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The Role of Dividends and Investor Sentiment in the Relation Between Idiosyncratic Risk and Expected Returns

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THE ROLE OF DIVIDENDS AND INVESTOR SENTIMENT IN THE RELATION BETWEEN IDIOSYNCRATIC RISK AND EXPECTED RETURNS

by

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ABSTRACT

We test the role of dividends and investor sentiment in the relation between idiosyncratic risk and expected returns because Pastor and Veronesi (2003) find evidence that dividends reduce firm-specific uncertainty by sending information to the market participants through dividends. Also, Baker and Wurgler (2006) document that the negative relation between idiosyncratic risk and expected return only exists under the optimistic sentiment. We first document that the negative relation between idiosyncratic risk and expected return is more concentrated for stocks without dividends than stocks with dividends. We further find that the role of dividends in the relation between idiosyncratic risk and expected return is not affected by investor sentiment. These findings are robust to weighing schemes of returns and firm characteristics such as beta, size, book-to-market ratio, momentum, and liquidity.

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DEDICATION

I dedicate this book to my parents, Zhiqiang Yang and Weili Zhang, and my wife, Xu Wang.

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CHAPTER 1

INTRODUCTION

The modern portfolio theory illustrates the relationship between risk and return. The capital asset pricing model (CAPM) of Sharpe (1964), Lintner (1965), Black (1972) suggests that only the systematic risk is priced, and idiosyncratic risk should not be priced. Several studies by Levy (1978), Merton (1987) document that there is a positive relation between idiosyncratic volatility (IVOL) and expected returns when investors do not hold well-diversified portfolios. On the other hand, Ang et al. (2006) suggest that high idiosyncratic volatility stocks tend to experience lower expected returns in the following month. However, Bali and Cakici (2008) find no negative relation between idiosyncratic volatility and expected returns in the equal-weighted portfolio returns.

Recent empirical evidence provides that the dividend policy impacted the relation between idiosyncratic risk and expected returns (Pastor & Veronesi 2003). The dividend payment is considered one channel of information flow from managers to market participants based on the information theory. Investors use dividend information to adjust their long-run expectations of the firm. The information about dividend payments would reduce the uncertainty of stocks. The decrease of uncertainty reduces the idiosyncratic volatility of stocks because the uncertainty of stocks is highly correlated with idiosyncratic volatility. Hence, the idiosyncratic volatility puzzle would be weakened for those stocks with dividends. Also, there would be a significant negative relation between idiosyncratic volatility and expected returns for non-dividend-paying stocks.

Atmaz and Bassk (2020) develop a model of the aggregate stock market featuring dividend-paying stocks and non-dividend stocks in a consumption-based equilibrium framework and show that stocks without dividends command lower mean returns but have higher return volatilities.[1] Their prediction on non-dividend stocks is consistent with one of our main findings.

Baker and Wurgler (2006, 2007) show that investor sentiment plays a critical role in determining expected returns. The investors are risk-seeking and willing to purchase high idiosyncratic volatility stocks under optimistic sentiment periods. However, investors show risk-averse under pessimistic sentiment periods. Therefore, high idiosyncratic volatility stocks would be overpriced in equilibrium when the sentiment is optimistic and underpriced in pessimistic sentiment periods. The studies conclude that higher volatility stocks perform poorly in optimistic sentiment periods and perform well when the sentiment is pessimistic. This finding suggests a potential role of investor sentiment in the volatility-return relationship.

In this study, the relation between idiosyncratic volatility and expected returns is examined. For value-weighted decile portfolios, the portfolio return difference between the highest and lowest idiosyncratic volatility is -0.82%, with a *t*-statistic of -3.08. The corresponding Fama and French (1993) three-factor alpha is -1.21% and statistically

[1] We greatly appreciate an anonymous referee to encourage us to connect our finding with Atmaz and Basak (2020).

significant. The result is consistent with Ang et al. (2006). For equal-weighted portfolios, the IVOL puzzle is also confirmed when the equal-weighted portfolios are formed.[2]

The relationship between idiosyncratic volatility and expected returns with different dividend payment policies is investigated. The results showed a significantly negative relation between idiosyncratic risk and expected returns for both value and equal-weighted portfolio returns among non-dividend-paying firms. However, the findings show that the return difference between the highest and lowest IVOL portfolio for dividend-paying firms is only significant for equal-weighted portfolio returns. Furthermore, the return difference between these two different samples is tested, and results show that the IVOL puzzle for non-dividend-paying firms is significantly stronger than those with dividends. The portfolio return difference between different dividend policies shows a significant result for both value-weighted and equal-weighted portfolios.

The high idiosyncratic volatility stocks tend to be small, illiquid, and with low returns over the prior formation periods. Hence, bivariate sorting methods are used to examine the robustness of the results. Those results show that the negative relation between IVOL and expected returns are robust to size, momentum, and turnover. Also, these results are robust in Fama-MacBeth's (1973) cross-sectional regressions after controlling for other explanatory variables.

The IVOL puzzle is further tested by considering investor sentiment. Consistent with the hypothesis of Baker and Wurgler (2006, 2007) hypothesis, the negative relation between idiosyncratic risk and expected return for both value-weighted and equal-weight

[2] We exclude stocks with the price below $5 when we form portfolios in our sample due to the fact that these penny stocks are typically associated with high illiquidity, high transaction costs, and severe short-selling restrictions.

portfolios only exists under optimistic sentiment periods. Moreover, an examination was performed on the relationship between idiosyncratic volatility and expected returns with dividend policy and investor sentiment. The negative relation between idiosyncratic risk and expected return exists for both dividend-paying and non-dividend-paying firms in optimistic sentiment periods. However, in pessimistic sentiment periods, there is a significantly negative relation between idiosyncratic risk and expected returns only for non-dividend-paying firms. Therefore, the negative relation between idiosyncratic and expected returns for non-dividend-paying firms exists under optimistic and pessimistic sentiment periods. The negative relation between idiosyncratic risk and expected return is not affected by investor sentiment.

Thus, the key finding of Baker and Wurgler (2006) is that a negative and significant relation between idiosyncratic volatility and expected in enriched and returns should be only concentrated under optimistic sentiment periods. To check the robustness of these findings, the Fama-MacBeth (1973) cross-sectional regressions is used to examine the relation between idiosyncratic risk and expected returns after controlling other firm-level variables. The results confirm the research hypothesis and show that the IVOL-puzzle is stronger for non-dividend-paying firms than those with dividends. A significant return difference is found between non-dividend-paying and dividend-paying firms under optimistic and pessimistic investor sentiment periods.

The research study makes several contributions to explain idiosyncratic volatility and the relationship of the expected return. First, the negative relation between idiosyncratic risk and expected return is documented and proves to be significantly stronger for non-paying dividend firms than those with dividends. This finding shows that the dividend payment policy plays a critical role in explaining the idiosyncratic volatility puzzle. Second, the idiosyncratic volatility puzzle exists for both optimistic sentiment periods and pessimistic periods for non-dividend-paying firms. The finding confirms that the IVOL-puzzle would not be affected by investor sentiment for non-dividend-paying firms. Third, the IVOL puzzle is stronger for non-paying dividend firms than those with dividends under both optimistic and pessimistic investor sentiment.

The dissertation is organized as follows. Chapter 2 describes the data and methodology. Chapter 3 provides the empirical results. Chapter 4 concludes the paper.

CHAPTER 2

DATA AND METHODOLOGY

The sample includes daily and monthly returns of common stocks (share codes 10 and 11) listed on the New York Stock Exchange (NYSE), American Stock Exchange (AMEX), and Nasdaq from the Centre for Research in Security Prices (CRSP). The sample period is from January 1965 to December 2016. Stocks with a price below $5 are excluded in the portfolio formation month to minimize the effect of illiquid securities from the results.

Similar to Ang et al. (2006), the idiosyncratic volatility of stock *i* is calculated each month from the following time-series regression of excess daily returns of stocks on the daily Fama-French (1993) three factors:

$$R_{i,d} - R_{f,d} = \alpha_i + \beta_i(R_{m,d} - R_{f,d}) + s_i SMB_d + h_i HML_d + \varepsilon_{i,d}\,, \qquad (1)$$

where $R_{i,d}$ is the daily return of stock *i* on day *d*, $R_{f,d}$ is the daily risk-free rate, $(R_{m,d} - R_{f,d})$, SMB_d, and HML_d are the daily Fama-French (1993) factors. The idiosyncratic volatility of a stock *i* is measured as the standard deviation of the residuals from regression (1). The monthly idiosyncratic volatility is calculated by multiplying the idiosyncratic volatility of stocks from (1) by the square root of the number of trading days in the month.

The dividend payment situation of a stock is identified by using the CRSP cash distribution codes following the method employed in Asem (2009). The first three digits between 121 and 126 are defined as dividend-paying firms. The sample is separated by sorting stocks into dividend-paying firms and non-dividend-paying firms each month.

The investor sentiment index of Baker and Wurgler (2006, 2007)[3] was collected, and the hypothesis was tested by segregating portfolio formation months into optimistic sentiment periods and pessimistic sentiment periods.[4] There are 324 months of optimistic sentiment periods and 277 months of pessimistic sentiment periods in the sample period. Bivariate sorting methods and the Fama-MacBeth (1973) cross-sectional regressions for robustness tests are conducted to control for the other control variables. The Newey and West (1987) adjusted standard errors are used to compute the *t*-statistics in our empirical tests to consider serial correlation in the coefficient estimate.

[3] The sentiment index data set is collected from Jeff Wurgler's website at http://people.stern.nyu.edu/jwurgler/.

[4] We classify the decile portfolios, formed at the end of month *t*, as optimistic when the sentiment index score is positive in month *t*, *t* - 1, and *t* - 2. The pessimistic sentiment periods are defined as the sentiment index score is non-positive in month *t*, *t* - 1, and *t* - 2. To take into account for a 1-month delay sentiment announcement, we use the sentiment index score from month *t*, *t* - 1, and *t* - 2 to calculate the rolling sentiment measure actually corresponds to sentiment during months *t* - 1, *t* - 2, and *t* - 3. The results are still held after considering different sentiment specifications based on two and four month lags.

CHAPTER 3

RESULTS

Idiosyncratic Volatility and Portfolio Returns

First, existing evidence is verified about the negative relationship between idiosyncratic volatility (IVOL) and the subsequent returns in the sample. Each month from January 1965 to December 2016, the NYSE/Amex/Nasdaq stocks are sorted into ten portfolios based on their monthly idiosyncratic volatilities and examine the returns of these portfolios in the following month. Stocks with a price below $5 are excluded.

Table 1 presents summary statistics for all available stocks in Panel A, stocks without dividends in Panel B, and stocks with dividends in Panel C. In each month, the sample stocks are divided into subgroups based on their dividend policy. Stocks without dividends are non-dividend-paying firms, and stocks with dividends are dividend-paying firms. Decile portfolios are formed every month from January 1965 to December 2016 based on idiosyncratic volatility, which is the square root of the number of trading days in the month multiplied by the standard deviation of residuals of time-series regression of excess daily returns on Fama-French daily three factors in the month. Portfolio 1 (10) is the portfolio of stocks in the bottom (top) decile of idiosyncratic volatility.

Table 1

Summary Statistics

Panel A: All stocks

	1 (L)	2	3	4	5	6	7	8	9	10 (H)	H-L
Num	294	294	295	294	294	295	294	294	294	294	0
IVOL	3.03	4.56	5.58	6.55	7.58	8.73	10.09	11.83	14.42	22.25	19.22
Size	5.84	4.18	3.03	2.26	1.68	1.26	0.95	0.73	0.55	0.35	-5.49
Beta1	0.48	0.69	0.78	0.85	0.92	0.99	1.06	1.12	1.18	1.23	0.75
Beta2	0.17	0.32	0.43	0.52	0.62	0.72	0.83	0.92	1.03	1.25	1.08
Beta3	-0.17	-0.22	-0.24	-0.24	-0.23	-0.22	-0.20	-0.16	-0.14	-0.12	0.05
BTM	0.85	0.80	0.79	0.78	0.78	0.77	0.77	0.77	0.77	0.82	-0.03
MOM	8.84	7.73	8.04	8.36	8.81	9.51	10.47	11.73	14.22	23.01	14.18
TOVER	0.05	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.13	0.20	0.15
DVR	0.021	0.020	0.018	0.017	0.015	0.014	0.012	0.011	0.009	0.007	-0.014

Panel B: Stocks without Dividends

Num	123	124	124	124	123	124	124	124	124	123	0
IVOL	4.27	6.56	7.91	9.11	10.28	11.54	13.00	14.84	17.60	26.30	22.04
Size	2.23	1.59	1.21	0.99	0.80	0.66	0.56	0.47	0.40	0.28	-1.95
Beta1	0.58	0.89	1.03	1.11	1.17	1.20	1.27	1.28	1.33	1.32	0.74
Beta2	0.39	0.64	0.79	0.86	0.92	1.02	1.07	1.15	1.23	1.42	1.03
Beta3	-0.11	-0.12	-0.11	-0.10	-0.08	-0.06	-0.06	-0.05	-0.02	-0.03	0.07
BTM	0.80	0.73	0.71	0.70	0.69	0.69	0.69	0.69	0.70	0.76	-0.04
MOM	11.95	10.79	11.15	11.98	13.01	14.02	15.18	17.09	20.11	32.43	20.48
TOVER	0.07	0.08	0.10	0.10	0.11	0.12	0.13	0.14	0.16	0.25	0.19
DVR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Panel C: Stocks with Dividends

Num	171	171	171	171	171	172	171	171	171	171	0
IVOL	2.78	4.05	4.84	5.58	6.34	7.18	8.19	9.51	11.51	17.67	14.89
Size	7.04	5.69	4.74	3.79	3.12	2.57	1.99	1.48	1.10	0.67	-6.37
Beta1	0.46	0.66	0.74	0.80	0.85	0.90	0.95	0.99	1.03	1.04	0.58
Beta2	0.14	0.24	0.33	0.40	0.47	0.54	0.62	0.71	0.82	0.98	0.84
Beta3	-0.17	-0.23	-0.26	-0.28	-0.29	-0.30	-0.31	-0.31	-0.32	-0.34	-0.17
BTM	0.86	0.81	0.80	0.80	0.81	0.81	0.84	0.85	0.90	0.99	0.13
MOM	8.35	7.23	7.33	7.42	7.63	7.80	7.91	8.24	8.86	11.51	3.17
TOVER	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.08	0.12	0.07
DVR	0.024	0.024	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.024	0.000

Only stocks with a price higher than or equal to $5 and at least 12 daily returns each month are included. Num is the number of stocks. Size is the average market capitalization (in billions of dollars). Beta1 (2, 3) is the loading of the market (size, book-to-market) factor in the estimation of IVOL. BTM is boot-to-market ratio. MOM is the buy and hold return over the past six months. TOVER (turnover ratio) is trading volume divided by the number of shares outstanding. DVR is the dividend ratio.

In Panel A of Table 1, the average idiosyncratic volatility for all stocks in the lowest IVOL portfolio is 3.03%, and the average idiosyncratic volatility is 22.25% in the highest idiosyncratic volatility portfolio. The mean idiosyncratic volatility difference between the highest and lowest IVOL portfolio is 19.22%. The average firm size decreases from $5.84 billion for the lowest IVOL portfolio to $0.35 billion for the highest IVOL portfolio. The market beta (Beta1), size beta (Beta2), book-to-market beta (Beta3), the book-to-market ratio (BTM), momentum (MOM), turnover ratio (TOVER), and dividend ratio (DVR) within each portfolio are provided in Table 1. The summary statistic for stocks without dividends and stocks with dividends is presented in Panel B and Panel C, respectively. While there are around 124 firms without dividends in each decile portfolio, there are 171 dividend-paying firms in each decile portfolio.

Although the number of non-dividend-paying firms is fewer than the number of dividend-paying firms, the firm number is large enough for robust statistical inference. The difference of average idiosyncratic volatility between the highest and lowest idiosyncratic volatility portfolio for non-dividend-paying firms in Panel B is 22.04%, which is higher than the corresponding difference for dividend-paying firms of 14.89% in Panel C. Non-dividend-paying firms also have a smaller size and a higher momentum return and turnover ratio compared to dividend-paying firms. There is a positive relation between idiosyncratic volatility and market beta, size beta, momentum returns, and turnover ratio. However, idiosyncratic volatility is negatively correlated with size and dividend ratio.

Idiosyncratic Volatility, Stock Returns, and Dividend Payments

The idiosyncratic volatility puzzle in Panel A of Table 2 is authenticated with entire stocks. As shown in Panel A of Table 2, the value-weighted average return difference for all stocks between the highest and lowest idiosyncratic volatility portfolio is -0.82% per month with a *t*-statistic of -3.08. The difference in the equal-weighted returns of the extreme idiosyncratic volatility portfolios is -0.80% per month, which is statistically significant (*t*-statistic = -3.51). The corresponding Fama-French (1993) three-factor alphas are statistically significant for both value-weighted and equal-weighted portfolios at -1.21% (*t*-statistic = -6.87) and -1.13% (*t*-statistic = -8.07). This result is consistent with Ang et al. (2006). The idiosyncratic volatility is negatively correlated with subsequent expected returns.[5]

In each month, the sample stocks are divided into subgroups based on their dividend policy. Stocks without dividends are non-dividend-paying firms. Stocks with dividends are dividend-paying firms. Decile portfolios are formed every month from January 1965 to December 2016 based on idiosyncratic volatility calculated using the Fama-French (1993) three-factor model. The stocks are sorted into decile portfolios based on their IVOL each month and compute the value-weighted (VW) and equal-weighted (EW) returns of these portfolios in the following month. Portfolio 1 (10) is the portfolio of stocks in the bottom (top) decile of IVOL. We only include stocks with a price higher than or equal to $5 and at least 12 daily returns each month. Alpha is the difference in Fama-French's (1993) three-factor alphas between the highest and lowest IVOL

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[5] Note that these findings are inconsistent with Bali and Cakici (2008) and Huang et al. (2010), whose result is not significant in equal-weighted portfolios. We find similar results with Bali and Cakici (2008) and Huang et al. (2010) when we do not exclude stocks with price below $5.

portfolios. The *t*-statistics, reported in parentheses, are adjusted for autocorrelation using three lags in the Newey-West method.

Table 2

Returns on Portfolios of Stocks Sorted by Idiosyncratic Volatility by Dividend Payment

Panel A: All stocks

	1 (L)	2	3	4	5	6	7	8	9	10 (H)	H-L	Alpha
VW	0.88	0.94	0.92	0.97	1.03	0.95	1.01	0.84	0.74	0.06	-0.82	-1.21
											(-3.08)	(-6.87)
EW	1.05	1.19	1.25	1.31	1.35	1.38	1.21	1.20	0.97	0.25	-0.80	-1.13
											(-3.51)	(-8.07)

Panel B: Stocks without Dividends

	1 (L)	2	3	4	5	6	7	8	9	10 (H)	H-L	Alpha
VW	1.23	1.30	1.35	1.19	1.11	1.03	0.81	0.77	0.32	-0.20	-1.43	-1.75
											(-5.00)	(-6.75)
EW	1.32	1.50	1.49	1.34	1.45	1.24	1.12	0.96	0.69	-0.11	-1.43	-1.68
											(-6.01)	(-8.43)

Panel C: Stocks with Dividends

	1 (L)	2	3	4	5	6	7	8	9	10 (H)	H-L	Alpha
VW	0.88	0.92	0.95	0.93	0.96	0.95	1.09	0.89	0.93	0.53	-0.34	-0.77
											(-1.50)	(-4.54)
EW	1.05	1.15	1.24	1.26	1.34	1.31	1.35	1.29	1.22	0.66	-0.39	-0.75
											(-2.47)	(-8.30)

Panel D: Stocks without Dividends – Stocks with Dividends

VW	Alpha	EW	Alpha
-1.08	-0.98	-1.04	-0.94
(-3.88)	(-3.51)	(-5.35)	(-4.69)

Since Pastor and Veronesi (2003) document stocks that do not pay dividends have more volatile returns, the relation between idiosyncratic volatility and portfolio returns for dividend-paying firms and non-dividend-paying firms is tested. In each month, stocks are grouped into non-dividend-paying firms (Panel B of Table 2) and dividend-paying firms (Panel C of Table 2). The stocks are formed into decile portfolios on their idiosyncratic volatility separately for dividend-paying firms and non-dividend-paying firms. Panel B of Table 2 reports that the value-weighted average return difference between the highest and lowest idiosyncratic volatility portfolio for non-dividend-paying firms is statistically significant at -1.43% with a *t*-statistic of -5.00. The corresponding return difference of equal-weighted portfolios is statistically significant at -1.43% (*t*-statistic = -6.01). The Fama-French (1993) three-factor alpha is -1.75% (*t*-statistic = -6.75) for the value-weighted return difference between the highest and lowest idiosyncratic volatility portfolio and -1.68% (*t*-statistic = -8.43) for the equal-weighted average return difference of portfolios for non-dividend-paying firms, respectively.

However, Panel C of Table 2 shows that the difference of value-weighted average monthly return between the highest and lowest idiosyncratic volatility portfolio for dividend-paying firms is not statistically significant at -0.34% (*t*-statistic = -1.50). The difference of equal-weighted mean return between the highest and lowest idiosyncratic volatility portfolio is -0.39%, with a *t*-statistic of -2.47. The Fama-French (1993) three-factor alphas for value-weighted and equal-weighted portfolio return differences between the highest and lowest IVOL portfolio for dividend-paying firms are -0.77% (*t*-statistic: -4.54) and -0.75% (*t*-statistic: -8.30), respectively.

It was further tested whether the IVOL-puzzle is significantly stronger for non-dividend-paying firms than those firms with dividends. Panel D of Table 2 presents the return differences between non-dividend-paying firms and dividend-paying firms for both value-weighted and equal-weighted portfolios. The mean return difference for value-weighted portfolios between non-dividend-paying firms and dividend-paying firms is -1.08%, which is statistically significant (*t*-statistic = -3.88). The corresponding difference is also significant at -1.04% (*t*-statistic = -5.35) for the difference of equal-weighted portfolio returns. The Fama-French (1993) three-factor alphas for value-weighted and equal-weighted portfolio return differences between non-dividend-paying stocks and dividend-paying stocks are -0.98% (*t*-statistic: -3.51) and -0.94% (*t*-statistic: -4.69), respectively.

A striking finding of Table 2 is that the negative relationship between idiosyncratic risk and expected return is significantly stronger for non-dividend-paying firms than those firms with dividends. The results support our hypothesis, indicating that the IVOL-puzzle is more concentrated in firms without dividends. Also, the significance of the IVOL-puzzle disappears for dividend-paying firms in the value-weighted portfolios.

Robustness Checks

This section examines the relation between idiosyncratic volatility and portfolio returns after controlling for size, momentum return, and turnover ratio. In Table 1, we find that the idiosyncratic volatility is highly correlated with size, momentum return, and turnover ratio in our sample. A dependent sorting procedure is employed for this test. Firstly, decile portfolios are formed by sorting the stocks on size (Panel A of Table 3). Then, within each of these decile portfolios, ten additional portfolios are formed by sorting the stocks on their idiosyncratic volatilities. The returns are averaged across the ten size portfolios within each of the IVOL portfolios.

Table 3

Returns on Portfolios of Stocks Sorted by Idiosyncratic Volatility After Controlling for Firm Characteristics

	1 (L)	2	3	4	5	6	7	8	9	10 (H)	H-L	Alpha
Panel A: Controlling for Size												
VW	1.10	1.29	1.34	1.33	1.32	1.28	1.18	1.08	0.85	0.22	-0.88	-1.15
											(-10.48)	(-11.95)
EW	1.13	1.31	1.35	1.35	1.34	1.30	1.20	1.09	0.87	0.22	-0.91	-1.18
											(-10.81)	(-12.04)
IVOL	3.26	4.91	5.99	6.97	7.94	8.99	10.20	11.72	13.96	20.71	17.44	
Num	294	294	295	294	294	295	294	294	294	294	0	
Panel B: Controlling for MOM												
VW	1.07	1.05	1.04	0.94	0.96	0.97	0.89	0.77	0.61	0.01	-1.06	-1.34
											(-11.16)	(-13.19)
EW	1.16	1.26	1.32	1.29	1.29	1.28	1.19	1.04	0.90	0.19	-0.97	-1.20
											(-14.31)	(-15.71)
IVOL	3.41	4.98	5.97	6.89	7.83	8.86	10.10	11.68	14.08	21.09	17.67	
Num	294	294	295	294	294	295	294	294	294	294	0	
Panel C: Controlling for TOVER												
VW	1.00	1.05	1.03	0.98	0.98	0.90	0.92	0.88	0.67	0.17	-0.83	-1.12
											(-9.63)	(-12.85)
EW	1.11	1.24	1.27	1.30	1.29	1.23	1.23	1.15	0.96	0.37	-0.75	-1.09
											(-10.97)	(-14.35)
IVOL	3.69	5.14	6.08	6.94	7.84	8.85	10.05	11.61	13.97	20.72	17.03	
Num	294	294	295	294	294	295	294	294	294	294	0	

This procedure ensures similar levels of the size variable across each of the IVOL portfolios, thereby providing a convenient method to control for size. A similar sorting method is used to control for momentum return (Panel B of Table 3) and turnover ratio (Panel C of Table 3). Panel A of Table 3 reports both value-weighted and equal-weighted portfolio returns. We find that the difference in the value-weighted average returns of the highest and lowest IVOL portfolio is negative and statistically significant at -0.88% per month with a *t*-statistic of -10.48 after controlling for size. The results also show similar patterns in the difference of the Fama-French (1993) three-factor alphas. The difference in the equally-weighted average monthly returns of the extreme IVOL portfolio is -0.91%, with a *t*-statistic of -10.81. The difference in the Fama-French (1993) three-factor alphas have the same signs and are statistically significant. In Panel B of Table 3, we find a statistically significant return difference between the extreme IVOL portfolios after controlling for momentum return. The difference in the value-weighted mean return is -1.06% with a *t*-statistic of -11.16. The difference in equal-weighted portfolio, -0.97%, is statistically significant (*t*-statistic = -14.31). The corresponding difference in the Fama-French three-factor alpha is -1.34% (-1.20%) with a *t*-statistic of -13.19 (-15.71). Panel C of Table 3 reports the difference of the IVOL portfolio average monthly returns after controlling for the turnover ratio. The difference of mean return for the value-weighted portfolio is -0.83% per month with a *t*-statistic of -9.63. The difference in the equal-weighted returns of the highest and lowest IVOL portfolio is -0.75% (*t*-statistic = -10.97). The corresponding difference in the Fama-French three-factor alphas for both value-weighted and equal-weighted are also statistically significant. Therefore, we confirm that the negative IVOL-return relationship persists after controlling for size, momentum return, and turnover.

Table 4 presents the relation between idiosyncratic risk and expected returns for non-dividend-paying firms and dividend-paying firms after controlling for size, momentum, and turnover for both value-weighted and equal-weighted portfolios. Panel A.1 of Table 4 shows that the difference between the highest and lowest idiosyncratic volatility in value-weighted (equal-weighted) portfolios for non-dividend-paying firms after controlling for size is -1.41% (-1.47%) with a *t*-statistic of -11.39 (-11.84). The corresponding difference in the Fama-French (1993) three-factor alpha is -1.62% (-1.67%) with a *t*-statistic of -11.44 (-11.66), indicating that the average difference of return is statistically significant. As shown in Panel A.2 of Table 4, the return difference between the extreme IVOL value-weighted portfolios for dividend-paying firms after controlling for size is statistically significant at -0.41% with a *t*-statistic of -6.28. The return difference in Fama-French's (1993) three-factor alpha is statistically significant. We also find a similar negative IVOL-returns relationship pattern in the equal-weighted portfolios. Panel A.3 of Table 4 reports that the difference in the return spreads of the extreme IVOL portfolio between non-dividend-paying firms and dividend-paying firms is statistically significant for both value-weighted and equal-weighted portfolios. The difference between dividend-paying and non-dividend-paying firms in Fama-French's (1993) three-factor alpha for the value-weighted portfolios is about -0.87% per month with a *t*-statistic of -6.16. We also estimate the Fama-French (1993) three-factor alpha for equal-weighted portfolios and find similar results.

Table 4

Returns on Portfolios of Stocks Sorted by Idiosyncratic Volatility by Dividend Payment After Controlling for Firm Characteristics

Panel A: Controlling for Size

Panel A.1: Stocks without Dividends

	1 (L)	2	3	4	5	6	7	8	9	10 (H)	H-L	Alpha
VW	1.36	1.53	1.52	1.39	1.38	1.26	1.11	0.91	0.45	-0.06	-1.41	-1.62
											(-11.39)	(-11.44)
EW	1.41	1.55	1.51	1.40	1.39	1.27	1.13	0.92	0.46	-0.06	-1.47	-1.67
											(-11.84)	(-11.66)
Num	123	124	124	124	123	124	124	124	124	123	0	

Panel A.2: Stocks with Dividends

VW	1.06	1.25	1.32	1.33	1.34	1.26	1.29	1.24	1.00	0.64	-0.41	-0.76
											(-6.28)	(-10.29)
EW	1.08	1.26	1.32	1.35	1.36	1.27	1.31	1.26	1.01	0.65	-0.42	-0.75
											(-6.47)	(-10.18)
Num	171	171	171	171	171	172	171	171	171	171	0	

Panel A.3: Stocks without Dividends - Stocks with Dividends

VW	Alpha	EW	Alpha
-1.00	-0.87	-1.05	-0.92
(-7.31)	(-6.16)	(-7.71)	(-6.52)

Panel B: Controlling for MOM

Panel B.1: Stocks without Dividends

VW	1.42	1.36	1.20	1.21	1.05	1.02	0.70	0.77	0.40	-0.46	-1.88	-2.07
											(13.55)	(-13.43)
EW	1.43	1.57	1.52	1.40	1.23	1.21	1.02	1.00	0.71	-0.30	-1.73	-1.91
											(-15.61)	(-15.56)
Num	123	124	124	124	123	124	124	124	124	123	0	

Table 4 (Continued)

Panel B.2: Stocks with Dividends

VW	1.03	1.09	1.00	1.02	0.98	0.89	1.00	0.94	0.80	0.54	-0.49	-0.80
											(-5.14)	(-8.07)
EW	1.15	1.22	1.24	1.29	1.28	1.26	1.27	1.23	1.06	0.62	-0.52	-0.74
											(-9.03)	(-11.06)
Num	171	171	171	171	171	172	171	171	171	171	0	

Panel B.3: Stocks without Dividends - Stocks with Dividends

VW	Alpha	EW	Alpha
-1.40	-1.27	-1.21	-1.16
(-8.32)	(-7.26)	(-9.84)	(-9.07)

Panel C: Controlling for TOVER

Panel C.1: Stocks without Dividends

VW	1.37	1.31	1.15	1.39	1.22	0.92	0.84	0.82	0.37	-0.26	-1.63	-1.97
											(-11.75)	(-13.26)
EW	1.39	1.47	1.35	1.50	1.44	1.16	1.05	1.07	0.62	-0.01	-1.40	-1.68
											(-11.71)	(-12.71)
Num	123	124	124	124	123	124	124	124	124	123	0	

Panel C.2: Stocks with Dividends

VW	0.97	1.00	1.04	1.04	1.08	0.95	1.00	0.94	0.96	0.55	-0.42	-0.72
											(-5.19)	(-8.48)
EW	1.09	1.19	1.29	1.29	1.33	1.24	1.29	1.24	1.17	0.75	-0.34	-0.69
											(-5.59)	(-10.20)
Num	171	171	171	171	171	172	171	171	171	171	0	

Panel C.3: Stocks without Dividends - Stocks with Dividends

VW	Alpha	EW	Alpha
-1.22	-1.26	-1.06	-1.00
(-7.70)	(-7.70)	(-8.12)	(-7.30)

These results confirm our hypothesis that the IVOL-puzzle is significantly stronger for non-dividend-paying firms than those firms with dividends after controlling for size.Double sorted, decile portfolios are formed every month from January 1965 to December 2016 from CRSP based on idiosyncratic volatility calculated using the Fama-French (1993) three-factor model. The stocks are sorted into decile portfolios based on their IVOL each month and compute the value-weighted (VW) and equal-weighted (EW) returns of these portfolios in the following month after controlling the firm size (momentum, turnover ratio). Portfolio 1 (10) is the portfolio of stocks in the bottom (top) decile of IVOL. Only stocks with a price higher than or equal to $5 and at least 12 daily returns each month are included. Num is the number of stocks. Size is the average market capitalization (in billions of dollars) of firms within each portfolio. MOM is the buy and hold return over the past six months. TOVER (turnover ratio) is trading volume divided by the number of shares outstanding. DVR is the dividend ratio. Alpha is the difference in Fama-French's (1993) three-factor alphas between the highest and lowest IVOL portfolio. The *t*-statistics, reported in parentheses, are adjusted for autocorrelation using three lags in the Newey-West method.

Panel B of Table 4 shows the relation between idiosyncratic volatility and expected returns after controlling for momentum. The IVOL-puzzle exists for different dividend payment policies, and the IVOL-puzzle for non-dividend-paying firms is significantly stronger than those firms with dividends in Panel B.3. As presented in Panel C of Table 4, both the value-weighted and equal-weighted average return differences between the highest and lowest IVOL portfolio are statistically significant, and the extreme IVOL portfolio return difference between non-dividend-paying and dividend-paying firms after controlling for turnover is statistically significant as well in Panel C.3.

Overall, findings show that the idiosyncratic volatility puzzle from the bivariate sort on size (momentum, turnover) is statistically significant. Moreover, the idiosyncratic volatility puzzle is significantly stronger for non-dividend-paying firms than those for dividend-paying firms. These results are consistent with the hypothesis. The Fama-MacBeth (1973) cross-sectional regressions are then performed, including these explanatory variables, to test the robustness in the next section.

Fama-MacBeth Cross-Sectional Regressions

The firm-level Fama-MacBeth (1973) cross-sectional regressions is used to test the relation between idiosyncratic volatility and subsequent expected returns. We run the following cross-sectional regression:

$$R_{i,t+1} = \alpha_t + \beta_{1t}IVOL_{i,t} + \beta_{2t}Beta_{i,t} + \beta_{3t}Size_{i,t} + \beta_{4t}BTM_{i,t} + \beta_{5t}MOM_{i,t} + \beta_{6t}TOVER_{i,t} + \varepsilon_{i,t+1}\,, \tag{2}$$

where the dependent variable, $R_{i,t+1}$, is the return on stock i in month t + 1. Independent lagged variables include the idiosyncratic volatility ($IVOL_{i,t}$), the estimate of stock i's beta in month t ($Beta_{i,t}$), the market capitalization ($Size_{i,t}$), the book-to-market ratio ($BTM_{i,t}$), the cumulative return over 12-month period ending in month t ($MOM_{i,t}$), the turnover ratio ($TOVER_{i,t}$). These variables are defined in detail and calculated in the Appendix.

Cross-sectional regressions were performed with several specifications and report the average of the estimated coefficients in Table 5.[6] Each month from January 1965 to December 2016, we run firm-level cross-sectional regressions of month $t + 1$ individual stock returns on the lagged explanatory variables computed in month t.

Table 5

Fama-MacBeth Cross-Sectional Regressions by Dividend Payment

	(1) Without Dividends	(2) With Dividends	(3) (1) - (2)	(4) Without Dividends	(5) With Dividends	(6) (4) - (5)
Intercept	0.019	0.014	0.006	0.041	0.028	0.013
	(7.27)	(8.45)	(3.23)	(5.65)	(5.55)	(1.92)
IVOL	-0.074	-0.035	-0.039	-0.102	-0.060	-0.041
	(-8.17)	(-3.23)	(-4.03)	(-9.51)	(-8.44)	(-4.30)
Beta				-0.001	-0.000	-0.000
				(-1.41)	(-0.10)	(-1.35)
Size				-0.002	-0.001	-0.001
				(-4.03)	(-3.51)	(-2.20)
BTM				0.001	0.001	0.000
				(1.34)	(1.58)	(0.54)
MOM				0.007	-0.002	0.009
				(3.87)	(-0.94)	(4.93)
TOVER				0.001	0.002	-0.001
				(1.74)	(2.33)	(-0.91)
Num	1,230	1,710		1,230	1,710	

Explanatory variables include the stock's idiosyncratic volatility (IVOL), market beta (Beta), the average market capitalization (in billions of dollars) of firms (Size), book-to-market ratio (BTM), the buy and hold return over the past six months (MOM), turnover ratio (TOVER). Num is the number of stocks. The table presents the time-series

[6] We appreciate the point by the anonymous referee on the computation of standard errors in the Fama-MacBeth method in Tables 5 and 8. As the referee suggests that controlling for serial correlation in the computation of standard errors of the estimates of the Fama-MacBeth method is important, we use Newey-West method with 3 lags since the results are similar with lags from 1 to 6.

means of coefficient estimates from the cross-sectional regressions. Stocks with a price of less than $5 at the end of month *t - 1* are excluded from the sample. The results for non-dividend-paying firms and dividend-paying firms are shown separately in columns. The *t*-statistics, reported in parentheses, are adjusted for autocorrelation using three lags in the Newey-West method.

Model (1) and model (2) are results of univariate regressions on IVOL separately for the non-dividend-paying and dividend-paying firms sample. We find that the coefficient on IVOL for the non-dividend-paying firm's sample is -0.074 and statistically significant (*t*-statistic = -8.17). For dividend-paying firms, the estimated coefficient of IVOL is weakened at -0.035, albeit it shows a significant negative relation between idiosyncratic volatility and subsequent expected returns. Model (3) reports the difference of the estimated coefficient of IVOL between non-dividend-paying firms and dividend-paying samples and is significant at -0.039 and statistically significant (*t*-statistic = -4.03). This evidence suggests that the IVOL-puzzle is stronger for non-dividend-paying firms than those firms with dividends.

The remaining models report the results after including all control variables. The estimated coefficient on IVOL for non-dividend-paying firms is negative at -0.102 with a *t*-statistic of -9.51. The coefficient on firm size is also negative and statistically significant. The average slope on IVOL remains negative and significant in model (5) after adding all control variables for dividend-paying firms. The model (6) shows similar results compared to model (3), confirming our previous findings. This result is consistent with our hypothesis that the negative relation between idiosyncratic volatility and expected returns is stronger for non-dividend-paying firms than those presented for dividend-paying firms even after controlling firm characteristics.

Idiosyncratic Volatility, Stock Returns, and Investor Sentiment

In this section, we further investigate our main hypothesis across investor sentiment. We separate each month by the investor sentiment index (Baker & Wurgler, 2006) to identify whether a particular portfolio formation month is optimistic or pessimistic. Table 6 reports the value-weighted and equal-weighted returns of decile portfolios based on their idiosyncratic volatility. As shown in Table 6, we find that the difference in the value-weighted returns of the highest and lowest IVOL portfolio in optimistic periods is significant at -1.82% (*t*-statistic = -4.67). The corresponding Fama-French three-factor alpha is -1.59%, which is also statistically significant (*t*-statistic = -6.44). The equal-weighted average monthly return difference between the highest and lowest IVOL portfolio in optimistic periods is significant at -1.53% with a *t*-statistic of -4.46. The corresponding alpha based on the three-factor model presents a similar result compared to the value-weighted portfolio under optimistic sentiment periods.

Double sorted, decile portfolios are formed every month from January 1965 to December 2016 from CRSP based on idiosyncratic volatility calculated using the Fama-French (1993) three-factor model. In each month, stocks are sorted into optimistic and pessimistic sentiment periods. N is the sentiment period in months. We then sort the stocks into decile portfolios based on their IVOL each month and compute the value-weighted (VW) and equal-weighted (EW) returns of these portfolios in the following month. Portfolio 1 (10) is the portfolio of stocks in the bottom (top) decile of IVOL. We only include stocks with a price higher than or equal to $5 and at least 12 daily returns each month. Num is the number of stocks. Alpha is the difference in Fama-French's (1993) three-factor alphas between the highest and lowest IVOL portfolios. The *t*-statistics, reported in parentheses, are adjusted for autocorrelation using three lags in the Newey-West method.

Table 6

Portfolios Sorted On Idiosyncratic Volatility Across Investor Sentiment

	Optimistic Sentiment (N=324)		Pessimistic Sentiment (N=277)	
	VW	EW	VW	EW
1 (L)	1.04	1.13	0.68	0.96
2	1.03	1.25	0.87	1.13
3	0.82	1.15	1.06	1.34
4	0.78	1.16	1.20	1.49
5	0.90	1.13	1.21	1.59
6	0.62	1.06	1.31	1.75
7	0.56	0.81	1.49	1.68
8	0.26	0.68	1.50	1.82
9	-0.03	0.37	1.60	1.65
10 (H)	-0.77	-0.40	0.92	0.91
H-L	-1.82	-1.53	0.23	-0.04
	(-4.67)	(-4.46)	(0.64)	(-0.14)
Alpha	-1.59	-1.34	-0.66	-0.82
	(-6.44)	(-7.50)	(-2.85)	(-4.21)
Num	294	294	294	294

Table 6 confirms Baker and Wurgler (2007) that there is no significant relation between idiosyncratic volatilities and subsequent expected returns for both value-weighted and equally weighted portfolios when investor sentiment in pessimistic periods. These findings indicate that the negative relation between the IVOL and subsequent expected returns is attributable to the difference in sentiment. Our result is consistent with Baker and Wurgler (2007) that the stocks most sensitive to investor sentiment will be those of companies that are younger, smaller, more volatile, unprofitable, non-dividend-paying, distressed, or with extreme growth potential. These stocks have a high degree of idiosyncratic volatility in their returns.

Overall, Table 6 confirms our hypothesis that the negative relation between IVOL and expected returns mainly exists in those stocks in optimistic periods. The IVOL-puzzle disappears when stocks are in pessimistic periods.

Idiosyncratic Volatility, Stock Returns, Dividend Payment, and Investor Sentiment

The evidence in the previous section shows that the negative relation between idiosyncratic volatility and expected return is significant only during optimistic sentiment periods for both value-weighted and equally weighted portfolios. This section examines the IVOL-return relationship in different investor sentiment separately for non-dividend-paying firms and dividend-paying firms. We first identify dividend-paying firms and non-dividend-paying firms and sort stocks into decile portfolios based on idiosyncratic volatility separately. We then compute returns separately for optimistic and pessimistic sentiment periods using sentiment measures (Baker and Wurgler, 2006, 2007).

Table 7 shows the results for the relation between idiosyncratic volatility and expected returns separately for optimistic sentiment and pessimistic sentiment periods for non-dividend- paying firms and dividend-paying firms. Panel A (B) of Table 7 shows results under the optimistic (pessimistic) sentiment period. The value-weighted average return difference between the highest and lowest IVOL portfolio in optimistic sentiment periods for non-dividend-paying firms is -2.10% per month with a *t*-statistic of -5.08. The difference in the Fama-French three-factor alpha between the highest and lowest IVOL portfolio is -1.87% per month with a *t*-statistic of -5.40. We find similar patterns in equal-weighted portfolios for non-dividend-paying firms in optimistic sentiment periods. The return difference between the highest and lowest IVOL portfolio is -1.91% (*t*-statistic = -5.72), and the corresponding Fama-French three-factor alpha is -1.66% (*t*-statistic = -6.93. In Panel B, the value (equal)-weighted average return difference between the highest and lowest IVOL portfolio for non-dividend-paying firms under pessimistic sentiment periods is -0.78% (-0.94%) with a *t*-statistic of -1.93 (-2.87). The corresponding high-low difference in the Fama-French three-factor alpha is significant at -1.40% (-1.52%) (*t*-statistic = -3.59 (-5.29)). Thus, our results suggest that the IVOL puzzle for non-dividend-paying firms is not subject to investor sentiment.

Decile portfolios are formed every month from January 1965 to December 2016 from CRSP based on idiosyncratic volatility calculated using the Fama-French (1993) three-factor model. Monthly IVOL (idiosyncratic volatility) is the daily idiosyncratic volatility times the square root of the number of trading days in the month. In each month, stocks are sorted into non-dividend-paying firms and dividend-paying firms. We then sort stocks into optimistic and pessimistic sentiment periods. N is the sentiment period in months. Stocks in each subgroup are sorted into decile portfolios based on their IVOL each month and compute the value-weighted (VW) and equal-weighted (EW) returns of these portfolios in the following month. Portfolio 1 (10) is the portfolio of stocks in the bottom (top) decile of IVOL. We only include stocks with a price higher than or equal to $5 and at least 12 daily returns each month. Num is the number of stocks. Alpha is the difference in Fama-French's (1993) three-factor alphas between the highest and lowest IVOL portfolios. The *t*-statistics, reported in parentheses, are adjusted for autocorrelation using three lags in the Newey-West method.

Table 7

Returns on Portfolios of Stocks Sorted by Idiosyncratic Volatility by Dividend Payment and Investor sentiment

	Panel A: Optimistic Sentiment (N=324)				Panel B: Pessimistic Sentiment (N=277)			
	Without Dividends		With Dividends		Without Dividends		With Dividends	
	VW	EW	VW	EW	VW	EW	VW	EW
1 (L)	1.10	1.03	1.03	1.17	1.39	1.68	0.69	0.90
2	0.86	1.01	1.06	1.23	1.80	2.06	0.78	1.05
3	0.84	0.98	1.01	1.27	1.93	2.05	0.91	1.20
4	0.75	0.85	0.83	1.21	1.73	1.91	1.06	1.32
5	0.44	0.75	0.81	1.20	1.89	2.26	1.15	1.51
6	0.35	0.55	0.73	1.12	1.89	2.09	1.17	1.51
7	0.01	0.41	0.91	1.19	1.67	1.92	1.31	1.52
8	-0.05	0.29	0.44	0.99	1.73	1.69	1.36	1.61
9	-0.85	-0.09	0.45	0.96	1.54	1.54	1.43	1.51
10 (H)	-1.01	-0.89	0.04	0.41	0.61	0.74	1.07	0.85
H-L	-2.10	-1.91	-1.00	-0.76	-0.78	-0.94	0.38	-0.06
	(-5.08)	(-5.72)	(-3.24)	(-3.85)	(-1.93)	(-2.87)	(1.15)	(-0.23)
Alpha	-1.87	-1.66	-1.01	-0.88	-1.40	-1.52	-0.39	-0.67
	(-5.40)	(-6.93)	(-3.84)	(-6.53)	(-3.59)	(-5.29)	(-1.89)	(-5.07)
Num	123	123	171	171	123	123	171	171

However, the results for dividend-paying firms in Table 7 show strong contrasts from non-dividend-paying firms. As shown in Panel A of Table 7, the value-weighted average return difference between the highest and lowest idiosyncratic volatility portfolio for dividend-paying firms in optimistic periods is statistically significant at -1.00% per month with a *t*-statistic of -3.24. The equal-weighted average return difference is also statistically significant. The corresponding high-low IVOL portfolio difference in the Fama-French three-factor alphas for both value-weighted and equal-weighted portfolios are -1.01% (*t*-statistic: -3.84) and -0.88% (*t*-statistic: -6.53), respectively. On the other hand, we do not find a significant relation between idiosyncratic volatility and expected return for dividend-paying firms in pessimistic periods.

In summary, we document that while the IVOL-puzzle for dividend-paying firms only exists under optimistic sentiment periods, it exists under both optimistic and pessimistic sentiment periods for non-dividend-paying firms.

Firm-Level Cross-Sectional Regressions

This section further examines the cross-sectional relation between idiosyncratic volatility and expected returns along with dividend policy and investor sentiment by using Fama-MacBeth's (1973) cross-sectional regressions. Table 8 presents the time-series mean of the regression coefficients obtained from running the monthly Fama-MacBeth (1973) cross-sectional regressions. We run several regressions for optimistic and pessimistic sentiment periods separately. In the univariate regression under optimistic sentiment periods, the coefficient estimate on IVOL for firms without dividends in regression (1) is -0.087 with a *t*-statistic of -7.83. The coefficient estimate of IVOL for firms with dividends in regression (2) is negative and statistically significant at -0.054 with a *t*-statistic of -4.66. The difference of the estimated coefficient of IVOL between firms without dividends and firms with dividends in regression (3) is also statistically significant at -0.033 with a *t*-statistic of -2.57. When we include other control variables in the monthly regressions, the coefficient of IVOL for firms without dividends in regression (4) is -0.094 with a *t*-statistic of -9.93 under the optimistic sentiment. In regression (5), the coefficient estimate of IVOL for firms with dividends is negative and statistically significant at -0.058 with a *t*-statistic of -5.58.

Table 8

Fama-MacBeth Cross-Sectional Regressions by Investor Sentiment and Dividend Payment

	Optimistic Sentiment (N=324)						Pessimistic Sentiment (N=277)					
	(1) Without Dividends	(2) With Dividends	(3) (1)-(2)	(4) Without Dividends	(5) With Dividends	(6) (4)-(5)	(7) Without Dividends	(8) With Dividends	(9) (7)-(8)	(10) Without Dividends	(11) With Dividends	(12) (10)-(11)
Intercept	0.016	0.015	0.001	0.029	0.025	0.005	0.025	0.013	0.011	0.052	0.032	0.020
	(4.79)	(6.26)	(0.61)	(4.44)	(4.50)	(1.37)	(5.73)	(5.66)	(4.03)	(4.18)	(3.68)	(2.64)
IVOL	-0.087	-0.054	-0.033	-0.094	-0.058	-0.035	-0.060	-0.013	-0.047	-0.105	-0.062	-0.044
	(-7.83)	(-4.66)	(-2.57)	(-9.93)	(-5.58)	(-3.39)	(-4.79)	(-0.89)	(-3.18)	(-4.99)	(-6.20)	(-2.58)
Beta				-0.000	-0.000	-0.000				-0.000	0.000	-0.001
				(-2.03)	(-0.89)	(-1.13)				(-0.18)	(0.65)	(-0.84)
Size				-0.001	-0.001	-0.001				-0.002	-0.002	-0.001
				(-3.14)	(-2.42)	(-1.90)				(-2.87)	(-2.70)	(-1.37)
BTM				0.003	0.001	0.002				-0.001	0.001	-0.002
				(2.91)	(1.07)	(2.72)				(-0.44)	(1.21)	(-1.69)
MOM				0.008	-0.000	0.008				0.005	-0.005	0.010
				(3.85)	(-0.06)	(3.63)				(1.72)	(-1.36)	(3.50)
TOVER				0.001	-0.000	0.001				0.001	0.004	-0.003
				(1.30)	(-0.01)	(0.96)				(1.08)	(2.78)	(-1.72)
Num	1,230	1,710		1,230	1,710		1,230	1,710		1,230	1,710	

The difference of the coefficient of IVOL between firms without dividends and firms with dividends is still statistically significant at -0.035 with a *t*-statistic of -3.39 in regression (6). Under pessimistic sentiment periods, we find that the IVOL coefficient is negative (-0.060) and statistically significant (*t*-statistic = -4.79) for firms without dividends in the univariate regression (7). However, the coefficient of IVOL is insignificant (*t*-statistic of -0.89) for firms with dividends in regression (8) under pessimistic sentiment periods. The difference of the estimated coefficient of IVOL between firms without dividends and firms with dividends in regression (9) is negative (-0.047) and statistically significant with a *t*-statistic of -3.18. In the full specification that includes all of the control variables, the coefficient on IVOL for firms without dividends under pessimistic sentiment periods is negative (-0.105) and statistically significant (*t*-statistic = -4.99) in regression (10). The coefficient on IVOL in regression (11) is negative (-0.062) and statistically significant (*t*-statistic = -6.20) for firms with dividends under pessimistic sentiment periods. The difference of coefficients between firms without dividends and firms with dividends under pessimistic sentiment periods in regression (12) is -0.044, which is statistically significant with a *t*-statistic of -2.58. The results are similar to those previously reported under optimistic sentiment periods.

Each month from January 1965 to December 2016, we run firm-level cross-sectional regressions of month $t + 1$ individual stock returns on the lagged explanatory variables, computed in month t. Explanatory variables include a stock’s idiosyncratic volatility (IVOL), market beta (Beta), the average market capitalization (in billions of dollars) of firms (Size), book-to-market ratio (BTM), the buy and hold return over the past six months, (MOM), turnover ratio (TOVER). We sort stocks into optimistic and pessimistic sentiment periods. N is the sentiment period in months. The table presents the time-series means of coefficient estimates from the cross-sectional regressions. N is the sentiment period in months. Stocks with a price of less than $5 at the end of month $t - 1$ are excluded from the sample. Num is the number of stocks. The results for non-dividend-paying firms and dividend-paying firms in different investor sentiments are shown separately in columns. The *t*-statistics, reported in parentheses, are adjusted for autocorrelation using three lags in the Newey-West method.

Overall, we find that the estimated coefficient of IVOL for firms without dividends is negative and statistically significant under both optimistic and pessimistic sentiment periods with and without control variables. Thus, our firm-level regressions confirm the results of Table 7 that the IVOL puzzle for firms without dividends is not subject to investor sentiment. Moreover, we show that the IVOL puzzle only exists under optimistic sentiment periods for firms with dividends. This finding is also consistent with the result of Table 7. We also confirm that the negative relationship between idiosyncratic volatility and subsequent returns is significantly stronger for non-dividend-paying firms than those with dividends across both sentiment periods. These findings extend existing literature that the role of dividends in the relation between idiosyncratic risk and expected return is not affected by investor sentiment.

CHAPTER 4

CONCLUSION

Numerous studies have shown empirical evidence on the relation between idiosyncratic volatility and expected returns. Ang et al. (2006, 2009) find a negative relation between monthly idiosyncratic volatility and value-weighted portfolio returns in the following month. An alternative result shows no significant IVOL puzzle for equal-weighted portfolio returns by Bali and Cakici (2008). The idiosyncratic volatility puzzle is considered a significant anomaly in the finance literature. In this paper, we investigate the role of dividend policy in the IVOL-puzzle because information about dividend payments would reduce the uncertainty of stocks, then decrease idiosyncratic volatility (Pastor & Veronesi, 2003). We hypothesize that the negative relation between idiosyncratic volatility and expected returns would be concentrated in non-dividend-paying firms. Our results support this hypothesis. We find a robust negative relationship between idiosyncratic volatility and subsequent returns for non-dividend-paying firms for equal-weighted and value-weighted portfolios. However, we do not find such a relationship for dividend-paying firms in value-weighted portfolio returns. Also, we further document that the IVOL puzzle is significantly stronger for non-dividend-paying firms than those with dividends.

In addition, we investigate the relation between idiosyncratic volatility and expected returns across investor sentiment. Baker and Wurgler (2006) present that high volatility stocks tend to earn lower (higher) returns in positive (negative) sentiment periods. We hypothesized a negative relationship between idiosyncratic volatility and expected returns among stocks only in optimistic sentiment periods. We confirm our hypothesis that the idiosyncratic volatility puzzle exists among stocks in optimistic sentiment periods. In contrast, the IVOL-puzzle pattern disappears when investor sentiment in pessimistic periods.

We further examined the relationship between idiosyncratic volatility and expected returns with dividend payments and investor sentiment together. We show that IVOL-puzzles for non-dividend-paying firms are not subject to investor sentiment. For dividend-paying firms, the IVOL puzzle only exists under optimistic sentiment periods. Moreover, the negative relation between idiosyncratic volatility and expected returns is stronger for non-dividend-paying firms than those with dividends across both sentiment periods.

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APPENDIX A

VARIABLE DEFINITIONS

Variable Definitions

IDIOSYNCRATIC VOLATILITY: We calculate idiosyncratic volatility of stock *i* from the following time-series regression of excess daily stock returns on the daily Fama-French (1993) three factors:

$$R_{i,d} - R_{f,d} = \alpha_i + \beta_i(R_{m,d} - R_{f,d}) + s_i SMB_d + h_i HML_d + \varepsilon_{i,d},$$

where $R_{i,d}$ is the daily excess return of stock *i* on day *d*, $R_{f,d}$ is the daily risk-free rate, $(R_{m,d} - R_{f,d})$, $s_i SMB_d$, and $h_i HML_d$ are the daily Fama-French (1993) factors. The idiosyncratic volatility of a stock *i* is measured as the standard deviation of the regression residuals. We calculate the monthly idiosyncratic volatility by the multiplying the daily standard deviation by the square root of the number of trading days in the month:

$$IVOL_{i,t} = \sqrt{\mathrm{var}(\varepsilon_{i,d})} \times \sqrt{D_t} \ ,$$

where D_t is the number of trading days for stock *i* in month *t*.

BETA: Following Scholes and Williams (1977) and Dimson (1979), we calculate the beta after controlling for the effect of nonsynchronous trading:

$$R_{i,d} - R_{f,d} = \alpha_i + \beta_{1,i}(R_{m,d-1} - R_{f,d-1}) + \beta_{2,i}(R_{m,d} - R_{f,d}) + \beta_{3,i}(R_{m,d+1} - R_{f,d+1}) + \varepsilon_{i,d} \ ,$$

where $R_{i,d}$ is the daily excess return of stock *i* on day *d*, $R_{m,d}$ is the market return on day *d*, and $R_{f,d}$ is the daily risk-free rate. The estimate of a stock's beta in month *t* is given by

$$\hat{\beta}_i = \hat{\beta}_{1,i} + \hat{\beta}_{2,i} + \hat{\beta}_{3,i} \ .$$

SIZE: Firm size is natural log of the average market capitalization (a stock's price times shares outstanding in billions of dollars) of firms.

BTM: BTM is the firm's book-to-market ratio. Following Fama and French (1992), the book-to-market ratio is measured in month t using the book value of equity for the fiscal year ending in the prior calendar year and market value of equity at the end of December of the prior calendar year. The book value of equity plus balance-sheet deferred taxes for the firm's latest fiscal year ending in the prior calendar year.

MOM: MOM is the momentum variable following Jegadeesh and Titman (1993). The momentum variable for each stock in month t is defined as its buy and hold return over the past six months.

TOVER: TOVER (turnover ratio) is trading volume divided by the number of shares outstanding.

DVR: DVR (dividend payout ratio) equals cash dividends divided by the net income of firms.

IDIOSYNCRATIC VOLATILITY: We calculate idiosyncratic volatility of stock i from the following time-series regression of excess daily stock returns on the daily Fama-French (1993) three factors:

$$R_{i,d} - R_{f,d} = \alpha_i + \beta_i(R_{m,d} - R_{f,d}) + s_i SMB_d + h_i HML_d + \varepsilon_{i,d},$$

where $R_{i,d}$ is the daily excess return of stock i on day d, $R_{f,d}$ is the daily risk-free rate, $(R_{m,d} - R_{f,d})$, $s_i SMB_d$, and $h_i HML_d$ are the daily Fama-French (1993) factors. The idiosyncratic volatility of a stock i is measured as the standard deviation of the regression residuals. We calculate the monthly idiosyncratic volatility by the multiplying the daily standard deviation by the square root of the number of trading days in the month:

$$IVOL_{i,t} = \sqrt{\mathrm{var}(\varepsilon_{i,d})} \times \sqrt{D_t} \ ,$$

where D_t is the number of trading days for stock i in month t.

BETA: Following Scholes and Williams (1977) and Dimson (1979), we calculate the beta after controlling for the effect of nonsynchronous trading:

$$R_{i,d} - R_{f,d} = \alpha_i + \beta_{1,i}(R_{m,d-1} - R_{f,d-1}) + \beta_{2,i}(R_{m,d} - R_{f,d}) + \beta_{3,i}(R_{m,d+1} - R_{f,d+1}) + \varepsilon_{i,d} \ ,$$

where $R_{i,d}$ is the daily excess return of stock i on day d, $R_{m,d}$ is the market return on day d, and $R_{f,d}$ is the daily risk-free rate. The estimate of a stock's beta in month t is given by $\hat{\beta}_i = \hat{\beta}_{1,i} + \hat{\beta}_{2,i} + \hat{\beta}_{3,i}$.

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