NBER WORKING PAPER SERIES

LEVERED RETURNS

Ivo Welch

Working Paper 22150
http://www.nber.org/papers/w22150

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
April 2016

Levered Returns
Ivo Welch
NBER Working Paper No. 22150
April 2016
JEL No. G12,G31,G32,G35

ABSTRACT

Do financial markets properly reflect leverage? Unlike Gomes and Schmid (2010) who examine this question with a structural approach (using long-term monthly stock characteristics), my paper examines it with a quasi-experimental approach (using short-term a discrete event). After a firm has declared a dividend (i.e., after the news release), but in the few days that precede the payment date, an investor in the traded equity owns a claim to the dividend cash plus the remaining firm equity within the corporate shell. After the payment date, the shell contains only the dividend-sans-cash firm equity. The empirical evidence confirms rational increases in volatilities but shows unexpected decreases in average returns. The best explanation is behavioral.

Ivo Welch
Anderson School at UCLA (C519)
110 Westwood Place (951481)
Los Angeles, CA 90095-1482
and NBER
ivo.welch@anderson.ucla.edu

For common projects, levered assets should be riskier and—if risk-taking is rewarded—offer higher average returns than equivalent unlevered assets. These leverage implications are even more basic than common equilibrium models. They should apply not only in any common factor structure but even if risk-averse investors are unable to diversify. Gomes and Schmid (2010) similarly characterize these leverage predictions 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. Unfortunately, despite, or perhaps because of, its extreme clarity, this relation between leverage and returns has met with, at best, mixed empirical success.

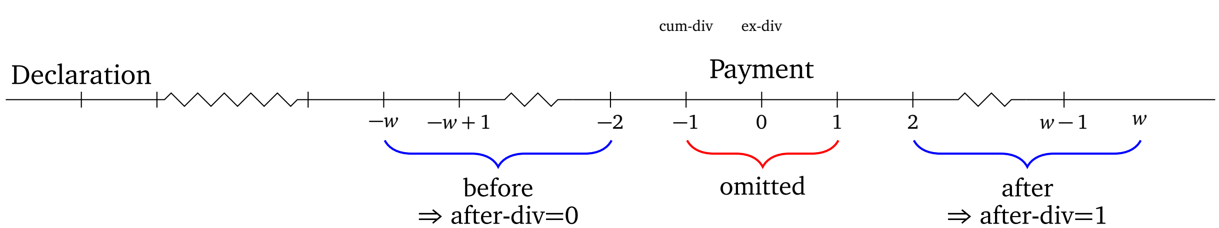
They then provide an intuitive answer: an omitted variable. Leverage is endogenous. Riskier firms with more growth options (reflected in market equity but not book equity) presumably choose lower leverage. Thus, they have both lower market leverage and higher expected returns. Their explanation is theoretically appealing, and it makes plain sense. If there is a shortcoming in Gomes-Schmid's "corporate supply side" argument, it is that it fails to embed less appealing "investor demand side" alternatives. For example, what if investors simply "liked" levered firms more, resulting in higher prices and lower returns? What if financial markets simply did not respond (appropriately) to financial leverage? What if the relationship between leverage and average returns was not due to optimal corporate leverage choice in the presence of growth options, but only due to realized cash payment patterns? (Pharmaceutical and technology companies happen to have been more profitable.) Could one decompose empirical evidence into "corporate supply" and "investor demand" forces?

My own paper follows an alternative identification strategy to shed a different light on the relation between net leverage and returns. It explores a setting in which it is easier to test whether risk and returns increase or decrease with leverage, because there is a discrete change in leverage that is not accompanied by a change in projects. The purpose of investigating this limited setting is not an attempt to fully explain the long-term slow-frequency relation between leverage and stock returns, but instead to focus only on a smaller piece of the puzzle for which a clearer answer can be found.

This particular setting are the discrete cum-to-ex day transitions associated with previously-announced dividend payments.[1] Any systematic news about projects associated with dividend payments should already have been revealed earlier at the firms' dividend declarations. After the declaration but *before* the payment, the firm has already committed to the dividend cash outflow. Its stockholders in effect then own a low-risk claim on a cash payment plus a higher-risk claim on the remaining equity components of the projects, both inside the corporate shell. After the payout, investors still own the same claims, except that the low-risk asset component has shifted from inside the corporate shell to the outside. The public stock return quotes are henceforth only for the residual riskier project assets. From the owners' perspective, public equity quotes prior to the payment are for both claims; quotes after the payment are only for the more levered claim. Note that leverage here is *net* leverage, with cash subtracted off obligations, and it can take on negative values.

This is all true regardless of the firm's underlying investment policy. It is true even if the firm invests the dividend-required resources in risky projects up until the moment of payment: any post-payment equity risk would attach to the residual traded firm equity net of the risk-free dividend payment. The dividend cash was—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.

Unlike earlier dividend literature (explored and reviewed in, e.g., Michaely, Thaler, and Womack (1995) or Allen and Michaely (2003)), my paper explores the stock returns around neither the dividend announcement dates nor the dividend payment dates. Instead, it compares the behavior of stock returns just before to just after payment dates, excluding payment dates themselves, *and* while restricting the sample to days on which the declaration had already been made public many days earlier. A timeline can illustrate the return windows. The payment day itself is ignored, because there are known (tax) regularities at work. All results are robust to reasonably different event windows.



[1]For convenience, I refer to the ex-date as the payment date. The actual payment date, e.g., as in CRSP, is never used.

The empirical findings are as follows:

1. Stock return volatilities increased when leverage increased. Stocks paying more dividends experienced more volatility increases. The increases were almost perfectly in line with the predictions of the rational leverage theory.

2. The leverage-induced increases in volatilities were accompanied not by (small) increases but by *decreases* in average rate of returns, and firms paying higher dividends experienced stronger decreases. This average return effect dissipated within about two to four weeks.

As noted, the point of the experiment is not to assess the complete leverage asset-pricing association, but to find a clean setting in which there is a discrete leverage change without contemporaneous project changes. Yet, the documented dividend-leverage average-return pattern turns out to be nontrivial (and not close-to-zero). With about a 30-bp mean return difference in the total two weeks around the payment, firms that paid dividends four times a year would have experienced declines in average rates of return of about 0.5-1% (relative to the prepayment stock return patterns) for increased leverage of about 3-5%. (This is *excluding* both the announcement and the payment rates of return.) Discrepancies that were any higher would have violated reasonable risk-arbitrage limits (Lamont and Thaler (2003)).

The paper now proceeds as follows: Section I explains the setup, model, and data. Section II presents the primary empirical findings about volatilities and average returns, as well as some secondary related evidence. Section III discusses some conceptual and empirical issues. And Section IV concludes.

I Setup

A The Rational Model

Dividend payments are (small increasing) shocks to *net* leverage. For intuition, start with a simple example. Consider a firm that invests \$1 in a stock-market index fund. Assume a risk-free rate of zero and no imminent bankruptcy to simplify the notation. Now consider the declaration of a dividend DV to be paid in the next period. In one case, assume the firm keeps the money in the index up until the moment of payment, when it sells index shares to satisfy the 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 $1-DV$. If the market has a rate of return of r_M between the announcement and the payment, the risk-free claim will pay DV and the residual firm will be worth $\$1\cdot(1+r_M)-DV$. The entire risk is on the residual claim, which is riskier than $\$1\cdot(1+r_M)$. In the other case, in which the firm immediately sells some index shares to defease the dividend, the intuition is even simpler. In net terms, the cum-dividend stock returns were less levered than the ex-dividend stock returns and the split was determined at the moment of declaration, not at the moment of payment.[2]

Because the approach is quasi-experimental, the model itself is simple. In the rational finance framework,

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

where δ is the single-event dividend yield paid at the event date. 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, $E(\tilde{R})_{\text{post}} - E(\tilde{R}_{\text{pre}}) \approx \delta\cdot E(\tilde{R}_{\text{pre}})$. For daily stock returns, this is a tiny increase, but strictly

[2] The appendix contains a numerical example for intution

positive and quantitatively pinned down by the model. An empirical change larger or smaller rejects the model.

Because risk-free dividends have zero variability, the equivalent implications on second moments are simpler:

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

Similarly, $\beta_{\text{post}} = (1/(1-\delta)) \cdot \beta_{\text{pre}}$. For ordinary firms, the model predicts that volatilities and market-betas increase roughly one-to-one in accordance with the increase in dividend yields. For small δ, $1/(1-\delta) \approx (1+\delta)$.

A.1 Measure Sufficiency and Magnitudes

Note that the leverage and cash ratios are *not* inputs into the equity-risk increase. This is because the pre-payment equity risk is a sufficient statistics for equity stock return effects (with the dividend yield for the change therein). Of course, an high-cash zero-leverage firm experiences exactly a zero increase when paying a dividend, while a low-cash high-leverage firm experiences a large increase. But this is captured by th messaye. There is neither a need nor a desire to include leverage or cash measures (e.g., as control). This is a great advantage: the calculations are agnostic with respect to the measures of leverage—including whether these measures are operational or financial. Attempts to use financial statements to tease out leverage are theoretically neither necessary nor helpful.

Because both the volatility and the means tests are scaled by the dividend yield, they both have positive predictions but the volatility predictions are quantitatively stronger. This is because the factor multiplies the initial value, and the average daily volatility is about 1%, while the average daily mean is two orders of magnitude lower—positive but near zero. The theory predictions are quantitative.

B Data

The main data in my study comes from CRSP. The results are therefore immediately and universally replicable.

I define the (one-payment) dividend yield as an ordinary cash dividend payment, distribution code *1232*, divided by the market price of the stock at the start of the event window (either 5 or 9 days before the payment); and winsorize it at 50%.[3] The signal-to-noise ratio for detecting the effects of dividend payments on stock returns is necessarily very small. Stock returns are very volatile on a daily basis (1-3% per day) relative to their means (1-3 bp per day). The dividend payment yields are typically under 1%.[4] Consequently, dividend payments predict only very small changes in stock return moments. Fortunately, there are many observations. CRSP identifies 494,643 ordinary cash dividends distributions from 1962 to 2015. Unfortunately, dividends from before 1962 had to be excluded because CRSP does not report their declaration dates.

[Insert Table 1 here: **Timespan From Declaration to Payment (Ex-) Date**]

The distribution of days between the declaration and the payment is in Table 1. The CRSP database reports no cases in which a firm declared a dividend but failed to pay it, nor are any cases familiar to me. (For further discussion of selection biases and their possible effects, see Section III.)

The primary data restriction in most of my study is the requirement of a specific number of days between the dividend declaration and the dividend (cum-to-ex) payment date. This is because the maintained assumption in the experiment is that any information about the leverage change, projects, or dividends must have been released and thus already known. My event window never begins earlier than three trading days *after* the declaration. Events in which the payments occurred more closely to the declaration dates were excluded.

This raises a complication. The availability of stock returns in the window could change the composition of firms. In other words, some (but not other) stocks with shorter declaration notices should not mix in the averages on different days. Permitting this could cause spurious differences in stock return moments. Thus, my paper's main specifications are based on stocks with 5-day and 9-day windows that have full data throughout their entire event windows.

The imposition of the requirement of availability of rate of return data from two days after the declaration through the payment date is not a concern, because the declaration-to-payment timespan is a known ex-ante (pre-event) criterion. (It does affect the kind of dividend events from and to which the findings obtain—only distributions that would occur

[3] Winsorization affects about 300 dividend events. The results are similar if yields are winsorized at 10%, 20%, or if such observations are completely removed. (This is valid, because the declaration has already occurred and therefore this criterion is based on an *ex-ante* known characteristic.)

[4] They are on the order of 1% of equity per payment in an unweighted portfolio and 1.5% of equity in the dividend-weighted portfolio. The inference is the same, regardless of weighting.

no sooner than in 7 or 11 days.) Stocks that disappeared from the CRSP data set before the dividend payment dates are not included in CRSP. Thus they cannot affect my study, either.

The imposition of the same-firm-set requirement could have introduced a bias if large attrition had occurred just after the payment date. This turns out not to be a concern. Out of 434,923 distribution events with a stock return at the payment date, 433,375 had a stock return five days after the payment date. This is just the normal background attrition of stock returns on CRSP.

Robustness checks indicate that the results remain *very* robust when all stock returns on any available dates are used, which means (for example) including stocks that were delisted during the window and even mixing different stocks into different days.

The event study requires little sophistication. The event dates are not (greatly) clustered, and the time intervals are short (i.e., daily returns for about 1-2 weeks). Moreover, the main adjustment methods subtracts off the contemporaneous equal-weighted stock market rate of return. The averages and standard errors can be presumed to have been (nearly) independent draws. (The results are not different if the standard errors are calculated from the event time-series.) Heteroskedasticity could be an issue, and thus my paper reports both plain and White heteroskedasticity-adjusted standard errors.

The computer programs were rewritten independently to reduce the chance of inadvertent selection issues or programming bugs. The reported results are robust to all considered variations.

[Insert Table 2 here: **Descriptive Statistics**]

Table 2 provides general background statistics. In the two event windows around dividend dates, stock returns had average rates of return of 5-6 bp above the prevailing 30-day Treasury bill and 1-2 bp below the equal-weighted stock market. In the normal variation, stock returns were winsorized at –20% and +20%. The volatility of stock returns was about 2% per day. Dividend yields were about 0.75% per event.

II Results

A Volatility

The first prediction of the rational theory is that, *ceteris paribus*, more levered stocks should have higher volatilities. The simplest measures of risk (which should not be priced in terms of higher expected rates of return) are absolute returns and standard deviations, either plain or market-adjusted.

[Insert Table 3 here: **Explaining Volatility Around Previously declared Dividend Payments**]

Table 3 provides test statistics for comparing the volatility of stock returns before and after the dividend payments. The inference is always through the coefficient on a dummy that takes a value of 0 before the payment and 1 after. (It can be considered NA during the payment.)

Each row shows the coefficients of one panel regression. There are variations as to whether (a) the measure is the standard deviation of the rate of return (relative to the own pre-window mean or post-window mean) or a simple absolute rate of return, (b) whether the window is five days or nine days (always excluding the payment day and the two surrounding days), (c) whether the return is net of the 30-day Treasury yield or net of the equal-weighted rate of return on the market, and (d) whether there are one or multiple intercepts (year fixed effects or dividend-event fixed effects). It turns out that specification differences barely mattered.

The coefficients on the "after-payment" dummy (excluding all days outside the window and the payment-plus-one days themselves) suggest that the volatility increased by about 0.01%/day (from a basis of about 1.5%/day). When the metrics and models have better adjustments, the coefficients tend to be higher. The strongest results obtain when the abnormal return adjustment is the equal-weighted market rate of return. With an average dividend yield of about 0.9% (see Table 2), the magnitude of the volatility increase was well in line with the leverage-theory prediction.

[Insert Table 4 here: **Explaining Volatility Around Previously Declared Dividend Payments, By Dividend Yield**]

Table 4 runs the same regressions, but includes the dividend yield itself and a cross-variable on the dividend-yield before versus after the event. The leverage-theory prediction becomes even better aligned with the theory. The cross-variable subsumes almost the entire effect—only the higher-dividend payment events showed the marked increase in volatility. The intercept becomes insignificant.

[Insert Figure 1 here: **Explaining Volatility around Previously Declared Payment Dates**]

Figure 1 illustrates the observed and predicted volatility change. Regardless of adjustment, the average volatility increase was in line with the theory. There is measurement noise, and the effect measures were not perfect: The volatilities four days and seven days before the payment were about as large as the average volatilities after the payment. All in all, the rational-leverage theory performs very well.

[Insert Figure 2 here: **Explaining Volatility around Previously-Declared Payment Dates, By Dividend Yield**]

Figure 2 illustrates how the leverage volatility increase was larger for higher-dividend yield stocks, just as predicted and also suggested by Table 4. Again, we can conclude that volatilities behaved just as the leverage theory predicts. The payment of a dividend was associated with an approximately linear increase in stock return volatility.

B Average Returns

The second prediction of the rational theory is that, *ceteris paribus*, more levered stocks should have a tiny bit higher daily expected rates of returns. The simplest measures of expected returns are realized average returns.

[Insert Table 5 here: **Explaining (Average) Rates of Return Around Previously Declared Dividend Payments**]

Analogous to Table 3 for volatilities, Table 5 provides statistics comparing the average rates of returns before and after the dividend payments. Again, each row shows the coefficients of one panel regression. The "after-payment dummy" coefficients here suggest that the average return *decreased* by about 3-6 bp per day. This average-rate-of-return effect is the opposite of that predicted by the rational leverage theory.[5] Over a window of 10 days,

[5]A functional explanation for the discrepancy between risk and reward is that the market offered too high a rate of return before and at the payment dates themselves. Of course, means and standard deviations do not necessarily need to move together.

this implies a cumulative rate of return before the payment date that was, on average, about 30 bp higher than it was after the payment date. This is just within reasonable bounds: 30 bp is high enough to be economically meaningful, but not high enough to attract more (risky) arbitrage to eliminate it (Lamont and Thaler (2003)).

[Insert Table 6 here: **Explaining (Average) Rates of Return Around Predeclared Dividend Payments, By Dividend Yield**]

Table 6 shows the analogous regressions for average returns that Table 4 showed for volatilities. They include the dividend yield itself and a cross-variable on the dividend-yield before versus after the event. The rational leverage theory again predicts the opposite of what the empirical evidence shows; and the cross-variable again largely subsumes the after-dividend dummy: Only the higher-dividend yield stock events showed the marked decrease in average returns.

[Insert Figure 3 here: **Explaining Returns Around Payment Dates**]

Figure 3 illustrates that the average rate-of-return effect was even more consistent than the volatility effect. Plotted by event days, every single pre-event average rate of return was higher than every single post-event average rate of return. The drawn arrows are almost flat, because the rational-leverage theory has a quantitative prediction about expected returns that is very near zero. This is not born out by the data.

[Insert Figure 4 here: **Explaining Returns around Payment Dates, By Dividend Yield, With Sensitivities to Stock Return Availability Requirements**]

Figure 4 illustrates how the effect was concentrated in the high-dividend yield stocks.[6] There is no clear effect for stocks paying low dividends (i.e., dividends of less than 1% of the stock price at the start of the window). There are strong effects only for firms paying significant dividends. The average return also reverted modestly with each day after the event. This is as it must be: Over longer intervals, the change-in-leverage average effect must become less pronounced.

In sum, we can conclude that the rational leverage theory predicts exactly the opposite of what occurred. Known payments of dividends were associated with approximately linear

[6] There was moderate year clustering, but the reported results are *not* driven by the year of payment. They were similarly not driven by day-of-week effects or day-of-month effects. Including individual dummies does not change the reported means and standard deviations to the level of accuracy reported in my paper.

decreases in volatility. The stock price had increased "too much" before and through the payment, thus reducing post-payment average rates of returns relative to prepayment average rates of return.

C Other Dividend-Related Evidence

Before discussing the evidence and interpretation caveats (in Section III), it is useful to look briefly at some further empirical data.

[Insert Figure 6 here: **Explaining Patterns For High Dividend-Yield-High-Stock-Volatility Distributions**]

High-Volatility High-Dividend Yield: It is possible to examine subsets of distributions that are likely to show larger effects. For example, there were 52,861 distributions by firms with dividend yields above 1% and a sum of absolute returns from days –9 through –6 of at least 2%. (Note that the volatility event selector was not based on any plotted information, but on volatility measured earlier.) The volatility itself is a more powerful a priori selector than leverage, because it should include the net effect of both leverage and underlying asset volatility.[7] Figure 6 focuses only on these dividend distributions in which both the dividend payment and the prepayment volatilities were higher. Again, the same conclusions obtain: Volatilities increased and means decreased.

[Insert Figure 5 here: **Explaining Market Betas Around Previously Declared Payment Dates**]

Market-Beta: Figure 5 looks at market-betas from a cross-sectional regression of the event-window return on the contemporaneous equal-weighted market return. Unlike the clear directional findings for volatilites and means, there is no solid evidence that market-betas changed (or increased, as predicted by the rational leverage theory). The higher market-betas four and eight days before the dividend distributions suggest the appropriate caution. If there was an impact of leverage on market-factor loadings, priced or not priced, it was not robust. Because the leverage theory made a clear positive prediction, it can be viewed as not supported by the data.[8]

[7] 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 was in nominal terms rather than in quantile terms, the results are robust.

[8] In portfolio time-series, Braun, Nelson, and Sunier (1995) found that, while volatility was related to leverage, market-beta was not.

Taxes: Dividends are taxed. The surprising finding of my paper is that investors "overpriced" shares before the dividend date. My paper always excludes the payment date itself, when tax preferences should matter most. Any tax-caused preference would be an investor-demand-side preference which, as far as my paper is concerned, would be one good imperfect-market explanation for the origin of these price preferences—perhaps one among others. Plainly put, tax-arbitraging investors may not just have purchased and thereby driven up the price of dividend-paying stocks before the payment date; but they may have done so cautiously over a number of days, perhaps in order not to trigger further IRS scrutiny.

[Insert Figure 7 here: **Year by Year Highest Individual Dividend Income Tax Rates**]

However, this does not seem broadly consistent with the year-by-year post-dividend effects coefficients, as well as the preliminary observations in the context of seasoned equity offerings (in Subsection D).

Figure 7 shows that the highest Federal income dividend tax rates were fairly steady around 65-70% from 1962 to 1982, 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.

[Insert Figure 8 here: **Year by Year Coefficients Explaining Stock Return Moments After the Payment**]

Figure 8 plots the most interesting OLS coefficients (on the bivariate-only *after-payment dummy* and on the multivariate *cross*-variables) when run year by year. It shows that although a tax-related phenomenon may have contributed to the coefficients, the relation between the dividend tax rates in Figure 7 and the before-after dummy was weak. The dummy and the cross-coefficients show moderate—but not clear or pronounced—trends corresponding to changes in the prevailing dividend income tax rates.[9] However, with no direct measure of tax-based trading and endogeneity of the tax rates, this evidence is not perfect.

If tax effects (but possibly also other payment-related demand effects) were responsible, then including the payment (not announcement) stock rate of return should help explain

[9]Unreported regressions explaining the volatility of year-by-year "after the event dummy" coefficients (and cross-coefficients) with dividend taxes have adjusted R^2s that are negative. Regressions explaining the average return year-by-year "after the event dummy" coefficients (and cross-coefficients) with dividend taxes have adjusted R^2's of 3-5%.

the reduced cum-to-ex rate of return and reduce the expected return differential. The cum-to-ex average rate of return was about 25bp—implying an average effective tax rate of about $25/90 \approx 28\%$—with a standard deviation of 212bp. This test is also imperfect, because the tax-trading measure is noisy. Finance researchers do not have access to actual tax-trading patterns, which tax-exempt traders are not eager to share.

[Insert Table 7 here: **Explaining (Average) Returns around Previously Declared Payment Dates, Controlling for Cum-To-Ex Day Stock Returns**]

Table 7 shows that firms with higher cum-to-ex rates of return also had lower post-event mean returns. However, controlling for the payment-date stock return has no effect on the inference about the difference between pre-payment and post-payment rates of return. This evidence again suggests that although tax effects may have contributed, they seem unlikely to have played the main role.

[Insert Figure 9 here: **Explaining Average Trading Liquidity Patterns around Previously Declared Payment Dates**]

Liquidity: Dividend or tax trading should also have left an imprint on enhanced trading patterns before and after the payment date. Table 9 plots the day-by-day average log number of trades and log dollar volume (also obtained from CRSP). There were the tiniest of up-blips in liquidity on days –1 and 0, but there were no increasing or decreasing trends either before or after the payment. In the event windows used for calculating volatilities and average returns, there was no increasing buying pressure before the payment or decreasing selling pressure after the payment. Not shown, in unreported regressions, the *after-payment dummy* regression coefficients in panel regressions explaining either liquidity variable were insignificant.

D Some Preliminary Seasoned Equity-Issuing Evidence

Are there corporate events other than dividend payments that are similarly suitable to studying the effects of leverage?

Equity *repurchases* are unfortunately not suitable for an analogous experiment, because they tend to be spread over long time windows. Similarly, equity shelf-offerings are not suitable for lack of clear event dates.[10] The only other equity-related events with sharp pre-announced event dates are seasoned equity offerings.

There are some analogies. The dividends and issuing events are similar in that cash is moved through the corporate wall in both cases, with specific predictions on leverage, volatility, and average return. For intuition, consider a firm that has committed to keep the raised funds for x days in cash and then purchase risky assets—say, for example, a stock-market ETF. There are two cases to consider. On the one hand, if the purchase has not yet been committed, the asset purchase price is floating, and the holding company stock should be less risky for x days until the asset purchase and more risky thereafter. The volatility and average return should be low (that of cash) until the asset purchase date and high after (that of the market). On the other hand, if the asset purchase price has been committed and fixed beforehand, as in a forward contract, then the volatilities and means should not change. Thus, the leverage theory *weakly* predicts decreases in volatility and average returns when equity offerings are executed.

Yet the analogy breaks down in other ways. First, firms often issue both debt and equity at the same time. Second, the ultimate decision to move the cash is not with the firm, but with the investors. The probabilities that the event is canceled in the days before it occurs is higher. If an offering is canceled, it could be good or bad news. If execution beliefs had increased in the days before the actual issues, and equity offerings were bad news per se (and not just via the irretractible signaling value through announcement of intent), then firms could have first experienced abnormally low average returns that would not have continued after the execution. This could have created a selection-based increase in average returns after the actual issue.

With these caveats, it is still interesting to look briefly at pre- and post-execution stock returns for equity offerings. In early 2016, the Thomson SDC global issue database 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, a filing date, an issue date, complete filing amount, specific issue filing amount, primary shares sold, at least 10 days between filing and offering date, and a merge with CRSP by CUSIP, left 9,569 corporate equity offerings.[11] The WRDS

[10] 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.

[11] Some hand-checking revealed that the CRSP data are not a good data source for the number of shares outstanding. CRSP is more (but not greatly) reliable at picking up reasonable number-of-shares estimates at month-ends than mid-months. This is also why I did not attempt to measure the dilution.

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.

[Insert Table 8 here: **Explaining Market-Adjusted Stock Returns Around Actual Share-Issue Dates, Given Previously Declared Issue Intentions**]

Table 8 shows the results when I repeat an analogous-to-the-dividend study on these identified equity issues in the set of same-issue market-adjusted stock returns around the execution dates. The leverage theory predicts a decrease in average returns and volatilities. Again, the theory is born out at conventional statistical significance levels for volatilities but not for average rates of returns. The former decreased; the latter increased. The chosen window from –6 to –3 versus +3 to +6 is conservative, in that pulling it one day closer to the issue date would further increase the difference. A visual inspection reveals a pattern similar to dividend payments: The leverage theory works well in predicting the decreases in volatilities but not in predicting the increases for average returns.

Again, I emphasize that equity issues are a more “sloppy” experiment than dividend payments: The data are less reliable; other securities are more likely to be issued simultaneously; raised cash may have already been committed to risky projects and thus effectively may be risky beginning on the day of the offering; and, while it is the firm that announces the event, it is the investors who can choose not to participate. The equity offering experiment is only mildly suggestive. It is interesting only to the extent that the stock returns happened to exhibit the analogous patterns for equity issues as for dividend payments.

III Discussion

The empirical evidence in my paper is not disputing the evidence in Gomes and Schmid (2010). Indeed, their study of long-term returns used book-to-market measures and the stock returns from many calendar days that I did not even use in my study. My quasi-experiment provides plausible inference on my short-term bases (i.e., a few days) but not on their long-term bases (i.e., months).[12] It requires that the dividends have been declared and committed to, but not yet paid. The days around the payment have to be ignored, because there could be first-order effects due to other aspects (e.g., tax or dividend-preference trading). The studies simply explore the same hypothesis from different angles, and the two angles yield different inference from different empirical data. Economic theories often hold in some contexts, but not others.

Stepping back, the leverage theory had made strong predictions about both risk and return in this experiment. Even if they had been borne out, my paper's findings would still have been interesting. If anything, I would have preferred to find rational market behavior akin to that in Gomes and Schmid (2010). The rationality aspect of the theory here was neither sophisticated nor deep. It was simply that investors should have demanded and earned more expected return for more risk.

This leaves us with a mystery: Even if the average rate of return had stayed the same (rather than declined), the leverage theory would have been rejected. But, worse: we need an explanation not just for why financial markets *ignored* changes in leverage in their determination of average returns, but even for why expected rates of return *declined*. Why did the stock price appreciate too much before the payment?

In this section, I discuss a number of possible theories (or "issues") that could explain the lower averages after the payment, even if these would have had to be strong enough to overcome any simultaneously-present rational leverage force. But my conclusion is that I cannot identify plausible non-behavioral theories that can explain *both* the volatility increase *and* the average mean decrease at the same time.

Intrinsic Preferences: Perhaps, investors had intrinsic preferences about dividends or leverage. In the absence of independent measures of preferences, such a theory can explain any kind of pattern. It seems implausible, except perhaps as an ex-post

[12] Indeed, when firms pay dividends every quarter, after 6 weeks, the post-payment period from the previous payment becomes the pre-payment period for the next payment. Of course, the pattern already evens out after a shorter time-frame. The design is also simply not amenable to testing long-term average return patterns.

statement of finding. Investors behaved as if they had wanted to be present just in time to receive the dividends.

Timing: Even if corporate managers had the forecasting ability to time their dividend payments to occur on days when average stock returns would then be lower (which is dubious), naive versions of this hypothesis would require that investors would not have recognized 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. It seems implausible.

Selection Design and Survivorship Concerns: I am not aware of any cases in which a publicly-traded company retracted its dividend declaration (and such events would not have appeared in my CRSP sample). An increasing belief that the payment would occur in the days before the payment date could have been good news. Even if the dividend payment had not been paid but instead was completely dissipated, in order to explain the documented lower average returns, non-payments would have had to occur about 1-in-100 times, with hundreds of companies failing to pay declared dividends every year. It seems implausible.

Cash Holdings: Although it is the defeasance of the dividend that should matter and not the actual underlying risky investment patterns (see Pages 2 and 5), we can speculate about whether firms liquidated risky projects to pay dividends just days before the payment date.

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. It seems implausible.

Underlying Investment Activities: As with the previous point, 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 means and volatilities.[13] It seems implausible.

(Changes in) Growth Options: Again, as with the two previous hypotheses, growth options are unlikely to explain simultaneous increases in variance and decreases in means. It is mentioned separately only because it was the explanation put forth in Gomes and Schmid (2010). While plausible and consistent in their contest, it seems implausible *in this context*.

Negative Loadings on Price-Relevant Factors: Dividend-paying stocks could have been the equivalent of extremely low-beta stocks, providing insurance to investors. By paying out dividends, the stocks become even better insurance instruments on factor-loadings against the unknown factors. (Market-betas, whose levels hovered around 0.9-0.95, cannot be this factor.) It seems implausible.

Random Noise: The results could have been the draw of the sample, despite huge T-statistics, strong robustness in all specifications, years, event days, etc. Similarly, perhaps the ex-post outcomes happened not to reflect the ex-ante outcome by chance. It seems implausible.

Volatility Preferences: One unappealing hypothesis is that investors *liked* increases in idiosyncratic volatility so much that they bid up the price, leaving lower average rates of return after the payment-induced risk-increase.

In unreported regressions, if the rate of return is explained with the absolute rate of return and the cross-effect post-payment dummy, it appears that it is the stocks with the higher post-event volatilities that experienced lower average returns after the payments.[14] This suggests again that investors earned lower average rates of return when volatility increased because of the payment, and perhaps specifically because the payment increased volatility (Goyal and Santa-Clara (2003)). Although such a theory would also suggest that managers could increase shareholder value by gambling more aggressively, the problem here is still that the option-induced higher expected rates of return should have been reflected at the announcement. It seems implausible.

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

[14] When the mean is not-zero, then there is an association between returns and absolute returns. It should, however, be weak.

The design of the experiment suggests that the prevailing force was unlikely to have been a firm-caused change. Instead, it was more likely an investor-caused effect. But what? Quoting Sherlock Holmes, ”When you have eliminated the impossible, whatever remains, however improbable, must be the truth.”

The improbable theory in this context is that investors became infatuated with dividend payments and bid up the price a little too much before the dividend. The historical average rates of return were thus not reflective of investors' true expected rates of return because investors were naive and non-anticipatory. Put differently, the return patterns could have been caused by a financial market which was non-blissfully ignorant of risks and outlooks, with more levered companies having been exposed to more post-payment risk (and malaise) more frequently. Thus, they could have had lower average rates of return, with financial market prices not taking this added risk appropriately into account. This explanation seems unappealing, but it is 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 were particularly irrational. The effects documented in my paper are smaller but also more pervasive. Moreover, the findings have direct implications for the broader issue of dividend payments—often considered important corporate events—and the generic questions about the effects of leverage, risk and return changes.[15] Interestingly, although Baker, Hoeyer, and Wurgler (2016) (BHW) explore Gomes-Schmid-like long-run performance and have overlapping implications (e.g., riskier firms choosing lower leverage), BHW interpret the evidence as suggestive of risk-leverage mispricing. They then consider both the perspective and optimal behavior of the corporation.

[15] Benartzi, Michaely, and Thaler (1997) also conclude from stock return responses to dividends that the financial markets do not seem rational, but their context and inference do not seem directly related.

IV Conclusion

My paper has offered a direct quasi-experimental test for one of the clearest predictions of classic rational asset-pricing theory—the effect of leverage.[16] The empirical evidence in the days around pre-declared dividend payments was consistent with the rational leverage-theory view that risk should also have increased. However, the evidence was inconsistent with the view that average rates of return should have increased. Investors did not receive higher but lower average (expected) rates of return for equally risky projects with higher leverage. This is not plausibly attributable to (news about) the underlying projects.

The experimental design was "clean," in that Gomes and Schmid (2010) simultaneous changes in the investments or opportunities correlated with payment decisions should have been incorporated into the traded equity prices at the moment of the dividend announcements and not later—i.e., just before and just after the actual payment dates.

In the context of the days around the dividend payments, it appears that the financial markets were driven more by mysterious investor-demand forces than corporate-asset-supply forces. More levered corporate assets seemed to have yielded lower average rates of return, not because of growth options and type-of-firm selection effects, but because investors either seemed to have "preferred" the less-levered pre-dividend corporate assets for some reason, or they seemed to have bid up prices too much and thus were regularly disappointed. Post-leverage change stocks earned lower average rates of return. In this context, it should be noted that this "perverse" negative association between leverage and expected rates of return in my short-term stock-return study is also in line with some—but not all—earlier long-term monthly stock return regressions. It is also not inconsistent with the view expressed in Hoberg and Prabhala (2009) that the volatility increase in Campbell et al. (2001) could have had direct corporate finance implications—though perhaps in the opposite direction.

Yet, the behavioral investor preference here and in Baker, Hoeyer, and Wurgler (2016) should not be viewed as mutually exclusive with respect to the rational growth-option hypotheses in Gomes and Schmid (2010). More than likely, they both play roles in the association of leverage with risk and returns. My paper does suggest, however, that

[16]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 have not sought 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?

caution is appropriate when interpreting the empirical evidence. Before concluding that the associations between leverage and returns are solely or primarily due to rational responses to growth options based on book-to-market moments—especially in the absence of direct empirical measures of the underlying within-firm growth options rather than indirect inference measures from the book-to-market ratios—it seems appropriate not to ignore non-arbitrageable, collectivist, imperfect-market (tax) and/or behavioral investor preferences. Rational-leverage theories like Gomes and Schmid (2010) require stronger tests that measure growth options more directly and/or break out other possible investor demand-based forces, as observed in my paper and in Baker, Hoeyer, and Wurgler (2016).

Future research could expand the scope of tests for the effects of leverage on stock returns. The fact that average rates of return declined with leverage yields makes it possible to contrast and/or embed the predictions of the rational-leverage theory with those of the behavioral-finance theory. For example, one could jointly investigate the discrete short-term evidence together with the slow long-term rate-of-return evidence. Did those instances in which stocks showed certain patterns in short-term volatilities and average stock returns around their dividend payments also show the same patterns in their year-long monthly stock return volatilities and averages? To what extent were growth firms merely riskier, and to what extent were they merely more disappointing? And, within and across book-to-market stock-type portfolios were the high volatilities responsible for the low average returns? In changes? Would it be possible to identify specific investor preferences for leverage and growth firms from other contexts (e.g., analysts' opinions) in order to give more "bite" to the "demand preference" or "investor surprise" alternatives? Unlike the short-run sharp evidence provided by the dividend-payment quasi-experiment in my paper, such investigations will require many more assumptions.

References

Allen, Franklin and Roni Michaely (2003). “Payout Policy”. In: North Holland, pp. 337–430.

Baker, Malcolm, Mathias F. Hoeyer, and Jeffrey Wurgler (2016). *The Risk Anomaly Tradeoff of Leverage*. Tech. rep. NBER and Harvard Business School.

Baker, Malcolm and Jeffrey Wurgler (2004). “A Catering Theory of Dividends”. In: 59 (3), pp. 1125–1165.

Becker, Bo, Marcus Jacob, and Martin Jacob (2013). “Payout taxes and the allocation of investment”. In: *Journal of Financial Economics* 107.1, pp. 1–24.

Benartzi, Shlomo, Roni Michaely, and Richard Thaler (1997). “Do Changes in Dividends Signal the Future or the Past?” In: *The Journal of Finance* 52.3, pp. 1007–1034.

Braun, Phillip A., Daniel B. Nelson, and Alain M. Sunier (1995). “Good News, Bad News, Volatility, and Betas”. In: *Journal of Finance* 50.5, pp. 1575–1603.

Campbell, John Y. et al. (2001). “Have Individual Stocks Become More Volatile? An Empirical Exploration of Idiosyncratic Risk”. In: 56.1, pp. 1–43.

Farre-Mensa, Joan, Roni Michaely, and Martin C. Schmalz (2014). *Payout Policy*. Tech. rep. Harvard Business School, Cornell University, and University of Michigan.

Gomes, Joao F. and Lukas Schmid (2010). In: *The Journal of Finance* 65.2, pp. 467–494.

Goyal, Amit and Pedro Santa-Clara (2003). “Idiosyncratic Risk Matters!” In: *The Journal of Finance* 58 (3), pp. 975–1007.

Hoberg, Gerard and Nagpurnanand R. Prabhala (2009). “Disappearing Dividends, Catering, and Risk”. In: *The Review of Financial Studies* 22.1, pp. 79–116.

Jacob, Martin, Roni Michaely, and Maximilian A. Mueller (2016). *The Effect of Consumption Taxes on Corporate Investment*. Tech. rep. WHU and Cornell.

Kaplan, Steven N., Tobias J. Moskowitz, and Berk A. Sensoy (2013). “The Effects of Stock Lending on Security Prices: An Experiment”. In: *The Journal of Finance* 68 (3), pp. 1891–1936.

Korteweg, Arthur (2004). *Financial leverage and expected stock returns: Evidence from pure ex change offers*. Tech. rep. Stanford University and University of Southern California.

Lamont, Owen A. and Richard H. Thaler (2003). “Anomalies: The Law of One Price in Financial Markets”. In: *Journal of Economic Perspectives* 17.4, pp. 191–202.

Michaely, Roni, Richard H. Thaler, and Kent L. Womack (1995). “Price Reactions to Dividend Initiations and Omissions: Overreaction or Drift?” In: *The Journal of Finance* 50.2, pp. 573–608.

Sialm, Clemens (2009). “Tax Changes and Asset Pricing”. In: *American Economic Review* 99.4, pp. 1356–83.

tbl:timespan

Table 1: Timespan From Declaration to Payment (Ex-) Date

	Days	Obs	Win Obs
	Same	996	434,923
	1	9,807	433,926
	2	10,088	424,119
	3	19,086	414,031
	4	30,747	394,945
	5	32,692	364,198
	6	37,022	331,506
(5-Day Window)	7	30,534	294,484
	8	28,790	263,950
	9	22,703	235,160
	10	17,988	212,457
(9-Day Window)	11	15,565	194,469
	12	13,885	178,904

Explanations: This table describes the time span between the declaration and the ex-date in the sample. For simplicity, the ex-date is referred to as payment date in the paper. The data source is CRSP. Only ordinary cash payment dividends (code 1232) are used.

tbl:descriptives

Table 2: Descriptive Statistics

Panel A: Stock Returns

Wndw	Net of	Variable	Wnsr	Min	Median	Max	Mean	Stddv
5d	tb30ms	Plain		–58%	0.00%	98%	0.059%	2.26%
			W	–20%	0.00%	20%	0.057%	2.22%
		Absolute		0%	0.91%	98%	1.398%	1.78%
			W	0%	0.91%	20%	1.394%	1.73%
	ewretd	Plain		–57%	–0.085%	97%	–0.014%	2.13%
			W	–20%	–0.085%	20%	–0.016%	2.09%
		Absolute		0%	0.88%	98%	1.363%	1.64%
			W	0%	0.88%	20%	1.360%	1.59%
9d	tb30ms	Plain		–61%	0%	134%	0.057%	2.23%
			W	–20%	0%	20%	0.053%	2.19%
		Absolute		0%	0.89%	133%	1.380%	1.75%
			W	0%	0.89%	20%	1.377%	1.70%
	ewretd	Plain		–57%	–0.09%	134%	–0.017%	2.09%
			W	–20%	0%	20%	–0.018%	2.05%
		Absolute		0%	0.86%	133%	1.338%	1.61%
			W	–20%	0%	20%	1.335%	1.56%
5d	ewretd	Stddv	W	0.93%	1.27%	23.09%	1.64%	1.38%

Panel B: Years and Dividend Yields

Variable	Wndw	Min	Median	Max	Mean	Stddv	N
Year		1962	1991	2015			
Dividend Yield	5d	0.00	0.75%	50%	0.91%	0.91%	2,343,728
	9d	0.00	0.73%	50%	0.88%	0.91%	3,087,488

Explanations: The samples are all CRSP "1232" (ordinary cash dividend) distributions with stock return, price, and dividend yield data, from 1926 to 2015. The pre-window was either from –5 to –2 or from –9 to –2, given that the payment was declared at least 7 days or 11 days, respectively, before the payment. The post-window was either +2 to +5, or +2 to +9. The ex-day, the day before, and the day after were always excluded. There were 2,343,728 (3,087,488) daily stock return observations in the 5-day (9-day) window. When winsorization (Wnsr) was applied, it was for daily returns at +20% and –20%. "ewretd" lines are stock returns net of the CRSP equal-weighted return. "tb30ms" are net of the prevailing 30-day Treasury bill rate (from FRED). The absolute returns are measures of volatility. The last row in Panel A ("Stddv") is a statistic relative to the stock distribution events means before and after the event separately (i.e., the 5d standard deviation is calculated before the distribution over four days only). The dividend yield is with respect to a single dividend distribution (*never* annualized) and always calculated once at the outset of the event window. The windows and samples remain the same throughout most of the paper. Robustness checks later confirm that neither is critical.

tbl:abs-befaft

Table 3: Explaining Volatility Around Previously declared Dividend Payments

	Wndw	Net of	Wnsr	Def	Fxd	Intercept			"After Dividend"-Dummy			
						Coef	(se)	(se.het)	Coef	Stdzd	(se)	(se-het)
(1)	5d	tb30ms	N	stddv	Int	1.711	(0.001)	(0.001)	0.010	0.003	(0.002)	(0.002)
(2)			N	abs	Int	1.394	(0.002)	(0.002)	0.007	0.002	(0.002)	(0.002)
(3)			W		Int	1.391	(0.002)	(0.002)	0.006	0.002	(0.002)	(0.002)
(4)			N		Year	— many —			0.007	0.002	(0.002)	(0.002)
(5)			N		Evt	— many —			0.007	0.002	(0.002)	(0.002)
(6)		ewretd	N	stddv	Int	1.629	(0.001)	(0.001)	0.013	0.005	(0.002)	(0.002)
(7)			N	abs	Int	1.356	(0.002)	(0.002)	0.013	0.004	(0.002)	(0.002)
(8)			W		Int	1.353	(0.001)	(0.001)	0.013	0.004	(0.002)	(0.002)
(9)			N		Year	— many —			0.013	0.004	(0.002)	(0.002)
(10)			N		Evt	— many —			0.013	0.004	(0.002)	(0.002)
(11)	9d	tb30ms	N	stddv	Int	1.792	(0.001)	(0.001)	0.011	0.004	(0.001)	(0.001)
(12)			N	abs	Int	1.375	(0.000)	(0.001)	0.009	0.003	(0.002)	(0.002)
(13)			W		Int	1.372	(0.001)	(0.001)	0.008	0.002	(0.002)	(0.002)
(14)			N		Year	— many —			0.009	0.003	(0.002)	(0.002)
(15)			N		Evt	— many —			0.009	0.003	(0.002)	(0.002)
(16)		ewretd	N	stddv	Int	1.691	(0.001)	(0.001)	0.014	0.006	(0.001)	(0.001)
(17)			N	abs	Int	1.331	(0.001)	(0.001)	0.014	0.004	(0.002)	(0.002)
(18)			W		Int	1.329	(0.001)	(0.001)	0.013	0.004	(0.002)	(0.002)
(19)			N		Year	— many —			0.014	0.004	(0.002)	(0.002)
(20)			N		Evt	— many —			0.014	0.005	(0.002)	(0.002)
1992–	5d	ewretd	W	Int		1.353	(0.002)	(0.002)	0.020	0.006	(0.003)	(0.003)

Explanations: Samples and variables are described in Table 2. Each line contains the coefficients of one panel regression. The "after-dividend" dummy is 0 for days from $-T$ to -2 (inclusive) and 1 for days from 2 to T (inclusive). Other days were excluded. The dividend declaration must have occurred at least two days before the start of the window. The "stddv" rows explain the standard deviations of the rate of return (with respect to 4-day averages). The more common "abs" rows explain the adjusted *absolute* rates of return. The column labeled "Stdzd" coefficient is the plain coefficient multiplied by sd(x)/sd(y). The column labeled "se-het" is the heteroskedasticity-adjusted standard error on the plain coefficient.

Interpretation: The volatility after the dividend payment was higher, by about 1 bp per day.

Table 4: Explaining Volatility Around Previously Declared Dividend Payments, By Dividend Yield

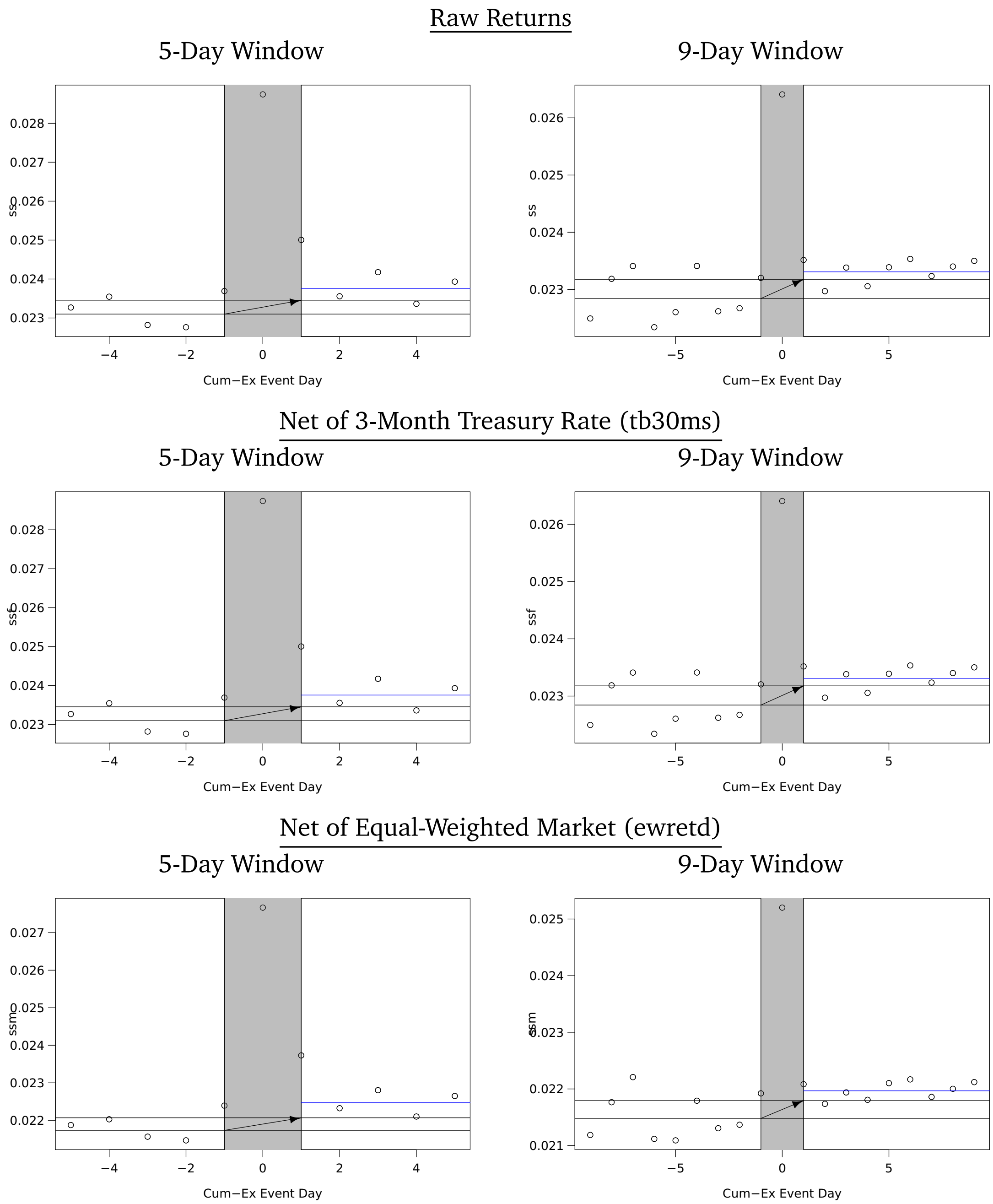
	Wndw	Net of	Wnsr	Def	Fxd	"After-Dividend"-Dummy				Window-start Div Yield				Cross			
						Coef		(se)	(se.het)	Coef	Stdzd	(se)	(se-het)	Coef	Stdzd	(se)	(se-het)
(1)	5d	tb30ms	N	sd	Int	–0.001	0.000	(0.002)	(0.003)	–3.937	–0.024	(0.150)	(0.327)	1.198	0.006	(0.212)	(0.412)
(2)			N	abs	Int	–0.005	–0.001	(0.003)	(0.005)	–4.093	–0.021	(0.181)	(0.365)	1.283	0.006	(0.257)	(0.471)
(3)			W		Int	–0.005	–0.001	(0.003)	(0.004)	–4.298	–0.023	(0.176)	(0.341)	1.240	0.006	(0.249)	(0.438)
(4)			N		Yr	–0.005	–0.001	(0.003)	(0.005)	–5.284	–0.027	(0.180)	(0.378)	1.283	0.006	(0.252)	(0.479)
(5)			N		Evt	–0.005	–0.002	(0.003)	(0.003)		— not possible —			1.283	0.006	(0.212)	(0.327)
(6)		ewretd	N	sd	Int	0.000	0.000	(0.003)	(0.004)	–1.385	–0.009	(0.140)	(0.282)	1.386	0.008	(0.198)	(0.358)
(7)			N	abs	Int	–0.001	–0.001	(0.003)	(0.004)	–1.247	–0.007	(0.167)	(0.317)	1.550	0.007	(0.236)	(0.412)
(8)			W		Int	–0.001	–0.000	(0.003)	(0.004)	–1.382	–0.008	(0.162)	(0.291)	1.483	0.007	(0.229)	(0.375)
(9)			N		Yr	–0.001	–0.000	(0.003)	(0.004)	–3.022	–0.017	(0.166)	(0.331)	1.550	0.007	(0.233)	(0.418)
(10)			N		Evt	–0.001	0.000	(0.003)	(0.003)		— not possible —			1.550	0.007	(0.196)	(0.309)
(11)	9d	tb30ms	N	sd	Int	0.009	0.003	(0.002)	(0.003)	–4.099	–0.028	(0.114)	(0.271)	0.329	0.002	(0.161)	(0.359)
(12)			N	abs	Int	0.007	0.002	(0.003)	(0.004)	–4.178	–0.022	(0.155)	(0.311)	0.251	0.001	(0.220)	(0.419)
(13)			W		Int	0.006	0.002	(0.003)	(0.004)	–4.356	–0.023	(0.151)	(0.294)	0.254	0.001	(0.213)	(0.393)
(14)			N		Yr	0.007	0.002	(0.003)	(0.004)	–5.020	–0.026	(0.154)	(0.321)	0.251	0.001	(0.216)	(0.424)
(15)			N		Evt	0.007	0.000	(0.001)	(0.001)		— not possible —			0.251	0.001	(0.190)	(0.283)
(16)		ewretd	N	sd	Int	0.009	0.004	(0.002)	(0.003)	–1.204	–0.009	(0.106)	(0.224)	0.616	0.004	(0.150)	(0.298)
(17)			N	abs	Int	0.008	0.003	(0.003)	(0.003)	–0.919	–0.005	(0.142)	(0.264)	0.609	0.003	(0.201)	(0.356)
(18)			W		Int	0.008	0.003	(0.002)	(0.003)	–1.062	–0.006	(0.138)	(0.243)	0.605	0.003	(0.195)	(0.323)
(19)			N		Yr	0.008	0.003	(0.003)	(0.004)	–2.762	–0.016	(0.142)	(0.280)	0.609	0.003	(0.198)	(0.366)
(20)			N		Evt	0.008	0.003	(0.002)	(0.003)		— not possible —			0.609	0.003	(0.175)	(0.269)
(6') no cross	5d	ewretd	W		Int	0.013	0.004	(0.002)	(0.002)	–0.640	–0.004	(0.114)	(0.187)		— not included —		
(') 1992-	5d	ewretd	W		Int	0.009	0.000	(0.003)	(0.004)	2.226	0.015	(0.192)	(0.374)	1.432	0.008	(0.271)	(0.501)
(') no $\delta > 0.1$	5d	ewretd	W		Int	–0.015	–0.005	(0.004)	(0.004)	–4.474	–0.019	(0.223)	(0.279)	3.069	0.013	(0.315)	(0.402)

Explanations: Samples and variables are described in Table 2. The regressions are the same as in Table 3, except that they include as regressors also the dividend-yield at the start of the event-window and the "cross"-variable, i.e., the Dividend Yield times the "After Dividend" Dummy.

Interpretation: The volatility after the dividend payment was higher for higher-dividend yield events.

fig:abs-sds

Figure 1: Explaining Volatility around Previously Declared Payment Dates

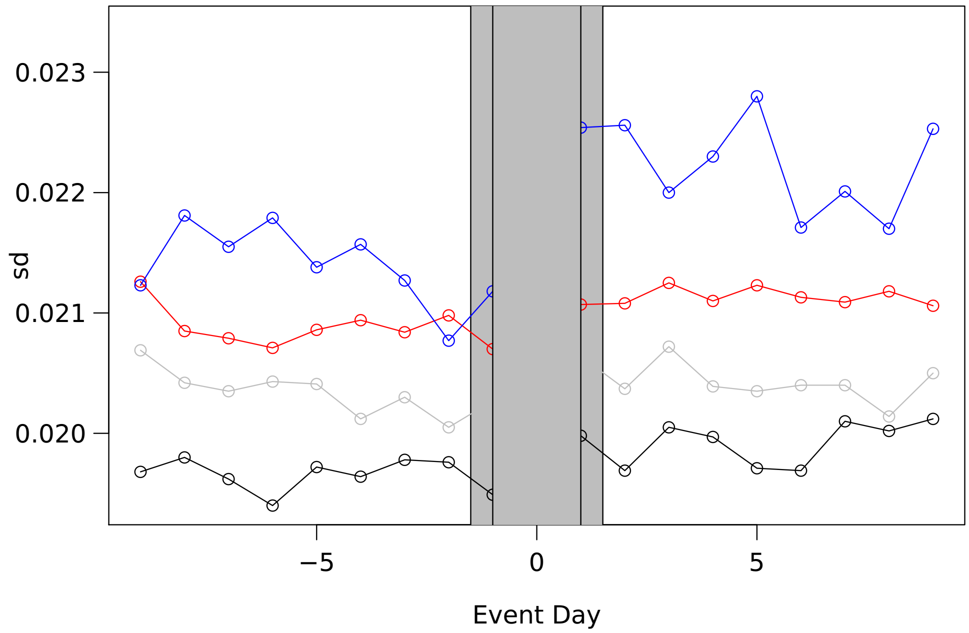


Explanations: The left plots required 11 days of data around the payment date (here defined as the ex-date), the right plots required 19 days. Distributions in which the declaration dates were less than 7 (11) days before the payment dates were excluded. Unlike the regressions in earlier tables, the portfolios here were weighted based on the dividend-yield. The black arrow from days –1 to +1 shows the expected change under the rational leverage hypothesis. The blue line shows the post-payment mean.

Interpretation: Post-payment volatilities were higher than the pre-payment volatilities in line with the theory.

fig:abs-sdbyyield

Figure 2: Explaining Volatility around Previously-Declared Payment Dates, By Dividend Yield



Red: Dividend Yield 0% to 0.5%. Gray: Dividend Yield 0.5% to 1.0%
Black: Dividend Yield 1.0% to 2.0%. Blue: Dividend Yield > 2.0%

Explanations: Samples and variables are described in Table 2. The plot is similar to the 5-day market-adjusted window from the preceding Figure 1, but broken out by dividend yield. For visual focus, the (regression-excluded) event-date volatilities are blotted out.

Interpretation: Post-payment volatilities were higher than the pre-payment volatilities only for high-dividend yield events, roughly—but not perfectly—in line with the theory.

tbl:befaft

Table 5: Explaining (Average) Rates of Return Around Previously Declared Dividend Payments

	Wndw	Net of	Wnsr	Fxd	Intercept Coef	Intercept (se) (se.het)	"After"-Dummy Coef	"After"-Dummy Stdzd	"After"-Dummy (se) (se-het)
(1)	5d	tb30ms	N	Int	0.076	(0.002) (0.002)	–0.035	–0.008	(0.003) (0.003)
(2)			W	Int	0.075	(0.002) (0.002)	–0.035	–0.008	(0.003) (0.003)
(3)			W	Yr	— many —		–0.035	–0.008	(0.003) (0.003)
(4)			W	Evt	— many —		–0.035	–0.008	(0.003) (0.003)
(5)		ewretd	N	Int	0.014	(0.002) (0.002)	–0.056	–0.013	(0.003) (0.003)
(6)			W	Int	0.013	(0.002) (0.002)	–0.056	–0.014	(0.003) (0.003)
(7)			W	Yr	— many —		–0.056	–0.014	(0.003) (0.003)
(8)			W	Evt	— many —		–0.056	–0.014	(0.003) (0.003)
(9)	9d	tb30ms	N	Int	0.071	(0.002) (0.002)	–0.029	–0.006	(0.003) (0.003)
(10)			W	Int	0.070	(0.002) (0.002)	–0.029	–0.007	(0.002) (0.002)
(11)			W	Yr	— many —		–0.029	–0.007	(0.002) (0.002)
(12)			W	Evt	— many —		–0.029	–0.007	(0.002) (0.002)
(13)		ewretd	N	Int	–0.002	(0.002) (0.002)	–0.030	–0.007	(0.002) (0.002)
(14)			W	Int	–0.003	(0.002) (0.002)	–0.030	–0.007	(0.002) (0.002)
(15)			W	Yr	— many —		–0.030	–0.007	(0.002) (0.002)
(16)			W	Evt	— many —		–0.030	–0.008	(0.002) (0.002)
(17)1992-	5d	ewretd	W	Int	–0.003	(0.003) (0.003)	–0.050	–0.012	(0.004) (0.004)

Explanations: Samples and variables are described in Table 2. The sample is the same as that in Table 3, except that there is no absolute-value transformation on the dependent stock return variable.

Interpretation: The average rate of return after the dividend payment was lower by about 2-5 bp per day. With 4-8 day windows, this amounts to about 20-30 bp over the full windows.

tbl:cross

Table 6: Explaining (Average) Rates of Return Around Predeclared Dividend Payments, By Dividend Yield

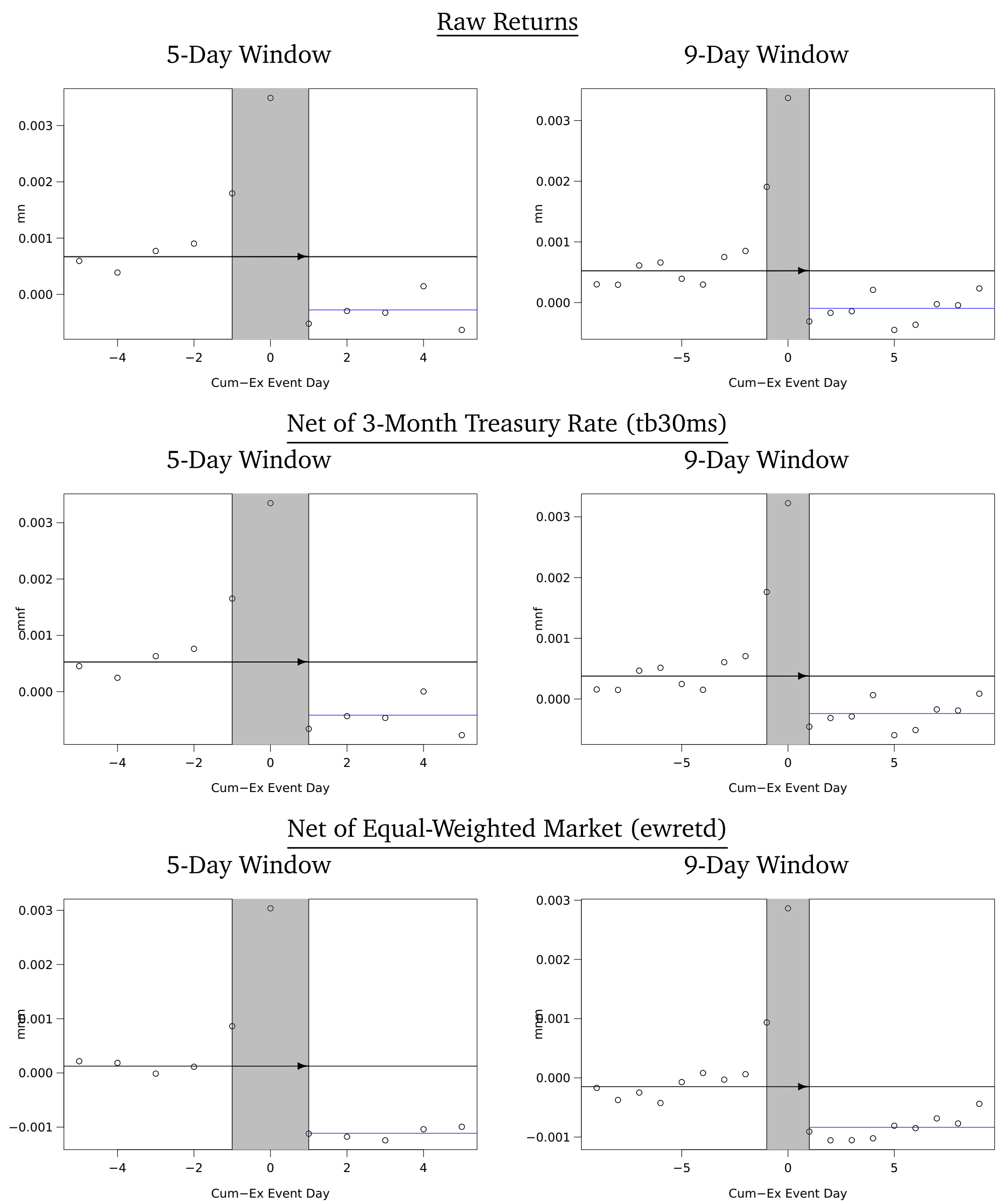
					"After-Dividend"-Dummy				Window-start Div Yield				Cross			
	Wndw	Net of	Wnsr	Fxd	Coef		(se)	(se.het)	Coef	Stdzd	(se)	(se-het)	Coef	Stdzd	(se)	(se-het)
(1)	5d	tb30ms	N	Int	0.009	0.002	(0.004)	(0.005)	2.895	0.012	(0.231)	(0.380)	–4.843	–0.017	(0.326)	(0.504)
(2)			W	Int	0.008	0.002	(0.004)	(0.005)	2.766	0.011	(0.226)	(0.353)	–4.772	–0.017	(0.319)	(0.469)
(3)			W	Yr	0.008	0.002	(0.004)	(0.005)	2.811	0.011	(0.228)	(0.359)	–4.772	–0.017	(0.319)	(0.469)
(4)			W	Evt	0.008	0.002	(0.004)	(0.005)	— not possible —				–4.772	–0.015	(0.302)	(0.452)
(5)		ewretd	N	Int	0.000	0.000	(0.004)	(0.005)	3.220	0.014	(0.217)	(0.362)	–6.178	–0.023	(0.307)	(0.484)
(6)			W	Int	–0.001	0.000	(0.004)	(0.005)	3.116	0.014	(0.213)	(0.337)	–6.137	–0.023	(0.301)	(0.451)
(7)			W	Yr	–0.001	0.000	(0.004)	(0.005)	3.068	0.013	(0.215)	(0.342)	–6.137	–0.023	(0.301)	(0.452)
(8)			W	Evt	–0.001	0.000	(0.004)	(0.005)	— not possible —				–6.137	–0.020	(0.285)	(0.436)
(9)	9d	tb30ms	N	Int	–0.006	–0.001	(0.004)	(0.004)	2.140	0.009	(0.198)	(0.314)	–2.575	–0.009	(0.280)	(0.425)
(10)			W	Int	–0.007	–0.002	(0.003)	(0.004)	2.041	0.008	(0.194)	(0.293)	–2.509	–0.009	(0.274)	(0.395)
(11)			W	Yr	–0.007	–0.002	(0.003)	(0.004)	2.095	0.009	(0.196)	(0.299)	–2.509	–0.009	(0.274)	(0.395)
(12)			W	Evt	–0.007	–0.002	(0.003)	(0.004)	— not possible —				–2.509	–0.007	(0.267)	(0.386)
(13)		ewretd	N	Int	0.001	0.000	(0.003)	(0.004)	2.108	0.009	(0.185)	(0.298)	–3.547	–0.013	(0.262)	(0.406)
(14)			W	Int	0.000	0.000	(0.003)	(0.004)	2.029	0.009	(0.182)	(0.278)	–3.502	–0.013	(0.257)	(0.376)
(15)			W	Yr	0.000	0.000	(0.003)	(0.004)	2.083	0.009	(0.184)	(0.283)	–3.502	–0.013	(0.257)	(0.376)
(16)			W	Evt	0.000	0.000	(0.003)	(0.004)	— not possible —				–3.502	–0.011	(0.251)	(0.369)
(6') no cross	5d	ewretd	W	Int	–0.056	–0.013	(0.003)	(0.003)	0.130	0.001	(0.154)	(0.235)	— not included —			
(6') 1992–2015	5d	ewretd	W	Int	–0.002	–0.001	(0.005)	(0.006)	2.737	0.014	(0.005)	(0.006)	–5.932	–0.024	(0.355)	(0.572)
(6') no $\delta > 10\%$	5d	ewretd	W	Int	0.036	0.009	(0.005)	(0.005)	4.949	0.016	(0.293)	(0.346)	–10.244	–0.032	(0.415)	(0.500)

Explanations: Samples and variables are described in Table 2. The regressions are the same as in Table 5, except that they include as regressors the dividend yield and the cross variable of the "dividend yield times the post-payment dummy."

Interpretation: Only the cross-effect mattered. Firms paying more dividends appreciated more at the payment and then delivered lower returns thereafter. The dividend payment reduced the average daily rate of return by about 3bp for every 1% dividend yield. Over 4-8 day windows, this amounts to about 20-30bp.

fig:means

Figure 3: Explaining Returns Around Payment Dates

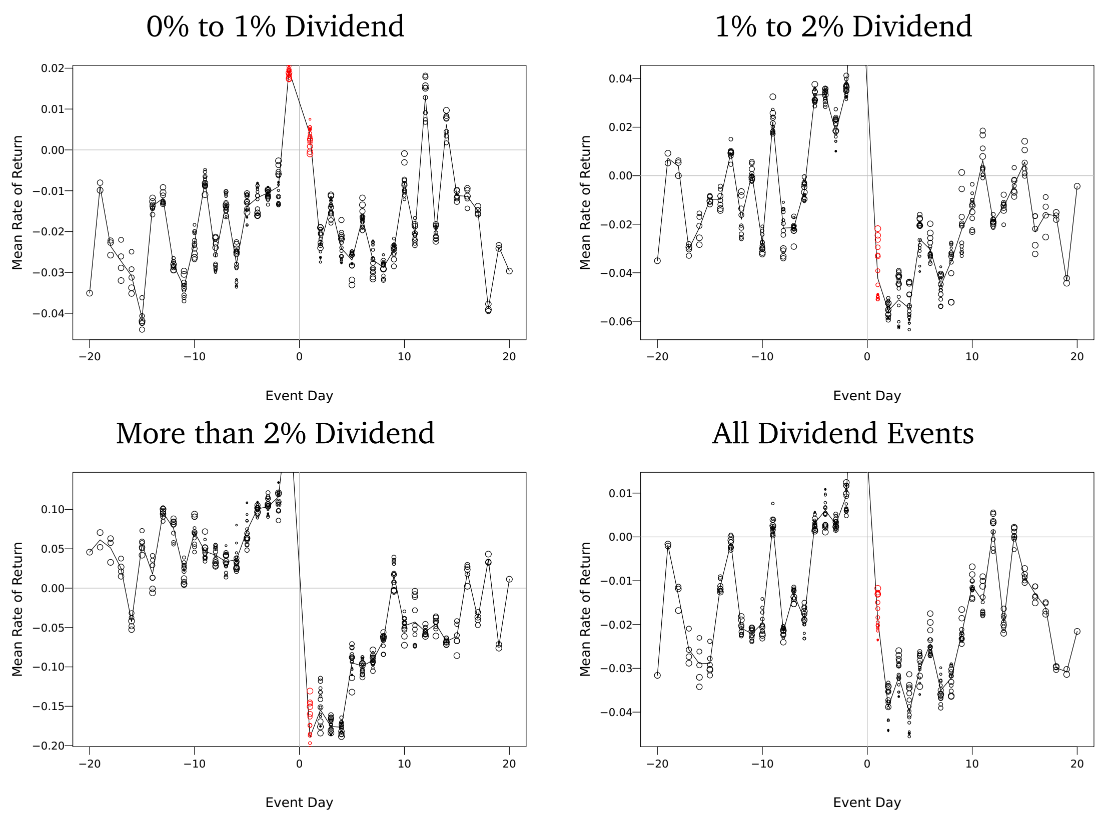


Explanations: Samples and variables are described in Table 2. The figure is identical to Figure 1, except that the returns are not measured in absolute terms.

Interpretation: Contrary to the rational-leverage theory, average returns were *lower* after the dividend payment date.

fig:meansbyyield

Figure 4: Explaining Returns around Payment Dates, By Dividend Yield, With Sensitivities to Stock Return Availability Requirements

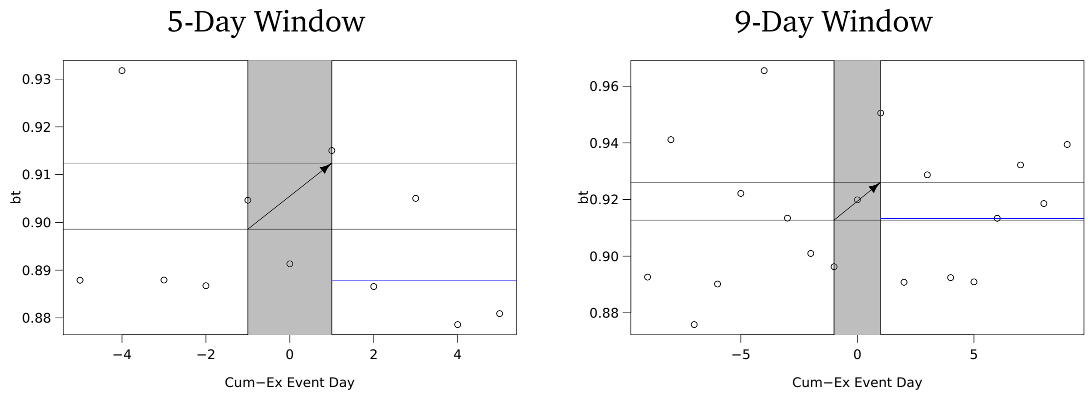


Explanations: Samples and variables are described in Table 2. The four plots are, in clockwise order, low-, mid-, high-, and all dividend payments. For each event day, the average rate of return above the market is plotted, conditional on there having been at least x days (with plot point size x) of data around the payment. Thus, for the –20 event day, there is only a (size 20 px) rate of return of 0.05% in the high-dividend-yield, but for the –2 event day, there are (slightly) different average rates of return depending on whether one requires 2, ... 20 days of available rates of return on both sides of day zero. For visual focus, the (regression-excluded) –1, 0, and +1 event-day volatilities are not y-scaled and only –1 and +1 event-day volatilities are plotted but in red. The gray lines are the selection-unconditional event-day means, where changes in composition in firms are ignored.

Interpretation: Post-payment average returns were lower than the pre-payment volatilities for high-yield dividend events, contrary to leverage theory. The selection window influences the reported average return, but only moderately so. Even the selection-unconditional mix of firms produces roughly the same inference.

fig:betas

Figure 5: Explaining Market Betas Around Previously Declared Payment Dates

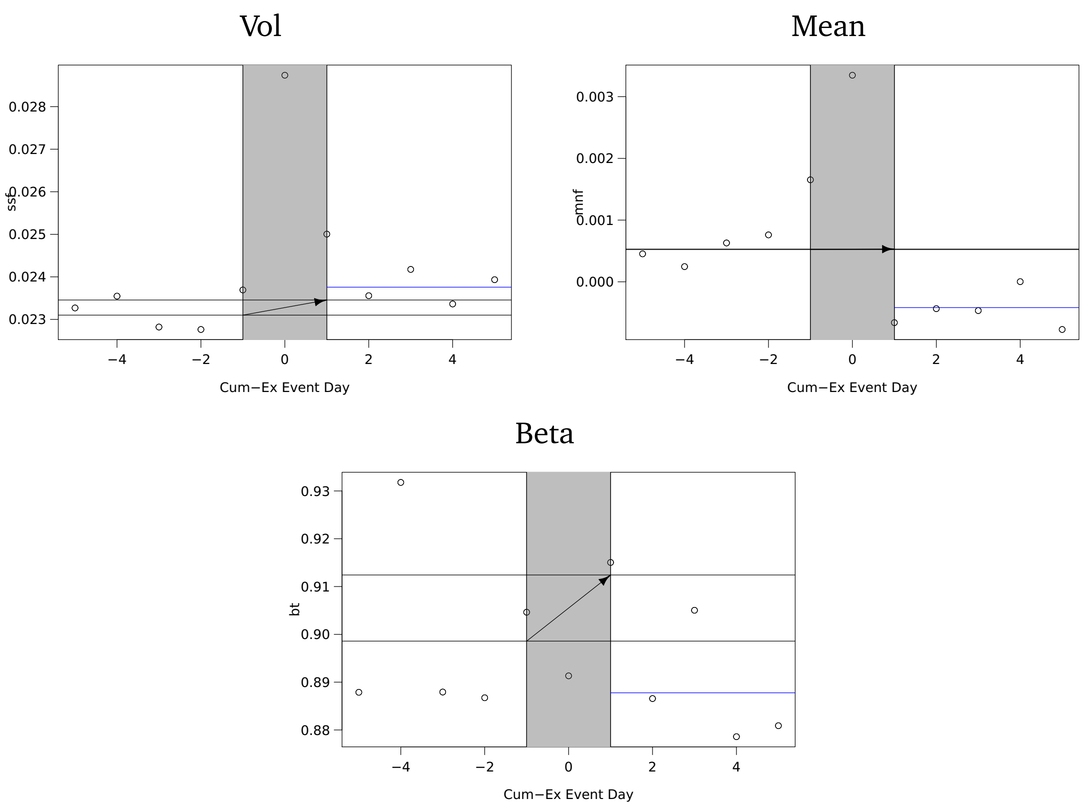


Explanations: Samples and variables are described in Table 2. The plotted coefficients are from cross-sectional market-model regressions—i.e., each event day, one regression between the stock return and the equal-weighted market rate of return is run.

Interpretation: Post-payment market-betas were not higher than pre-payment market betas. There is no clear pattern.

fig:high

Figure 6: Explaining Patterns For High Dividend-Yield-High-Stock-Volatility Distributions



Explanations: Variables are described in Table 2. The sample here includes only 52,861 distributions in which the dividend yield was at least 1% and the sum of absolute returns from eventdates -9 to -6 (inclusive) was at least 2%. Otherwise, the plots are identical to earlier plots.

Interpretation: Average returns were higher before the payment date than after.

fig:taxesbyyear

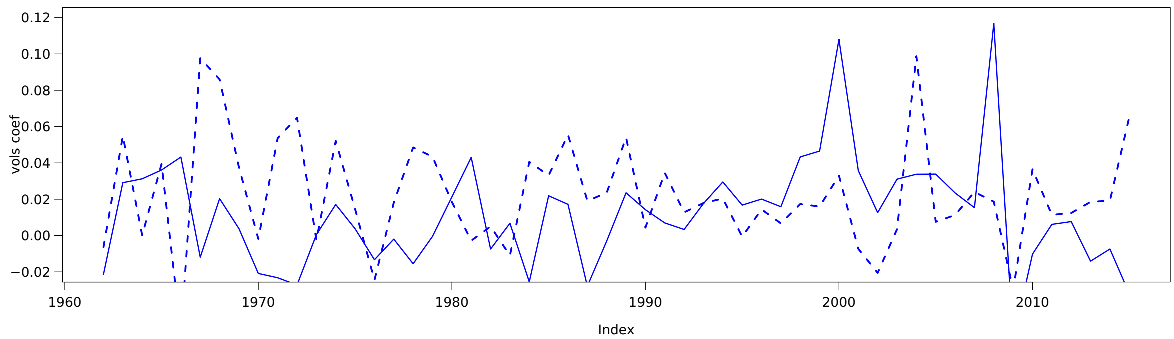
Figure 7: Year by Year Highest Individual Dividend Income Tax Rates

Explanations: The sources of these dividend tax rates are Sialm (2009), Becker, Jacob, and Jacob (2013), and Jacob, Michaely, and Mueller (2016).

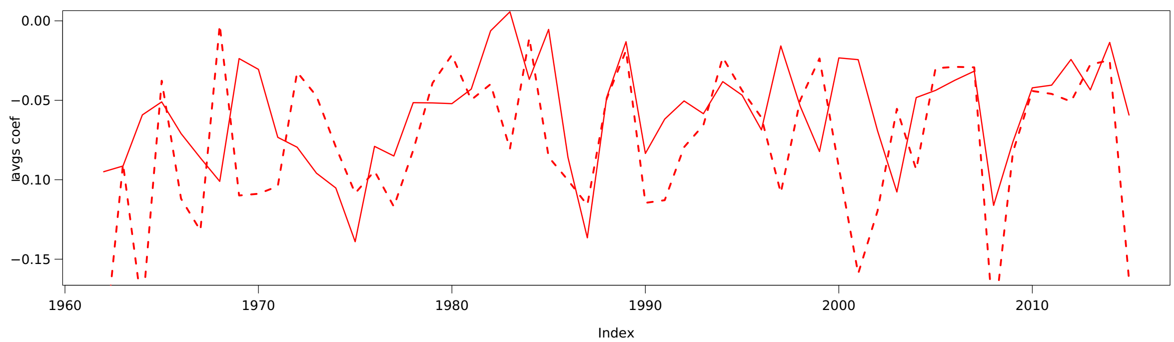
fig:coefsbyyear

Figure 8: Year by Year Coefficients Explaining Stock Return Moments After the Payment

Panel A: Explaining Volatility (Absolute Return)



Panel B: Explaining Average (Returns)



Explanations: Samples and variables are described in Table 2. These are the regression coefficients of interest when each year is run by itself for the market-adjusted 5-day window. The blue lines are for volatility: The solid blue line is on the "after-payment" dummy in a bivariate regression, as in Table 3. The dashed blue line is on a multivariate regression for the "cross" variable, as in Table 4. The red lines are for average returns: The solid red line is on a bivariate regression "after-payment" dummy, as in Table 5. The dashed red line is on a multivariate regression for the *cross* variable, as in Table 6. To fit on the same scale, the cross-coefficients were divided by 100.

Interpretation: Although there may have been a contributions of personal dividend income tax-related preferences to the dividend-payment effect, they could not have been too powerful.

tbl:withevtret

Table 7: Explaining (Average) Returns around Previously Declared Payment Dates, Controlling for Cum-To-Ex Day Stock Returns

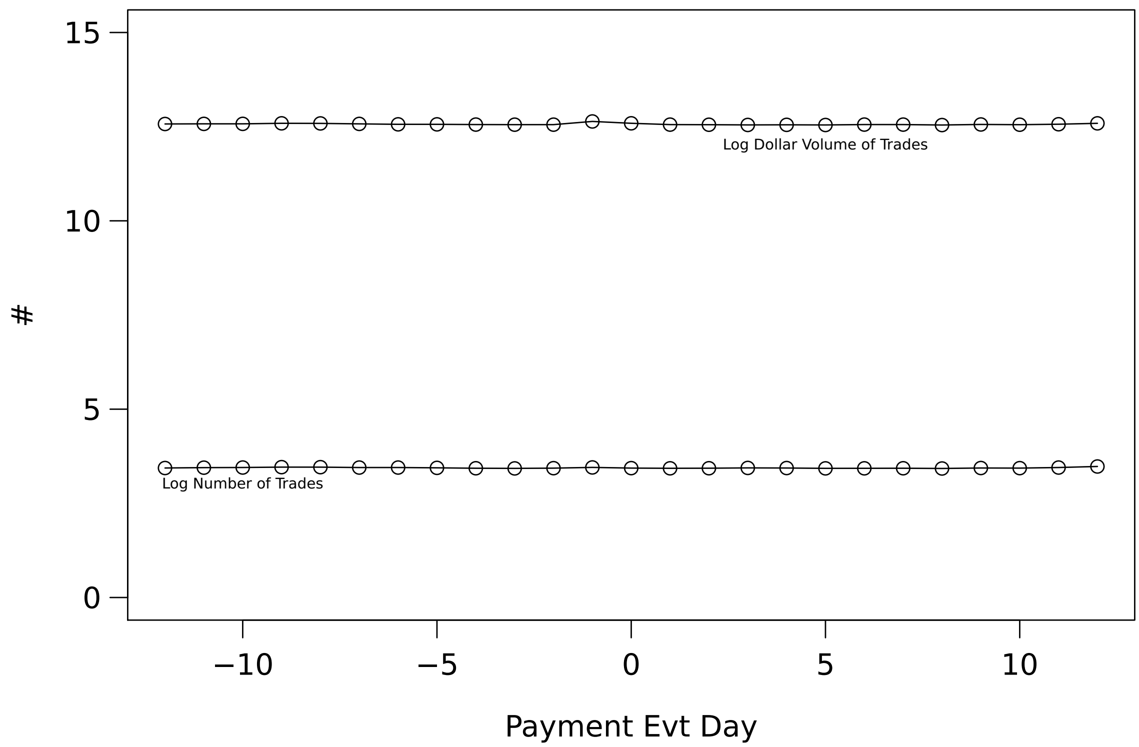
Variable	Coef	Std.Err	T (se-het)	Stdzd
Intercept	–0.007	0.001	–6.39	
"Afer-Dividend" Dummy	–0.018	0.001	–11.94	–0.004
Intercept	–0.006	0.001	-5.55	
"Afer-Dividend" Dummy	–0.018	0.001	–11.93	–0.004
Cum-To-Ex Return	–0.004	0.000	–6.79	–0.004
Intercept	–0.006	0.001	-4.87	
"Afer-Dividend" Dummy	–0.019	0.002	–12.55	–0.004
Cum-To-Ex Return	–0.007	0.001	–7.73	–0.007
"Afer-Dividend" Dummy × Cum-To-Ex Return	0.005	0.001	4.37	0.004

Explanations: The panel contains 81,058,017 observations, balanced to have an equal number of stock returns on either side up to 21 days and with the requirement of knowledge of the declaration. The regressions predict the market-adjusted event day rate of return with the post-event dummy, and the payment day cum-to-ex return.

Interpretation: Events with more positive cum-to-ex returns also had (modestly) lower post-dividend average returns. However, this makes no difference to the inference about lower average rates of return after the dividend has been paid.

fig:liquidity

Figure 9: Explaining Average Trading Liquidity Patterns around Previously Declared Payment Dates



Explanations: Samples and variables are described in Table 2. These are plots of the by-event-day averages of the log number of trades and log value of dollar trades.

Interpretation: Liquidity did not change.

tbl:sdc

Table 8: Explaining Market-Adjusted Stock Returns Around Actual Share-Issue Dates, Given Previously Declared Issue Intentions

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

Panel B: Panel Regressions Explaining Daily Market-Adjusted Rates of Return

	Intercept			"After"-Dummy			
	Coef	(se)	(se.het)	Coef	Stdzd	(se)	(se-het)
Days |3| to |6|	–0.162	(0.014)	(0.014)	0.062	0.011	(0.018)	(0.017)
Days |3| to |6|, Fixed Eff	many			0.062	0.011	(0.018)	(0.015)
Days |3| to |8|, Fixed Eff	many			0.039	0.008	(0.015)	(0.015)

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 per event day (in Panel A), for a sample of about 100,000 stock returns in the days from 3 to 6 days earlier (in Panel B).

Interpretation: As with dividends, the prediction of the leverage theory is born out for volatilities but not for average returns *tbl:illustrate*

Table 9: Illustrative Numerical Example of (Post-Announcement) At-Payment Changes

	Firm	Low Leverage ($D_0 = \$5$, $E_0 = \$95$, $\delta = 1.05\%$) Security	$T = 0$	$T = 2$	Risk @ T	High Leverage ($D_0 = \$95$, $E_0 = \$5$, $\delta = 20\%$) 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 $(-10.43\%, +10.43\%)$.