2008

The Cross-Section of Stock Return and Volatility

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN FINANCE

SINGAPORE MANAGEMENT UNIVERSITY
2008

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Abstract

There has been increasing research on the cross-sectional relation between stock return and volatility. Conclusions are, however, mixed, partially because volatility or variance is modeled or parameterized in various ways. This paper, by using the Jiang and Tian (2005)'s model-free method, estimates daily option implied volatility for all US individual stocks from 1996:01 to 2006:04, and then employs this information to extract monthly volatilities and their idiosyncratic parts for cross-sectional regression analyses. We follow the Fama and French (1992) cross-sectional regression procedure and show that each of the 4 monthly measures of change of total volatility, total volatility, expected idiosyncratic variance, and expected idiosyncratic volatility is a negative priced factor in the cross-sectional variation of stock returns. We also show that the negative correlation between return and total volatility or expected idiosyncratic variance or expected idiosyncratic volatility strengthens as leverage increases or credit rating worsens. However, leverage does not play a role in the relation between return and change of total volatility. Finally, responding to recent papers, we show that the investor sentiment does not have a significant impact on the cross-sectional relation between return and volatility.

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Acknowledgement

I highly appreciate my supervisor LIM Kian Guan and TING Hian Ann Christopher.

1. Introduction

1.1 Literature Review

There has been extensive literature on the relation between return and volatility. In this thesis, we shall explore the rationality between return as well as both volatility and variance. Some research into stock indices or portfolios, while others focus on individual stocks; some compute volatilities by various econometrics models, while others use option implied volatilities; some differentiate between expected and unexpected volatilities, while others directly use total (gross) volatilities; some work on level of volatilities, while others work on innovations; and some explore time-series relations, while others are interested in cross-sectional relations. The conclusions are so far mixed, partly due to the differences described here. This paper tries to uncover the cross-sectional relation between individual stock return and innovation or level of volatility or variance, by using option implied volatility accurately computed by the Jiang and Tian (2005)'s model-free method. Our approach is advantageous as it avoids pitfalls or biases due to wrong assumptions for the underlying price processes as well as underlying volatility processes. We do not make any explicit assumption about these to arrive at our empirical results.

1.1.1 On Time-Series Aspect

Empirical findings on time-series aspect are conflicting. Black (1976), Christie (1982), Turner, Startz, and Nelson (1989), Glosten, Jagannathan, and Runkle (1993), Nelson (1991), Daouk and Ng (2007) find the relation between volatility and expected return to be negative. French, Schwert, and Stambaugh (1987), Campbell and Hentschel (1992), and Goyal and Santa-Clara (2003), Jiang and Lee (2004) find it to be positive. Baillie and DeGennaro (1990) conclude that any relation between a stock portfolio's return and volatility is weak. Interestingly, Guo and Savickas (2004) show a positive risk-return relation for the stock market as a whole, but find that idiosyncratic volatility is negatively related to future stock returns. Explanations of the findings also vary: Black (1997), Christie (1982), Schwert (1990), and Duffee (1995) resort to leverage hypothesis (a drop in the value of the stock increases financial leverage, which makes the stock riskier and increases its volatility); whereas Pindyck (1984), French, Schwert, and Stambaugh (1987), and Campbell and Hentschel (1992) conclude with time-varying risk premium theory (volatility feedback effect). Interestingly, Daouk and Ng (2007) reveal that at the firm level, financial leverage explains most of the volatility asymmetry, but it does not explain index-level volatility asymmetry. Timing issues are the key between the two competing explanations: leverage hypothesis claims that return shocks lead to changes in conditional volatility, while volatility feedback effect contends that return shocks result from changes in conditional volatility. Besides these differences, Black (1976), Christie (1982), Cheung and Ng (1992), Braun, Nelson, and Sunier (1995), and Duffee (1995) worked on individual stocks or portfolios, while others mainly focus on market index. Furthermore, Black (1976), Christie (1982), and Duffee (1995) use unconditional volatility, while others are interested in conditional volatility. Most of these studies estimate volatility by employing specifications of econometric models, especially the ARIMA and GARCH model.

Still on time-series aspect, Giot (2003) find that there is a negative significant relation between index return and its option implied volatility. However, there have been so far few attempts to apply option implied volatility to a large set of individual stocks, mainly due to data availability and the question of how to compute an implied volatility accurately. Dennis, Mayhew, and Stivers (2005) find that the negative relation between return and innovation of implied volatility is much stronger in index than in individual firms, using S&P 100 index and 50 largest U.S. stocks. Figlewski and Wang (2007), by applying implied volatility to S&P 100 index component stocks, conclude that the “leverage effect” is actually a “down market effect” (the negative relation is much weaker or even nonexistent when stock price increases) that may have little direct connection to firm leverage.

1.1.2 On Cross-sectional Regression

There is a lively debate on empirical findings on the pricing of volatility in cross-sectional stock return. Lehmann (1990), Malkiel and Xu (1997, 2006), Spiegel and Wang (2005), and Fu (2005) find that volatility is positively related to the cross-sectional stock returns. Bali and Cakici (2006) conclude that there is no significant, robust relation between volatility and return. Longstaff (1989) finds that a cross-sectional regression coefficient on total variance for size-sorted portfolios carries an insignificant negative sign. These results emanate from quite different methodologies. Lehmann (1990) considers residual variance from econometrics models. Malkiel and Xu (2006)'s main findings are not based on a measure of an individual stock's idiosyncratic volatility. Spiegel and Wang (2005), and Bali and Cakici (2006) use residual volatility estimated from Fama-French 3-factor model. Using monthly data, Fu (2005) provides in-sample estimates of the conditional idiosyncratic variance of stock returns based on the EGARCH model of Nelson (1991).

In a slightly different context, Baker and Wurgler (2006) match the standard deviation of monthly returns over the 12 months ending in June of year *t* with monthly returns from July of year *t* to June of year *t*+1 for every stock, and conclude that when sentiment at the end of the previous year is low (high), high volatility stock will earn high (low) returns in the current year.

Differentiating between expected and unexpected volatility, Chua, Goh, and Zhang (2007) show that expected idiosyncratic volatility is significantly and positively related to expected returns, and this relation gets monotonically stronger as leverage increases. Their volatility estimation is based on Fama-French 3-factor model and an AR model on volatility.

Perhaps the paper most relevant to our research is Ang, Hodrick, Xing and Zhang (2006). They demonstrate that stocks with high idiosyncratic volatility relative to the Fama-French 3-factor model have abysmally low average returns. This phenomenon cannot be explained by exposure to aggregate volatility risk, and it is robust to controlling for size, book-to-market, momentum, and liquidity measures.

1.2 Our Research Methodology and Results

We first compute *IV*, the option implied volatility of 30-day constant maturity, by Jiang and Tian's (2005) model-free method on a daily basis, and then we follow the Fama and French (1992) procedure to research into the relation between cross-sectional stock returns and volatility.

We first explore the relationship with total volatility by taking the average of all *IV* in a month for a stock as the total volatility (*TIV*) for that stock in that month and computing the change of total volatility (*CTIV*) as the difference between log of this month's and log of last month's *TIV*. We then regress return on *CTIV* or *TIV* with control variables. We show that there is a negative relation between return and *CTIV* and also *TIV* at 1% significance level. For *TIV*, this relation strengthens as leverage increases or as credit rating worsens. For *CTIV*, leverage does not have impact on this relation, and the role of credit rating is ambiguous.

We then explore the relation between cross-sectional stock return and expected idiosyncratic variance (*Idio*) and also expected idiosyncratic volatility *(Idio_vo*). The steps to construct *Idio* and *Idio_vo* are detailed below.

For each month, for every stock that has more than 16 trading (more than 70%) days, we run Fama-French (1993) time-series regressions using daily observations:

$$r_{i,d,m} = \alpha_{i,m} + \beta_{i,m}^{MKT} MKT_{i,d,m} + \beta_{i,m}^{SMB} SMB_{i,d,m} + \beta_{i,m}^{HML} HML_{i,d,m} + \varepsilon_{i,d,m} \quad (1)$$

where $r_{i,d,m}$ is the daily return for stock *i* in day *d* of month *m*. We compute SSE (sum of squares explained) and SSR (sum of squares residual) for regression (1). Taking variance of both sides in (1), we have:

$$\text{var}(r_{i,d,m}) = \text{var}(\beta_{i,m}^{MKT} MKT_{i,d,m} + \beta_{i,m}^{SMB} SMB_{i,d,m} + \beta_{i,m}^{HML} HML_{i,d,m}) + \text{var}(\varepsilon_{i,d,m}) \qquad (2)$$

where var($r_{i,d,m}$) is the realized variance for stock *i* in month *m*. The first term on the right-hand side of (2) is its systematic component, and the second term is the idiosyncratic component. We use $SSE_{i,m}$ / ($N_{i,m}$ -1) in regression (1) to estimate the first term on right-hand side in (2), and $SSR_{i,m}$ / ($N_{i,m}$ -4) in regression (1) for the second term.

As Jiang and Tian (2005) have demonstrated that implied volatility computed by their model-free method is a more efficient forecast for future realized volatility than other volatility gauges, it is natural and reasonable to assume that model-free *IV* contains useful information for forecasting realized volatility in the ensuing month. We write the following monthly time-series regressions for stock *i*:

$$RVa_{i,m} = \alpha + \beta * IVa_{i,m-1} + \varepsilon_i \qquad (3)$$

where $RVa_{i,m}$ is stock *i*'s realized variance in month *m*, namely, var($r_{i,d,m}$), and $IVa_{i,m-1}$ is stock *i*'s implied variance at the end of month *m*-1, i.e., the square of *IV* for stock *i* at the end of month *m*-1. Because we have implied variance that is 30 calendar days forward, so $IVa_{i,m-1}$ basically covers month *m*. Combining (2) and (3), we can write equations:

$$Sys_{i,m} + Idio_{i,m} = \alpha + \beta * IVa_{i,m-1} + \varepsilon_i \qquad (4)$$

where $Sys_{i,m}$ is the systematic component of realized volatility, i.e., $SSE_{i,m}$ / ($N_{i,m}$ -1) in regression (1), and $Idio_{i,m}$ is the idiosyncratic component, i.e., $SSR_{i,m}$ / ($N_{i,m}$ -4) in regression (1). We then decompose (4) into 2 regressions:

$$Sys_{i,m} = \alpha_1 + \beta_1 * IVa_{i,m-1} + e_i \qquad (5)$$

$$Idio_{i,m} = \alpha_2 + \beta_2 * IVa_{i,m-1} + f_i \qquad (6)$$

where e_i and f_i are iid and are not correlated. We run regressions (5) and (6) in the whole sample period to obtain coefficient estimates $\hat{\alpha}_1$, $\hat{\beta}_1$, $\hat{\alpha}_2$, and $\hat{\beta}_2$, and then take $\hat{\alpha}_1 + \hat{\beta}_1 * IVa_{i,m-1}$ as expected systematic variance for stock *i* in month *m*, and $\hat{\alpha}_1 + \hat{\beta}_2 * IVa_{i,m-1}$ as expected idiosyncratic variance. Note that we use all sample data to run regressions (5) and (6), so there is an implied assumption that the market knows the structure of the model and we can use ex-post data to estimate parameters in the model.

We can also write an equation that is in the same spirit as (3):

$$RVo_{i,m} = x + y * IVo_{i,m-1} + \eta_i \qquad (7)$$

where $RVo_{i,m}$ is stock *i*'s realized volatility in month *m*, and $IVo_{i,m-1}$ is stock *i*'s implied volatility at the end of month *m*-1, namely, the square root of $IVa_{i,m-1}$. Then (5) and (6) are transformed into:

$$sqrt(SSE_{i,m} /(N_{i,m} - 1)) = x_1 + y_1 * IVo_{i,m} + g_i \qquad (8)$$

$$sqrt(SSR_{i,m} /(N_{i,m} - 4)) = x_2 + y_2 * IVo_{i,m} + h_i \qquad (9)$$

where g_i and h_i are iid and are not correlated. We use predicted values in (8) and (9) as the expected systematic volatility (*Sys_vo*) and expected idiosyncratic volatility (*Idio_vo*) respectively.

After *Idio* and *Idio_vo* are obtained, we follow Fama and French (1992) regression to research the cross-sectional relation between stock returns and expected idiosyncratic variance or volatility, controlling for other variables. The results for variance and volatility are consistent as they are both negatively correlated with stock return at 1% significance level. The correlation is insignificant when leverage is very low or credit rating is very good, and the correlation becomes monotonically stronger as leverage increases or credit rating worsens.

Our paper contributes to the research on cross-sectional stock return risk premium by applying accurate model-free option implied volatilities, which can be naturally used to extract the market participants' expectations of future realized volatilities, on a large cross-section of stocks. Importantly, we obtain clear results, including the role of leverage and credit rating for expected idiosyncratic variance or volatility, and we also show that the investor sentiment does not have a significant impact.

The rest of this paper is organized as follows. Section 2 describes the data and how we construct implied volatility and other control variables. Section 3 reports all the results for change of total volatility and total volatility. Section 4 reports all the results for expected idiosyncratic variance and volatility. Section 5 discusses the role of investor sentiment. Section 6 concludes with a discussion of some future research directions.

2. Data and Construction of Volatility and Control Variables

2.1 Data Sources and Brief Descriptions

Data used in this study are from the following sources:

1. Daily data for call options on U.S. stocks, between January 1996 and April 2006, are obtained from OptionMetrics, where we extract variables including CUSIP, date, expiration date, strike price, best bid and best offer.

2. From CRSP, we obtain daily stock closing prices and dividends, from January 1996 to December 2006[1], as well as monthly CRSP Value Weighted Return

[1] Later we take the future realized dividends as expected dividends when options are traded; this means that for options traded in 2006, we may need dividends data until April 2007. However, when we was computing volatility, the data on CRSP ended in the end of 2006.

(includes distributions), monthly stock returns, numbers of shares outstanding, SIC codes and exchange codes, from July 1990 to May 2006.

3. From January 1996 to April 2006, daily 4-week, 3-month and 6-month Treasury Bill Secondary Market Rate Discount Basis are obtained from Federal Reserve Bank Reports. Prior to July 31, 2001, 4-week rate is not available from the Fed's website, so One Month Treasury Bill Rate Return is downloaded from French's data library[2], and is approximately transformed from daily to 4-week annualized rate in the form of: (1+TBill_Return*22)^12-1.

4. Daily Fama-French 3 factors, from February 1996 to May 2006, are downloaded from French's data library.

5. The following annual data from 1994 to 2005 are downloaded from COMPUSTAT: total asset (DATA 6), total liabilities (DATA 181), total common equity (DATA 60), and deferred taxes (Balance Sheet) (DATA 74).

6. Bond rating data from 1996 to 2006 is downloaded from Mergent FISD from WRDS.

7. Four commonly used annual measures of liquidity or illiquidity are downloaded from Professor Joel Hasbrouck's website[3]: Amivest liquidity ratio, the Amihud (2002) illiquidity measure, the Pastor and Stambaugh (2002) reversal measure and the Gibbs sampler estimates.

8. Yearly and Monthly proxies for investor sentiment and sentiment change, from 1995 to 2005, are downloaded from http://pages.stern.nyu.edu/~jwurgler/[4].

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[2] We thank Kenneth French for making the data public.
[3] We thank Professor Hasbrouck for making these measures publicly available.
[4] We thank Professor Wurgler for making the data public.

In the OptionMetrics dataset, on average, in every month during the sample period, we have 1,317,458 call option observations (i.e., 1,317,458 different contracts), and 1,171,286 of them are on stocks (OptionMetrics includes index options).

We merge the OptionMetrics dataset with data from CRSP to compute implied volatility. Among the 1,171,286 observations, 1,169,891 can be matched with the computed risk-free rate, 995,434 have at most one cash dividend for the underlying stock during the life of the option, and furthermore, 931,862 of them do not violate the following boundary condition:

$$C \geq S_0 - X * e^{-rT} \tag{10}$$

where C is the call option price, S_0 is current stock price adjusted for dividends, X is the strike price, r is the risk-free rate, and T is time to maturity.

As we only need near-term and next-term options, so in the end, we are left with 442,238 call option observations (contracts) for every month. These observations cover 2,231 stocks on average in a month, and we have 26,882 volatility data on average in a month. Note that one stock should have one volatility data in one trading day, but sometimes the data is missing, generally due to two reasons: first, if the stock price is less than $5, or time to maturity for the option is less than 6 days, then we do not compute implied volatility; second, referring to Jiang and Tian (2005), if we cannot compute the Black-Sholes implied volatility, we do not compute model-free implied volatility, either. Note that the Black-Sholes model is only used in curve-fitting procedure in numerical calculation, and our model-free method does NOT assume that the Black-Sholes model is the true model underlying option prices (refer to Jiang and Tian (2005) for detailed explanations).

For the whole sample period, we have 3,333,317 implied volatility data, which covers 5,278 stocks. After deleting outlier implied volatility bigger than 200%, we are left with 3,284,391 implied volatility data, which covers 5,274 stocks. It is noted that the set of stocks with *IV* on each trading day may differ slightly across days.

We take the lowest credit rating for bonds issued by a company during the sample period as the rating for that stock. The ratings are divided into 4 groups, as is indicated by table I. In our sample of 5,274 stocks, 1,830 have ratings, among which 192 belong to group 1, 400 belong to group 2, 779 belong to group 3, and 459 belong to group 4.

[Insert Table I Here]

2.2 Implied Volatility Estimation

All the option implied volatility is for 30-day constant maturity. We compute model-free near-term (i.e., time to maturity τ_1 is less than 30 days) (annualized) implied volatility σ_1, and next-term (i.e., time to maturity τ_2 is immediately bigger than 30 days) (annualized) implied volatility σ_2 in the same way as in Jiang and Tian (2005), and then interpolate them to obtain the (annualized) constant maturity volatility σ in the way of:

$$\sigma^2 \frac{30}{365} = \frac{\tau_2 - 30}{\tau_2 - \tau_1} \sigma_1^2 \tau_1 + \frac{30 - \tau_1}{\tau_2 - \tau_1} \sigma_2^2 \tau_2 \tag{11}$$

where τ_1 and τ_2 are in number of days. This σ is transformed to daily data to be use in (5), (6), (8), and (9), and predicted values from them are transformed back to annualized measures in cross-sectional Fama French (1992) regressions.

Jiang and Tian's method is briefly explained as follows. Jiang and Tian (2005) use numerical interpolation and integration to compute the following formula:

$$E_0^F [\int_0^T (\frac{dS_t}{S_t})^2] = 2\int_0^\infty \frac{C[T, K / B(0,T)] - \max(0, S_0 - K)}{K^2} dK \tag{12}$$

where the superscript *F* denotes the forward probability measure, *T* is the time to maturity, S_t is the spot stock price minus the present value of all expected future dividends during the life of the option, *B*(0,*T*) is the time *t* price of a zero-coupon bond that pays $1 after time *T*, and $C(T,K)$ is the spot option price. Details can be referred to Jiang and Tian (2005). In our numerical computation, the truncation point is set at about 3.5 standard deviations away from the initial stock price, and the discretization length is set to be $0.1. We obtain daily 4-week, 3-month, and 6-month Treasury Bill rate, and use two of them straddling an option's expiration date to obtain the risk-free rate corresponding to the option's maturity. We then assume that all cash dividends during the life of an option (no longer than 1 year) can be perfectly expected when the option is traded, and discount the future dividends using the risk-free rate. Jiang and Tian's (2005) formula does not assume any specific process for the volatility, and it also approximately takes into consideration jump processes, as is proved in their appendix, so the computation of volatility is model-free and not affected by model bias.

The Jiang and Tian's method, as well as most other ways to compute option implied volatility, is only valid for European option. In the option research literature, Bakshi and Kapadia (2003) eliminate options with dividends within their lives as a robustness check to their results, because American options should never be exercised early in the absence of dividends. Noting that Jiang and Tian (2005) only use call options, we can take advantage of the following argument in John Hull (p 259):

If during the life of the call option, the stock has no cash dividend or one cash dividend $D <= X * [1 - \exp(r * (t - T))]$, where X is the strike price, r is the risk-free rate, t is current time, and T is the expiration date, then it is not optimal for early exercise. When computing volatilities, we require that the time to maturity for the next term options is at most 1 year, and we take realized dividends within the future 1 year as the expected dividends when options are traded.

After obtaining the implied volatility σ for 30-day, we compute expected idiosyncratic and systematic variance in the way described in section 1.2. In the end, we have 178,958 expected idiosyncratic variance samples (one stock should have one sample in one month), among which 300 are negative and thus deleted.

[Insert Table II Here]

2.3 Computation of Other Variables

1. The monthly stock return is computed as log of end of current month's price minus log of end of last month's price (all stock prices are adjusted for any dividends and splits). We use CRSP Value Weighted Return (includes distributions) as a proxy for market return.

2. We take last month's return and sum of monthly returns from 12 months ago to 2 months ago as the momentum factors as in Chua, Goh, and Zhang (2007).

3. We follow Fama and French (1992) to define size and book-to-market ratio. That is, from July this year until June next year, size for each stock is its market capitalization at the end of June this year, and book-to-market is ratio of its book value of common equity plus balance-sheet deferred taxes in its latest fiscal year ending last calendar year to its market capitalization at the end of last year.

4. Market β (the slope in the regression of a security's return on the market's return) is estimated using similar methodology as in Fama and French (1992). Two minor differences are that we use portfolios formed on pre-ranking β s alone to estimate the "full-period" β, whereas Fama and French (1992) use portfolios sorted by both size and pre-ranking β s, and the second difference is that we estimate β just as the slope in the regression of the return on a portfolio on the current month's market return, while Fama and French (1992) estimate β as the sum of the slopes in the regression of the return on a portfolio on the current and prior month's market return. Our methodology is more straight-forward and provides an even wider spread of β s from 0.443 to 2.067 than a range from 0.53 to 1.79 in Fama and French (1992). Our 10 post-ranking portfolio β s are as follows:

Low			→						High
0.443	0.402	0.522	0.638	0.789	0.918	1.072	1.302	1.596	2.067

Computation details are specified below.

From July of year *t*-5 until June of year *t*, all stocks with no less than 24 monthly return data are kept, and their returns are regressed on the market returns to estimate pre-ranking β s. Then these stocks are ranked into ten equal portfolios by their β s, and we compute the equally-weighted monthly returns of these ten portfolios from July of year *t* to June of year *t*+1. We repeat the procedures for the whole sample period, and then have monthly returns for ten portfolios formed on pre-ranking β s in the full period. These returns are regressed again on market returns to estimate β for each of the ten portfolios, and a stock is assigned the β of the portfolio it belongs to when this stock is ranked into ten portfolios by pre-ranking β .

5. Following Chua, Goh, and Zhang (2007), financial leverage is defined as the book value of total liabilities (COMPUSTAT DATA 181) divided by the sum of the book value of debt, other equity and the market value of common equity (total assets (DATA 6) minus total common equity (DATA 60) plus current month market capitalization). Note that, from July of year *t* to June of year *t*+1, accounting measures are still obtained at the end of year *t*-1.

3. Results for Change of Total Volatility and Total Volatility

In this section, we run cross-sectional regressions of stock returns on their changes of total volatilities and also on total volatilities on monthly basis; and we follow the Fama and MacBeth (1973), and Fama and French (1992) method to perform the *t*-test of the null hypothesis of zero mean. We also control for other stock characteristics that are well documented to have explanatory power for the cross-sectional returns. All regressions are run with a constant.

3.1 Regression of Return on Change of Total Volatility or Total Volatility

Stock returns are regressed on their changes of total volatilities in every month:

$$R_{i,m} = a_m + b_m * CTIV_{i,m} + \eta_{i,m} \tag{13}$$

$R_{i,m}$ is the return of stock *i* in month *m*, and $CTIV_{i,m}$ is log of $TIV_{i,m}$ (total volatility for stock *i* in month *m)* minus log of $TIV_{i,m-1}$. We obtain the coefficient series consisting of b_1, b_2, …, b_{124}, from February of 1996 until April of 2006, and compute the *t*-stat for *CTIV* as square root of the number of months times the mean of this series (i.e., the average slope for *CTIV*) divided by the standard deviation of this series. Panel A of table III shows that the average slope and *t*-stat for *CTIV* are -0.026 (-2.6%) and -6.269, respectively. This means that return and change of volatility have negative correlation that is both economically and statistically significant (at 1% level).

To examine the stability over time of this effect, tests are done separately for two sub-periods from 1996:01 to 2001:02 and from 2001:03 to 2006:04, respectively. Table III shows that the average coefficients for *CTIV* for the first and second sub-periods are -0.017 (-1.7%) and -0.035 (-3.5%), with *t*-stats of -2.710 and -6.890, respectively. So it turns out that this effect is not only robust across time, but it has also strengthened in recent years.

We also run cross-sectional regressions of monthly stock returns on monthly total volatilities *TIV*, and Panel B of table III shows similar results for the coefficients of *TIV*.

[Insert Table III Here]

3.2 Regression of Return on Change of Total Volatility or Total Volatility with Control Variables

We add 5 control variables that are well documented to have explanatory power in cross-sectional variation of stocks returns in the regressions to check the robustness of our results. They are market β, size, book-to-market ratio, last month's return, and the sum of returns from 12 to 2 months ago. These variables cover the majority of risk factors that are well documented to have explanatory powers in the cross-sectional variation of stock returns. Panel A of table IV shows that the change of total volatility, with mean of -0.023 (-2.3%) and *t*-stat of -6.073, still remain highly negatively significant (at 1% level) in the regression, and this is robust in the two sub-periods.

We also run cross-sectional regressions of monthly stock returns on monthly total volatilities (*TIV*) with these control variables, and Panel B of table IV shows similar results.

[Insert Table IV Here]

We next add the liquidity factor in the regressions, but we only have annual liquidity measures until the end of 2005. Panel A of table V shows that, with the presence of Amivest liquidity ratio, the change of total volatility has mean of -0.026 (-2.6%) and *t*-stat of -6.166, which is highly negatively significant. This is also robust in sub-periods. Results using other illiquidity estimates remain the same. We also do this on monthly volatility *TIV*, and obtain similar results for the coefficients.

[Insert Table V Here]

Interestingly, with or without control variables market β, size, book-to-market ratio, last month's return, and the sum of returns from 12 to 2 months ago, and with or without additionally the control variable illiquidity measure, in the same sample period, the value of the mean and *t*-stat for *CIV* and *IV* are quite similar.

3.3 Additional Robustness Checks

We conduct three more robustness tests. The first one is that, in every month, we sort all stocks in our sample into 10 size quintiles based on current month's market capitalization, and we exclude the smallest quintile from the sample; in the second one, we exclude all NASDAQ stocks; in the third one, we combine the first two. We then repeat the cross-sectional regressions with and without control variables in the whole period and in two sub-periods, and still obtain negative significant relationship between return and change of total volatility or total volatility at the 1% significance level.

3.4 On Leverage

We run regressions of return on the change of volatility in a cross-sectional context, but studies have also done this in time-series context, and some of them, such as Black (1976), Christie (1982), Schwert (1990), and Duffee (1995), claim that the negative correlation between return and the change of volatility is a "leverage effect". So what if we take the leverage into consideration in our regressions?

We do two kinds of regressions to take into consideration leverage. In each month, we sort stocks into 3 groups by their leverage, and run two kinds of cross-sectional regressions. Firstly, we run 3 separate regressions for those 3 groups in every month, and report the results for groups 1 (highest leverage), 2, and 3 (lowest leverage), respectively. Secondly, we run the following regressions in every month, and report the results for independent variables *H*CTIV*, *M*CTIV*, and *L*CTIV*:

$$R_{i,m} = a_m + b_m^H * H_m * CTIV_{i,m} + b_m^M * M_m * CTIV_{i,m} + b_m^L * L_m * CTIV_{i,m} + b_m * Ctl_m + \eta_{i,m} \qquad (14)$$

where b_m^H, b_m^M, and b_m^L are coefficients, and *H*, *M*, and *L* are dummies taking a value of 0 or 1. If a stock is in the leverage group 1 / 2 / 3, then *H*=1 / *M*=1 / *L*=1, otherwise *H*=0 / *M* =0 / *L*=0. $b_m * Ctl_m$ is a symbol representing the sum of coefficients times various control variables, including beta, size, b-t-m, ret (-1) and ret (-12-2).

It turns out that, here and later on in section 4, both types of regressions are consistent with each other most of the time. The second method is more efficient. In the first method, there would be fewer stocks in every group than in total, that is, fewer observations in every regression. Thus, we may lose some information in regressions in the first method. The first method provides a way of confirming the results of the second method.

Panel A of table VI shows the results in the whole sample period using the first method of regressions. For all 3 leverage groups, coefficients for change of total volatility are negatively significant, so leverage has no influence here. What is more, the coefficient has no monotonic trend as leverage increases. This is reconfirmed when stocks are sorted into 5, or 10 or 20 portfolios. We do not repeat the latter results due to space constraints. Panel A of table VII shows the results in the whole sample period using the second method of regression, and we have similar results: all coefficients for 3 groups are negatively significant, and there is no monotonic relation between return and *CTIV* as leverage changes.

Panel B of table VI shows the results for regressions on *TIV*. As leverage increases, the coefficient monotonically decreases from -0.032 to -0.047, and the absolute value of the *t*-stat monotonically increases from 2.720 to 6.797. However, this is not reconfirmed if stocks are sorted into 10 or 20 portfolios. Nevertheless, we obtain different results using the second method of regressions. When stocks are sorted into 3 leverage groups, as Panel B of table VII shows, the coefficient for *TIV* monotonically decreases from -0.014 to -0.065 as leverage increases, and the absolute value of *t*-stat monotonically increase from 1.575 to 7.595, with the *t*-stat for the lowest leverage group even insignificant. The monotonic trend of the relation between return and *TIV* as leverage changes is reconfirmed when stocks are sorted into 5, or 10, or 20 portfolios. So is the *t*-stat. When portfolios are sorted into 10, or 20 portfolios, the t-stat for the lowest leverage group becomes positive but is insignificant. So obviously leverage has influence on the relation between return and *TIV*: the negatively significant coefficient for total volatility in cross-section stock returns does not exist among very low leverage stocks, and the relation between return and total volatility strengthens as leverage increases.

[Insert Table VI and Table VII Here]

We also do regressions in the sub-periods, and include the liquidity factor in regressions, and come to the same conclusions. In summary, in cross-sectional context, the negatively correlation between return and change of total volatility is not affected by leverage, but leverage does have something to do with the relation between return and total volatility itself.

As we are dealing with financial leverage here, we do robustness checks by throwing away financial firms (SIC code 4900 to 4999), or both financial firms and utility firms (SIC code 6000 to 6999), and the conclusions remain the same.

3.5 On Credit Rating

We find out that actually credit rating, instead of financial leverage, may have great impact on the relationship between return and change of volatility. The negative coefficients for change of volatility seem to be only significant in low credit rating stocks, but this is not robust across time.

We sort stocks into 4 credit rating groups, and run two kinds of cross-sectional regressions. Firstly, we run 4 separate regressions for those 4 groups in every month, and report the results for credit rating groups 1 (highest rating), 2, 3, and 4 (lowest rating), respectively. Secondly, we run the following regressions in every month, and report the results for independent variables *H*CTIV*, *MH*CTIV*, *ML*TCIV*, and *L*CTIV*:

$$R_{i,m} = a_m + b_m^H * H_m * CTIV_{i,m} + b_m^{MH} * MH_m * CTIV_{i,m} + b_m^{ML} * ML_m * CTIV_{i,m} + b_m^L * L_m * CTIV_{i,m} + \eta_{i,m} \quad (15)$$

b_m^H, b_m^{MH}, b_m^{ML}, and b_m^L are coefficients, and *H*, *MH*, *ML*, and *L* are dummies taking value of 0 or 1: if a stock is in the credit rating group 1 / 2 / 3 / 4, then *H*=1 / *MH*=1 / *ML*=1 / *L*=1, otherwise *H*=0 / *MH*=0 / *ML*=0 / *L*=0.

Panel A of table VIII, using the first set of 4 separate regressions, shows that, in the whole period, with mean of -0.017 (-1.7%) and -0.073 (-7.3%), and *t*-stat of -4.285 and -6.582, credit rating group 3 and 4 (low credit rating stocks) exhibit negatively significant correlation between return and change of total volatility. Credit rating group 1 and 2, however, do not show this effect, and they have insignificantly positive *t*-stat in the first sub-period. What is interesting is that, in the second sub-period, credit rating groups 1 and 2 show negatively significant relationship between return and change of volatility. Panel A of table IX, using the second set of regressions with dummies, reach the same conclusions. Taking liquidity or illiquidity measures into consideration, the results almost remain the same. So, from good to bad credit rating stocks, the negative relation between return and change of total volatility appears to strengthen, but not on a monotonic trend, and thus the role of credit rating is not clear.

Panel B of tables VIII and IX, also using the first and second sets of regressions, report the results for *TIV*. Results for *TIV* are similar to that for *CTIV* except for slight differences for credit rating group 2 in both sub-periods between Panel A and Panel B of table VIII: group 2 exhibits positively insignificant (*t*-stat: 1.627) and positively significant (*t*-stat: -2.975) coefficients in the first and second sub-period in Panel A, that is, when we use *CIV*; but it exhibits positively significant (*t*-stat: 2.994) and negatively insignificant (*t*-stat: -1.444) coefficients in the first and second sub-period in Panel B, that is, when we use *TIV*. But there are no similar statistical differences in table IX, that is, when we use the second set of regressions. We believe that the results from the second set of regressions are more appropriate, as is elaborated earlier in section 3.4. So, from Panel B of table IX, we can conclude that the negative relation between return and total volatility monotonically strengthens as credit rating worsens, because the coefficient for *TIV* monotonically decreases from -0.010 to -0.013 from highest to lowest credit rating group, and the absolute value of the negative *t*-stat monotonically increases from 1.638, which is not significant, to 5.568.

[Insert Table VIII and Table IX Here]

One limitation of our research involving credit rating is that the sample is not too big: of the 5,278 stocks with valid implied volatility data, only 1,830 stocks have valid credit rating. Another limitation is that instead of directly obtaining credit rating for a company as a whole entity, we take the lowest rating for bonds issued by a company during the sample period as the credit rating proxy for that company.

4. Results for Expected Idiosyncratic Variance or Expected Idiosyncratic Volatility

In this section, we run cross-sectional regressions of stock returns on their expected idiosyncratic variances (*Idio*) or expected idiosyncratic volatilities (*Idio_vo*) on a monthly basis. We follow the Fama and MacBeth (1973), and the Fama and French (1992) method to perform the *t*-test of the null hypothesis of zero mean. We also control for a number of stock characteristics, and we explore the role of leverage and credit rating in the relation between return and variance. All regressions are run with a constant.

4.1 Regression of Return on Variance or Volatility

Stock returns are first regressed on their expected idiosyncratic variances in every month:

$$R_{i,m} = a_m + b_m * Idio_{i,m} + \eta_{i,m} \quad (16)$$

$R_{i,m}$ is the return of stock *i* in month *m*, and $Idio_{i,m}$ is the expected idiosyncratic variance of stock *i* in month *m*. The *t*-stat for *Idio* are computed in similar way to *CTIV* as in section 3.1. The second and third columns in Panel A of table X show that the average slope and *t*-stat for *Idio* are -0.040 (-4.0%) and -3.636, respectively. This says that return and expected idiosyncratic variance have negative correlation that is both economic and statistical significant (at 1% level).

The sixth and seventh columns of Panel A of table X show that, if we add *Sys* (expected systematic variance) as another independent variable in regression (16), the negative correlation between expected idiosyncratic variance and return becomes more significant, as the average slope and *t*-stat are -0.051 (-5.1%) and -6.501, respectively.

To examine the stability over time of this effect, tests are done separately for two equal sub-periods. Panel B of table X shows that the average coefficients for *Idio* for the first and second sub-periods are -0.065 (-6.5%) and -0.036 (-3.6%), with *t*-stats of -5.687 and -3.388, respectively. So this effect is robust across time. Note that, as our sample period is not too long (124 months), robustness checks done in sub-periods may only be rough examinations.

We also regress return on expected idiosyncratic volatility:

$$R_{i,m} = a_m + b_m * Idio\_vo_{i,m} + \eta_{i,m} \tag{16}$$

Then we regress return on expected systematic volatility (*Sys_vo*), or both of *Idio_vo* and *Sys_vo*. Results for volatility are shown to be consistent with results for variance.

Panel C of table X shows that the average slope and *t*-stat for *Idio_vo* are -0.054 (-5.4%) and -3.025, respectively. This shows that return and expected idiosyncratic volatility have negative correlation that is both economically and statistically significant (at 1% level). Panel C also shows that, with expected systematic volatility, this negative relation becomes much stronger with means of -0.088 and t-stat of -6.421. This is robust across sub-periods.

[Insert Table X Here]

4.2 Regression of Return on Expected Idiosyncratic Variance or Volatility with Control Variables

We add 5 more control variables in cross-sectional regressions: market β, size, book-to-market ratio, last month's return, and the sum of returns from 12 to 2 months ago. Panel A of table XI shows that in the whole sample period, with control variables, the expected idiosyncratic variance, with mean of -0.041 (-4.1%) and *t*-stat of -5.614, becomes even more negatively significant than being regressed alone, and this is robust across the two sub-periods. Also interesting is that, in the whole sample period, consistent with literature, beta is not significant, size and return of last month is negatively significant. However, book-to-market ratio and sum of monthly returns from 12 to 2 months ago are not significant any more, although their coefficients have the correct sign. We shall briefly discuss these control variables in section 4.

Results for regression on expected idiosyncratic volatility are shown in Panel B of table XI, and they are consistent with those for variance.

[Insert Table XI Here]

We then add liquidity factor. Panel A of table XII shows that, with the presence of Amivest liquidity ratio, *Idio* (expected idiosyncratic variance) has mean of -0.039 (-3.9%) and *t*-stat of -5.230, which is significantly negative. This is robust across the sub-periods. Results for *Idio* using other illiquidity measure remain the same. Besides, the results for liquidity measures (positive significant) are consistent with literature. Panel B of table XII shows that, with the presence of Amivest liquidity ratio, *Idio_vo* (expected idiosyncratic volatility) has a mean of -0.062 (-6.2%) and a *t*-stat of -4.551, which is significantly negative. This is robust across the sub-periods.

[Insert Table XII Here]

4.3 Additional Robustness Checks

We conduct three more robustness tests as in section 3.3, and still obtain negative significant relationship between return and change of volatility nearly at the 1% level.

4.4 On Leverage

We first explore the role of leverage in the relation between cross-section return and expected idiosyncratic variance, by running similar regressions as section 3.4. In each month, we sort stocks into 5 groups by their leverage, and run two kinds of cross-sectional regressions. In the first method, we run 5 separate regressions for those 5 groups in every month, and report the results for group 1 (lowest leverage), 2, 3, 4, and 5 (highest leverage), respectively. In the second method, we run the following regression in every month, and report the results for independent variables *L*Idio, ML* Idio, M* Idio, MH* Idio, H* Idio*:

$$R_{i,m} = a_m + b_m^L * L_{i,m} * Idio_{i,m} + b_m^{ML} * ML_{i,m} * Idio_{i,m} + b_m^M * M_{i,m} * Idio_{i,m} + b_m^{MH} * MH_{i,m} * Idio_{i,m} + b_m^H * H_{i,m} * Idio_{i,m} + b_m * Ctl_m + \eta_{i,m} \quad (17)$$

b_m^L, b_m^{ML}, b_m^M, b_m^{MH}, and b_m^H are coefficients, and *L, ML, M, MH,* and *M* are dummies taking value of 0 or 1: if a stock is in the leverage group 1 / 2 / 3 / 4 / 5, then *L*=1 / *ML*=1 / *MH*=1 / *M*=1 / *H*=1, otherwise *L*=0 / *ML*=0 / *MH*=0 / *M*=0 / *H*=0. $b_m * Ctl_m$ is a symbol representing the sum of coefficients times various control variables, including beta, size, b-t-m, ret (-1) and ret (-12-2).

It continues to turn out that the results from the second method are stronger and clearer than the first one, while the results from both methods are consistent with each other.

Panel A of table XIII shows the results for *Idio* in the whole sample period using the above first method of regressions. The coefficients for *Idio* monotonically decrease from -0.005 for the lowest leverage group to -0.082 for the highest leverage group, that is, the absolute value of the coefficients monotonically increase from low to high leverage group. For the lowest group of stocks, the coefficient for *Idio* is not significant, and the *t*-stat for *Idio* from low to high leverage group also displays a rough monotonic trend. This implies that the negative correlation between return and expected idiosyncratic variance is much stronger among stocks with high leverage. This is reconfirmed when stocks are sorted into 10 or 20 portfolios.

Panel A of table XIV shows the results for *Idio* in the whole sample period using the second method of regressions. It displays an even wider spread for the coefficients for *Idio* than provided by the first way: the coefficient decreases monotonically from 0.008 for the lowest leverage group to -0.115 for the highest leverage group. This is also the case for the *t*-stat, and it is worth noting that the *t*-stat for the lowest leverage group is even positively insignificant: 0.954.

We then explore the influence of leverage on the relation between cross-sectional return and expected idiosyncratic volatility, and Panel B or table XIII and Panel B of table XIV show the results on *Idio_vo* in the first and second methods, respectively. Results for expected idiosyncratic volatility are definitely consistent with those for expected idiosyncratic variance.

[Insert Table XIII and Table XIV Here]

We also run regressions including liquidity factor, or by removing financial firms (SIC code 4900 to 4999) or both financial firms and utility firms (SIC code 6000 to 6999), and the conclusions remain the same.

4.5 On Credit Rating

We are also interested in the role of credit rating in the relationship between return and variance or volatility. We find that the negative significant coefficient for expected idiosyncratic variance or volatility may only exist among low credit rating stocks.

We first work on *Idio*. We sort stocks into 4 credit rating groups, and run two sets of cross-sectional regressions. In the first set, we run 4 separate regressions for those 4 groups in every month, and report the results for credit rating groups 1 (highest rating), 2, 3, and 4 (lowest rating), respectively. In the second set, we run the following regressions in every month, and report the results for independent variables *H*Idio, MH* Idio*, *ML* Idio*, and *L* Idio*:

$$R_{i,m} = a_m + b_m^H * H_m * Idio_{i,m} + b_m^{MH} * MH_m * Idio_{i,m} + b_m^{ML} * ML_m * Idio_{i,m} + b_m^L * L_m * Idio_{i,m} + \eta_{i,m} \quad (18)$$

b_m^H , b_m^{MH} , b_m^{ML} , and b_m^L are coefficients, and *H*, *MH*, *ML*, and *L* are dummies taking value of 0 or 1: if a stock is in the credit rating group 1 / 2 / 3 / 4, then *H*=1 / *MH*=1 / *ML*=1 / *L*=1, otherwise *H*=0 / *MH*=0 / *ML*=0 / *L*=0.

Panel A of table XV, using the first set of 4 separate regressions, shows that, in the whole period, with mean of -0.002 (-0.12%) and -0.013 (-1.3%), and *t*-stat of -0.057 and -0.628, credit rating group 1 and 2(high credit rating stocks) do not exhibit negative significant correlation between return and expected idiosyncratic variance. The coefficient for *Idio* monotonically decrease from -0.002 for highest rating group to -0.050 to lowest rating group, and the absolute value of *t*-stat (the *t*-stat) also monotonically increase from 0.057 to 3.306. The trends of coefficients and their *t*-stat's are also displayed in the sub-periods. Note that in the second sub-period, group 1 even exhibits positively insignificant coefficient for *Idio*.

Panel A of Table XVI, using the second set of regressions with dummies, also exhibits the monotonic trends for coefficients and *t*-stat. Still, results on Idio_vo, expected idiosyncratic volatility, shown in Panel B of table XV and Panel B of table XVI, are consistent with results on *Idio*.

[Insert Table XV and Table XVI Here]

The limitations of research here involving credit rating is still that the sample is too small: of the 5,278 stocks with valid implied volatility data, only 1,830 stocks have valid credit rating, and we do not directly obtain credit rating for a company as a whole entity.

In a word, we have conclusions that negative significant correlation between return and expected idiosyncratic variance or volatility only exist in low credit rating stocks, but this needs future research when ratings are more extensively available.

5. Robustness Checks Involving Investor Sentiment

In the research of the time-series relation between return and volatility, investor sentiment has long been taken into consideration. For example, Whaley (2000) popularizes the notion of using the volatility index as an investor fear gauge, and Ting (2006) also quantifies the “fear factor” in the Korea stock market using the volatility index. However, comprehensive empirical studies on the role of sentiment in the cross-sectional relation between return and volatility only emerge recently, such as Baker and Wurgler (2006), and Baker and Wurgler (2007). By using yearly proxy for sentiment, Baker and Wurgler (2006) conclude that when beginning-of-period sentiment is low, subsequent returns are relatively high for high volatility stocks. By using monthly proxy for sentiment, Baker and Wurgler (2007) conclude that the return and sentiment change index are negatively correlated (by time-series regressions) for low volatility stocks, but are positively correlated for high volatility stocks.

We thus check the influence of sentiment on the relation between cross-sectional stock return and volatility using 3 methods, the first two of which are in the same spirit as Baker and Wurgler (2006), and Baker and Wurgler (2007), respectively. The methodologies are specified below.

We run cross-sectional regressions of stock returns on volatilities or variances with various control variables including liquidity, and obtain the monthly coefficients for each month from 1996 to 2005. Then, in the first method, we divide these months into two groups: for one group, the yearly sentiment index $SENTIMENT^{\perp}$ used in Baker and Wurgler (2006) is positive for the previous calendar year, and for another group, it is negative. There are 3 years (1999, 2004, and 2005) in the second group. We compute *t*-stat as in Fama and French (1992) discussed earlier for the two groups respectively, and report the results for each of our 4 volatility or variance measures in Table XVII. It turns out that all the 8 *t*-stat's for the 4 volatility measures in the two groups are negative (-5.431, -4.910, -4.577, and -4.364 for *CTIV*, *TIV*, *Idio*, and *Idio_vo* in the first group, and -3.750, -2.235, -2.824, and -1.571 for them in the second group), and they are all significant except the one (-1.571) for *Idio_vo* when $SENTIMENT^{\perp}$ is negative for the previous year. Besides, this insignificant -1.571 cannot imply any statistically reliable conclusion, as in our sample, there are only 36 months (3 years: 1999, 2004, and 2005) in the second group.

In the second method, we divide our monthly coefficients into two groups: for one group, the monthly sentiment change index $\Delta SENT$ used in Baker and Wurgler (2007) in this month is bigger than last month's, while for another group, it is smaller. We have 65 months belonging to the first group. We also compute *t*-stat in Fama and French (1992) way as discussed earlier for the two groups respectively, and report the results for each of our 4 volatility or variance measures in Table XVIII. Still, all the 8 *t*-stat's for the 4 volatility measures in the two groups are negative (-4.031, -1.881, -1.814, and -0.979 for *CTIV*, *TIV*, *Idio*, and *Idio_vo* in the first group, and -4.736, -5.744, -6.322, and -6.128 for them in the second group), and they are all significant except the three (-1.881, -1.814, and -0.979) for *TIV*, *Idio*, and *Idio_vo* when $\Delta SENT$ in this month is bigger than last month's. The insignificant -1.881 for the total volatility is actually quite near to -1.96, the critical value at 5% significance level. It is worth noting that sentiment plays a relatively bigger role on expected idiosyncratic variance or volatility than the total volatility, which is researched in Burger and Wurgler (2007).

We need to note that the sentiment change index is not the simple difference between current and lag sentiment index. Besides, $SENT^{\perp}$ is a sentiment index that removes business cycle variation, while *SENT* is another index that does not.

In the third method developed independently here, we divide the monthly coefficients into two groups: for one group, the monthly sentiment change index $\Delta SENT^{\perp}$ in this month is positive, while for another group, it is negative. Results are reported in Table XIX. Method 2 deals with the change of sentiment change index as in Baker and Wurgler (2007), and method 3, which we think may be more efficient in affecting the relation between return and volatility, deals with sentiment change index itself. Indeed, only by method 3, we can have positively insignificant coefficient for one of the 4 volatility measures, that is, the expected idiosyncratic volatility, when sentiment change index is positive. In the first group, that is, when $\Delta SENT^{\perp}$ in this month is positive, the coefficients for *TIV* and *Idi*o are negatively insignificant, and that for *Idio_vo* are positively insignificant (*t*-stat: 0.258). Introducing investor sentiment still cannot reverse the statistical properties of the coefficients for volatilities or variances, that is, it cannot create a positively significant coefficient. So sentiment does have impact on the relation between return and volatility, but only a little, and this effect is stronger on expected idiosyncratic volatility than total volatility, which is researched by Burgler and Wurgler (2007). By the way, we note that the change of total volatility, *CTIV*, is always negatively significantly related to stock return. So in research into the relation between cross-sectional stock return and total volatility, the change of total volatility may be a better choice than total volatility itself.

6. Conclusions and Future Research Directions

6.1 Summary

This paper is the first to extensively research into the relation between cross-sectional stock return and volatility or variance extracted from option implied volatility. The implied volatility is computed by the Jiang and Tian (2005)'s model-free method, and from it, 4 kinds of monthly volatility or variance for cross-sectional regression analysis are estimated: the change of total volatility, total volatility, expected idiosyncratic variance, and expected idiosyncratic volatility. We cover the period from 1996:01 to 2006:04, and show that each of these 4 measures is a negatively priced factor in the cross-sectional variation of stock returns. We also show that the negative correlation between return and total volatility or expected idiosyncratic variance or expected idiosyncratic volatility strengthens as leverage increases or credit rating worsens; but leverage does not play a role in the relation between return and change of total volatility, and the role of credit rating is ambiguous. We also show that although investor sentiment has influence on the relation between cross-sectional stock return and volatility, the impact is not significant.

6.2 Future Research Directions

In some of our regressions, size and book-to-market ratio, which Fama and French (1992) document to be negative and positive related to cross-sectional stock returns, are not significant or even in opposite signs. Actually, if we repeat Fama and French (1992) regressions in our sample period, that is, from 1996 to 2006, size and book-to-market ratio will both be insignificant. So this is an indication that what Fama and French previously found may not be valid in recent years, and it needs careful and comprehensive research to validate.

When we have credit rating data for companies as whole entities for most of the stocks with valid volatility data, we can do more research into the impact of credit rating on the relation between return and volatility or variance.

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Appendix

Table I

Credit Rating Groups

This table shows how we group stocks into 4 categories according to their credit ratings by 4 rating agencies.

	Rating Agency			
	Standard and Poor's	Moody's	Fitch	Duff and Phelps
Group 1	AAA to A-	Aaa to A3	AAA to A-	AAA to A-
Group 2	BBB+ to BBB-	Baa1 to Baa3	BBB+ to BBB-	BBB+ to BBB-
Group 3	BB+ to B-	Ba1 to B3	BB+ to B-	BB+ to B-
Group 4	CCC+ to D	Caa1 to C	CCC+ to D	CCC to DD

Table II

Summary Statistics for Implied Volatility (*IV*), Total Volatility (*TIV*), Change of Total Volatility (*CTIV*), Expected Idiosyncratic Variance (*Idio*), Expected Systematic Variance (*Sys*), Expected Idiosyncratic Volatility (*Idio_vo*), and Expected Systematic Volatility (*Sys_vo*)

IV, *TIV*, *CTIV*, *Idio*, *Sys*, *Idio_vo*, and *Sys_vo* are described in section 1.2. For *IV* and *TIV*, the sample is from 1996:01 to 2006:04; for *CTIV*, the sample is from 1996:02 to 2006:04; for *Idio*, *Sys*, *Idio_vo*, and *Sys_vo*, the sample is from 1996:02 to 2006:05. Time-series averages of the cross-sectional (daily for *IV*, and monthly for *TIV*, *CTIV*, *Idio*, *Sys*, *Idio_vo*, and *Sys_vo*) statistics are presented.

	IV	TIV	CTIV	Idio	Sys	Idio_vo	Sys_vo
Mean	0.655	0.660	-0.001	0.285	0.113	0.443	0.271
Median	0.596	0.598	0.002	0.214	0.080	0.417	0.247
Minimum	0.186	0.107	-1.529	0.006	0.005	0.065	0.069
Maximum	1.828	1.997	1.251	3.906	1.188	1.423	0.918
Stdev.	0.300	0.305	0.255	0.267	0.107	0.185	0.113
Skewness	1.191	1.195	-0.510	4.162	3.129	0.877	1.265
Kurtosis	1.887	1.847	4.274	52.020	20.844	1.434	2.613

Table III

Cross-sectional Regression of Monthly Stock Return on Monthly Change of Total Volatility or Total Volatility

The whole sample is from 1996:01 to 2006:04, and the first and second periods are its 2 sub-periods. Daily volatility *IV* is our implied volatility using Jiang and Tian's (2005) method; monthly total volatility *TIV* is the mean of all daily volatilities in a certain month, and *CTIV* is the change of monthly total volatility, i.e., this month's *TIV* minus last month's *TIV*. Each month, for all stocks, we run cross-sectional regressions of monthly stock returns on *CTIV* in Panel A, and we do this on *TIV* in Panel B.

The average slope is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope times square root of number of months divided by the standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: Regression of Return on Change of Total Volatility

	Whole Period		First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
CTIV	-0.026	-6.269	-0.017	-2.710	-0.035	-6.890
Adj R	0.004		0.003		0.005	

Panel B: Regressions of Return on Total Volatility

	Whole Period		First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
TIV	-0.051	-3.811	-0.053	-2.464	-0.050	-3.076
Adj R	0.058		0.062		0.053	

Table IV

Cross-sectional Regression of Monthly Stock Return on Monthly Change of Total Volatility or Total Volatility with Control Variables

The whole sample is from 1996:01 to 2006:04, and the first and second periods are its 2 sub-periods. Monthly total volatility *TIV* is the mean of all daily implied volatilities computed by Jiang and Tian's (2005) method in a certain month, and *CTIV* is the change of monthly total volatility, i.e., this month's *TIV* minus last month's *TIV*. Each month, for all stocks, we run cross-sectional regressions of monthly stock returns on *CTIV* with various control variables in Panel A, and we do this on TIV in Panel B. For each stock, beta is our post-ranking portfolio beta, ret (-1) is last month's return, and ret (-12-2) is sum of monthly returns from 12 months ago to 2 months ago. We follow Fama and French (1992) to define size and book-to-market ratio (b-t-m). That is, from July this year until June next year, size for each stock is its market capitalization at the end of June this year, and book-to-market is ratio of its book value of common equity plus balance-sheet deferred taxes in its latest fiscal year ending last calendar year to its market capitalization at the end of last year. The average slope is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope times square root of number of months divided by the standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: Regression of Return on Change of Total Volatility with Controls

	Whole Period		First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
CTIV	-0.023	-6.073	-0.012	-2.466	-0.034	-6.226
Beta	-0.008	-1.929	-0.006	-1.065	-0.009	-1.476
Size	0.002	1.848	0.003	1.562	0.000	0.000
b-t-m	0.003	2.377	0.004	1.736	0.002	1.750
Ret (-1)	-0.017	-1.964	-0.015	-1.095	-0.021	-1.969
Ret (-12-2)	0.006	1.706	0.008	1.453	0.002	0.450
Adj R	0.084		0.087		0.081	

Panel B: Regression of Return on Total Volatility with Control Variables

	Whole Period		First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
TIV	-0.044	-5.212	-0.034	-2.502	-0.053	-5.283
Beta	-0.002	-0.602	-0.002	-0.508	-0.001	-0.187
Size	-0.002	-2.475	0.000	0.000	-0.003	-2.953
b-t-m	0.002	2.025	0.003	1.687	0.001	0.875
Ret (-1)	-0.025	-3.200	-0.021	-1.705	-0.028	-2.863
Ret (-12-2)	0.003	0.903	0.008	1.465	-0.001	-0.187
Adj R	0.095		0.099		0.090	

Table V

Cross-sectional Regression of Monthly Stock Return on Monthly Change of Total Volatility or Total Volatility with Control Variables Including Liquidity

The whole sample is from 1996:01 to 2006:04, and the first and second periods are its 2 sub-periods. *IV* is our implied volatility using Jiang and Tian's (2005) method; monthly total volatility *TIV* is the mean of all daily volatilities in a certain month, and *CTIV* is the change of monthly total volatility, i.e., this month's *TIV* minus last month's *TIV*. Each month, for all stocks, in Panel A, we run cross-sectional regressions of monthly stock returns on *CIV* with various control variables, including Amivest liquidity ratio (Liquidity); and in Panel B, we do this on *TIV*. For each stock, beta is our post-ranking portfolio beta, ret (-1) is last month's return, and ret (-12-2) is sum of monthly returns from 12 months ago to 2 months ago. We follow Fama and French (1992) to define size and book-to-market ratio (b-t-m). That is, from July this year until June next year, size for each stock is its market capitalization at the end of June this year, and book-to-market is ratio of its book value of common equity plus balance-sheet deferred taxes in its latest fiscal year ending last calendar year to its market capitalization at the end of last year.

The average slope is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope times square root of number of months divided by the standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: Regression of Return on Change of Total Volatility with Controls Including Liquidity

	Whole Period		First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
CTIV	-0.026	-6.166	-0.013	-2.456	-0.039	-6.319
Beta	-0.010	-2.321	-0.006	-1.192	-0.012	-1.792
Size	0.001	0.779	0.002	0.861	0.001	0.846
b-t-m	0.005	3.030	0.006	2.213	0.003	1.904
Ret (-1)	-0.029	-3.330	-0.022	-1.639	-0.033	-3.065
Ret (-12-2)	0.001	0.280	0.005	0.880	-0.002	-0.435
Liquidity	2.24*e(-7)	3.26	4.43*e(-7)	3.39	6.08*e(-10)	1.57
Adj R	0.089		0.087		0.088	

Panel B: Regression of Return on Total Volatility with Controls Including Liquidity

	Whole Period		First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
TIV	-0.048	-5.258	-0.035	-2.508	-0.061	-5.324
Beta	-0.003	-0.888	-0.001	-0.289	-0.004	-0.683
Size	-0.002	-2.191	-0.001	-0.651	-0.003	-2.880
b-t-m	0.004	2.921	0.004	1.838	0.003	1.920
Ret (-1)	-0.037	-4.768	-0.030	-2.547	-0.044	-4.447
Ret (-12-2)	0.002	-0.592	0.006	1.090	-0.010	-2.649
Liquidity	3.12*e(-7)	4.95	6.14*e(-7)	5.50	6.19*e(-10)	1.93
Adj R	0.100		0.099		0.101	

Table VI

Cross-sectional Regression of Monthly Stock Return on Change of Total Volatility or Total Volatility with Control Variables for 3 Leverage Groups

The sample is from 1996:01 to 2006:04. Daily volatility *IV* is our implied volatility using Jiang and Tian's (2005) method; monthly total volatility *TIV* is the mean of all daily volatilities in a certain month, and *CTIV* is the change of monthly total volatility, i.e., this month's *TIV* minus last month's *TIV*. Each month, all stocks are sorted into 3 groups by their leverage, and within each group, in Panel A, we run cross-sectional regressions of monthly stock returns on *CTIV* with various control variables, and in Panel B, we run similar regressions on *TIV*. For each stock, beta is our post-ranking portfolio beta, ret (-1) is last month's return, and ret (-12-2) is sum of monthly returns from 12 months ago to 2 months ago. We follow Fama and French (1992) to define size and book-to-market ratio (b-t-m). That is, from July this year until June next year, size for each stock is its market capitalization at the end of June this year, and book-to-market is ratio of its book value of common equity plus balance-sheet deferred taxes in its latest fiscal year ending last calendar year to its market capitalization at the end of last year. Following Chua, Goh, and Zhang (2007), financial leverage is defined as the book value of total liabilities (COMPUSTAT DATA 181) divided by the sum of the book value of debt, other equity and the market value of common equity (total assets (DATA 6)- total common equity (DATA 60)+current month market capitalization).

The average slope is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope times square root of number of months divided by the standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: Regression on Change of Total Volatility with Controls for 3 Leverage Groups

	Low Leverage		Medium Leverage		High Leverage	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
CTIV	-0.027	-4.340	-0.017	-4.599	-0.022	-6.421
Beta	-0.011	-2.596	-0.019	-3.976	-0.012	-3.095
Size	0.002	1.479	0.004	3.697	0.005	4.266
b-t-m	0.010	5.837	0.018	12.477	0.008	7.394
Ret (-1)	-0.054	-5.704	-0.041	-4.290	-0.002	-0.177
Ret (-12-2)	-0.007	-2.043	-0.009	-2.079	0.012	2.610
Adj R	0.077		0.102		0.093	

Panel B: Regression on Total Volatility with Controls for 3 Leverage Groups

	Low Leverage		Medium Leverage		High Leverage	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
TIV	-0.032	-2.720	-0.043	-5.094	-0.047	-6.797
Beta	-0.006	-1.806	-0.011	-2.849	-0.006	-1.758
Size	-0.001	-0.928	0.001	1.237	0.002	2.025
b-t-m	0.009	6.264	0.017	13.522	0.007	7.795
Ret (-1)	-0.056	-6.564	-0.049	-5.368	-0.012	-1.174
Ret (-12-2)	-0.008	-2.475	-0.013	-3.147	0.006	1.392
Adj R	0.090		0.113		0.102	

Table VII

Cross-sectional Regressions of Monthly Stock Return on Monthly Change of Total Volatility or Total Volatility Times Dummies for 3 Leverage Groups with Controls

The sample is from 1996:01 to 2006:04. Daily volatility *IV* is our implied volatility using Jiang and Tian's (2005) method; monthly total volatility *TIV* is the mean of all daily volatilities in a certain month, and *CTIV* is the change of monthly total volatility, i.e., this month's *TIV* minus last month's *TIV*. Each month, all stocks are sorted into 3 groups by their leverage: High, Medium, and Low; and H, M, and L are dummies taking value of 0 or 1: if a stock is in the leverage group High / Medium / Low, then H=1 / M=1 / L=1, otherwise H=0 / M =0 / L=0. Then, in Panel A, we run cross-sectional regressions of monthly stock returns on *CTIV* times H, M, and L, with various control variables. We run similar regressions on *TIV* in Panel B. For each stock, beta is our post-ranking portfolio beta, ret (-1) is last month's return, and ret (-12-2) is sum of monthly returns from 12 months ago to 2 months ago. We follow Fama and French (1992) to define size and book-to-market ratio (b-t-m). That is, from July this year until June next year, size for each stock is its market capitalization at the end of June this year, and book-to-market is ratio of its book value of common equity plus balance-sheet deferred taxes in its latest fiscal year ending last calendar year to its market capitalization at the end of last year.

The average slope is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope times square root of number of months divided by the standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: on Change of Total Volatility | **Panel B: on Total Volatility**

	Avg. Slope	t-stat		Avg. Slope	t-stat
H*CTIV	-0.028	-6.185	H*TIV	-0.065	-7.954
M*CTIV	-0.017	-4.471	M*TIV	-0.041	-5.017
L*CTIV	-0.021	-3.314	L*TIV	-0.014	-1.575
Beta	-0.009	-2.115	Beta	-0.008	-2.475
Size	0.002	1.841	Size	0.001	1.237
b-t-m	0.004	3.156	b-t-m	0.009	11.136
Ret (-1)	-0.026	-2.991	Ret (-1)	-0.041	-5.371
Ret (-12-2)	0.004	1.105	Ret (-12-2)	-0.005	-1.547
Adj R	0.088		Adj R	0.109	

Table VIII

Cross-sectional Regressions of Monthly Stock Return on Monthly Change of Total Volatility or Total Volatility with Control Variables for 4 Credit Rating Groups

The whole sample is from 1996:01 to 2006:04, and the first and second periods are its 2 sub-periods. Daily volatility *IV* is our implied volatility using Jiang and Tian's (2005) method; monthly total volatility *TIV* is the mean of all daily volatilities in a certain month, and *CTIV* is the change of monthly total volatility, i.e., this month's *TIV* minus last month's *TIV*. Each month, all stocks are put into 4 credit rating groups: 1 (highest), 2, 3, and 4 (lowest). Within each group, in Panel A, we run cross-sectional regressions of monthly stock returns on *CTIV* with various control variables. In Panel B, we run similar regressions on *TIV*. For each stock, beta is our post-ranking portfolio beta, r (-1) is last month's return, and r (-12-2) is sum of monthly returns from 12 months ago to 2 months ago. We follow Fama and French (1992) to define size and book-to-market ratio (b-t-m). That is, from July this year until June next year, size for each stock is its market capitalization at the end of June this year, and book-to-market is ratio of its book value of common equity plus balance-sheet deferred taxes in its latest fiscal year ending last calendar year to its market capitalization at the end of last year.

Avg. is the average slope, which is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope times square root of number of months divided by the standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: Results on Change of Total Volatility Involving Credit Rating in the First Method

	1 (High)		2		3		4 (Low)	
	Avg.	t-stat	Avg.	t-stat	Avg.	t-stat	Avg.	t-stat
WHOLE PERIOD								
CTIV	-0.003	-1.280	-0.001	-0.482	-0.017	-4.285	-0.073	-6.582
Beta	0.001	0188	-0.001	-0.252	-0.004	-0.905	-0.005	-0.990
Size	-0.001	-1.109	-0.002	-2.218	-0.002	-1.848	-0.002	-1.167
b-t-m	0.000	0.000	0.001	1.109	0.003	2.079	0.000	0.151
R (-1)	-0.061	-4.202	-0.035	-2.714	-0.018	-1.512	0.023	1.604
R (-12-2)	-0.002	-0.288	0.005	0.866	0.003	0.652	0.025	4.472
Adj R	0.116		0.089		0.092		0.112	
FIRST PERIOD								
CTIV	0.003	0.868	0.005	1.627	-0.009	-1.757	-0.039	-3.173
Beta	0.002	0.237	0.006	1.090	-0.001	-0.159	-0.006	-0.919
Size	0.001	0.651	-0.002	-1.302	-0.002	-1.202	0.001	0.459
b-t-m	0.000	0.000	0.001	0.651	0.005	2.055	0.002	0.710
R (-1)	-0.070	-3.797	-0.036	-1.926	-0.023	-1.230	0.025	1.328
R (-12-2)	-0.003	-0.272	0.006	0.756	0.001	0.147	0.030	3.905
Adj R	0.107		0.078		0.083		0.094	

SECOND	**PERIOD**							
CTIV	-0.011	-3.580	-0.008	-2.975	-0.025	-4.154	-0.106	-5.999
Beta	0.002	0.295	-0.007	-1.215	-0.007	-1.093	-0.002	-0.260
Size	-0.003	-2.929	-0.004	-5.207	-0.002	-1.420	-0.004	-1.562
b-t-m	-0.001	-0.434	0.000	0.000	0.001	0.651	-0.002	-0.744
R (-1)	-0.051	-2.238	-0.035	-1.925	-0.014	-0.911	0.021	0.954
R (-12-2)	-0.004	-0.473	0.005	0.574	0.004	0.651	0.017	2.142
Adj R	0.125		0.100		0.101		0.128	

Panel B: Results on Total Volatility Involving Credit Rating in the First Method

	1 (High)		2		3		4 (Low)	
	Avg.	t-stat	Avg.	t-stat	Avg.	t-stat	Avg.	t-stat
WHOLE	**PERIOD**							
TIV	-0.001	-0.157	0.008	1.291	-0.018	-2.386	-0.080	-5.465
Beta	0.002	0.405	-0.002	-0.518	-0.001	-0.259	0.008	1.713
Size	-0.001	-1.114	-0.002	-2.227	-0.003	-3.037	-0.005	-3.275
b-t-m	0.000	0.000	0.001	1.114	0.002	1.485	0.000	0.000
R (-1)	-0.066	-4.804	-0.036	-2.926	-0.023	-2.049	0.007	0.506
R (-12-2)	-0.003	-0.451	0.006	1.044	0.002	0.445	0.014	2.642
Adj R	0.122		0.096		0.100		0.128	
FIRST	**PERIOD**							
TIV	0.014	1.413	0.027	2.994	-0.011	-0.921	-0.063	-3.307
Beta	0.000	0.000	0.001	0.183	0.000	0.000	0.001	0.192
Size	0.001	0.716	0.000	0.000	-0.002	-1.312	-0.002	-1.125
b-t-m	0.001	0.606	0.002	1.312	0.004	1.658	0.000	0.000
R (-1)	-0.079	-4.748	-0.035	-2.012	-0.027	-1.563	0.012	0.656
R (-12-2)	-0.002	-0.185	0.008	0.984	0.002	0.292	0.024	3.150
Adj R	0.115		0.089		0.094		0.115	
SECOND	**PERIOD**							
TIV	-0.017	-2.231	-0.011	-1.444	-0.020	-2.157	-0.097	-4.390
Beta	0.003	0.463	-0.006	-1.099	-0.003	-0.514	0.015	1.936
Size	-0.003	-2.953	-0.003	-3.375	-0.004	-3.150	-0.007	-2.901
b-t-m	-0.001	-0.492	0.000	0.000	0.000	0.000	-0.001	-0.394
R (-1)	-0.053	-2.426	-0.037	-2.111	-0.018	-1.254	0.003	0.143
R (-12-2)	-0.005	-0.625	0.003	0.363	0.003	0.514	0.004	0.553
Adj R	0.129		0.103		0.106		0.142	

Table IX

Cross-sectional Regressions of Monthly Stock Return on Monthly Change of Total Volatility or Total Volatility Times Dummies for 4 Credit Rating Groups

The whole sample is from 1996:01 to 2006:04, and the first and second periods are its 2 sub-periods. Daily volatility *IV* is our implied volatility using Jiang and Tian's (2005) method; monthly total volatility *TIV* is the mean of all daily volatilities in a certain month, and *CTIV* is the change of monthly total volatility, i.e., this month’s *TIV* minus last month’s *TIV*. Each month, all stocks are put into 4 credit rating groups: 1 (highest), 2, 3, and 4 (lowest), and in Panel A, we run cross-sectional regressions of monthly stock returns on *CTIV* times dummies for which credit rating group a certain stock belongs to; in Panel B, we run similar regressions on monthly volatility *TIV*. Dummies H, MH, ML, and L are defined as follows: they take value of 0 or 1: if a stock is in the credit rating group 1 / 2 / 3 / 4, then H=1 / MH=1 / ML=1 / L=1, otherwise H=0 / MH=0 / ML=0 / L=0.

The average slope is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope times square root of number of months divided by the standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: Results on Change of Total Volatility Involving Credit Rating in the Second Method

	Whole Period		First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
H*CTIV	-0.002	-0.853	0.003	0.808	-0.008	-2.840
MH*CTIV	0.000	0.000	0.006	1.802	-0.007	-2.734
ML*CTIV	-0.017	-4.285	-0.008	-1.562	-0.026	-4.414
L*CTIV	-0.080	-7.042	-0.046	-3.822	-0.113	-6.087
Beta	-0.006	-1.358	-0.004	-0.613	-0.008	-1.302
Size	0.000	0.000	0.001	0.601	-0.001	-0.868
b-t-m	0.002	2.016	0.003	1.674	0.000	0.000
Ret (-1)	-0.004	-0.370	-0.007	-0.456	-0.001	-0.064
Ret (-12-2)	0.013	2.827	0.013	1.991	0.011	1.685
Adj R	0.105		0.093		0.116	

Panel B: Results on Total Volatility Involving Credit Rating in the Second Method

	Whole Period		First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
H*TIV	-0.010	-1.638	0.008	0.887	-0.028	-3.556
MH*TIV	-0.013	-2.227	0.001	0.121	-0.027	-3.429
ML*TIV	-0.023	-3.201	-0.012	-1.112	-0.034	-3.718
L*TIV	-0.048	-5.568	-0.036	-2.922	-0.061	-5.110
Beta	0.001	0.278	0.001	0.213	0.001	0.183
Size	-0.003	-3.712	-0.001	-0.787	-0.004	-3.937
b-t-m	0.001	1.114	0.002	1.312	0.000	0.000
Ret (-1)	-0.012	-1.204	-0.014	-0.993	-0.010	-0.703
Ret (-12-2)	0.008	1.856	0.01`	1.698	0.004	0.685
Adj R	0.120		0.110		0.130	

Table X

Cross-sectional Regressions of Monthly Stock Return on Expected Idiosyncratic Variance or Expected Idiosyncratic Volatility

The whole sample is from 1996:02 to 2006:05, and the first and second periods are its 2 sub-periods. *Idio* and *Sys* are monthly expected idiosyncratic and systematic variances obtained by regressions described in section 1.2, and *Idio_vo* and *Sys_vo* are monthly expected idiosyncratic and systematic volatilities. In Panel A and B, each month, we run cross-sectional regressions of monthly stock returns on *Idio*, or *Sys*, or both of them. In Panel C and D, each month, we run cross-sectional regressions of monthly stock returns on *Idio_vo*, or *Sys_vo*, or both of them.

The average slope is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope times square root of number of months divided by the standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: Regression on Variance in the whole Sample Period

	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
Idio	-0.040	-3.636			-0.051	-6.501
Sys			-0.061	-1.972	0.043	1.394
Adj R	0.042		0.052		0.064	

Panel B: Regression on Variance in sub-periods

	First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat
Idio	-0.065	-5.687	-0.036	-3.388
Sys	0.100	2.089	-0.015	-0.398
Adj R	0.073		0.054	

Panel C: Regression on Volatility in the whole Sample Period

	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
Idio_vo	-0.054	-3.025			-0.088	-6.421
Sys_vo			-0.05	-1.575	0.078	2.282
Adj R	0.053		0.062		0.075	

Panel D: Regression on Volatility in the sub-periods

	First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat
Idio_vo	-0.131	-6.251	-0.045	-2.857
Sys_vo	0.155	2.955	-0.001	-0.024
Adj R	0.087		0.063	

Table XI

Cross-sectional Regressions of Monthly Stock Return on

Expected Idiosyncratic Variance or Volatility with Control Variables

The whole sample is from 1996:02 to 2006:05, and the first and second periods are its 2 sub-periods. *Idio* is monthly expected idiosyncratic variance obtained by regressions described in section 1.2, and *Idio_vo* is monthly expected idiosyncratic volatility. Each month, in Panel A, we run cross-sectional regressions of monthly stock returns on *Idio* and other control variables, and we do this in Panel B for *Idio_vo*. For each stock, beta is our post-ranking portfolio beta, ret (-1) is last month's return, and ret (-12-2) is sum of monthly returns from 12 months ago to 2 months ago. We follow Fama and French (1992) to define size and book-to-market ratio (b-t-m). That is, from July this year until June next year, size for each stock is its market capitalization at the end of June this year, and book-to-market is ratio of its book value of common equity plus balance-sheet deferred taxes in its latest fiscal year ending last calendar year to its market capitalization at the end of last year.

The average slope is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope times square root of number of months divided by the standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: Regression on Expected Idiosyncratic Variance (*Idio*) with Controls

	Whole Period		First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
Idio	-0.041	-5.614	-0.039	-3.375	-0.044	-4.980
Beta	-0.003	-0.812	-0.002	-0.437	-0.003	-0.499
Size	-0.002	-2.218	-0.001	-0.656	-0.003	-2.929
b-t-m	0.001	0.924	0.002	1.125	0.000	0.000
Ret (-1)	-0.026	-3.068	-0.020	-1.458	-0.033	-3.263
Ret (-12-2)	0.003	0.853	0.007	1.198	-0.001	-0.252
Adj R	0.091		0.099		0.084	

Panel B: Regression on Expected Idiosyncratic Volatility (*Idio_vo*) with Controls

	Whole Period		First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
Idio_vo	-0.060	-4.589	-0.062	-2.855	-0.058	-3.974
Beta	-0.001	-0.308	0.000	0.000	-0.002	-0.372
Size	-0.003	-3.327	-0.002	-1.432	-0.003	-2.603
b-t-m	0.001	1.008	0.001	0.606	0.000	0.000
Ret (-1)	-0.027	-3.255	-0.021	-1.575	-0.032	-3.246
Ret (-12-2)	0.003	0.876	0.007	1.198	-0.001	-0.269
Adj R	0.092		0.102		0.082	

Table XII

Cross-sectional Regressions of Monthly Stock Return on Expected Idiosyncratic Variance or Volatility with Control Variables Including Liquidity Measures

The whole sample is from 1996:02 to 2005:12, and the first and second periods are its 2 sub-periods. *Idio* is monthly expected idiosyncratic variance obtained by regressions described in section 1.2, and *Idio_vo* is monthly expected idiosyncratic volatility. Each month, in Panel A, we run cross-sectional regressions of monthly stock returns on *Idio* with control variables, including Amivest liquidity ratio (Liquidity), and we do this for *Idio_vo* in Panel B. For each stock, beta is our post-ranking portfolio beta, ret (-1) is last month's return, and ret (-12-2) is sum of monthly returns from 12 months ago to 2 months ago. We follow Fama and French (1992) to define size and book-to-market ratio (b-t-m). That is, from July this year until June next year, size for each stock is its market capitalization at the end of June this year, and book-to-market is ratio of its book value of common equity plus balance-sheet deferred taxes in its latest fiscal year ending last calendar year to its market capitalization at the end of last year.

The average slope is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope times square root of number of months divided by the standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: Regression on *Idio* with Control Variables Including Liquidity Measures

	Whole Period		First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
Idio	-0.039	-5.230	-0.036	-3.031	-0.043	-4.746
Beta	-0.004	-1.035	-0.001	-0.250	-0.007	-1.045
Size	-0.003	-2.716	-0.003	-1.660	-0.003	-2.539
b-t-m	0.003	2.037	0.003	1.291	0.002	1.088
Ret (-1)	-0.036	-4.116	-0.028	-2.066	-0.045	-4.129
Ret (-12-2)	-0.001	-0.272	0.003	0.516	-0.006	-1.385
Liquidity	3.040*e(-7)	4.722	5.969*e(-7)	5.194	1.029*e(-9)	0.592
Adj R	0.095		0.097		0.093	

Panel B: Regression on *Idio_vo* with Controls Including Liquidity Measures

	Whole Period		First Period		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
Idio_vo	-0.062	-4.551	-0.059	-2.657	-0.065	-4.160
Beta	-0.001	-0.302	0.002	0.620	-0.005	-0.865
Size	-0.004	-3.950	-0.004	-2.582	-0.003	-2.285
b-t-m	0.002	1.448	0.003	1.452	0.002	1.172
Ret (-1)	-0.038	-4.487	-0.030	-2.278	-0.046	-4.379
Ret (-12-2)	-0.001	-0.279	0.004	0.689	-0.006	-1.523
Liquidity	3.118*e(-7)	4.965	6.124*e(-7)	5.529	8.699*e(-10)	0.955
Adj R	0.096		0.100		0.092	

Table XIII

Cross-sectional Regressions of Monthly Stock Returns on Expected Idiosyncratic Variance or Volatility with Control Variables for 5 Leverage Groups

The sample is from 1996:02 to 2006:05. *Idio* is monthly expected idiosyncratic variance obtained by regressions described in section 1.2, and *Idio_vo* is monthly expected idiosyncratic volatility. Each month, all stocks are sorted into 5 groups by their leverage, and within each group, in Panel A, we run cross-sectional regressions of monthly stock returns on *Idio* with controls, and we do this for *Iido_vo* in Panel B. For each stock, beta is our post-ranking portfolio beta, ret (-1) is last month's return, and ret (-12-2) is sum of monthly returns from 12 months ago to 2 months ago. We follow Fama and French (1992) to define size and book-to-market ratio (b-t-m). Following Chua, Goh, and Zhang (2007), financial leverage is defined as the book value of total liabilities (COMPUSTAT DATA 181) divided by the sum of the book value of debt, other equity and the market value of common equity (total assets (DATA 6)- total common equity (DATA 60)+current month market capitalization).

The average slope is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope times square root of number of months divided by the standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: Results on *Idio* Involving Leverage in the First Method

		Idio	Beta	Size	b-t-m	Ret (-1)	Ret (-12-2)
1 (Low)	Avg. Slope	-0.005	-0.007	0.000	0.010	-0.054	-0.007
	t-stat	-0.590	-1.652	0.000	5.041	-4.909	-1.991
	Adj R			0.076			
2	Avg. Slope	-0.041	-0.011	0.000	0.015	-0.061	-0.015
	t-stat	-4.134	-2.490	0.000	7.233	-5.638	-3.616
	Adj R			0.100			
3	Avg. Slope	-0.058	-0.007	0.001	0.017	-0.050	-0.014
	t-stat	-5.146	-1.617	0.853	9.427	-4.366	-3.375
	Adj R			0.107			
4	Avg. Slope	-0.059	-0.010	0.000	0.015	-0.033	-0.007
	t-stat	-4.362	-2.641	0.000	8.318	-2.752	-1.386
	Adj R			0.120			
5 (High)	Avg. Slope	-0.082	-0.003	0.002	0.006	-0.021	0.007
	t-stat	-6.104	-0.756	1.584	4.436	-1.713	1.386
	Adj R			0.131			

Panel B: Results on *Idio_vo* Involving Leverage in the First Method

		Idio_vo	Beta	Size	b-t-m	Ret (-1)	Ret (-12-2)
1 (Low)	Avg. Slope	-0.011	-0.008	0.000	0.009	-0.055	-0.007
	t-stat	-0.758	-2.016	0.000	4.537	-5.083	-1.991
	Adj R				0.075		
2	Avg. Slope	-0.060	-0.009	0.000	0.015	-0.060	-0.014
	t-stat	-3.824	-2.218	0.000	7.233	-5.499	-3.450
	Adj R				0.101		
3	Avg. Slope	-0.073	-0.006	0.000	0.018	-0.049	-0.014
	t-stat	-4.819	-1.512	0.000	9.981	-4.454	-3.450
	Adj R				0.107		
4	Avg. Slope	-0.069	-0.009	-0.001	0.015	-0.034	-0.006
	t-stat	-4.501	-2.627	-0.924	8.318	-2.835	-1.188
	Adj R				0.114		
5 (High)	Avg. Slope	-0.113	0.001	-0.001	0.005	-0.020	0.006
	t-stat	-6.596	0.264	-0.853	3.961	-1.596	1.232
	Adj R				0.126		

Table XIV

Cross-sectional Regressions of Monthly Stock Return on Expected Idiosyncratic Variance or Volatility Times Dummies for 5 Leverage Groups with Control Variables

The sample is from 1996:02 to 2006:05. *Idio* is monthly expected idiosyncratic variance obtained by regressions described in section 1.2, and *Idio_vo* is monthly expected idiosyncratic volatility. Each month, all stocks are sorted into 5 groups by their leverage: Low, ML, Medium, MH, and High; and L, ML, M, MH, H are dummies taking value of 0 or 1: if a stock is in the leverage group Low / ML / Medium / MH / High, then L=1 / ML=1 / MH=1 / M=1 / H=1, otherwise L=0 / ML=0 / MH=0 / M=0 / H=0. Then, in Panel A, we run cross-sectional regressions of monthly stock returns on *Idio* times L, ML, M, MH, and H, with various control variables, and we do this in Panel B for *Idio_vo*. For each stock, beta is our post-ranking portfolio beta, ret (-1) is last month's return, and ret (-12-2) is sum of monthly returns from 12 months ago to 2 months ago. We follow Fama and French (1992) to define size and book-to-market ratio (b-t-m). That is, from July this year until June next year, size for each stock is its market capitalization at the end of June this year, and book-to-market is ratio of its book value of common equity plus balance-sheet deferred taxes in its latest fiscal year ending last calendar year to its market capitalization at the end of last year.

The average slope is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope times square root of number of months divided by the standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: on *Idio*

	Avg. Slope	t-stat
L*Idio	0.008	0.954
ML*Idio	-0.028	-3.450
M*Idio	-0.054	-6.581
MH*Idio	-0.076	-8.601
H*Idio	-0.115	-10.203
Beta	-0.006	-1.664
Size	-0.001	-1.109
b-t-m	0.007	7.058
Ret (-1)	-0.041	-4.889
Ret (-12-2)	-0.005	-1.499
Adj R	0.110	

Panel B: on *Idio_vo*

	Avg. Slope	t-stat
L*Idio_vo	-0.012	-0.881
ML*Idio_vo	-0.045	-3.466
M*Idio_vo	-0.068	-5.349
MH*Idio_vo	-0.088	-6.873
H*Idio_vo	-0.129	-8.777
Beta	-0.006	-1.957
Size	-0.001	-1.109
b-t-m	0.010	10.082
Ret (-1)	-0.044	-5.362
Ret (-12-2)	-0.007	-2.156
Adj R	0.112	

Table XV

Cross-sectional Regressions of Monthly Stock Return on Expected Idiosyncratic Variance or Volatility with Control Variables for 4 Credit Rating Groups

The whole sample is from 1996:02 to 2005:12, and the first and second periods are its 2 sub-periods. *Idio* is monthly expected idiosyncratic variance obtained by regressions described in section 1.2, and *Idio_vo* is monthly expected idiosyncratic volatility. Each month, all stocks are sort into 4 credit rating groups: 1 (highest), 2, 3, and 4 lowest). Within each group, in Panel A, we run cross-sectional regressions of monthly stock returns on *Idio* with various control variables, and we do this for *Idio_vo* in Panel B. For each stock, beta is our post-ranking portfolio beta, r (-1) is last month's return, and r (-12-2) is sum of monthly returns from 12 months ago to 2 months ago. We follow Fama and French (1992) to define size and book-to-market ratio (b-t-m). That is, from July this year until June next year, size for each stock is its market capitalization at the end of June this year, and book-to-market is ratio of its book value of common equity plus balance-sheet deferred taxes in its latest fiscal year ending last calendar year to its market capitalization at the end of last year. Avg. is the average slope, which is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope divided by its time-series standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: Results on *Idio* Involving Credit Rating in the First Method

	1 (High)		2		3		4 (Low)	
	Avg.	t-stat	Avg.	t-stat	Avg.	t-stat	Avg.	t-stat
WHOLE PERIOD								
Idio	-0.002	-0.057	-0.013	-0.628	-0.029	-2.297	-0.050	-3.306
Beta	0.005	0.992	-0.001	-0.236	0.000	0.000	0.003	0.584
Size	-0.002	-1.818	-0.002	-1.975	-0.003	-2.377	-0.006	-3.273
b-t-m	-0.001	-0.839	0.000	0.000	0.001	0.652	0.000	0.000
R (-1)	-0.050	-3.047	-0.032	-2.272	-0.021	-1.688	0.004	0.258
R (-12-2)	-0.002	-0.276	0.005	0.754	0.001	0.213	0.014	2.279
Adj R	0.146		0.116		0.106		0.128	
FIRST PERIOD								
Idio	-0.028	-0.528	-0.022	-0.667	-0.030	-1.564	-0.023	-1.184
Beta	0.005	0.624	0.005	0.755	0.001	0.179	0.000	0.000
Size	0.001	0.586	0.000	0.000	-0.003	-1.476	-0.003	-1.428
b-t-m	0.000	0.000	0.001	0.472	0.003	1.125	0.002	0.635
R (-1)	-0.047	-2.118	-0.023	-1.150	-0.030	-1.534	0.014	0.720
R (-12-2)	0.002	0.169	0.012	1.192	0.002	0.267	0.021	2.387
Adj R	0.142		0.108		0.101		0.104	
SECOND PERIOD								
Idio	0.022	0.477	-0.006	-0.232	-0.028	-1.695	-0.076	-3.373
Beta	0.005	0.797	-0.006	-1.116	-0.002	-0.319	0.005	0.601
Size	-0.004	-3.471	-0.004	-3.471	-0.004	-2.840	-0.009	-3.056
b-t-m	-0.002	-1.420	-0.001	-0.781	0.000	0.000	-0.003	-0.976
R (-1)	-0.053	-2.202	-0.041	-2.066	-0.013	-0.853	-0.006	-0.249
R (-12-2)	-0.006	-0.689	-0.002	-0.230	0.001	0.174	0.008	0.933
Adj R	0.149		0.122		0.111		0.150	

Panel B: Results on *Idio_vo* Involving Credit Rating in the First Method

	1 (High)		2		3		4 (Low)	
	Avg.	t-stat	Avg.	t-stat	Avg.	t-stat	Avg.	t-stat
WHOLE PERIOD								
Idio_vo	-0.006	-0.259	-0.002	-0.122	-0.017	-1.193	-0.071	-3.174
Beta	0.005	0.974	-0.002	-0.472	-0.001	-0.252	0.005	0.940
Size	-0.002	-1.818	-0.002	-1.975	-0.003	-2.377	-0.006	-3.117
b-t-m	-0.001	-0.839	0.001	0.836	0.002	1.305	0.000	0.000
R (-1)	-0.050	-3.030	-0.030	-2.144	-0.019	-1.561	0.009	0.588
R (-12-2)	-0.003	-0.414	0.005	0.744	0.002	0.427	0.015	2.479
Adj R	0.137		0.115		0.104		0.122	
FIRST PEIROD								
Idio_vo	-0.012	-0.318	-0.007	-0.258	-0.020	-0.865	-0.036	-1.252
Beta	0.004	0.499	0.004	0.604	0.001	0.187	0.002	0.354
Size	0.001	0.586	0.000	0.000	-0.002	-0.926	-0.002	-0.952
b-t-m	0.000	0.000	0.002	0.944	0.003	1.125	0.003	0.914
R (-1)	-0.048	-2.125	-0.019	-0.976	-0.028	-1.460	0.016	0.846
R (-12-2)	0.001	0.085	0.012	1.192	0.003	0.414	0.021	2.352
Adj R	0.135		0.109		0.101		0.104	
SECOND PERIOD								
Idio_vo	0.000	0.000	0.003	0.157	-0.013	-0.775	-0.105	-3.130
Beta	0.006	0.919	-0.007	-1.271	-0.003	-0.499	0.009	1.019
Size	-0.005	-3.905	-0.004	-3.471	-0.003	-2.130	-0.010	-3.254
b-t-m	-0.002	-1.302	-0.001	-0.781	0.000	0.000	-0.003	-0.976
R (-1)	-0.052	-2.160	-0.040	-2.029	-0.011	-0.734	0.002	0.083
R (-12-2)	-0.007	-0.828	-0.001	-0.113	0.002	0.347	0.010	1.240
Adj R	0.139		0.120		0.106		0.139	

Table XVI

Cross-sectional Regressions of Monthly Stock Return on Expected Idiosyncratic Variance or Volatility Times Dummies for 4 Credit Rating Groups

The whole sample is from 1996:02 to 2005:12, and the first and second periods are its 2 sub-periods. *Idio* is monthly expected idiosyncratic variance obtained by regressions described in section 1.2, and *Idio_vo* is monthly expected idiosyncratic volatility. Each month, all stocks are put into 4 credit rating groups: 1 (highest), 2, 3, and 4 (lowest). Each month, in Panel A, we run cross-sectional regressions of monthly stock returns on *Idio* times dummies for which credit rating group a certain stock belongs to, and we do this for *Idio_vo* in Panel B. Dummies H, MH, ML, and L are defined as follows: they take value of 0 or 1: if a stock is in the credit rating group 1 / 2 / 3 / 4, then H=1 / MH=1 / ML=1 / L=1, otherwise H=0 / MH=0 / ML=0 / L=0.

The average slope is the time-series average of the monthly regression slopes in the sample period, and the t-statistic is the average slope times square root of number of months divided by the standard error. Adjusted R is the time-series average of the adjusted R-square for the cross-sectional regressions.

Panel A: Results on *Idio* Involving Credit Rating in the Second Method

	Whole Period		First Peiod		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
H*Idio	0.013	0.671	0.015	0.507	0.011	0.438
MH*Idio	-0.013	-0.942	-0.013	-0.656	-0.013	-0.668
ML*Idio	-0.028	-2.283	-0.023	-1.215	-0.034	-2.177
L*Idio	-0.061	-4.902	-0.045	-2.664	-0.076	-4.151
Beta	0.000	0.000	0.000	0.000	0.000	0.000
Size	-0.003	-3.025	-0.001	-0.656	-0.005	-4.339
b-t-m	0.000	0.000	0.001	0.606	-0.001	-0.868
Ret (-1)	-0.018	-1.664	-0.019	-1.268	-0.017	-1.079
Ret (-12-2)	0.006	1.280	0.009	1.288	0.003	0.478
Adj R	0.128		0.118		0.138	

Panel B: Results on *Idio_vo* Involving Credit Rating in the Second Method

	Whole Period		First Peiod		Second Period	
	Avg. Slope	t-stat	Avg. Slope	t-stat	Avg. Slope	t-stat
H*Idio_vo	-0.013	-0.901	-0.005	-0.215	-0.022	-1.282
MH*Idio_vo	-0.022	-1.595	-0.017	-0.797	-0.027	-1.517
ML*Idio_vo	-0.030	-2.067	-0.024	-1.050	-0.037	-2.064
L*Idio_vo	-0.059	-3.895	-0.046	-2.023	-0.071	-3.532
Beta	0.001	0.277	0.001	0.232	0.001	0.170
Size	-0.003	-3.025	-0.001	-0.656	-0.005	-3.905
b-t-m	0.000	0.000	0.001	0.606	-0.001	-0.781
Ret (-1)	-0.014	-1.339	-0.017	-8.924	-0.011	-0.722
Ret (-12-2)	0.008	1.740	0.010	1.458	0.005	0.831
Adj R	0.124		0.119		0.129	

Table XVII

Cross-Sectional Regressions of Monthly Stock Return on Volatility or Variance with Control Variables Including Liquidity in the First Method in Section 5

This table reports the coefficients and their *t*-stat's for cross-sectional regressions of monthly stock returns on each of the 4 volatility measures (*CTIV*, *TIV*, *Idio*, and *Idio_vo*) with control variables including liquidity for each of the two groups of months described in the first method in section 5. The sample is from 1996 to 2005. Daily volatility *IV* is our implied volatility using Jiang and Tian's (2005) method; monthly total volatility *TIV* is the mean of all daily volatilities in a certain month, and *CTIV* is the change of monthly total volatility, i.e., this month's *TIV* minus last month's *TIV*. *Idio* is monthly expected idiosyncratic variance obtained by regressions described in section 1.2, and *Idio_vo* is monthly expected idiosyncratic volatility.

Panel A: Results when $SENTIMENT^{\perp}$ for the previous calendar year is positive

		CTIV	Beta	Size	b-t-m	R(-1)	R(-12-2)	Liquidity
	Avg.	-0.031	-0.013	0.001	0.006	-0.041	0.000	2.295*e(-7)
CTIV	t-stat	-5.431	-2.322	0.569	2.733	-3.735	0.000	2.605
	Adj R				0.103			
		TIV						
	Avg.	-0.06	-0.003	-0.003	0.004	-0.05	-0.004	3.628*e(-7)
TIV	t-stat	-4.910	-0.687	-2.500	2.157	-5.329	-0.894	4.464
	Adj R				0.117			
		Idio						
	Avg.	-0.046	-0.005	-0.003	0.003	-0.051	-0.003	3.361*e(-7)
Idio	t-stat	-4.577	-1.006	-2.264	1.509	-4.811	-0.632	4.111
	Adj R				0.109			
		Idio_vo						
	Avg.	-0.080	-0.002	-0.005	0.002	-0.052	-0.003	3.514*e(-7)
Idio_vo	t-stat	-4.364	-0.477	-3.773	1.132	-5.118	-0.647	4.395
	Adj R				0.111			

Panel B: Results when $SENTIMENT^{\perp}$ for the previous calendar year is negative

		CTIV	Beta	Size	b-t-m	R(-1)	R(-12-2)	Liquidity
	Avg.	-0.015	-0.003	0.001	0.002	-0.002	0.004	2.111*e(-7)
CTIV	t-stat	-3.750	-0.514	0.600	1.091	-0.156	0.857	2.046
	Adj R				0.057			
		TIV						
	Avg.	-0.019	-0.001	-0.001	0.002	-0.006	0.003	1.946*e(-7)
TIV	t-stat	-2.235	-0.194	-0.857	1.200	-0.480	0.667	2.173
	Adj R				0.060			
		Idio						
	Avg.	-0.024	0.000	-0.001	0.002	-0.004	0.004	2.309*e(-7)
Idio	t-stat	-2.824	0.000	-0.667	1.200	-0.282	0.828	2.313
	Adj R				0.062			
		Idio_vo						
	Avg.	-0.022	0.000	-0.001	0.002	-0.004	0.004	2.217*e(-7)
Idio_vo	t-stat	-1.571	0.000	-0.750	1.200	-0.286	0.828	2.315
	Adj R				0.062			

Table XVIII

Cross-Sectional Regressions of Monthly Stock Return on Volatility or Variance with Control Variables Including Liquidity in the Second Method in Section 5

This table reports the coefficients and their *t*-stat's for cross-sectional regressions of monthly stock returns on each of the 4 volatility measures (*CTIV*, *TIV*, *Idio*, and *Idio_vo*) with control variables including liquidity for each of the two groups of months described in the second method in section 5. The sample is from 1996 to 2005. Daily volatility *IV* is our implied volatility using Jiang and Tian's (2005) method; monthly total volatility *TIV* is the mean of all daily volatilities in a certain month, and *CTIV* is the change of monthly total volatility, i.e., this month's *TIV* minus last month's *TIV*. *Idio* is monthly expected idiosyncratic variance obtained by regressions described in section 1.2, and *Idio_vo* is monthly expected idiosyncratic volatility.

Panel A: Results when this month's $\Delta SENT$ is bigger than last month's

			Beta	Size	b-t-m	R(-1)	R(-12-2)	Liquidity
		CTIV						
	Avg.	-0.023	0.004	-0.003	0.000	-0.036	0.000	3.443*e(-7)
CTIV	t-stat	-4.031	0.768	-1.861	0.000	-2.992	0.000	3.649
	Adj R				0.086			
		TIV						
	Avg.	-0.021	0.007	-0.004	-0.001	-0.043	-0.001	3.543*e(-7)
TIV	t-stat	-1.881	1.612	-3.583	-0.537	-3.852	-0.187	3.976
	Adj R				0.095			
		Idio						
	Avg.	-0.018	0.007	-0.004	-0.001	-0.044	0.000	3.806*e(-7)
Idio	t-stat	-1.814	1.485	-2.932	-0.474	-3.620	0.000	4.158
	Adj R				0.093			
		Idio_vo						
	Avg.	-0.017	0.007	-0.004	-0.001	-0.045	0.000	3.633*e(-7)
Idio_vo	t-stat	-0.979	1.710	-3.225	-0.504	-3.860	0.000	4.205
	Adj R				0.093			

Panel B: Results when this month's $\Delta SENT$ is smaller than last month's

			Beta	Size	b-t-m	R(-1)	R(-12-2)	Liquidity
		CTIV						
	Avg.	-0.029	-0.026	0.006	0.011	-0.021	0.003	0.790*e(-7)
CTIV	t-stat	-4.736	-3.980	3.149	5.052	-1.677	0.711	0.812
	Adj R				0.057			
		TIV						
	Avg.	-0.079	-0.014	0.000	0.008	-0.029	-0.003	2.628*e(-7)
TIV	t-stat	-5.744	-2.884	0.000	4.564	-2.757	-0.742	2.949
	Adj R				0.106			
		Idio						
	Avg.	-0.066	-0.017	0.000	0.008	-0.027	-0.002	2.100*e(-7)
Idio	t-stat	-6.322	-2.947	0.000	4.480	-2.160	-0.441	2.376
	Adj R				0.098			
		Idio_vo						
	Avg.	-0.117	-0.012	-0.003	0.006	-0.029	-0.002	2.486*e(-7)
Idio_vo	t-stat	-6.128	-2.361	-1.820	3.640	-2.372	-0.441	2.721
	Adj R				0.101			

Table XIX

Cross-Sectional Regressions of Monthly Stock Return on Volatility or Variance with Control Variables Including Liquidity in the Third Method in Section 5

This table reports the coefficients and their *t*-stat's for cross-sectional regressions of monthly stock returns on each of the 4 volatility measures (*CTIV*, *TIV*, *Idio*, and *Idio_vo*) with control variables including liquidity for each of the two groups of months described in the third method in section 5. The sample is from 1996 to 2005. Monthly total volatility *TIV* is the mean of all daily volatilities in a certain month, and *CTIV* is the change of monthly total volatility, i.e., this month's *TIV* minus last month's *TIV*. *Idio* is monthly expected idiosyncratic variance obtained by regressions described in section 1.2, and *Idio_vo* is monthly expected idiosyncratic volatility.

Panel A: Results when this month's $\Delta SENT^{\perp}$ is positive

		CTIV	Beta	Size	b-t-m	R(-1)	R(-12-2)	Liquidity
	Avg.	-0.019	0.008	-0.004	-0.003	-0.040	0.004	3.781*e(-7)
CTIV	t-stat	-3.157	1.488	-2.403	-1.674	-3.324	0.710	3.766
	Adj R				0.080			
		TIV						
	Avg.	-0.004	0.010	-0.005	-0.003	-0.041	0.003	3.563*e(-7)
TIV	t-stat	-0.395	2.170	-3.905	-1.802	-3.519	0.545	3.962
	Adj R				0.086			
		Idio						
	Avg.	-0.006	0.009	-0.006	-0.003	-0.045	0.004	3.892*e(-7)
Idio	t-stat	-0.625	1.714	-4.260	-1.674	-3.623	0.710	$4.260
	Adj R				0.085			
		Idio_vo						
	Avg.	0.004	0.007	-0.005	-0.003	-0.044	0.004	3.808*e(-7)
Idio_vo	t-stat	0.258	1.519	-3.905	-1.674	-3.617	0.744	4.195
	Adj R				0.084			

Panel B: Results when this month's $\Delta SENT^{\perp}$ is negative

		CTIV	Beta	Size	b-t-m	R(-1)	R(-12-2)	Liquidity
	Avg.	-0.033	-0.029	0.007	0.013	-0.017	-0.001	0.617*e(-7)
CTIV	t-stat	-5.712	-4.908	4.101	5.824	-1.377	-0.224	0.691
	Adj R				0.099			
		TIV						
	Avg.	-0.093	-0.016	0.000	0.010	-0.032	-0.007	2.669*e(-7)
TIV	t-stat	-7.289	-3.615	0.000	5.487	-3.151	-1.792	3.002
	Adj R				0.113			
		Idio						
	Avg.	-0.075	-0.017	0.001	0.010	-0.027	-0.006	2.128*e(-7)
Idio	t-stat	-7.757	-3.291	0.686	5.033	-2.192	-1.294	2.537
	Adj R				0.106			
		Idio_vo						
	Avg.	-0.133	-0.011	-0.002	0.008	-0.031	-0.007	2.380*e(-7)
Idio_vo	t-stat	-6.819	-2.355	-1.324	4.160	-2.536	-1.499	2.721
	Adj R				0.109			