage had not found overwhelming—or even modest—support. Fama and French (1992) had noted that corporate leverage had failed to associate reliably with higher average rates of return. Book and market-leverage had opposite signs in explaining future stock returns, mattered only because of extreme mutual multicollinearity, and market-book ratios alone could easily and fully subsume their explanatory power. As Gomes and Schmid (GS) write, "Unfortunately, despite, or perhaps because of, its extreme clarity, this relation between leverage and [average] returns has met with, at best, mixed empirical success." Table 1 below will show that, as of 2016, using various leverage definitions, controls, and specifications, firms with more leverage have not offered higher average rates of return.

Fama and French (1998) conclude in a related context that there "must be information about profitability [that] obscures [the] effect of financing decisions," i.e., an omitted variable contaminating and invalidating the test. (The paper is not explaining stock returns, but book-market ratios.) Gomes and Schmid (2010) propose a specific omitted variable. Because leverage is endogenous, riskier firms with more growth options *should* choose lower leverage. Thus, intrinsically riskier firms could have lower leverage, more risk, and higher expected returns. Lower average stock returns would not be disappointments, but simply fair and expected compensation for less risk. This omitted-variable explanation is not only conceptually possible, but also makes plain sense.

Nevertheless, my paper provides evidence that information contamination and endogenous leverage choice cannot put the matter to rest.

First, it investigates empirically not only average rates of return, but also risk. Second moments are much less noisy than first moments, making it easier to diagnose the role of leverage. The simplest measure of risk is equity volatility. It is interesting not because it should be priced, but because it is one risk measure (among many) for which leverage offers sharp, specific, and quantitative implications. Therefore, volatility can serve as an indicator for the basic theory prediction of leverage—that any risky asset should become riskier when leveraged more. Volatility also has the pragmatic advantage that it avoids having to take sides in the controversial academic debate about what the correct priced risk factors are. And by focusing on own risk, the paper can help to distinguish between two theories: If risk increases in leverage, leverage can be viewed as principally exogenous. If risk decreases in leverage, leverage can be viewed as principally endogenous in the GS sense. And finally, in corporate finance theories, such as GS, firms often want to avoid financial distress costs which can relate directly to own risk and volatility.

Second, it investigates not (just) *levels of* leverage but *changes in* leverage, and it does so in a range of specifications that differ in terms of the tradeoff between breadth and identification.

In addition to the above investigation of risk and reward in the entire CRSP/Compustat cross-section of returns in relation to leverage changes—**which is the heart of this paper**[1]—I also investigate a setting that is even better identified but also much narrower. This setting are the days surrounding discrete cum-to-ex day dividend transitions. This is as close an empirical analog to the standard Miller and Modigliani (1961) perfect-market thought experiment as can be. Conditional on having been declared in the past, the cum-to-ex date is no longer at the firm's discretion (endogenous). Any systematic news about the underlying projects associated with the dividends would have already become public at the declarations, days or weeks earlier. *Before* the cum-to-ex date, the firm's stockholders in effect own one low-risk claim on a cash payment plus one higher-risk claim on the remaining equity components of the projects, both inside the corporate shell. After the ex-date, investors still own the same two claims, except that the low-risk asset component has shifted from inside the corporate shell to the investors on the outside. The publicly quoted stock returns are henceforth only for the residual riskier project assets. From the owners' perspective, cum-dividend stock price quotes are for both claims; ex-dividend quotes are only for the more levered claim. The bundle's net risk and reward does not change—only the part that is quoted in the stock returns changes.

This is all true regardless of the firm's underlying investment policy. It is true regardless of whether the firm already holds the cash or whether it leaves the dividend-required resources in risky projects up until the moment of the cum-ex transition: Any post-payment project equity risk would attach to the residual traded firm equity net of the risk-free dividend payment. The dividend cash is—repurposing an accounting term—de-facto defeased at the moment of declaration and merely quoted together in the public stock price as part of a bundle for a few more days.

The advantage of the dividend setting is that it is quasi-experimental. Any leverage change effects do not seem plausibly attributable to contemporaneous changes in corporate projects and/or to new contaminating information. Without plausible endogenous corporate supply-side forces, only exogenous investor demand forces remain. The disadvantage is that it can highlight only a smaller piece of the leverage-risk-reward puzzle. Thus, although it seems nearly impossible to dispute its specific inference, its external validity is debatable.

[1] This is different from the original draft of this paper.

That is, although the observed leverage-risk-reward behavior turns out to be the same in the discrete leverage change context as in the full-panel context, it is possible that these same effects are not expressions of the same general investor behavior patterns. Similar external validity caveats apply to all empirical work.

The key empirical findings of my paper are easy to summarize:

1. After increases in corporate leverage, stock return volatility has increased.
2. After increases in corporate leverage, average stock returns have decreased.

This is also the case for firms that have both lagged increases in leverage and volatility. And this is also the case both for leverage changes that are caused by stock returns and changes that are caused by managers. (The effects seem larger when management induced rather than stock-return induced.) And this is also the case for equity issuing activity and dividend issuing activity, where changes are both discrete and known-in-advance (and here the volatility changes in these best-identified experiments even quantitatively well in line with the predictions of the exogenous leverage-risk-reward theory). Neither risk-metric mismeasurement, nor new information, nor corporate responses, nor other contaminations can plausibly explain both associations in all contexts. Simply put, investors price leverage-increasing assets so dearly that they experience low average rates of return thereafter.

Why would investors want to buy stocks with high leverage, high volatility, and low average returns? There are two possible explanations:

1. The paradigm would suggest that there are some unknown desirable aspects of these stocks that investors value greatly and that compensate them enough to overcome the effects of both higher leverage and volatility risk.
2. An alternative imperfect-market perspective would suggest that investors are too eager to hold leverage-increasing stocks, are not sufficiently aware of ex-post average return patterns, and end up systematically disappointed.

The evidence in my paper raises the empirical hurdles that the first explanation will have to overcome, although one can never completely exclude it.

It is important not to consider leverage "merely" as yet another empirical anomaly in the zoo of anomalies (Harvey, Liu, and Zhu (2016)). Leverage is theoretically even better founded than market-betas (Frazzini and Pedersen (2014)), and it has the advantage that it lends itself to better identification. Reasonable leverage metrics are known not only to hypothetical representative agents, but also investors and academics. And leverage has separable components, some determined by financial markets and others by corporate managers, with some changes even discrete and known-in-advance. And when quasi-experimentally identified, it can reduce pervasive concerns about measurement error, information and other potential contamination, and causality.

The purpose of my study is thus not to find yet another trading strategy on some variable that *should not* have, but happens to actually have predicted returns. Instead, it is about the fundamental building blocks of risk-reward theories, about variables that *should* predict both expected returns and volatility with the same sign in our canonical academic finance data set, the U.S. public equity markets on CRSP from 1926 to today.

Understanding these building blocks is important not only for asset pricing. Leverage is also a central building block of corporate finance. If leverage does not causally induce commensurate increases in required reward, firms face different capital-structure tradeoffs. Ceteris paribus, firms should then issue even more debt, because equity would no longer suffer commensurate risk externalities. Moreover, leverage can even be viewed as central both to banking and macro-asset pricing theories.

The paper now proceeds as follows: Section I investigates the role of leverage and leverage changes in the full cross-section of US CRSP and Compustat stocks. Section II investigates the role of leverage changes in the dividend payment and equity issuing contexts. Section III speculates on how the findings can be interpreted and offers some more perspective and relationship to other research. And Section IV concludes.

I The Full Panel

This first section presents a study of stock returns in the broad CRSP Compustat panel from 1962 to 2016.[2] Remarkably, despite the large role of leverage in corporate finance and asset pricing theory, there are very few empirical panel studies dedicated to leverage. This section shows that leverage changes (and sometimes levels) are powerful marginal predictors of future average stock returns. The explanatory power is roughly on par with those of the most prominent factors in the literature, such as value, firm-size, momentum, profitability, investment, idiosyncratic volatility, and so on. There is modest overlap, but leverage neither subsumes these variables, nor is it subsumed by them.

A Variable Definitions

The independent variables start from three basic definitions:

negcash: The negcash ratio is 1-cash/assets, where cash is preferably (Compustat) CHE, but CH if not available and assets are AT.[3]

flev: The financial leverage ratio is netdebt/(netdebt + equity), where netdebt is debt (itself DLTT plus DLC) minus cash. The book value of equity is the Compustat book-value (CEQ), net of the investment tax credit (TXDITC or TXDB) when available, and the value of preferred stock (PSTK). All ingredients are winsorized at 0.

liab: The liability ratio is total liabilities (LT) net of cash divided by total assets.

These measures can be viewed as ordered in terms of breadth: Negcash is the narrowest definition of leverage, while liab is the broadest.[4] All debt ratios are winsorized at 0.001 and 0.999.

[2] The results are virtually identical when all financial services firms (SIC 6) are excluded.

[3] Cash has been extensively studied in the corporate finance literature (e.g., Acharya, Almeida, and Campello (2007), Opler et al. (1999), Pinkowitz, Stulz, and Williamson (2006)). Cash may play operational roles in addition to its role as negative leverage. However, many publicly-traded firms hold cash far in excess of their operational needs, and the *marginal* dollar in cash is more than likely primarily negative leverage.

[4] The study ignores the common but conceptually problematic debt/asset ratio, which omits (often large) non-financial liabilities (Welch (2011)).

Debt and liabilities are always measured in book values. Prefixes of "bk" and "mk" denote measurement of the equity in terms of accounting and market values, respectively. That is, mk replaces the book value of equity (inside assets for negcash and liab) with the contemporaneous market-value of equity. This market value is from Compustat (either MKVALT or PRCC_f·CSHO) when available, and patched in (as of fiscal year end) from CRSP otherwise. Delta denotes one-year simple changes in these variables. For example, "Δmkflev" is the simple one-year change in the market-based financial leverage ratio.

Compustat-obtained variables are assumed to be available five (four) months after their applicable fiscal year end before (after) 2004 (Bartov, DeFond, and Konchitchki (2013)). Variable timing is easiest to understand in an example. Consider a firm that ends its fiscal year in December 2010:

FYR 2010	The debt ratio *levels* are reported on the balance sheet "as of 2010/12." Debt ratio *changes* are usually from 2009/12 to 2010/12. Any accounting-based controls in this study (such as book-to-market or operating profits) use the same timing.
2011/04	Fiscal Year 2010 data is assumed to be available.

There are two stock return statistics of interest, both typically calculated from 252 individual daily stock returns: the daily volatility of stock returns net of the equal-weighted market returns during the year ("SD Net"); and the compound rate of return over twelve separate months or over the year ("Compound Raw"). Their timing would be:

2009/05 - 2010/04	"Lagged^2" rates of return, often used as a benchmark or control.
2010/05 - 2011/04	"Contemporaneous" rates of return, also often used as a benchmark or control.
2011/05 - 2012/04	"Lead" rates of return, typically the predicted dependent variable.

The study also investigates leverage quartiles. Although later regressions add further control variables, the quartiles themselves are already constructed to balance stocks not only in each fiscal year but also in terms of their past average rates of return in the year before the leverage change ("Lagged^2"). This allows interpreting "Lead" average rates of returns also as (two-year) *changes* in average rates of return.[5] Mechanically, in each fiscal year, stocks are first sorted by the "Lagged^2 rate of return." Within each set of four contiguous similar-Lagged^2 firms, the one with the lowest indebtedness (or change in indebtedness) is assigned to Q1; the one with the highest is assigned to Q4.

The sorted quartiles are convenient, but not central. An earlier version controlled not for lagged stock returns, but for lagged assets. The key results were similar. Moreover, the Fama-Macbeth regressions also contain results that are not based on leverage quartiles but on the leverage measures themselves.

B Leverage Levels

[Insert Table 1 here: **Leverage Ratios — Levels**]

Table 1 begins with a description of the association of debt levels with subsequent stock return moments.

Panel A shows that the average firm holds about 10% of its market assets (15% of its book assets) in cash. The standard deviations are about 10-15% in the cross-section and 6% in the time-series. Financial leverage is about 25% on average, with 25% heterogeneity. Liabilities are about 40% of firm assets with 30% heterogeneity.

Panel B describes the Q1 and Q4 quartiles. The interquartile spreads in average leverage levels are typically a little less than twice their unconditional standard deviations. In Q1, the average cash is 20% of market assets; in Q4 it is 2%. The lowest net financial leverage ratio quartile is 7%, the highest is about 50%. The lowest total net liabilities ratio quartile is 15%, the highest is 61%.

The next set of rows show stock return statistics by quartile. The first shows the (Lagged^2) year before (best considered as a benchmark) and the year after (best considered the variable of interest). The interim year is omitted. The "Compound Raw Lagged^2" row shows that the sort has indeed produced quartiles that are not perfectly but well balanced in terms of historical average returns.

[5] Leverage changes have a near-mechanical *contemporaneous* correlation with stock returns (but not volatility). However, because the key dependent moments begin strictly after the leverage measurement, they never suffer such mechanical associations.

The "SD Net Lagged^2" row shows that less levered firms had higher volatilities during the year *before* the leverage measurement—the types of firms with low leverage levels are different in character from firms with high leverage levels. The "SD Net 2Y Delta" row shows that firms with higher leverage tend to experience increasing volatility. The end result is inconsistent. For negcash, the stock return volatility of the high quartile remains lower than for the low quartile; for flev, it becomes higher; and for liab, it depends.

The "Compound Raw" rows show that, without further controls, the average stock-return patterns differ across leverage measure. Firms tend to perform subsequently better with more cash, higher mkflev, and higher mkliab, but lower bkflev. Together with the volatility pattern, the average returns for leverage levels remain difficult to interpret. The firms are very different and it is difficult to "hold everything else constant." Omitted variable concerns loom large.

Panel C shows the Black, Jensen, and Scholes (1972)/Fama and French (1993) time-series monthly alphas of portfolios that are long in the quartile of (Lagged^2-return controlled) high-levered stocks and short in the quartiles of low-levered stocks.

Cash: As in Simutin (2010), the T-statistics on bknegcash are negative and in line with those for bkflev and bkliab without further controls.

Simutin did not explore market-value-scaled cash measures. The mknegcash coefficients are sometimes twice as high as the bknegcash coefficients. The T-statistics of around 5 are high enough to overcome even the stringent Harvey, Liu, and Zhu (2016) and Harvey (2017) hurdle.

Broader Measures: When few controls are included, bkflev does not have the aforementioned "theory-paradoxical" reliably negative relation with future stock returns.[6] Yet when book-to-market control is included, bkflev's association with stock returns also turns negative, as it always is for mkflev. The joint hypothesis that leverage is exogenous and stocks with high leverage offer high rewards is not supported by the evidence. These "paradoxical" negative relations (and their interplay with value-growth controls) were the original motivation for Gomes and Schmid (2010). A similar pattern appears for the

[6]Not shown, when the sort controls for firm-size, it even has the "exogenous theory-predicted" positive coefficient point estimate, albeit not statistically significant. Bhandari (1988) found a significant positive association, which is really absent in my data.

broader liability-asset ratios: mkliab is a negative predictor of subsequent average returns regardless of control, while bkliab turns negative only with further controls. The findings in Table 1 are also very different from those in Fama and French (1992, p.444), where book-leverage and market-leverage only appeared together and with opposite signs due to extreme multicollinearity.

The solid magnitude of the leverage level effects, and their robustness with respect to the Fama and French (2015) and Novy-Marx (2013) factors, suggests that leverage levels are worth consideration and control in other studies of empirical asset pricing.

Panel D shows monthly cross-sectional Fama-Macbeth regressions using Newey-West standard errors with one autocorrelation lag. The first few coefficient rows ("DT Quartiles") use the numerical quartile indicator value (from #1 to #4) in lieu of the debt ratios themselves ("DT Values"). Unlike in Panel C, firms from all four quartiles are included in Panel D. Because the difference in the Q4 and Q1 quartiles is 3, the Panel D quartile coefficients can be multiplied by 3 to obtain coefficient magnitude interpretations comparable to those in Panel C. The "+4 vars" row includes controls, inspired by Fama and French (2015), for

- the book-to-market ratio;
- the equity market-capitalization;
- the investment (the lagged percent change in assets);
- the operating profitablity, normalized by the book value of equity (Novy-Marx (2013)).

The "+10 vars" row further includes three controls each for lagged average returns and (daily-calculated) return volatilities (one and two years lagged to the dependent variable, plus the overlapping period of the fiscal year itself). The own stock-return volatility variables help control for the IVOL effect in Goyal and Santa-Clara (2003), Ang et al. (2006), and subsequent research (e.g., Herskovic et al. (2016)). Ang et. al. show that firms with higher volatility tend to have lower subsequent rates of return, later shown to be strongly related to marketcap. The evidence suggests that **the leverage effect here is conceptually related to (and, unreported, typically stronger than) the volatility effect, but volatility and leverage coexist comfortably.**

The coefficients in Panel C and Panel D suggest nearly identical inference. The inter-quartile spread in mknegcash predicts a rate-of-return spread of about ($\approx$)$0.3 \cdot 12 \approx 3.5\%$

per annum in Panel C vs. $3 \cdot (\approx)0.1 \cdot 12 \approx 3.5\%$ per annum in Panel D. The interquartile spreads in financial leverage and liability ratios predict abnormal return spreads of about 2%, but only when more controls are included.

The final two rows in Table 1 show that control for lagged asset-size instead of Lagged^2 net returns in the quartile sort yields weaker results; and predicting log stock returns instead of plain stock returns yields stronger results. (Buy-and-hold investors often care more about geometric returns than arithmetic returns.) On all leverage measures, more indebted stocks offer lower holding returns.

In sum, firms with different financial leverage tend to be quite heterogeneous. High leverage levels tend to anticipate subsequent increases in volatility. They also tend to anticipate lower average and compounding returns, but the strength depends on the specific leverage measures and controls. With controls, cash and financial book leverage are the best predictors. Yet it is not difficult to stumble upon a positive association in some specifications.

C Leverage Changes

The primary focus of our study are not indebtedness *levels* but indebtedness *changes*. Change comparisons are not immune but often suffer less from uncontrolled heterogeneity and selection concerns as well as contamination from spurious contemporaneous slow-moving factors than level comparisons.

[Insert Table 2 here: **Leverage Ratios — Changes**]

Table 2 shows how leverage changes predict subsequent average returns, average return changes, volatility, and volatility changes. It follows the same format as Table 1. The quartile sorts are now with respect to lag-return-controlled leverage changes.

Panel A shows that leverage increases slowly over the sample, except for mknegcash, which remains roughly steady. There is good cross-sectional and year-to-year variation in all leverage-change measures.

The "SD Net Lagged^2" row, which was not a sort variable, suggests more homogeneity in stocks relative to Table 1. The "SD Net 2Y Delta" rows in Panel B show that firms that increase leverage experience subsequent increases in volatility. The "Compound Raw" rows show that firms that increase leverage experience subsequently lower average rates of return.

The average stock return performance is explored in more detail in Panels C and D. Again, stocks that increase leverage have lower (and, due to the Lagged^2 controlled sort, declining) average rates of return both in Fama-French time-series and in Fama-Macbeth cross-sectional regressions. In Panel C, all spread portfolios, consisting of long the leverage-increasing stock quartile and short the leverage-decreasing stock quartile, subsequently underperform in BJS/FF time-series regressions. Even with Novy-Marx-Fama-French-Carhart factor controls, leverage increases can still predict lower average rates of return of around $0.2 \cdot 12 \approx 2.5\%$ per annum. Not surprisingly, leverage changes and momentum are connected: Stocks that experience positive momentum also tend to experience market-based leverage reductions. Thus, UMD control diminishes the magnitude of the market-based leverage change effects. Panel D again shows nearly identical results in terms of statistical significance and economic meaning as Panel C. Even with control for the aforementioned 10 control variables, i.e., even including past average returns, average return changes, volatility and volatility changes, leverage changes are still important marginal predictors.

The "asset-controlled quartiles" row uses a sort control not based on lagged firm returns. It shows that firm size is less important for leverage changes than it was for leverage levels.[7] The "log returns" row shows that buy-and-hold investors are especially better off with portfolios of leverage decreasers than increasers. Of course, even if the arithmetic average monthly returns had been the same (and they are not), stocks with less volatility would have ended up more profitably.

[Insert Table 3 here: **Explaining Changes in Volatility,** $\mathbf{sd}_t = a + \rho_1 \cdot \mathbf{sd}_{t-1} + \rho_2 \cdot \mathbf{sd}_{t-2} + \gamma \cdot \Delta\mathbf{Lev}_{t-2,t-1}$]

Table 3 sheds more light on the leverage-volatility relation. It reports regressions that explain (daily stock return-based) volatility over the full year with two equivalent lags of volatility, plus lagged leverage changes. The T-statistics are always high, and the results are always clear, because volatility measures are more reliable. Firms that increase in

[7] In other unreported related specifications, the coefficients' decay with the rank of firm size is roughly equivalent to the decay of HML or the book-to-market ratio.

leverage over the year subsequently experience higher volatility. However, the influence of mknegcash changes is weaker than that of the other leverages changes. Moreover, in unreported monthly instead of annual regressions, the sign sometimes reverses. Thus, the coefficient on Δmknegcash may as well be considered near-zero: As far as volatility is concerned, it is not very important whether firms increase or decrease their cash in exact proportion to their market-value of assets (i.e., primarily their market-value of equity). Such cash changes in firms do not induce much increase in stock return volatility. The magnitudes are more intuitive in Panel B of Table 2, but are comparable here, too. For leverage change measures other than mknegcash, the observed coefficients of about 0.01 suggest that a one-standard deviation change in leverage (from, say 20% to 30%) typically induces an increase in daily volatility of about $0.01 \cdot 0.1 \approx 0.001$ in daily volatility, or about 2% per annum.

From the perspective of an idealized exogenous leverage-risk relation, this volatility increase is too small. The univariate evidence in Table 2 Panel B suggests about twice the effect, but it is still too small. This may be because stock returns are generally noisier than economists can explain, because the auto-regressive process has itself absorbed some of the leverage effect, because leverage itself tends to mean-revert, and/or because there are both endogenous and exogenous aspects to volatility.

Summary: In one specification, leverage has little influence on risk; in five specifications, risk increases. In all specifications, average returns decline.

From the perspective of the exogenous leverage theory, the evidence is disappointing. The sign of the volatility evidence fits, but it cannot explain the sign of the average return evidence (the main conundrum).

From the perspective of the endogenous leverage perspective, the evidence is equally disappointing. It can explain the average return conundrum, but it cannot explain how it comes about. Not a single specification favors the perspective that increases in leverage reduce expected returns because of lower risk.

D Extreme Leverage Changes

As an alternative to "simple changes" in leverage ratios, one can also consider $1/(1-\Delta\text{ratio})$. For example, a 5% increase from 0% to 5% ratio maps into a change in 5.3%; a change from 50% to 55% maps into a change in 22.2%; and a change from 90% to 95% maps into a change of 1000%. This transformation is equivalent to working with changes in D/E ratios, rather than $D/(D+E)$ ratios. This transformation can be shown to appropriately reflect changes in expected rates of return under further assumptions (e.g., Caskey, Hughes, and Liu (2012)). When reasonably winsorized (e.g., at $[-200\%, +200\%]$), the results are almost identical to those in Table 2. Therefore, they are omitted.

E Leverage Changes with Simultaneous Equity Volatility Changes

Gomes and Schmid (2010) like endogenous-response explanations require not just a negative but a strong negative indirect leverage-risk link in order to overcome the mechanical positive direct leverage-risk link. Leverage increasers should be accompanied not just by weaker risk increases than what would obtain if there were no change in underlying projects, but by risk decreases so strong that they result in net decreases in risk and expected returns.

[Insert Table 4 here: **Subsequent Average Rates of Return After *both* Leverage Ratio *and* Volatility Increases**]

The exogenous and endogenous responses are not mutually exclusive in the entire sample, in that some firms may act according to one, while other firms could act according to the other. Thus, it is interesting to examine stocks that experience not only leverage increases, but also *simultaneous* equity volatility increases. These stocks are even less likely to be responders in the GS sense.[8] Thus, this subset of stocks should show primarily exogenous-leverage-like responses, with higher average rates of return to compensate for higher risk. Table 4 shows just the equivalent of Panel C. Average stock returns still do not increase with leverage-cum-risk increases, even in this subset.

[8] There should also be few(er) of the leverage-and-volatility increasing stocks. This is also not the case.

F Stock-Return and Managerially-Induced Leverage Changes

Debt ratios can change based on active corporate intervention or based on experienced stock returns. The stock-return-caused change in the debt ratio can be calculated without knowledge of actual year-end equity and debt but with knowledge of interim stock returns. For example,

$$\text{R.}\Delta\text{mkflev} \equiv \frac{D}{D+(1+r)\cdot E} - \frac{D}{D+E},$$

where D and E are the debt and equity at the beginning of the period, and r is the stock rate of return (with or without dividends) during the fiscal year. By definition, this is the leverage change induced only by the interim change in stock returns. The R.Δ variables exclude all managerial debt and equity capital-structure issuing or retiring activity, planned or unplanned.

The managerial-based active capital-structure change is the residual,

$$\text{FM.}\Delta\text{mkflev} \equiv \Delta\text{mkflev} - \text{R.}\Delta\text{mkflev} .$$

Tradeoff-oriented managers would adjust their leverage to compensate for stock returns. When shocked with a negative rate of return, they should undo the resulting increase in leverage by retiring some debt and issuing some equity. However, debt-overhang and other concerns may make it more difficult to issue more equity after a firm has experienced tough times. Moreover, corporate value functions may not be very sensitive to modest changes in leverage.

Fortunately, managerial responses need not just be conjectured but can be measured directly. The empirical evidence in Welch (2004) shows (1) that managers are very capital-structure active, but (2) they do not actively counteract stock-return-caused changes.[9] This renders R.Δ and FM.Δ measures nearly orthogonal and happens to make the interpretations of the results easier.

It is reasonable to view R.Δ leverage changes as more "exogenous" to the managerial capital structure planning and decisions than FM.Δ leverage changes. It is also intrinsically

[9]The experienced monthly stock returns are reflective more of realized value shocks, and less of changes in expected rates of return. This is because stock returns tend to be very noisy. Not reported, it makes little difference whether dividends are included or excluded in stock returns.

interesting to learn whether the source of the leverage changes predicts different return responses. However, the controls have to be more limited now, because it makes no sense to compete stock-return induced leverage changes with stock return controls. This is not just a statistical point, but an economic point. Past stock returns imply (negative) leverage changes for stocks with prior leverage. R.Δ variables proxy strongly for lagged returns.

[Insert Table 5 here: **Decomposition into Stock-Return-Caused and Firm-Caused Leverage Changes**]

Table 5 shows the results, limiting itself to basic accounting controls. The right-side FM.Δ columns show that firm-induced increases in leverage predict lower future average rates of return. A comparison with the plain Δ coefficients in Table 2 suggests that FM.Δ is less noisy but not more strongly predictive. The left-side R.Δ columns show that stock-return-induced increases in leverage have weaker T-statistics. However, with controls, the R.Δ coefficients on the left are often of similar sizes as the FM.Δ coefficients on the right. Not reported, the R.Δ coefficients are usually not statistically significantly lower than the FM.Δ coefficients. When stock returns are quoted in logs, the R.Δ variables even outperform the FM.Δ variables.

A reasonable interpretation of the evidence is that it is not just managerial intervention that is responsible for the negative leverage-reward association. Both "endogenous" managerially-caused leverage increases and "exogenous" stock-return-caused leverage increases have negative effects on subsequent stock returns. However, firm-caused leverage changes seem to have *more* predictive power. This is also visible in the more negative coefficients using book-leverage rather than market-leverage in Tables 1 and 2.

G Further Aspects

The abnormal performances of the leverage change elements are contrary to theory. Buy-and-hold investors interested in geometric returns would have benefitted not only from higher average rates of return but also from lower volatilities. In this sense, my paper has understated the leverage anomaly.

Decay: The intent of my paper is not to design a portfolio anomaly trading strategy for the future, but to understand the past behavior of stock prices and investors. It is this 1962-2016 CRSP-Compustat panel that remains the primary target of investigation in the asset-pricing literature. Mclean and Pontiff (2017) point out how many regularities disappear after they attract more attention. It seems likely that these leverage change anomalies will decline in the future. Some decline can already be observed in the data. It is difficult to judge, however, because it is related to the Great Recession, with its unusual monetary interventions. 2008/07 to 2009/12 saw unusually positive performance for the leverage-increasing portfolios. When the sample is divided into 4-year intervals beginning in 1968, the coefficients are usually between –0.35 and –0.45 until 1999, around –0.25 from 2000-2007, +0.39 from 2008-2011, and –0.16 from 2012 to 2015. A similar coefficient pattern also affects the momentum factor. (Unlike the UMD momentum factor, the leverage factors require very little rebalancing, however.)

Firm Size: When the sample is restricted to the largest 1,000 stocks in time, the effects of Δnegcash diminish sharply and become insignificant. The alphas of the broader leverage and leverage change variables decline modestly (typically by about 30%), and thus remain largely intact. (Similar declines are observed for other factor variables of prominence.)

[Insert Table 6 here: **Redundant Factors in Explaining Average Monthly Rates of Return**]

Abnormal Mean Spans: Tables 1 and 2 have already shown that the leverage factors cannot be explained by the most common factors. They have not considered whether the opposite can also be true. Table 6 shows that cash-based level portfolios can span the abnormal return explanatory power of the SMB factor. (Not reported, this is not the case for the other leverage-level portfolios.)

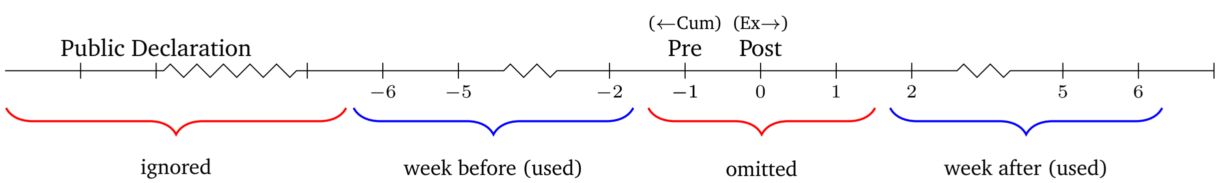
The Δbkflev and Δbkliab can span about half of the UMD factor. Two aspects are noteworthy: (1) These are *not* the market-based variables that share the stock-return ingredient in their construction with UMD; and (2) the leverage factors are handicapped because they are calculated only once per year, while UMD is updated more frequently.

II Managerially-Induced Sharp Leverage Changes

The full CRSP-Compustat panel shows a positive association between leverage and equity volatility, and a (paradoxical) negative association between leverage and average adjusted rates of return. The latter does not seem to stem from a negative association between leverage and risk.

Although the tests have improved on the identification of the effects of leverage—considering not only average return changes but also risk changes; investigating leverage changes rather than levels, instrumented changes, and joint risk-and-leverage changes—it is not inconceivable that omitted factors could still explain these associations. There could be unmeasured systematic risk factors—different from those already controlled for (XMKT, SMB, HML, RMW, CMA, and UMD)—which decreased so greatly that they could overcome the direct leverage effects. Although not expected *a priori*, an omitted risk factor explanation in such long-horizon regressions is never out of the question.

Therefore, the paper now turns to two event-study settings in which omitted factor and information-contamination based explanations become even less plausible: equity issuing and dividend issuing activities. These are not in themselves the primary object of inquiry but are discontinuity instruments for leverage changes.[10] To exclude information concerns, the paper investigates rates of return only *after* public declarations, and compares return statistics just before to just after their executions. A timeline helps to illustrate the relevant event windows:



[10]Kaplan, Moskowitz, and Sensoy (2013) provided perhaps the most prominent exception and a "gold-standard" study—a real experiment in U.S. financial markets on the effect of short-sales constraints. Although event studies have been quasi-experimental in design and have been in use for decades, more recent event studies do not seek to test basic asset-pricing implications other than stock market efficiency at the announcement. Moreover, it is not even clear how one would test factor asset pricing with an event study. What would pre-identified exogenous shocks to equity factor betas in isolation of other changes be?

The 1-week short-term nature of the returns makes it unlikely that there are coincidental non-leverage-induced endogenous corporate changes, leaving only the direct exogenous leverage-related effects. That is, any effects are likely to reflect investor demand effects more than corporate supply effects.

A Seasoned Equity Issuing

In an equity issue, cash moves from owner-investors through the corporate wall into the firm, predicting declines in leverage, volatility, and average returns for the corporate equity.

The Thomson SDC global issue database provides a sample of equity issuing events. In early 2016, it listed 1,131,497 offerings, of which 130,349 were corporate equity offerings. Removing IPOs yielded 97,440 offerings, of which 20,010 occurred in the United States, 17,862 were not privately placed, and 16,995 were identified as the issue containing the entire filing amount. The need for a stock ticker, CUSIP, filing date, issue date, complete filing amount, specific issue filing amount, primary shares sold, at least 10 days between filing and offering date, and successful CRSP-CUSIP merge, left 9,569 corporate equity offerings. The WRDS event-study program yielded 7,859 offerings that had complete or near-complete stock return histories from seven days before the offering to seven days after the offering, with about 7,600–7,800 stock return days per event day. Note again that all equity issues used in this event study must have been already publicly announced on the first day on which we look at stock returns. This is not a stringent constraint, because equity issues typically take a few weeks between filing and execution.

[Insert Table 7 here: **Explaining Market-Adjusted Stock Returns (in%) Around Actual Equity-Issue Execution Dates, Given Previous Declaration**]

Table 7 shows that equity volatility is higher before than after the issue execution on every single day. The average absolute rate of return from event day –6 to –3 is 4.63%, while the average absolute rate of return from event day +3 to +6 is 3.46%. This is as it should be. Equity becomes safer after cash flows into the corporate structure. Yet again, the average rate of return is not lower but higher. In the days before the issue, the average rate of return is –0.041%/day. In the days after, it is 0.078%/day. (Not reported, the difference is highly statistically significant in simple tests.) Both relations mirror the full panel results from Section I: Risk decreases as expected, but the reward paradoxically increases.

The equity-issuing study has two shortcomings.[11] There can be some uncertainty that is resolved in the days after the announcement but before the completion. Equity issues can and have been cancelled. Their success is not just dependent on corporate actions, but also on investor participation. Any successful equity-issue completion could thus still reveal information. A second contaminating aspect is that firms often issue debt together with equity and that new equity has effects that depend on the firm's prior capital structure (Welch (2004)). Thus, we now proceed to the even cleaner setting, dividend issuing.

B Dividend Issuing

Dividend payments are small but common and important in their cumulative effects over time. As explained, this study investigates neither the announcement dates nor the payment execution (cum-ex) dates.[12] Instead, it compares the behavior of stock returns just *before* (cum) to just *after* (ex) the transition, while

1. restricting the sample to days on which the declaration had already been made public at least 9 days earlier, in order to avoid new information contamination;
2. excluding the cum-to-ex days themselves, in order to avoid cum-ex tax-related and other contaminating effects; and
3. using only one week (5 trading days) of data, in order to reduce endogeneity and spurious factor accumulation concerns.

Note that the dividend experiment is *not* about corporate capital structure or dividend payout policy. Answering different questions, this paper does not share event periods with

[11]Unfortunately, there are no other large issuing or repurchasing capital structure experiments that easily lend themselves to similar tests. (One possible other event may be (relatively rare) call-forced conversions.) Equity *repurchases* are not suitable, because they tend to be spread over long time windows. Equity shelf-offerings are not suitable, because they lack clear event dates. This is also why exchange offers, as in Korteweg (2004), are not suitable for this experiment. An exchange offer is usually not executed on one sharp day, but over multiple weeks. Debt issues (into cash) and repurchases do not have clear directional predictions for corporate net leverage.

[12]For convenience and intuitive clarity, this study often refers to the ex-day day as the payment day. The study always ignores the actual payment day on which the checks are mailed out.

most earlier corporate finance work (explored and reviewed in, e.g., Michaely, Thaler, and Womack (1995) or Allen and Michaely (2003)). My paper here explores the stock returns neither on the dividend announcement dates nor on the dividend cum-ex dates.

B.1 The Basic Paradigm Theory in the Dividend Context

Dividend payments increase net leverage. For the intuition that any investment actions of the firm between the announcement and cum-ex transition can no longer have relevance, consider two extreme examples for a firm whose business is holding the underlying stock market index (so that it has a market-beta of 1). In one extreme case, the firm immediately sells some index shares and keeps the funds as cash, in effect defeasing the dividend at the moment of the announcement. The firm is now a bundle of both stock and cash up to the cum date, and it is only stock after the ex date. Clearly, the risk and reward of the residual stock should go up at the cum-ex transition. In the other extreme case, the firm remains fully invested in the stock market up to the final moment.[13] It then sells index shares to satisfy the cash payment promise. At the moment of the declaration, the firm becomes a composite of one risk-free claim worth DV and one levered claim worth $100\% - DV$. If the stock-market has a rate of return of r_M between the announcement and the payment, then the risk-free claim will pay DV and the residual firm will be worth $100\% \cdot (1 + r_M) - DV$. The entire risk is on the residual claim, which is riskier than $100\% \cdot (1 + r_M)$. The cum-dividend stock returns are always less levered than the ex-dividend stock returns. The cash-flow split is determined at the moment of its declaration, not at the moment the stock goes ex.[14]

[see also table with numerical example in the appendix]

[13]Realistically, it is likely that liquidation of ordinary risky projects into cash would occur more than 5-10 days before the payment, and dividend payments would be paid out of cash and short-term investments. Over time, firms would then replenish cash, either through cash flow or external financing. Farre-Mensa, Michaely, and Schmalz (2014) show that about a third of the dividends were externally financed. However, these were long-term finance patterns, and not likely to occur exactly at the dividend payment date. And, again, even if such managerial choices had had any influences on the average rate of return patterns, it is difficult to see how such an explanation could explain both averages and volatilities.

[14]To have a different impact on leverage would require that firms do more than just cover the dividend payment at the day of the dividend payment. For example, if they also sell further assets cum-day for even more cash, then the project leverage and risk could decline. There is no reason to believe that this should happen systematically.

Because the approach is quasi-experimental, the model is simple. In the exogenous leverage-risk-reward paradigm framework,

$$\begin{aligned}
\text{Equity}_{\text{pre}} &= \text{Equity}_{\text{Equity-Other}} &+& \quad (\text{Equity}_{\text{Risk-free}} = \text{Dividend})\ , \\
\tilde{R}_{\text{pre}} &= (1-\delta)\cdot\tilde{R}_{\text{Equity-Other}} &+& \quad \delta\cdot R_{\text{Risk-free}}\ , \\
\text{Equity}_{\text{post}} &= \text{Equity}_{\text{Equity-Other}}\ , \\
\tilde{R}_{\text{post}} &= \tilde{R}_{\text{Equity-Other}}\ ,
\end{aligned} \tag{1}$$

where δ is the single-event non-annualized paid dividend yield. Therefore, the expected rate of return on equity should increase by the dividend-yield scaled expected rate of return on the prepayment equity above the risk-free rate,

$$E(\tilde{R}_{\text{post}}) = \left(\frac{1}{1-\delta}\right)\cdot E(\tilde{R}_{\text{pre}})\ -\ \left(\frac{\delta}{1-\delta}\right)\cdot R_{\text{Risk-free}}\ ,$$

which is strictly greater than $E(\tilde{R}_{\text{pre}})$ if $E(\tilde{R}_{\text{pre}}) > R_{\text{Risk-free}}$. For small δ and risk-free rates, $E(\tilde{R})_{\text{post}} - E(\tilde{R}_{\text{pre}}) \approx \delta \cdot E(\tilde{R}_{\text{pre}})$.

Because risk-free dividends have zero variability, the equivalent implications on second moments require no caveat about the risk-free rate:

$$\sigma(\tilde{R}_{\text{post}}) = \left(\frac{1}{1-\delta}\right)\cdot\sigma(\tilde{R}_{\text{pre}}) \approx (1+\delta)\cdot\sigma(\tilde{R}_{\text{pre}})\ .$$

The predictions of the paradigm are quantitative: Ceteris paribus, twice the dividend payment should have twice the effect. Because both the volatility and the average return tests are scaled by the strictly positive dividend yield, they both have strictly positive predictions.

Empirical changes larger or smaller than these quantitative predictions for either the first or the second moment can reject the paradigm. However, the volatility predictions are larger. First, they are quantitatively larger. This is because the $1+\delta$ factor multiplies the initial value, and the average daily volatility is about 1%, while the average daily rate of return is only about 0.01%. Second, as in Section I, second moments are easier to measure than first moments. Average rates of return are less precise estimates (of underlying population expected rates of return). Third, there is no concern that some stocks could have rates of return decreasing in δ (e.g., stocks with extremely negative market-betas, as in the CAPM).

Measure Sufficiency: The firm's leverage and cash ratios are themselves *not* inputs into the predicted risk and reward changes. This is because the prepayment equity characteristics are sufficient statistics for all changes caused by dividend payouts. Of course, high-cash, zero-leverage firms are expected to experience small increases when paying dividends, while low-cash, high-leverage firms are expected to experience larger increases. But this is captured by the multiplicative factor on the ex-ante return attributes. There is neither a need nor a desire to include leverage or cash measures (e.g., as control). This is an important test advantage: Under the paradigm, the calculations are agnostic with respect to how leverage is measured and whether leverage measures are for operational or financial leverage. Attempts to use financial statements to tease out pre-existing leverage are theoretically neither necessary nor helpful. (Nevertheless, Table 10 shows that existing leverage is unimportant.)

B.2 Data and Methods

All data are from CRSP, including the dividend announcement and cum-ex payment dates. The key figures and tables focus only on ordinary quarterly taxable cash dividends, CRSP distribution code 1232. We define the (one-event-payment) dividend yield as the dividend payment divided by the market price of the stock at the dividend declaration (but at most 22 days prior). Both individual daily stock returns (always net of the equal-weighted market rate of return in this section) and dividend yields are winsorized at –20% and +20%. (The Appendix describes many specification variations, none of which affected the results.)

[Insert Table 8 here: **Descriptive Statistics for Dividend Event-Study**]

Table 8 shows some basic statistics. Panels A and B illustrate the sample selection. About half of the sample has to be eliminated because there are too few days between the declaration and the ex-date. The imposition of a 9-day minimum-distance requirement allows for two days after the declaration, one week of interest, and two days around the ex-day that are excluded to avoid the direct cum-ex returns themselves. There are about 240,000 ordinary taxable quarterly dividend payments, with about 6 million stock returns in the –12 to +12 day window around the ex date. The mean dividend payment is 89 basis points (median 74 bp), with a standard deviation of 68 bp. The mean daily rate of return is 1 bp (median –6 bp), with a standard deviation of 2.1%.

B.3 Dividend Risk and Reward Associations

[Insert Figure 1 here: **Pre-Announced Dividend Payments and Daily Cross-Sectional Standard Deviations**]

Figure 1 plots the observed stock return volatility for different pre-announced dividend yields in the trading days surrounding the cum-ex transition. Each plotted point is one simple cross-sectional standard deviation on the given event day. In clockwise order, the payments are (TL) below 0.75%, (TR) between 0.75% and 1.5%, (BL) above 1.5%, and (BR) all dividend payments. Volatility increases are only pronounced for large dividends.

The visible reversion to the mean over time in the figure is as it must be: Over longer intervals, the change-in-leverage effects must become less pronounced. If the figure were extended right, the quarterly dividend payment returns would reappear on the left.[15] Over time, firms also earn more and replenish their cash, which should reduce risk (and reward).

[Insert Figure 2 here: **Effects of Pre-Announced Dividend Payments on Cross-Sectional Average Rates of Return**]

Figure 2 repeats the plots for average rates of return. The pattern inversely mirrors the volatility pattern: When the dividend payment is larger, the decline in average returns is more severe. After about two weeks, the effect disappears. Hartzmark and Solomon (2012) find similar but longer-lived average-return declines around dividend cum-ex transitions in their Section 4.3. (Their investigation was motivated by a set of related but different dividend anomalies.)

[15] The effect documented in the paper is a *reduction* in average returns, unlike the effects documented in other studies of post-announcement or dividend payments, which generally show increases in average returns. This is not inconsistent. The question and study designs are different.

[Insert Table 9 here: **Weekly Changes in Return Moments, Cum and Ex Payment**]

Table 9 characterizes the difference between net-of-market returns in the week after (ex) and the week before (ex), always excluding both the ex-day and its two surrounding days. Volatility is now measured by the sum of five absolute net-of-market rates of return. Panel A shows that the absolute return increases by about $7/5 \approx 1$ bp per day, while the average return decreases by about $20/5 \approx 3$ bp per day. The effects are about three times as large for large dividend payments.

An investor who is long large dividend payers in the week before the event and short large dividend payers in the week after could earn about 40 bp before and 44 bp after. This net of 84 bp would have been without any dividend tax consequences. This is a reasonable magnitude and about half the magnitude as the 2.09% average dividend payment. It does not suggest a greatly profitable arbitrage strategy, because of trading tests and because of the time-offset (first holdings need to be held long, then short).

The increase in volatility is in line with that predicted by the theory in (1): $1/(1-0.0089) \cdot 6.67\% \approx 6.74\%$, not far from the 6.76% observed. (Not reported, calculating dividend yields with prices closer to the ex-date further enhances the alignment of quantitative predictions and evidence.) The increase in volatility in response to dividend payments is prima-facie evidence that the financial markets are aware of and respond appropriately to the increases in leverage caused by dividend payments. No alternative hypothesis discussed below seems to offer this (quantitative) prediction naturally.

Panels B and C run simple cross-sectional regressions explaining the ex-day weekly change with the cum-day weekly change. Stocks paying more dividends experience larger increases in volatility and larger decreases in average rates of return. The second regression quotes dividend payments as $\delta/(1-\delta)$ motivated by (1), and includes the ex-day rate of return. The transformed dividend-yield coefficient is almost the same. The single ex-date event return is unrelated to the volatility change surrounding it, and only very mildly related to the average return change surrounding it. The weekly return moment changes are not just extended versions of the cum-ex rate of return.

In sum, the leverage-risk relation is positive, but the leverage-reward relation is negative. Instead of *near-zero increases* in average returns, the known-in-advance payments of dividends associate with strong *decreases* in average returns. The stock price increases "too much" before the dividend payment, which reduces post-payment average rates of returns relative to prepayment average rates of return. The positive average-rate-of-return effect is the opposite of that predicted by the leverage-reward paradigm, but in line with both the equity-issuing event study in Subsection A and the full CRSP panel study in Section I.

B.4 Potential Concerns

Dividend payments are the most cleanly identified test of mean and volatility changes around leverage changes. Therefore, the paper now discusses some possible concerns.

Dividend Taxes and Clienteles: There is theory and evidence that show that personal dividend taxes play an important role on the single-cum-ex-day rate of return (e.g., Michaely (1991), Poterba (2004), Chetty and Saez (2005), and Chetty, Rosenberg, and Saez (2007)). Yet, their empirical evidence also suggests that clientele trading, even if present, cannot be of first-order importance. Their documented cum-ex transition responses indicate stock return effects that remain roughly in line with the prevailing dividend-tax rates. Tax-exempt investor clienteles could not have greatly influenced or eroded observed returns.

It is difficult to imagine how a "slowed tax effect" could provide a coherent theory for the surrounding weekly moment changes. Somehow, many low-tax investors would have to buy into dividend-paying stocks sooner than necessary, selling investors would have to be scarcer than buying investors, there would still have to be enough buyers to have a price impact, and the prices themselves would have to fail to adjust quickly (i.e., before the event window) and despite full advance common knowledge in the market. The IRS would have had to scrutinize 1-day activity, but not 1-week activity. Clientele trading also should not have eroded the cum-ex return itself. And, finally, somehow, it would have had to have an impact on volatility opposite to the impact on average returns.

Nevertheless, we can be pragmatic and examine whether there are empirical links between the surrounding weekly moments and dividend taxes. Because non-anonymous stock holding and trading data are not available, the tests cannot investigate tax-exempt holdings directly. They can only investigate whether the effects are stronger when dividend taxes are more important.

[Insert Figure 3 here: **Year-by-Year Coefficients Explaining Stock Return Moments after Payment and highest Individual Dividend Income Tax Rates**]

1. Cum-Ex Controls: In the sample, the cum-to-ex average rate of return is about 26 bp—implying an average effective tax rate of about 26/89 ≈ 29%—with a standard deviation of 212 bp. This cum-to-ex return drop could be a (noisy) proxy for tax or other unspecified rate of returns effects on the ex-day. But recall that the regressions in Table 9 controlled for the cum-to-ex drop. This control has no effect on volatility changes and no meaningful effect on average return changes. That is, the cum-to-ex return drop phenomenon seems mostly unaffected by changes in rate of return moments to its left and right.

2. Annual Effects: Figure 3 shows that the highest Federal income dividend tax rates were fairly steady from 1962 to 1982 (around 65-70%), declined all the way down to 15% from 1982 to 2013, and finally increased again to 20% and then 24%. In 1986 and 2003, there were particularly sharp declines in tax rates. The annual moment changes do not show time-patterns that look similar to the annual tax rate patterns.

[Insert Table 10 here: **Categorized Associations of Dividend Yield and Return Moments Changes**]

3. Non-Taxable Dividends: Not all dividends are taxable. About 1 in 50 dividend payments are treated as a return of capital and not taxed. In these cases, tax-related effects can be excluded as potential explanations. Table 10 shows that non-taxable dividend distributions suffer almost identical yield-related declines in average rates of return as taxable dividend distributions. However, non-taxable dividends are not associated with volatility increases, albeit without statistical significance.

The evidence suggests that tax effects are not a promising direction for further investigation. Hartzmark and Solomon (2012) reach similar conclusions.

[Insert Figure 4 here: **Explaining Average Trading Liquidity Patterns around Previously Declared Payment Dates**]

Liquidity and Trading: Prices can change with or without trading activity. For example, some investors could trade into dividend-paying stocks before the ex-date and then trade out again. This could but need not be rational (e.g., tax trading). Table 4 plots the day-by-day average log number of trades and log dollar volume (also obtained from CRSP). There is the tiniest of up-blips in liquidity on days –1 and 0, but there are no increasing or decreasing trends either before or after the ex-date. In the event windows used for calculating volatilities and average returns, there is no visible buying or selling pressure. In unreported regressions, the coefficients on risk- or reward-changes are not associated with liquidity, either. Hartzmark and Solomon (2012) find modest trading volume effects using different normalizations, but they do not point towards in-and-out arb trading, either. Instead, they suggest a (small) acceleration in transactions. Trading volume after the ex-date is *below* normal levels. One problem is that it is difficult to interpret volume effects further, because it is unclear whether they are due to demand or supply. In any case, although the sophistication of the trading tests could be enhanced, liquidity and trading could play a small role but are unlikely to be first-order determinants. They do not seem like promising directions for further investigation.

Surprises, Endogeneity, Selection, Survivorship: The design of this experiment is resistant to project endogeneity concerns. By the day that stock returns are beginning to be included in the stock return calculations, the impending dividend-caused leverage changes were already known for days. Nevertheless, we can push the endogeneity consideration even further backwards. Allowing non-1232 dividend distributions into the sample, the evidence in Table 10 shows that the effects appears regardless of whether CRSP classified the dividends as monthly, quarterly, or (semi-)annual; regardless of whether CRSP identified them as special dividends; and regardless of how long it has been since the last dividend payment. Regularity of dividends does not seem to be a promising direction for further investigation.

Pre-Existing Leverage and Firm Size: Table 10 also shows that firms with the highest liability-asset ratios have modestly stronger effects, but the effects appear in all categories. There is also no strong association between the effects and firm size. Pre-existing leverage and assets do not seem to be promising directions for further investigation.

Even Less Plausible Concerns: Even if corporate managers had the forecasting ability to time their cum-to-ex days to occur when stock prices are at their peaks (which is itself implausible), naive versions of this hypothesis would require that investors would not recognize this already at the moment of announcement. Dividend catering, as in Baker and Wurgler (2004), should similarly be reflected on the announcement date and not occur around the payment date, either. Managerial response misspecification concerns seem implausible.

Although it is the defeasance of the dividend that should matter and not the actual underlying risky investment patterns, correlated changes in risk patterns—other than those directly due to the leverage change—seem unlikely. And again, even an explanation based on the firm aggressively buying stock futures before the dividend payment and liquidating them afterwards cannot explain both mean decreases and volatility increases.[16] Growth options, as in Gomes and Schmid (2010), are unlikely to explain simultaneous increases in return volatility and decreases in average returns *in this dividend context*.

III Discussion

The key question remains whether low average returns for leverage- and volatility-increasing firms reflect appropriate and fair reward or whether they are disappointments.

A Perfect-Market Explanations

How would a rational leverage-risk-reward theory simultaneously explain increases in volatility and decreases in average returns? Somehow, the volatility increases would have to make stocks become *better* hedges against some risks that ultimately matter to investors. This mysterious risk-factor would not only have to decline with leverage, but decline systematically so much with leverage that its effect would reverse the near-mechanical positive influence of leverage on risk and reward.

Moreover, such a paradigm-based explanation has to remain roughly in line with the quantitative risk change evidence in the dividend event study, explain why firms care more about their exposure to this mysterious risk factor than about their own volatility risk, and

[16]Besides, if firms could follow strategies with higher average returns and lower risk, why would they stop doing so after the dividend payment?

explain how mechanically managers would bring down the risk-factor exposure without bringing down volatility.

The existence of a risk component that is so central but unknown seems far-fetched but not impossible given academic ingenuity.

B Imperfect-Market Alternatives

The alternatives to the perfect-market explanation are imperfect-market explanations, in which investors bid up the prices of stocks increasing leverage and thereby drive down subsequent average rates of return. These effects would be puzzling, if only because rational investors (once aware) should push against them (Mclean and Pontiff (2017)). There are two potential market imperfections worth mentioning:

Investor Misconceptions or Preferences: Investors could end up disappointed by problems that stocks with high and increasing leverage experience later.

Such disappointments could arise in a financial market which is (non-)blissfully ignorant of risks and outlooks, with more levered companies being exposed to more post-payment risk (and malaise) more frequently than investors anticipate. Their prices turn out too high on average to sustain the appropriate rewards. The arguments could but need not suggest an intrinsic like or dislike of leverage, but may suggest a predictable time-varying change in like and dislike.

Investor Agency: The second imperfection is agency-related. Advisors have time-varying preferences for stocks with leverage.

Harris, Hartzmark, and Solomon (2016) show that such an agency concern is especially plausible in the discrete dividend context. Mutual funds may have had preferences for dividends, because dividends to mutual-fund investors labeled as such are required to come from dividends in the underlying stock holdings.[17] These funds

[17]Mutual funds can still pay out funds, but they would not carry the dividend label. Quoting Harris-Hartzmark-Solomon, "while distributing cash to the fund's shareholders is easy, such distributions only can be labeled as 'dividends' if they correspond to dividends received by the fund on its underlying securities. This constraint arises because funds must satisfy a 'pass-through rule' that requires that they distribute all gains and losses each year to avoid paying corporate income taxes."

reported twice as much in quarterly dividends as their quarterly reported holdings would justify. Harris-Hartzmark-Solomon show that this "dividend juicing" would also harm fund investors—the opposite of tax trading which helps investors. They also note that this agency hypothesis pushes mutual funds into the dividend-preference direction because their retail investors seem, in turn, to be irrationally attached to receiving payments labeled dividends. The preference and agency hypotheses blend.

These explanations are ad-hoc, but they are not entirely implausible—Lamont and Thaler (2003) document even stranger law-of-one-price violations probably also due to investor-demand effects. Their evidence appears in a small number of isolated stocks with close-to-indisputable value evidence (and, of course, absence of easy arbitrage). It is sometimes discounted as mere "aberrations" when investors are particularly irrational. In contrast, the effects documented in my paper are more pervasive. Although Baker, Hoeyer, and Wurgler (2016) explore GS-like long-run performance and have overlapping implications (e.g., riskier firms choosing lower leverage), Baker-Hoeyer-Wurgler interpret the evidence as suggestive of risk-leverage mispricing.[18]

C Interpretation

Imperfect-market behavioral investor preferences are not always mutually exclusive with perfect-market behavior. More than likely, the economic forces all play roles in the association of leverage with risk and reward, possibly differently at different times or for different firms. Economic forces often hold in some contexts, but not others. Like all empirical findings, they are context specific, and most measured effects are "net" outcomes.

There is, however, one shortcoming in the "asset supply side" arguments worth mentioning. It is often too convenient to embrace the perfect-market rational paradigm with too little skepticism. Neither the news (as in Fama and French (1998)) nor the growth opportunities (as in Gomes and Schmid (2010)) were actually measured. Instead, they were free parameters. As such, they were allowed to absorb less appealing "investor demand side"

[18] They then consider both the perspective and optimal behavior of the corporation. Their findings are also not inconsistent with the views expressed in Hoberg and Prabhala (2009) that the volatility increases in Campbell et al. (2001) could have had direct corporate finance implications—though perhaps in the opposite direction.

alternatives that could also have played roles. The evidence in my paper suggests more skepticism. Before concluding that the associations between leverage and average returns are solely or primarily due to information revelation or corporate responses to growth options based on book-to-market moments, it seems appropriate not to make asset-supply effects the entire working hypothesis.

Similar concerns can be voiced for other reflexive perfect-market or imperfect-market interpretations. Could the Fama and French (1992) HML value factor have offered high average rates of return without commensurate declines in risk? Unfortunately, in the absence of discrete shocks to the HML factor (as there are to leverage), this is much more difficult to investigate. Fortunately, leverage changes can also induce such shocks in exposures and thus yield novel tests in future work.

D Related Literature

Panel: The leverage effects in the broad panel relates to three strands of the asset-pricing literature, at least conceptually.

The first strand is the literature about the CAPM and the security-market line. However, these papers have been primarily concerned about the underperformance of high-beta vs. low-beta stocks, observed as early as Black, Jensen, and Scholes (1972). Based on Black (1972), Black (1993, p.76) proposes leverage aversion of borrowing-constrained investors as one possible explanation for the better performance of low-beta stocks.[19] Asness, Frazzini, and Pedersen (2012) improve on Black's early work and also call the underperformance of stocks relative to bonds "leverage aversion." However, at their broad asset-class level, the Sharpe-ratio differential of 0.47 vs. 0.35 could be in line with the tax differential between capital gains and interest payments. Frazzini and Pedersen (2014) present more convincing evidence that higher beta stocks have pervasively lower alphas in many different markets and also *within* equally-taxed asset classes. Importantly, these papers mostly mean *investor leverage* when they discuss leverage aversion and leverage constraints, and not *corporate leverage*. Consequently, unlike my own paper, they are not even looking at the

[19]Black also briefly discusses the reaction of stocks to leverage offerings on the announcement date itself as evidence for a preference of investors in favor of debt financing. However, this is nowadays usually attributed only to news about the firm.

same variables. (They also do not consider volatility effects.) However, both their and my findings could be related to an intrinsic like or dislike of risk and leverage.[20]

The second strand is the idiosyncratic volatility anomaly in Ang et al. (2006). Higher risk seems to be associated with lower average returns. However, the basic primitive is different. Leverage has a more direct mechanical influence on volatility, than vice-versa. Moreover, the empirical evidence suggests that the two effects are different. Leverage is important even when volatility and risk are controlled for.

The third strand considers corporate leverage mostly in passing. Fama and French (1992) dismiss leverage, because ME/BE captured opposing effects of book and market leverage. A number of papers (such as Lewellen (2015) or Bartram and Grinblatt (2017)) include leverage as one of many variables. (Fama and French (1998) explains market-book ratios, not stock returns, and is therefore only indirectly related.)

I am aware of at least two published papers that have focused on leverage levels. The positive association of market leverage with subsequent stock returns in Bhandari (1988) does not hold in my data. The negative association of book-leverage *levels* on stock returns appears in Penman, Richardson, and Tuna (2007). As far as I know, no papers have investigated leverage *changes*.

Given the prominence of leverage in financial theory and corporate finance, and the ready data availability, the sparsity of empirical work related to leverage is somewhat surprising.

Events: The equity issuing event study does not seem to have predecessors. There are two papers closely related to the dividend-event study, Hartzmark and Solomon (2012) and Harris, Hartzmark, and Solomon (2016), were already noted several times throughout the paper. Hartzmark and Solomon (2012) even describe the same average return (but not risk) changes, though late and only briefly in their Section 4.3. Harris, Hartzmark, and Solomon (2016) provide an agency explanation, although in the context of mutual fund holdings and only for the dividend-based leverage change effect on average returns. My paper is different (1) in that it considers risk changes around dividend payments, and (2) in that it

[20]Another loose relation is to a new literature that uses information to time strategies (e.g., Daniel and Moskowitz (2016)). A prominent timer is the aggregate time-series volatility, as in Moreira and Muir (2016).

considers dividend payments as a quasi-experimental test for a broader leverage-related phenomenon.

IV Conclusion

Most previous tests of the modern finance paradigm have focused only on its risk-reward predictions. But they are difficult to test. Consumption asset-pricing tests are theoretically well identified, but their empirical failures to explain the cross-section of stock returns is easy to blame on ignorance of the relevant risk measures. This has made them difficult to reject. Empirical factor models (such as Fama and French (2015)) have explained large average stock return differentials, but their theoretical bases have remained controversial. In both approaches, misidentification of risk factors has remained a first-order concern. Academic tests could not investigate quasi-exogenous discrete shocks, because the empirical risk proxies are themselves typically endogenous and change smoothly. When risk proxies have failed to explain average returns, it has raised predominantly skepticism about risk proxies and not about whether the theory was wrong.

The tests in my paper have focused on the leverage-risk-reward predictions. These predictions are not “deep.” They require no hyper-sophistication and knowledge by investors. They are simply that when firms lever up, their levered equity should experience more risk and earn higher average returns.

From a testing perspective, leverage offers superior identification. Leverage is more resistant to problems stemming from academic ignorance and measurement concerns. It works together with, but also regardless of, the deeper factor structure. It offers both passive and continuous changes (from stock returns), and active and discrete changes (from management). And empiricists can choose among tests with different degrees of coverage, endogeneity, information contamination, and corporate response concerns.

The leverage-change related findings have not resolved but only deepened the enigma, despite their superior identification and lesser concerns about contamination. Leverage always seems to raise volatility, but lower average rates of return.

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A Appendix: Dividend Study, Unreported Aspects

The dividend event-study in the text is a fair representation of the data. An earlier draft and unreported regressions suggested that the results are very robust, and specifically with respect to the following:

- The results are not sensitive to different abnormal return adjustments, such as a market-model or Treasury-adjusted returns.

- The window length requirement is not an ex-post criterion, but it does affect the kind of dividend events from and to which the findings obtain.

  The results are strong for other event windows, too. Longer windows reduce the number of observations further because of the pre-declaration window length requirement, but increase the window length. The results are also robust to allowing changes in firm composition. (Of course, the volatility effect strongly depends on not including pre-announcement stock returns, because these reflect greater uncertainty before the annual meetings when dividends are often announced.)

  The results obtain also if we require as many returns in the ex-week as in the cum-week. Attrition of stock return days (i.e., occasional or permanent dropouts) are not different from normal background attrition.

- The results are the same for other volatility metrics, such as standard deviations, average absolute rates of return, absolute weekly rates of return, etc.

- The inference is the same with controls for day of week or day of month.

- There are some years with more dividend events, but the reported results are *not* driven by it. There was no clear clustering along other dimensions.

- The coefficients are stronger if, instead of a cross-sectional regression, the specification is a full panel regression and the event windows are selected with event-day dummies. (The statistical significance increases.) The effects then hold even with event-fixed effects. (This ends up being similar to the simple cross-sectional regressions reported here.)

- The stock price used in the calculation of the dividend yield affects the inference about exact vs. non-exact linear alignment of the magnitude of the effect, but not the effects or the approximate alignment of the overall magnitude of the volatility-change effect with the theory. Using stock prices closer to the ex-date enhances the results.

- Regarding the classification cuts of 0.75% and 1.5%, the number of dividend distributions per year ranged from (the absolute low of) 390 in 1962 to 644 in 2015, with local maxima of around 1,800-2,500 from 1973 to 1982, and above 1,000 in 1990, 1991, and 2008. Thus, even though the cutoff is in nominal terms rather than in quantile terms, the results are robust.

- The results are not sensitive to reasonable variation in the winsorization thresholds.

- Unreported, stock return variance changes usually correlate (insignificantly) positively with average return changes. Only leverage-induced stock return variance changes correlates negatively with average return changes.

Liabilities?: Accountants treat declared dividends as a liability upon declaration that is resolved at payment. This seems appropriate in this instance. However, consider the contrast to regular salary payments on the first of each month. Firms accumulate the liability and then pay this to the relevant party. This is intrinsically different from dividend payments, because the liability accrues to the stockholders and not other parties. This is why the same volatility-mean predictions for dividends do not hold for other payouts.

Survivorship Bias?: Publicly-traded company are not known to retract dividends after they have been declared. It is implausible that investors increase in belief that payments would occur in the days before the payment date. Even if the dividend payment were not paid but instead completely dissipated, in order to explain the documented lower average returns, non-payments would have to occur about 1-in-100 times, with hundreds of companies failing to pay *declared* dividends every year. Moreover, the leverage-reward finding could be consistent with firms moving large amounts of risky stock-market holdings into cash the day after the payment, thus becoming safer. However, beside the fact that such behavior is not known, it is also inconsistent with the leverage-risk findings. CRSP reports no cases in which a firm has already declared a dividend but fails to pay it as promised, nor are any cases familiar to me. (For further discussion of selection biases and their possible effects, see Section III.)

B Appendix: Panel Study, Unreported Aspects

Note to referees—There are many other possible specifications. I believe I have selected the simplest and most straightforward ones that still fit comfortably into the JF submission page limit. I can add other tests upon request. I believe the results are super-robust, comparable to or better than those related to other prominent factors. The only weak point seems to be the reversal in the financial crisis, which leverage shares with momentum (UMD). Neither I nor anyone else seems to understand this sudden change in behavior. I could spin a story (that investors are not cognizant of leverage in normal times and end up being disappointed, but that they paid attention to leverage in deep crisese), but this is very speculative.

Table 1: Leverage Ratios — Levels

Explanations: Columns are for the (six) measures of lagged leverage levels. negcash is 1 minus cash/assets; lev is net debt divided by net debt plus equity; liab is net liabilities divided by net assets. mk denotes market-value based, bk denotes accounting-value based measures of common equity. Panel A shows univariate leverage summary statistics. SD(X) is the average cross-sectional standard deviation, SD(T) is the average time-series standard deviation. Panel B is based on quartiles. These quartiles are balanced by fiscal year and "Lagged^2" compound return, and spread by leverage. (The Lagged^2 control aids the interpretation of future stock returns also as *changes* in returns.) The stock return statistics ("Compound Raw Lead" and "SD Net Lead") usually start 4-5 months after the fiscal year has ended relative to the year for which the independent variables (here leverage levels) were measured. Panel B shows that the sorts were successful, because Q1 and Q4 have different leverage levels and similar Lagged^2 stock returns. The Delta is not equal to the difference of the two previous columns, because of composition changes. Panel C shows BJS/FF monthly regression intercepts for the quartile-spread portfolios. Panel D shows (monthly averaged) Fama-Macbeth regression coefficients on the leverage variable. The +4 unreported control-variable coefficients are lagged: book-to-market, equity-marketcap, investment, and operating profits. The +10 control variables further add controls for three overlapping measures of lagged annual stock returns and (daily-based) stock volatilities. T-statistics greater than 1 are colored according to sign. T-statistics for Fama-Macbeth use Newey-West corrections with two lags of autocorrelation.

Interpretation: This table confirms and extends Fama and French (1998). The effect of leverage ratio *levels* depends on the measure, dependent variable, and controls. mknegcash has especially strong negative power for predicting subsequent average returns.

Panel A: Basic Statistics

	mknegcash	bknegcash	mklev	bklev	mkliab	bkliab
Mean	0.91	0.86	0.24	0.27	0.37	0.41
SD	(0.13)	(0.18)	(0.25)	(0.26)	(0.27)	(0.26)
SD(X,T)	(0.11,0.06)	(0.15,0.07)	(0.24,0.11)	(0.25,0.11)	(0.25,0.11)	(0.25,0.10)

Panel B: Statistics by Lag-Return Controlled Leverage-Measure Quartiles, Stock Returns, in %, Annual(ized)

	mknegcash		bknegcash		mklev		bklev		mkliab		bkliab	
Leverage Q Means	0.80	0.98	0.71	0.97	0.07	0.48	0.08	0.52	0.15	0.61	0.18	0.65
Quartile #	Q1	Q4	Q1	Q4	Q1	Q4	Q1	Q4	Q1	Q4	Q1	Q4
SD Net Lagged^2	51.2	44.6	51.0	44.8	47.5	47.5	47.1	47.1	49.7	46.9	50.1	46.4
SD Net Lead	51.2	45.8	50.9	46.2	46.9	49.7	46.6	49.0	49.3	49.1	49.9	48.0
SD Net 2Y Delta	0.4	1.8	0.3	2.0	–0.2	2.9	–0.2	2.6	0.0	2.7	0.1	2.3
Compound Raw Lagged^2	15.7	15.5	15.8	15.5	15.7	15.5	15.7	15.5	15.8	15.5	15.7	15.5
Compound Raw Lead	15.6	12.6	14.2	13.4	13.3	15.0	14.1	13.5	12.9	15.5	13.7	14.2
Compound Raw 2Y Delta	–0.7	–3.7	–2.0	–2.9	–2.7	–1.4	–2.0	–3.0	–3.2	–0.9	–2.4	–2.3

(Table continues on the next page)

Panel C: Fama-French Regressions on Leverage Measure Quartiles, Lag-Return Controlled, in % per month

	mknegcash	bknegcash	mklev	bklev	mkliab	bkliab
Indep Factor Controls	Alpha (T-stat)	Alpha (T-stat)	Alpha (T-stat)	Alpha (T-stat)	Alpha (T-stat)	Alpha (T-stat)
Constant	−0.39 (−5.44)	−0.25 (−2.90)	−0.01 (−0.10)	−0.19 (−2.78)	0.05 (0.59)	−0.14 (−1.75)
+XMKT	−0.34 (−4.98)	−0.17 (−2.19)	0.03 (0.43)	−0.17 (−2.51)	0.10 (1.12)	−0.12 (−1.46)
+SMB+HML	−0.37 (−6.14)	−0.31 (−5.01)	−0.18 (−3.01)	−0.31 (−5.41)	−0.15 (−2.29)	−0.28 (−4.14)
+RMW+CMA	−0.43 (−7.58)	−0.41 (−7.14)	−0.23 (−3.79)	−0.36 (−6.36)	−0.21 (−3.49)	−0.36 (−5.91)
+UMD	−0.41 (−6.79)	−0.38 (−6.00)	−0.17 (−2.74)	−0.32 (−5.44)	−0.17 (−2.74)	−0.34 (−5.30)

Panel D: Fama-Macbeth Regressions, in % per month

	mknegcash	bknegcash	mklev	bklev	mkliab	bkliab
Coefficient on	Coef (T-stat)	Coef (T-stat)	Coef (T-stat)	Coef (T-stat)	Coef (T-stat)	Coef (T-stat)
Leverage Quartiles	−0.13 (−4.67)	−0.08 (−2.52)	−0.01 (−0.21)	−0.07 (−2.55)	0.03 (0.79)	−0.04 (−1.44)
... +4 vars	−0.11 (−4.55)	−0.10 (−3.94)	−0.05 (−2.29)	−0.07 (−2.79)	−0.04 (−1.44)	−0.04 (−1.80)
... +10 vars	−0.10 (−5.03)	−0.09 (−4.43)	−0.05 (−2.69)	−0.07 (−3.26)	−0.03 (−1.56)	−0.05 (−2.25)
Leverage Values	−2.02 (−5.12)	−0.80 (−2.31)	−0.04 (−0.19)	−0.48 (−2.63)	0.25 (1.05)	−0.33 (−1.54)
... +4 vars	−1.62 (−4.88)	−1.29 (−4.39)	−0.46 (−2.49)	−0.47 (−2.95)	−0.29 (−1.42)	−0.39 (−2.15)
... +10 vars	−1.52 (−5.77)	−1.19 (−5.08)	−0.51 (−3.31)	−0.51 (−3.82)	−0.33 (−2.03)	−0.43 (−2.97)
Asset-Controlled Quartiles	−0.12 (−4.80)	−0.06 (−1.90)	0.02 (0.49)	−0.04 (−1.43)	0.05 (1.37)	−0.01 (−0.38)
Log Returns +10 vars	−0.08 (−6.93)	−0.05 (−4.69)	−0.03 (−4.69)	−0.03 (−5.36)	−0.02 (−2.61)	−0.03 (−4.17)

Table 2: Leverage Ratios — Changes

Explanations: This table is the analog of Table 1, but the sorts and columns are for (lagged) leverage *changes*.

Interpretation: *Increases* in leverage are associated with increases in (higher) subsequent volatility (except, perhaps, for mknegcash) and decreases in (lower) future average stock returns. Coefficients are similar across mk and bk measures, but T-statistics are higher on bk measures; the latter seem less noisy.

Panel A: Basic Statistics	Δ mknegcash	Δ bknegcash	Δ mklev	Δ bklev	Δ mkliab	Δ bkliab
Mean	–0.001	0.005	0.009	0.007	0.01	0.009
SD	(0.08)	(0.09)	(0.12)	(0.12)	(0.12)	(0.11)
SD(X,T)	(0.07,0.07)	(0.08,0.08)	(0.11,0.10)	(0.11,0.10)	(0.11,0.11)	(0.10,0.10)

Panel B: Statistics by Lag-Return Controlled ΔLeverage Quartiles, Stock Returns, in %, Annual(ized)

	Δ mknegcash Q1	Δ mknegcash Q4	Δ bknegcash Q1	Δ bknegcash Q4	Δ mklev Q1	Δ mklev Q4	Δ bklev Q1	Δ bklev Q4	Δ mkliab Q1	Δ mkliab Q4	Δ bkliab Q1	Δ bkliab Q4
Leverage Q Means	–0.06	0.06	–0.05	0.07	–0.08	0.10	–0.08	0.10	–0.07	0.11	–0.07	0.10
Quartile #	Q1	Q4	Q1	Q4	Q1	Q4	Q1	Q4	Q1	Q4	Q1	Q4
SD Net Lagged[2]	49.5	49.1	49.0	49.0	49.0	47.5	48.4	47.7	49.4	47.9	48.9	48.2
SD Net Lead	49.7	49.8	48.5	50.6	46.7	51.7	47.2	50.7	47.3	51.8	47.7	51.1
SD Net 2Y Delta	0.7	1.2	–0.1	2.1	–2.0	4.8	–0.9	3.8	–1.9	4.7	–1.0	3.7
Compound Raw Lagged[2]	15.8	15.5	15.8	15.5	15.8	15.5	15.8	15.5	15.8	15.5	15.8	15.5
Compound Raw Lead	15.3	12.8	14.7	12.6	15.0	13.0	14.8	12.3	14.6	13.1	14.7	12.5
Compound Raw 2Y Delta	–0.9	–3.3	–1.7	–3.4	–1.0	–3.5	–1.2	–4.3	–1.4	–3.3	–1.4	–3.9

(Table continues on the next page)

	Δ mknegcash	Δ bknegcash	Δ mklev	Δ bklev	Δ mkliab	Δ bkliab
Panel C: Fama-French Regressions on ΔLeverage Quartiles, Lag-Return Controlled, in % per month						
Indep Factor Controls	Alpha (T-stat)	Alpha (T-stat)	Alpha (T-stat)	Alpha (T-stat)	Alpha (T-stat)	Alpha (T-stat)
Constant	–0.24 (–5.72)	–0.22 (–5.90)	–0.18 (–2.75)	–0.28 (–6.38)	–0.20 (–2.77)	–0.24 (–6.03)
+XMKT	–0.24 (–5.87)	–0.23 (–6.16)	–0.20 (–3.12)	–0.30 (–7.00)	–0.21 (–3.21)	–0.26 (–6.68)
+SMB+HML	–0.22 (–5.48)	–0.24 (–6.47)	–0.32 (–5.53)	–0.35 (–8.25)	–0.34 (–5.58)	–0.29 (–7.68)
+RMW+CMA	–0.20 (–4.31)	–0.21 (–5.61)	–0.30 (–4.87)	–0.32 (–7.53)	–0.32 (–4.82)	–0.26 (–6.59)
+UMD	–0.20 (–3.71)	–0.18 (–4.61)	–0.17 (–2.65)	–0.26 (–5.75)	–0.17 (–2.50)	–0.19 (–5.11)
Panel D: Fama-Macbeth Regressions, in % per month						
Coefficient on	Coef (T-stat)	Coef (T-stat)	Coef (T-stat)	Coef (T-stat)	Coef (T-stat)	Coef (T-stat)
ΔLeverage Quartiles	–0.08 (–6.63)	–0.07 (–5.85)	–0.06 (–2.72)	–0.09 (–5.66)	–0.06 (–2.50)	–0.08 (–5.59)
... +4 vars	–0.07 (–6.49)	–0.07 (–6.01)	–0.04 (–2.25)	–0.05 (–3.90)	–0.04 (–1.78)	–0.04 (–3.24)
... +10 vars	–0.07 (–6.24)	–0.06 (–6.20)	–0.03 (–2.52)	–0.05 (–4.43)	–0.02 (–1.66)	–0.03 (–2.88)
ΔLeverage Values	–1.93 (–5.55)	–1.36 (–4.50)	–1.03 (–2.90)	–1.12 (–4.83)	–0.88 (–2.22)	–1.08 (–4.00)
... +4 vars	–1.58 (–4.83)	–1.27 (–4.54)	–0.81 (–2.57)	–0.59 (–2.82)	–0.65 (–1.85)	–0.56 (–2.46)
... +10 vars	–1.55 (–5.05)	–1.21 (–4.93)	–0.72 (–3.63)	–0.43 (–2.96)	–0.55 (–2.51)	–0.39 (–2.40)
Asset-Controlled Quartiles	–0.08 (–5.51)	–0.07 (–5.20)	–0.05 (–1.78)	–0.07 (–3.26)	–0.05 (–1.65)	–0.07 (–4.04)
Log Returns +10 vars	–0.09 (–6.92)	–0.08 (–7.29)	–0.07 (–7.21)	–0.04 (–5.45)	–0.06 (–6.10)	–0.04 (–4.87)

Table 3: Explaining Changes in Volatility, $\text{sd}_t = a + \rho_1 \cdot \text{sd}_{t-1} + \rho_2 \cdot \text{sd}_{t-2} + \gamma \cdot \Delta\text{Lev}_{t-2,t-1}$

Explanations: Panel A are Fama-Macbeth style annual regressions. In each fiscal year, sd is the standard deviation of the rate of return calculated over (12 months of) daily excess returns (i.e., net of the market), *not* annualized. The regressions are primarily cross-sectional and not time-series, which effectively renders the autoregressive coefficient bias moot. The interesting variable is the (lagged) leverage measure, which is named in the left-most column. The final column is the fraction of months in which the c coefficient on the (past) leverage increase is positive. Panel B are panel regressions with various corrections for cross-sectional, time-series, and heteroskedastic error correlations. The strongest (BTH) allows for all three.

Interpretation: Because stock return volatility is itself a fairly accurate measure, the estimates reported in this table are highly precise. Firms whose cash increased proportionally relative to market-based firm size experience only a tiny increase in stock return volatility. All other leverage increases induce clear increases in stock return volatility.

Fama-Macbeth-Like Regressions

ΔLeverage Measure	Method	a	ρ_1	ρ_2	γ	% Years Positive
Δmknegcash	Coefficients	0.004	0.724	0.175	0.004	87
	(NW(2) T-stat)	(7.00)	(25.39)	(9.30)	(4.89)	
Δbknegcash	Coefficients	0.004	0.721	0.176	0.007	92
	(NW(2) T-stat)	(7.04)	(25.64)	(9.60)	(9.07)	
Δmkflev	Coefficients	0.004	0.702	0.195	0.011	100
	(NW(2) T-stat)	(7.31)	(27.53)	(11.55)	(10.51)	
Δbkflev	Coefficients	0.004	0.714	0.184	0.008	98
	(NW(2) T-stat)	(7.10)	(26.01)	(10.11)	(12.44)	
Δmkliab	Coefficients	0.004	0.701	0.195	0.012	100
	(NW(2) T-stat)	(7.10)	(27.63)	(11.79)	(11.38)	
Δbkliab	Coefficients	0.004	0.714	0.183	0.009	100
	(NW(2) T-stat)	(6.96)	(25.92)	(10.11)	(12.89)	

Panel Regressions, T-statistics only for γ

ΔLeverage Measure	ρ_1	ρ_2	γ	OLS-T	SCC-T	ARL-T	WHT-T	BTH-T
Δmknegcash	0.749	0.133	0.003	(45.02)	(7.81)	(5.16)	(2.62)	(2.37)
Δbknegcash	0.745	0.135	0.008	(45.87)	(23.62)	(17.57)	(12.06)	(10.11)
Δmkflev	0.723	0.157	0.013	(52.69)	(48.40)	(35.50)	(13.07)	(12.33)
Δbkflev	0.738	0.142	0.009	(48.03)	(34.42)	(25.92)	(17.20)	(14.50)
Δmkliab	0.721	0.158	0.014	(53.28)	(50.13)	(36.83)	(14.03)	(13.20)
Δbkliab	0.737	0.143	0.010	(48.28)	(35.48)	(26.29)	(17.79)	(14.95)

Table 4: Subsequent Average Rates of Return After *both* Leverage Ratio *and* Volatility Increases

Explanations: This table is analogous to Panel C in Table 2, but the Q1 portfolio excludes firms that did not also experience reductions in volatility and the Q4 portfolio excludes firms that did not also experience increases in volatility, both in the same year in which changes in leverage are measured. Thus, there are considerably fewer stocks in each portfolio than there were in Table 2, which naturally explains lower T-statistics.

Interpretation: Even stocks with both leverage and volatility increases offered lower subsequent average rates of return than stocks with both leverage and volatility decreases. However, UMD control largely erases marginal explanatory power.

	Δmknegcash+		Δbknegcash+		Δmkflev+		Δbkflev+		Δmkliab+		Δbkliab+	
Indep Factor Controls	Alpha	(T-stat)	Alpha	(T-stat)	Alpha	(T-stat)	Alpha	(T-stat)	Alpha	(T-stat)	Alpha	(T-stat)
Constant	–0.17	(–2.21)	–0.18	(–2.33)	–0.19	(–1.99)	–0.21	(–2.52)	–0.12	(–1.25)	–0.21	(–2.69)
+XMKT	–0.19	(–2.48)	–0.19	(–2.52)	–0.20	(–2.23)	–0.24	(–3.00)	–0.15	(–1.60)	–0.23	(–3.17)
+SMB+HML	–0.18	(–2.43)	–0.22	(–3.00)	–0.33	(–3.74)	–0.32	(–4.07)	–0.29	(–3.34)	–0.29	(–4.00)
+RMW+CMA	–0.10	(–1.29)	–0.16	(–2.15)	–0.28	(–2.91)	–0.26	(–3.06)	–0.22	(–2.39)	–0.21	(–2.72)
+UMD	–0.09	(–0.95)	–0.12	(–1.37)	–0.14	(–1.47)	–0.15	(–1.73)	–0.06	(–0.70)	–0.12	(–1.60)

Table 5: Decomposition into Stock-Return-Caused and Firm-Caused Leverage Changes

Explanations: This table is the analog of Table 2, but the sorts and columns are split based on changes due to stock returns (R.Δ) and changes due to managerial activity (FM.Δ).

Interpretation: Stock return volatility increases after leverage has increased regardless of source. Average return decreases after leverage has increased. The leverage effects are stronger when caused by managerial increases, but they are not often economically and statistically significantly higher.

Panel A: Basic Statistics	R.Δmklev	FM.Δmklev	R.Δmkliab	FM.Δmkliab
Mean	–0.003	0.01	–0.006	0.02
SD	(0.07)	(0.09)	(0.08)	(0.09)
SD(X,T)	(0.06,0.06)	(0.09,0.08)	(0.07,0.07)	(0.08,0.08)
Panel B: Statistics by Quartiles, Stock Returns, in %, Annual(ized)				
Leverage Q Means	–0.05 0.05	–0.05 0.08	–0.06 0.05	–0.04 0.09
Quartile #	Q1 Q4	Q1 Q4	Q1 Q4	Q1 Q4
SD Net Lagged^2	47.8 49.2	50.0 46.1	48.2 49.6	50.4 46.6
SD Net Lead	45.4 53.5	49.2 48.4	45.7 54.0	50.4 48.0
SD Net 2Y Delta	–2.2 5.1	–0.3 2.9	–2.2 5.1	0.4 1.9
Compound Raw Lagged^2	15.7 15.5	15.8 15.5	15.7 15.5	15.8 15.5
Compound Raw Lead	13.9 13.8	15.5 12.4	14.1 13.7	15.5 12.9
Compound Raw 2Y Delta	–2.1 –2.7	–0.8 –3.9	–1.9 –2.9	–1.0 –3.2
Panel C: Fama-French Regressions on Quartiles, in % per month				
Indep Factor Controls	Alpha (T-stat)	Alpha (T-stat)	Alpha (T-stat)	Alpha (T-stat)
Constant	–0.04 (–0.51)	–0.33 (–7.99)	–0.06 (–0.66)	–0.28 (–7.41)
+XMKT	–0.07 (–0.88)	–0.33 (–8.03)	–0.07 (–0.92)	–0.28 (–7.48)
+SMB+HML	–0.20 (–3.06)	–0.36 (–8.93)	–0.23 (–3.27)	–0.29 (–7.79)
+RMW+CMA	–0.17 (–2.40)	–0.35 (–8.59)	–0.19 (–2.54)	–0.31 (–8.30)
+UMD	–0.03 (–0.35)	–0.32 (–7.47)	–0.03 (–0.38)	–0.29 (–7.51)
Panel D: Fama-Macbeth Regressions, in % per month				
	Coef (T-stat)	Coef (T-stat)	Coef (T-stat)	Coef (T-stat)
ΔLeverage Quartiles	–0.01 (–0.42)	–0.10 (–6.83)	–0.02 (–0.50)	–0.09 (–7.01)
... +4 vars	–0.04 (–1.68)	–0.05 (–3.27)	–0.04 (–1.60)	–0.04 (–3.13)
... +10 vars	–0.02 (–1.26)	–0.04 (–3.65)	–0.02 (–1.17)	–0.03 (–3.19)
ΔLeverage Values	–0.33 (–0.41)	–1.75 (–7.21)	–0.05 (–0.06)	–1.83 (–7.19)
... +4 vars	–1.12 (–1.73)	–0.82 (–3.08)	–0.81 (–1.34)	–0.58 (–2.20)
... +10 vars	–0.71 (–1.43)	–0.69 (–3.56)	–0.65 (–1.26)	–0.44 (–2.14)
Asset-Controlled Quartiles	0.02 (+0.63)	–0.11 (–7.57)	0.02 (+0.59)	–0.11 (–7.66)
Log Returns +10 vars	–0.16 (–5.98)	–0.04 (–4.50)	–0.16 (–5.79)	–0.02 (–2.29)

Table 6: Redundant Factors in Explaining Average Monthly Rates of Return

Explanations: Each set of rows describes the intercept, T of the intercept, and the R^2 of BJS/FF regressions when a factor is explained by a multivariate regression using all the other factors in the set. For example, in a BJS/FF regression, hml has an alpha of 0.09 (T of 1.0) when regressed on xmkt, smb, rmw, cma, and umd. In other words, its contribution to explaining return means is spanned by the remaining five factors. Moreover, the next line shows that with an R^2 of 53%, it's time-series variation is also relatively well explained by the other five factors. The data were from 1963/07 to 2016/12, with the first leverage return from 1965/01.

Interpretation: Negcash portfolios subsume the explanatory power of the smb factor in explaining stock returns; and leverage change portfolios (especially Δbklev and Δbkliab) span about half the the mean of the umd portfolios. Among these factors, leverage changes usually rank near the top in their marginal contributions.

added to set	stat	see left	xmkt	hml	smb	rmw	cma	umd
none	Alpha		0.85	0.09	0.31	0.35	0.21	0.72
	T(Alpha)		5.2	1.0	2.6	4.1	3.6	4.2
	R^2 (in %)		25	53	17	19	55	10
bknegcash	Alpha	–0.37	0.77	0.30	**+0.07**	0.51	0.20	0.52
	T(Alpha)	–6.5	4.6	4.1	**0.6**	6.6	3.3	2.9
	R^2 (in %)	60	25	65	24	37	55	12
mknegcash	Alpha	–0.40	0.80	0.25	**–0.06**	0.52	0.17	0.55
	T(Alpha)	–7.3	4.7	3.9	**–0.6**	6.4	2.8	3.1
	R^2 (in %)	45	25	57	30	31	56	11
(No other leverage ratio level can explain the abnormal rate of return attributed to other factors)								
Δbklev	Alpha	–0.25	0.92	0.14	0.40	0.32	0.21	0.30
	T(Alpha)	–6.0	5.5	1.6	3.3	3.6	3.6	1.8
	R^2 (in %)	20	25	53	19	20	55	20
Δmklev	Alpha	–0.17	0.87	0.14	0.38	0.37	0.21	0.32
	T(Alpha)	–3.1	5.3	1.7	3.3	4.2	3.5	2.1
	R^2 (in %)	39	25	56	23	20	55	31
Δbkliab	Alpha	–0.20	0.88	0.13	0.39	0.31	0.19	0.29
	T(Alpha)	–5.2	5.3	1.5	3.2	3.5	3.2	1.8
	R^2 (in %)	23	25	53	19	20	56	23
Δmkliab	Alpha	–0.17	0.87	0.15	0.37	0.28	0.19	0.30
	T(Alpha)	–3.0	5.3	1.8	3.2	4.4	3.4	2.0
	R^2 (in %)	42	25	57	22	20	56	34
Δbknegcash	Alpha	–0.16	0.80	0.08	0.39	0.32	0.20	0.51
	T(Alpha)	–4.5	4.8	0.9	3.3	3.7	3.3	3.0
	R^2 (in %)	10	25	53	20	20	55	14
Δmknegcash	Alpha	–0.20	0.84	0.07	0.30	0.33	0.19	0.71
	T(Alpha)	–4.5	5.0	0.8	2.5	3.7	3.2	4.1
	R^2 (in %)	3	25	53	17	20	56	10

Table 7: Explaining Market-Adjusted Stock Returns (in%) Around Actual **Equity-Issue** Execution Dates, Given Previous Declaration

Event Day	Daily Cross-Sectional Returns Std Dev	Daily Cross-Sectional Returns Mean	Event Range	Average Return	Average Abs Return
–7	4.04	0.167			
–6	5.29	0.031			
–5	4.05	0.032			
–4	4.27	–0.085			
–3	5.39	–0.139	–6 to –3	–0.041	4.63
–2	5.39	–0.359			
–1	5.21	–0.595			
0	5.81	–1.356	–2 to +2	–0.448	5.04
+1	4.98	–0.205			
+2	3.34	0.258			
+3	3.28	0.140	+3 to +6	0.078	3.46
+4	3.27	0.148			
+5	3.23	0.036			
+6	2.95	–0.018			
+7	3.01	0.164			

Explanations: This table explores stock return responses net of market returns around seasoned equity offering issues dates, provided the offerings were announced well in advance. There were about 7,700 issuing events per daily statistic. Not shown, the –6 to –3 means are statistically significantly different from the +3 to +6 means.

Interpretation: Equity return volatilities were lower after equity offerings, but average rates of return were higher.

Table 8: Descriptive Statistics for Dividend Event-Study

Panel A: Basics

First and Last Dividends	1962/07 to 2016/12
All Distributions on CRSP	N= 755,587
Ordinary "CRSP 1232" Dividends	N= 452,623
≥9 Days Between Declaration and Ex-Date	N= 239,684

Panel A: Timespan From Declaration to Payment (Ex-) Date

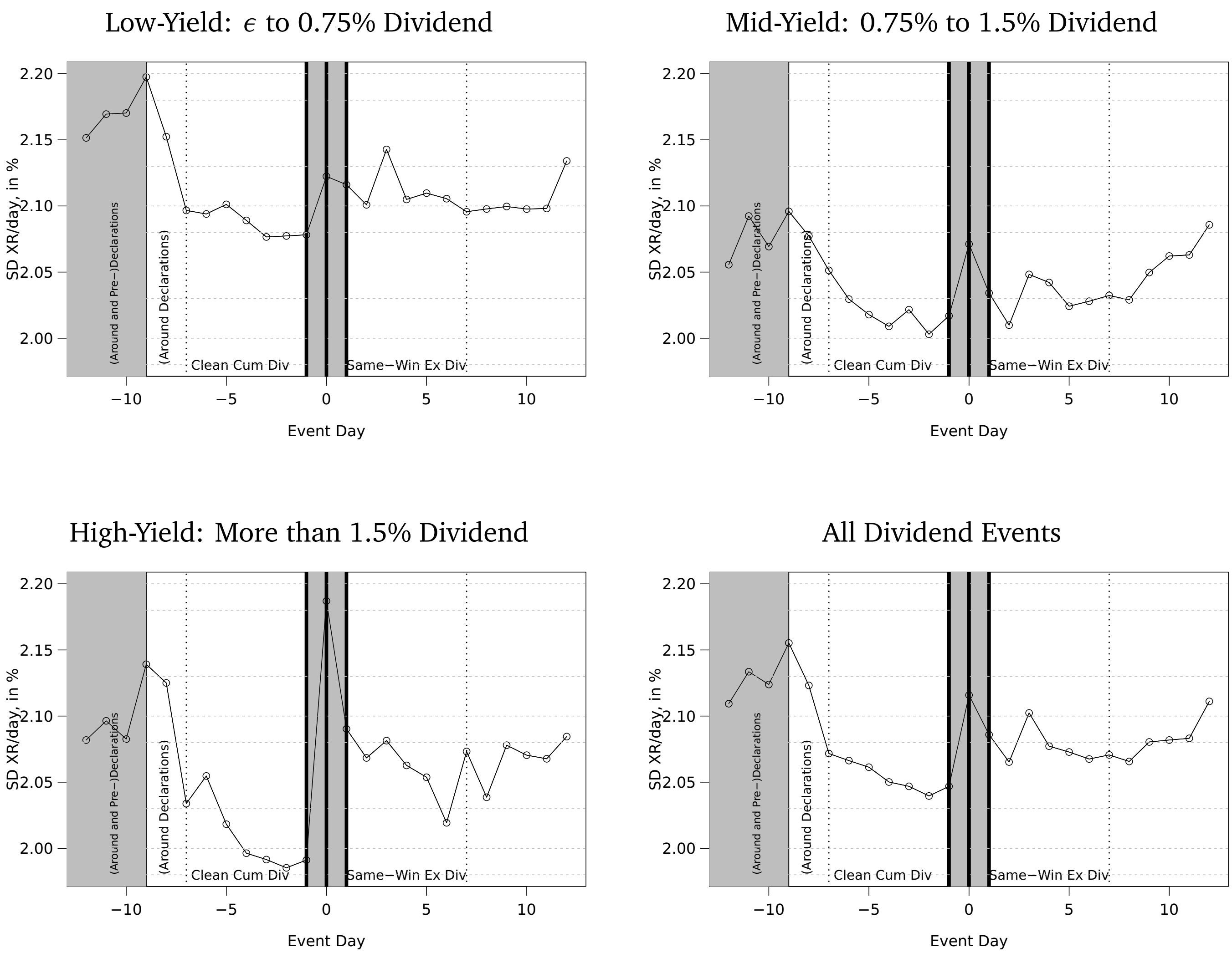
Days	0	1	2	3	4	5	6	7	8	9
Dclrtn to Ex	1,062	11,622	10,186	18,993	30,898	33,058	37,799	31,105	29,689	23,152
Cumulative	1,062	12,684	22,870	41,863	72,761	105,819	143,618	174,723	204,412	227,564
– Cumulative	451,561	439,939	429,753	410,760	379,862	346,804	309,005	277,900	248,211	225,059
After Selection	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Dclrtn to Ex		23,152	18,350	15,858	14,207	12,985	11,370	9,898	9,257	8,632
Cumulative		23,152	41,502	57,360	71,567	84,552	95,922	105,820	115,077	123,709
–Cumulative	239,684	216,532	198,182	182,324	168,117	155,132	143,762	133,864	124,607	115,975

Panel B: Means, Medians, Standard Deviations of Key Dependent and Independent Variables

	Min	Median	Max	%Pos	Mean	SD	(T)	#	# Wnsrzd
Net-of-Market Rates of Return, –12 to +12 days	–20	–0.0621	+20	47.8%	0.010	2.085	11.9	5,988,618	2,279
... in absolute values	0	+0.8751	+20		1.354	1.586			
Dividend Yield δ, | ≥ 9 days	0	0.0074	0.20		0.0089	0.0068		239,684	18

Explanations: The sample consists of all CRSP "1232" (ordinary cash dividend) distributions with data for stock returns, prices, and dividend yields, from 1962 to 2016. Panel A describes the basic constituents. Panel B describes the time span between the declaration and the cum-to-ex transition day. Panel C describes the principal variables of interest, the dividend yield and the daily rates of return, both winsorized at 20% (and –20%). The dividend yield is calculated with respect to the single dividend distribution (*never* annualized), and stock price at the declaration day (but at most 22 trading days before the ex date).

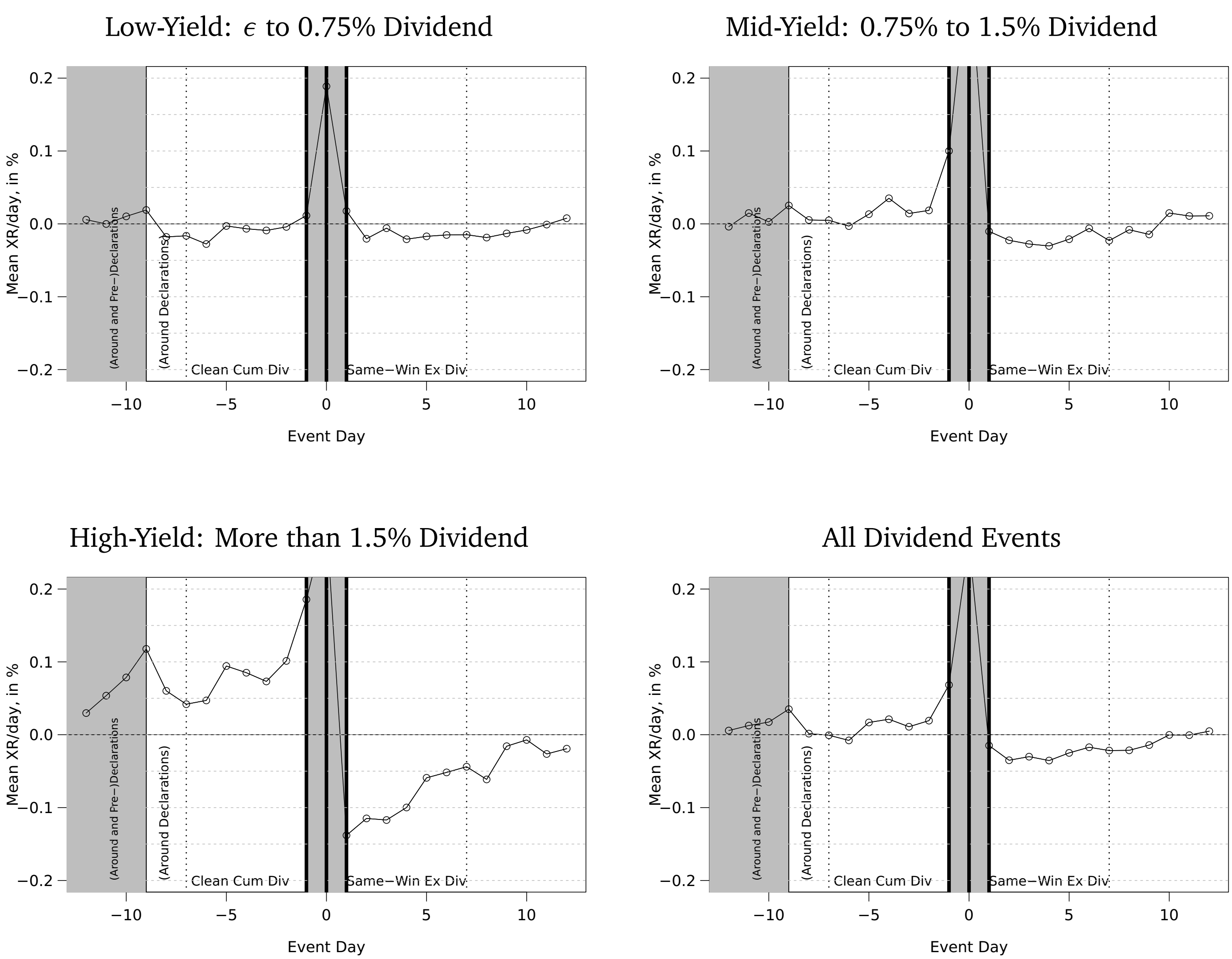
Figure 1: Pre-Announced Dividend Payments and Daily Cross-Sectional Standard Deviations



Explanations: Samples and variables are described in Table 8. The four plots are, in clockwise order, cross-sectional standard deviations of net-of-market rates of return for low-yield, mid-yield, high-yield, and all (CRSP code 1232) dividend payments, *conditional* on at least 9 days between declaration and event date.

Interpretation: Ex-day volatilities were higher than cum-day volatilities, but only reliably so for high-yield dividend payment events.

Figure 2: Effects of Pre-Announced Dividend Payments on Cross-Sectional Average Rates of Return



Explanations: Samples and variables are described in Table 8. The four plots are, in clockwise order, averages of net-of-market rates of return for low-yield, mid-yield, high-yield, and all (CRSP code 1232) dividend payments, *conditional* on at least 9 days between declaration and ex date.

Interpretation: Ex-day average net-of-market returns were higher than cum-day average net-of-market returns, but most reliably so for high-yield dividend payment events.

Table 9: Weekly Changes in Return Moments, Cum and Ex Payment

Panel A: By Dividend-Yield Category

		"Risk:" $\sum\|r\|$			"Reward:" $\sum r$			
	DivYield	Cum	Ex	Diff	Cum	Ex	Diff	N
All	0.0089	6.67	6.76	0.07	0.06	–0.14	–0.20	239,684
Low Div Yield ($\delta < -0.75\%$)	0.0043	6.87	6.92	0.06	–0.05	–0.08	–0.03^{-}	120,772
Mid Div Yield ($0.75 < \delta < 1.50\%$)	0.0106	6.55	6.60	0.05	0.08	–0.11	–0.19	83,657
High Div Yield ($1.50\% < \delta$)	0.0209	6.31	6.51	0.20	0.40	–0.44	–0.84	34,616

Panel B: Explaining Ex-Minus-Cum 5-Day Sum of Absolute Net-of-Market Return ("Risk")

					Newey-West	
	Coef	StdErr	T-stat	StdCoef	StdErr	T-stat
Intercept	0.001	0.017	0.04		0.022	0.03
Div Yield δ	8.170	1.535	5.32	0.011	2.250	3.63
Intercept	0.003	0.017	0.20		0.023	0.14
$\delta/(1-\delta)$	7.674	1.458	5.26	0.011	2.298	3.34
Ex-Day Return	0.003	0.005	0.55	0.001	0.008	0.33

Panel C: Explaining Ex-Minus-Cum 5-Day Sum of Net-of-Market Return ("Reward")

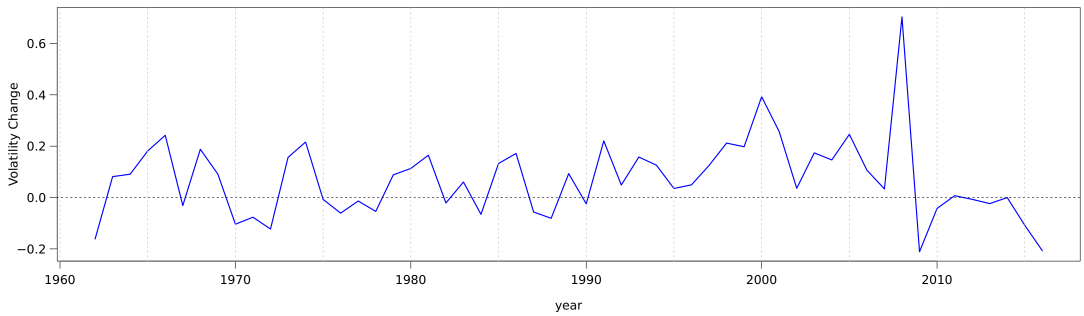
					Newey-West	
	Coef	StdErr	T-stat	StdCoef	StdErr	T-stat
Intercept	0.243	0.021	11.8		0.025	9.8
Div Yield δ	–50.147	1.837	–27.3	–0.056	2.412	–20.8
Intercept	0.219	0.020	10.9		0.025	8.7
$\delta/(1-\delta)$	–47.764	1.174	–27.4	–0.056	2.411	–19.8
Ex-Day Return	0.037	0.006	6.3	0.013	0.009	4.0

Explanations: Samples and variables are described in Table 8. This table provides numerical descriptions of the plotted weekly net-of-market stock return data from Figures 1 and 2. The statistics are based on simple cross-sectional relations, conditional on the dividend having been announced at least 9 days before the ex-day. The comparison is between the –7 to –2 (cum) net-of-market rates of returns and their +2 to +7 (ex) equivalents. The ex-day and its left and right surrounding days are always omitted. The *absolute* return are the sum of 5 absolute returns, one reasonable measure of stock return volatility. The StdCoef unit-normalizes all variables before running the regression. Newey-West statistics adjust for heteroskedasticity.

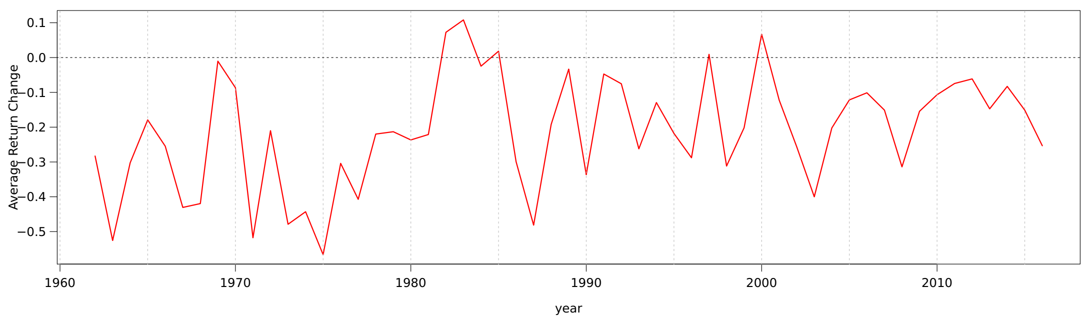
Interpretation: The intercepts suggest that dividend yield fully or more than fully explains the increase in stock return volatility and the decrease in average stock returns around dividend payments.

Figure 3: Year-by-Year Coefficients Explaining Stock Return Moments after Payment and highest Individual Dividend Income Tax Rates

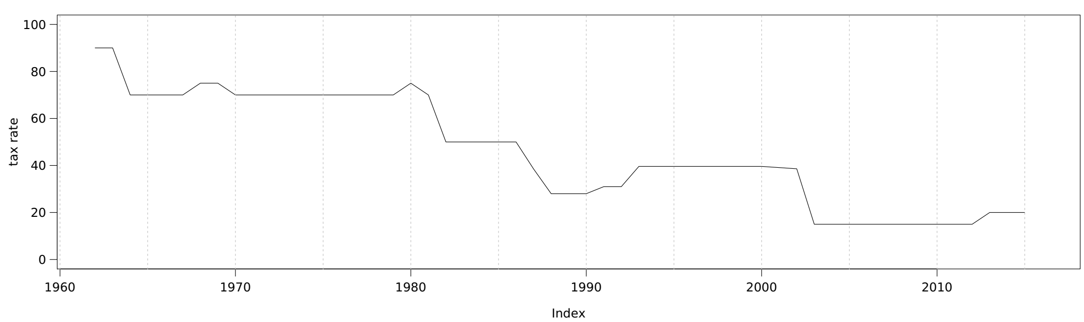
Panel A: Explaining Ex-Minus-Cum Risk



Panel B: Explaining Ex-Minus-Cum Reward



Panel C: Personal Income Tax Rate on Dividends by Year



Explanations: Samples and variables are described in Table 8. Panels A and B show the regression coefficients of interest (analogous to those in Table 9) when each year is run by itself for the market-adjusted 5-day window. The blue line in Panel A are annual coefficients relating dividend yields to weekly volatility changes. The red line in Panel B are annual coefficients relating dividend yields to weekly average return Panel C shows dividend tax rates, as in Sialm (2009), Becker, Jacob, and Jacob (2013), and Jacob, Michaely, and Mueller (2016).

Interpretation: The stock-return moment differences varied year-by-year, but did not change in a fashion strongly related to the dividend tax rates. This suggests that personal dividend income tax-related preferences were unlikely to be first-order determinants.

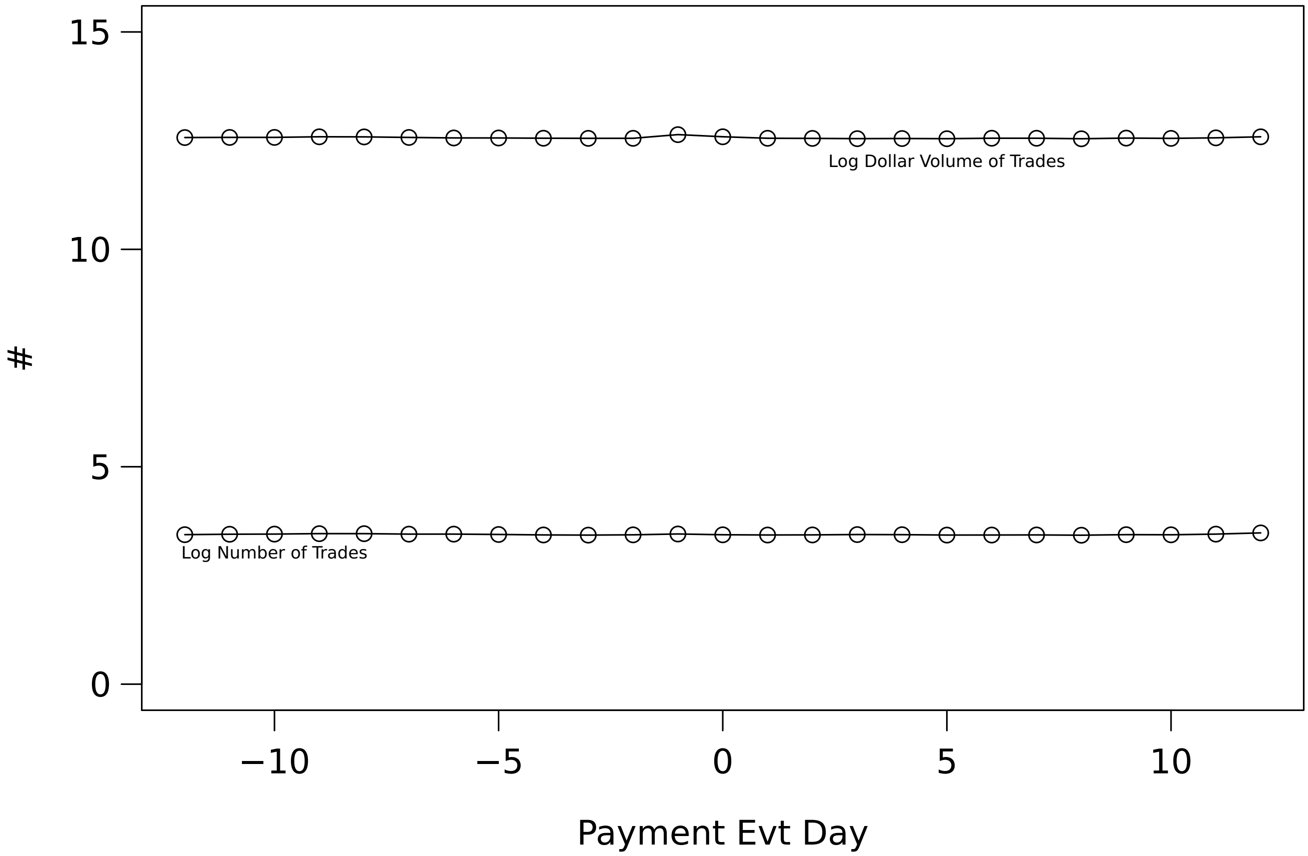
Table 10: Categorized Associations of Dividend Yield and Return Moments Changes

	Avg δ	Dividend Yield-Induced Change in Weekly				
		Volatility		Avg Return		
	in %	Coef	T-stat	Coef	T-stat	N
ALL (Code 1232)	0.9	8.17	5.3	–50.15	–27.3	239,684
Low Yield (Code 1232) (<0.75%)	0.4	–5.27	–0.7	–14.27	–1.5	120,772
Med Yield (Code 1232) (0.75-1.5%)	1.1	5.68	0.7	–62.59	–6.4	83,657
High Yield (Code 1232) (>1.5%)	2.1	13.72	4.3	–67.14	–17.6	34,616
Taxable Dividend	0.9	14.71	16.4	–28.71	–26.8	290,861
Non-Taxable	0.6	–1.50	–0.4	–41.83	–7.9	13,932
Monthly Dividend	0.6	38.78	7.1	–105.80	–14.7	33,157
Quarterly	0.9	8.04	5.4	–49.08	–27.4	243,259
Semi- and Annual	1.4	5.87	1.2	–22.72	–4.2	9,355
Special Dividend	3.0	18.27	10.0	–11.85	–5.6	4,038
Not Special	0.9	11.38	10.2	–37.81	–28.2	300,741
Last Dividend <40days	0.7	22.39	10.5	–30.21	–11.0	38,193
40-80days	0.9	8.60	6.4	–40.36	–25.1	234,397
>80days	1.3	21.51	10.1	–16.92	–7.0	14,740
w/ Compustat (t-1)	0.9	10.08	5.2	–48.91	–20.3	149,824
w/o Compustat	0.9	5.22	2.1	–52.06	–18.4	89,860
bkliab < 1/3	0.8	9.02	2.2	–49.92	–10.1	40,347
bkliab 1/3 - 2/3	0.9	7.81	3.0	–47.85	–14.7	80,833
bkliab > 2/3	0.9	16.78	3.9	–50.27	–9.7	28,644
Small (Assets < $100m)	1.0	7.87	1.4	–55.98	–9.1	29,672
Medium (Assets $100m - $3,000m)	0.9	12.16	5.0	–49.94	–16.2	86,800
Large (Assets > $3000m)	0.8	6.59	1.9	–37.09	–7.7	33,407

Explanations: This table reports the coefficients explaining the weekly equity volatility and average-return changes around dividend ex-dates (but excluding the ex-window itself) with dividend yields within different sets of firms, conditional on at least 9 days between declaration and ex-date. The first row (ALL) appears in both this table and Table 9. Taxability, frequency, and specialness are provided by CRSP's distcd. bkliab is total-liabilities divided by the book value of total assets.

Interpretation: The increase in weekly volatility and decrease in weekly average returns appears in almost all subsets. When dividend yields are small, there is not enough variation in dividend yields to determine their effects on changes in stock return behavior.

Figure 4: Explaining Average Trading Liquidity Patterns around Previously Declared Payment Dates



Explanations: Samples and variables are described in Table 8. These are plots of the by-event-day averages of the log number of trades and log value of dollar trades.

Interpretation: Liquidity-related trading explanations are unlikely to play a role.

Table 11: Illustrative Numerical Example of (Post-Announcement) At-Payment Changes

	Firm	Low Leverage ($D_0 = \$5$, $E_0 = \$95$, $\delta = 1.05\%$)				High Leverage ($D_0 = \$95$, $E_0 = \$5$, $\delta = 20\%$)			
		Security	$T = 0$	$T = 2$	Risk @ T	Security	$T = 0$	$T = 2$	Risk @ T
No Risk	Risky P $0, Safe C $100	Debt(FV=$5)	$5	($5,$5)		Debt(FV=$95)	$95	($95,$95)	
	[$100,$100]	Equity Cum$_{T=0.9}$	$95	($95,$95)	±0.00%	Equity Cum$_{T=0.9}$	$5	($5,$5)	±0.00%
		Equity Ex$_{T=1.1}$	$94	($95–$1,95–$1)	±0.00%	Equity Ex$_{T=1.1}$	$94	($5–$1,5–$1)	±0.00%
Low Risk	Risky P $2, Safe C $98	Debt(FV=$5)	$5	($5,$5)		Debt(FV=$95)	$95	($95,$95)	
	[$99.8,$100.2]	Equity Cum$_{T=0.9}$	$95	($94.8,$95.2)	±0.210%	Equity Cum$_{T=0.9}$	$5	($4.8,$5.2)	±4.0%
		Equity Ex$_{T=1.1}$	$94	($94.8–$1,95.2–$1)	±0.213%	Equity Ex$_{T=1.1}$	$94	($4.8–$1,5.2–$1)	±5.0%
High Risk	Risky P $98, Safe C $2	Debt(FV=$5)	$5	($5,$5)		Debt(FV=$100.8)	$95	($89.2,$100.8)	
	[$90.2,$109.8]	Equity Cum$_{T=0.9}$	$95	($85.2,$104.8)	±10.32%	Equity Cum$_{T=0.9}$	$5	($1,$9)	±80%
		Equity Ex$_{T=1.1}$	$94	($85.2–$1,104.8–$1)	±10.43%	Equity Ex$_{T=1.1}$	$94	($1–$1,9–$1)	±100%
Only Risk	Risky P $100, Safe C $0	Debt(FV=$5)	$5	($5,$5)		Debt(FV=$101)	$95	($90,$101)	
	[$90,$110]	Equity Cum$_{T=0.9}$	$95	($85,$105)	±10.53%	Equity Cum$_{T=0.9}$	$5	($1,$9)	±80%
		Equity Ex$_{T=1.1}$	$94	($85–$1,105–$1)	±10.64%	Equity Ex$_{T=1.1}$	$94	($1–$1,9–$1)	±100%

- Assume that the *previously-announced* dividend to be payed out at time $T = 1$ is $1, that risky projects will earn an $\tilde{r}$ of either –10% or +10%, for a risk of ±10%, and that cash is risk-free. Double numbers in parentheses represent possible random outcomes.
- If risk is zero or leverage is zero, these are the margin cases in which equity risk does not increase.
- If risk is low, the assumption of a minimum rate of return of –10% assures full payment.
- If leverage is low, the assumption of a minimum rate of return of –10% assures full payment.
- Consider high-risk, high leverage. The debt face value of $100.8 is pinned down by the debt-equity ratio of $95-to-$5 and consistency of the example. The equity receives $\$98 \cdot (1 + \tilde{r}) + \$2 - \$5$ from a $5 investment for rates of return of $\approx(-10.32\%, +10.32\%)$ with equal probability. After the payout, the equity is worth $94 (not $95), and the equivalent calculation yields $(-10.43\%, +10.43\%)$.