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Options-implied variance and future stock returns ☆

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ABSTRACT

Using options-implied variance, a forward-looking measure of conditional variance, we revisit the debate on the idiosyncratic risk-return relation. In both cross-sectional (for individual stocks) and time-series (for the market index) regressions, we find a negative relation between options-implied variance and future stock returns. Consistent with Miller's (1977) divergence of opinion hypothesis, the negative relation gets stronger (1) for stocks with more stringent short-sale constraints or (2) when shorting stocks becomes more difficult. Moreover, the negative correlation of realized idiosyncratic variance or analyst forecast dispersion with future stock returns mainly reflects their close correlation with our conditional idiosyncratic variance measure.

1. Introduction

A positive risk-return tradeoff is a fundamental law of finance, and there is an ongoing debate about whether such a tradeoff applies for company-specific or idiosyncratic risk. In classical asset pricing theories, e.g., the capital asset pricing model (CAPM), investors require a positive risk premium only for bearing systematic risk. This tenet, however, depends crucially on the assumption that investors can immunize themselves from idiosyncratic risk by holding diversified portfolios. When relaxing the perfect-diversification assumption, Merton (1987) and others (e.g., Levy, 1978; Malkiel and Xu, 2002) show that idiosyncratic risk is an important determinant of expected stock returns. Because many individual investors hold under-diversified portfolios (e.g., Blume and Friend, 1975; Goetzmann and Kumar, 2008), Merton's (1987) conjecture is potentially important. For example, practitioners often argue that the premium associated with a company's specific risk should be a part of the company's cost of capital (e.g., Calvert and Smith, 2011). Existing empirical studies, however, have found mixed evidence on the relation between conditional idiosyncratic variance and future stock returns.[3,4]

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[3] In cross-sectional studies, Lintner (1965), Lehmann (1990), Douglas (1969), Malkiel and Xu (2002), Fu (2009), and Chua et al. (2010), find a positive relation between idiosyncratic risk and future stock returns, while Ang et al. (2006) and subsequent studies, e.g., Chen et al. (2012b), George and Hwang (2013), and Hou and Loh (2012), uncover a negative relation. Bali and Cakici (2008), Guo et al. (2014), Han and Lesmond (2011), and Huang et al. (2010) have conducted robustness checks of the results reported in previous studies. Similarly, in time-series studies, Goyal and Santa-Clara (2003) find a positive relation between aggregate idiosyncratic risk and future excess market returns; Bali et al. (2005) and Wei and Zhang (2005) show that the relation is rather weak; and Guo and Savickas (2008) document a negative relation in quarterly data but a weak relation in monthly data. While variance is the appropriate risk measure in Merton's (1987) model, both variance and volatility (the square root of variance) have been commonly used in existing studies. We find qualitatively similar results using either variance or volatility as a measure of idiosyncratic risk.

[4] Armstrong et al. (2013) provide a rational mechanism that can generate the seemingly "puzzling" negative relation between idiosyncratic volatility and expected returns documented by Ang et al. (2006) and others. Specifically, the authors show that a firm's stock price is a convex function of its future risk-factor loading. Therefore, higher factor-loading uncertainty (and thus higher idiosyncratic volatility since factor-loading uncertainty is positively related to idiosyncratic volatility in their model) will be associated with higher stock price and hence lower expected return.

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We investigate whether the inconclusive evidence reflects measurement errors in conditional stock variance, which is unobservable and has been estimated using either the realized variance model or the GARCH model in existing studies. Because Ghysels et al. (2005) find that conditional variance is a function of long distributed lags of squared daily returns, the commonly used monthly realized variance can be a noisy measure of conditional variance. Moreover, Han and Lesmond (2011) emphasize that microstructure noise due to the bid-ask spread generates substantial measurement errors in realized variance constructed using closing prices. Similarly, while long time-series samples are needed to obtain reliable parameter estimates of the GARCH model, existing studies require a minimum of only 30–60 monthly stock return observations to estimate the GARCH model due to data limitations. In this paper, we use options-implied variance as a proxy for conditional variance because many authors, e.g., Christensen and Prabhala (1998), Fleming (1998), and Busch et al. (2011), show that this forward-looking measure subsumes the information content of both realized variance and GARCH variance in the forecast of future realized variance. Moreover, Guo and Whitelaw (2006) and others advocate for using options-implied variance instead of realized or GARCH variance adopted in previous studies (e.g., French et al., 1987) to uncover the positive stock market risk-return relation, as stipulated in Merton's (1973) intertemporal capital asset pricing model (ICAPM).

There are some issues with using options-implied variance as a proxy for conditional variance. First, it is a measure of total variance—the sum of variance due to (1) comovement with systematic risk and (2) idiosyncratic risk. To identify precisely the effects of idiosyncratic variance on expected stock returns, we explicitly control for its correlation with commonly used systematic risk measures. Second, because stock market variance may be priced (e.g., Bakshi and Kapadia, 2003; Ang et al., 2006), options-implied variance is an upward biased estimate of conditional variance. Moreover, the variance risk premium, the difference between options-implied variance and realized variance, correlates positively with future stock returns in both time-series (e.g., Bollerslev et al., 2009; Drechsler and Yaron, 2011) and cross-sectional (e.g., Bali and Hovakimian, 2009; Han and Zhou, 2011) data. To address this issue, we control for the variance risk premium in our empirical analysis. Last, not all stocks are optionable, and there is a concern about sample selection biases. Specifically, optionable stocks tend to have a bigger market capitalization than do nonoptionable stocks, and big stocks are less susceptible to market friction such as information costs than are small stocks (e.g., Merton, 1987). In a similar vein, Danielsen and Sorescu (2001) and others show that options introduction substantially alleviates short-sale constraints. Thus, as we confirm in this paper, by excluding nonoptionable stocks from the sample, we need to adopt powerful tests for the optionable stock data to uncover the idiosyncratic risk-return relation(s) associated with these market frictions.

In contrast with Merton's (1987) under-diversification hypothesis, we document a negative albeit insignificant relation between options-implied variance and future stock returns in the cross-sectional analysis. Consistent with Miller's (1977) divergence of opinions hypothesis, the negative relation becomes both statistically and economically significant when we include only stocks that are likely to have binding short-sale constraints.[5] Similarly, our measure of aggregate conditional idiosyncratic risk, aggregate options-implied variance orthogonalized by options-implied variance of the S&P 500 index (VIX), correlates negatively and significantly with future stock market returns in the time-series analysis; and such a relation is stronger when shorting stocks becomes more difficult. Moreover, we find that realized variance (e.g., Ang et al., 2006; Guo and Savickas, 2008) or analyst earnings forecast dispersion (e.g., Diether et al., 2002; Yu, 2011) predicts stock returns mainly because of their close correlation with our conditional idiosyncratic variance measure. Our novel empirical evidence provides strong support for Miller's (1977) hypothesis as an explanation of the negative relation between conditional idiosyncratic risk and future stock returns.

Specifically, in the univariate Fama and MacBeth (1973) cross-sectional regression, the relation between options-implied variance and one-month-ahead stock returns is negative but statistically insignificant. When we control for the commonly used stock return predictors, the negative relation becomes significant at the 5% level. Interestingly, while small stocks are arguably more susceptible to the under-diversification problem than are big stocks (Merton, 1987), we find that the negative relation between options-implied variance and future stock returns is actually stronger for small stocks. These results are puzzling because they appear to contradict the fundamental law of a positive risk-return tradeoff. However, the literature suggests a close relation between idiosyncratic variance and divergence of opinion (e.g., Shalen, 1993; Harris and Raviv, 1993; Beber et al., 2010). Thus, a possible explanation is that conditional variance (as proxied by options-implied variance) is a proxy for divergence of opinion, which, in the presence of short-sale constraints, leads stocks to be overvalued initially and to have low returns subsequently (Miller, 1977). Under this explanation, the negative relation between options-implied variance and future stock returns is more pronounced for small stocks than for big stocks possibly because small stocks are more susceptible to short-sale constraints.

We find strong support for Miller's (1977) implication that divergence of opinion affects only stocks with binding short-sale constraints. In Fama and Macbeth (1973) regressions, the interaction term of options-implied variance with a measure of short-sale constraints correlates negatively and significantly with future stock returns at the 1% level, and the interaction term completely subsumes the information content of options-implied variance about future stock returns. We find qualitatively similar results by forming portfolios. The return difference between low and high options-implied variance stocks has a significantly positive alpha only for the tercile of stocks with most stringent short-sale constraints, but is negligible for the other terciles. Moreover, we find that, consistent with Miller's hypothesis, it is the binding short-sale constraints, rather than market capitalization, that drive the cross-sectional relation between options-implied variance and future stock returns.[6] In an influential study, Ang et al. (2006) document a negative relation between realized idiosyncratic volatility and future stock returns. We find that options-implied variance, when interacting with short-sale constraints, drives out realized idiosyncratic volatility from cross-sectional regressions, suggesting that the latter is also a proxy for divergence of opinion. Consistent with this conjecture, the interaction term of realized idiosyncratic volatility with short-sale constraints has a strong negative

[5] The weak relation documented in the full optionable stock sample reflects the aforementioned sample selection bias: Options trading alleviates short-sale constraints and thus makes it more difficult to detect the divergence of opinion effect for the full optionable stock sample. For example, over a common sample period, while we confirm Ang et al.'s (2006) finding of a significantly negative univariate relation between realized idiosyncratic volatility and future stock returns for all common stocks, the relation is insignificant when we restrict the sample to optionable stocks. In a similar vein, focusing on optionable stocks with binding short-sale constraints allows us to have a more powerful test of Miller's (1977) divergence of opinion hypothesis.

[6] For example, our three-way portfolio sort results show that the alpha of the hedge portfolio based on options-implied variance is insignificant for small stocks with non-binding short-sale constraints, while it is highly significant for bigger stocks with binding short-sale constraints. Similarly, the interaction term between options-implied variance and the proxy for short-sale constraints is highly significant even when we orthogonalize the short-sale constraints proxy by market capitalization to specifically filter out the size effect.