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Does variance risk have two prices? Evidence from the equity and option markets☆

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ABSTRACT

We formally compare two versions of the market variance risk premium (VRP) measured in the equity and option markets. Both VRPs follow common patterns and respond similarly to changes in volatility and economic conditions. However, we reject the null hypothesis that they are identical and find that their difference is strongly related to measures of the financial standing of intermediaries. These results shed new light on the information content of the VRP, suggest the presence of market frictions between the two markets, and are consistent with the key role played by intermediaries in setting option prices.

1. Introduction

The market variance risk premium (VRP) is the compensation investors are willing to pay for assets that perform well when stock market volatility is high. Whereas this premium is embedded in the prices of various assets, notably equity portfolios exposed to market variance risk (the equity VRP), it can be easily computed using index options (the option VRP). For this reason, academics and policy makers alike commonly view the option VRP as the most readily available gauge of investors' risk aversion or, more colloquially, fear.[1] However, recent studies provide evidence of potential mispricing between equity and option markets and stress the key role played by financial intermediaries (broker-dealers) in determining index

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[1] See Bali and Zhou (2016), Bekaert and Hoerova (2014), Bollerslev, Gibson, and Zhou (2011), and Drechsler and Yaron (2011), as well as the recent report of the Bank for International Settlements (2014).

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option prices.[2] If option prices reflect local demand and supply forces in addition to broad economic fundamentals, the option VRP could behave differently from its equity-based counterpart.

In this paper, we formally test whether the two conditional market VRPs measured in the equity and option markets are equal. A key feature of our approach is that we do not compare the VRPs themselves, but their linear projections on a common set of predictive variables that capture volatility and economic conditions, as well as the financial standing of broker-dealers. This approach allows us to overcome the challenge of estimating the entire path of the premium, while guaranteeing that if the VRP projections are different, so are the VRPs. Therefore, a rejection of the null hypothesis of equal projections necessarily implies the same rejection for the VRPs.

Our conditional VRP measures are fully comparable, economically motivated, and simple to estimate. They are comparable across the two markets because they are conditioned on the same set of predictors. They allow for the measurement of the role played by several economically motivated predictors in driving the prices of variance risk and their potential difference. Finally, they can be easily estimated using standard time series and cross-sectional regressions. The only required inputs are price data on equity and index option portfolios that are sensitive to market variance shocks. For the equity market, we follow Ang, Hodrick, Xing, and Zhang (2006) and extract the VRP projection using a factor model that includes market variance risk. For the option market, we use the squared Volatility Index (VIX) which measures the price of an index option portfolio that tracks market variance risk (see Carr and Wu, 2009).

Our results reveal strong commonalities between the two market VRP projections measured at a quarterly frequency. Comparing them between 1992 and 2014, they mostly take negative values, consistent with the notion that investors are willing to pay a premium to hedge against variance shocks. Their average values are close to −1.80% per year, which implies that a simple unconditional analysis would conclude that the two VRPs are identical. Finally, both premia increase in magnitude after volatility shocks and during recession periods. Their paths are therefore closely aligned and exhibit a correlation coefficient of 0.69.

However, the empirical evidence formally rejects the null hypothesis that the two premia are identical. The difference between the VRP projections exhibits several key features. First, it changes signs, as the option VRP can be either below or above its equity-based counterpart. Second, it can be economically large. In 12 quarters out of 92, its magnitude is above 3.60% per year, which is two times the average premium itself. Third, it is not exclusively associated with crisis episodes such as the Great Recession in 2007–2008. Finally, its variations are driven by two measures of the financial standing of intermediaries commonly used in the literature, namely the leverage ratio of broker-dealers and the quarterly return of the prime broker index (PBI).[3] For instance, when these intermediaries take on leverage or make short-term gains, the magnitude of the option VRP decreases significantly, whereas the equity VRP remains unchanged. Equivalently, during these periods, a trading strategy that is long variance in the option market and short variance in the equity market delivers a positive alpha.

Before examining the implications of these results, we conduct an extensive analysis to confirm that the VRP difference is a robust feature of the data. First, we verify that it is not artificially caused by a misspecification of the factor model used to extract the equity VRP. We perform a large battery of tests and find it is not the case. The pricing errors are small, the model-implied mimicking portfolio closely tracks the market variance, and the inclusion of additional risk factors leaves the results unchanged. Second, we rely on theoretical and simulation analysis to show that variance jumps are unlikely to drive our results. Finally, we find the same VRP difference when repeating the entire estimation using monthly data or individual stocks (instead of portfolios).

The VRP difference between the equity and option markets has several implications. First, it leads to a more nuanced view of the information content of the option VRP, which is frequently interpreted as a measure of investors' risk aversion and future economic activity. However, this interpretation could be misleading if the two broker-dealer variables that drive the option VRP mainly capture shocks that are specific to intermediaries. Consistent with this view, changes in both variables do not affect the risk attitude of equity investors toward stocks exposed to variance risk. In addition, the equity VRP projection yields more accurate forecasts of the stock market return and economic activity than its option-based counterpart.

Second, the rejection of the null hypothesis that variance risk has the same price suggests the presence of market frictions between the equity and option markets. The simplest interpretation of this price difference is that investors face portfolio constraints that induce market segmentation.[4] In practice, such constraints can arise because equity investors face information costs or regulatory constraints that limit their positions in the option market or because broker-dealers do not have the mandate to trade stocks exposed to variance risk. An alternative explanation proposed by Garleanu and Pedersen (2011) is that investors with limited capital can value identical assets differently if they are traded in markets with different margin requirements, a situation observed in the equity and option markets. While the marginal contribution of each theory is difficult to determine without knowing all the

[2] The mispricing of Standard and Poor's 500 index options is documented by Constantinides, Czerwonko, Jackwerth, and Perrakis (2011). The role of intermediaries in setting option prices is discussed by Adrian and Shin (2010), Bates (2003, 2008), Chen, Joslin, and Ni (2016), and Garleanu, Pedersen, and Poteshman (2009).

[3] See, for instance, Adrian and Shin (2010, 2014) who demonstrate empirically that the leverage ratio drops when intermediaries hit their risk constraints, and Boyson, Stahel, and Stulz (2010) who use the PBI return in the context of hedge fund contagion.

[4] Market segmentation is also commonly used to explain mispricing across international markets. See, e.g., Bekaert, Harvey, Lundblad, and Siegel (2011).