News Sentiment as an Explanation for Changes in the VIX Futures Basis

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KEY FINDINGS

- Increases in VIX cause the VIX futures basis to narrow and the forward curve to flatten.
- Negative news sentiment is one source of heightened VIX and associated forward curve flattening.
- The impact of news sentiment is greatest during recession and for the most extreme changes in the VIX futures basis.

ABSTRACT: *Chicago Board Options Exchange Volatility Index (VIX) futures have become an increasingly important hedging instrument and aid to portfolio diversification. The authors study changes in the futures basis, which can be interpreted as changes in expectations of future VIX ("fear") levels. The authors find that higher levels of VIX are associated with a narrowing of the futures basis, suggesting that investors view fear as temporary, and a flatter forward curve. News sentiment offers one plausible explanation for changes in the basis. A wider (narrower) basis accompanies the more positive (negative) news associated with a falling (rising) VIX index. The identified relationships are most pronounced for extreme changes in the VIX futures basis and appear to be concentrated in recession.*

TOPICS: ***Options, futures and forward contracts****

"Fear is the mother of foresight."
— Thomas Hardy (1910)

The Chicago Board Options Exchange (CBOE) introduced the CBOE Volatility Index (VIX) in 1993. VIX provides a measure of consensus market expectations of near-term stock market volatility and is widely reported in the media as a measure of investor "fear." In 2004, CBOE introduced VIX futures, providing market participants with a means of actively trading a volatility instrument directly tied to VIX. VIX futures can significantly improve portfolio performance (Bahaji and Aberkane 2016; Warren 2012) and offer an effective hedge for investors with exposure to market volatility, such as those with short option positions (Lin and Lin 2016).

In the first year of trading, daily trading volume in VIX futures averaged just 462 contracts, but trading activity has grown quickly, surpassing 200,000 lots per day in 2014 and 300,000 in 2018. Given the increased usage of VIX futures, it is important to understand how the VIX futures basis (the difference between the index level and futures price) responds to

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changes in the underlying VIX index. Studying the basis in particular is worthwhile because Chen and Tsai (2017) found that, when the basis widens, VIX futures dominate the VIX index in the price discovery process, whereas Bordonado, Molnar, and Samdal (2017) found that the basis can be used as a signal for profitable trading strategies. Jones and Allen (2015) suggest that the volatile nature of VIX futures basis is related to the fact that the VIX index is noninvestible, and so VIX futures tend to be priced based on expectations rather than the typical cost-of-carry relationship.

More generally, research on VIX is beneficial because the literature has demonstrated its use as a predictor for a range of financial variables (and so it is valuable for market practitioners). For instance, Whaley (2009) showed that VIX works reasonably well in forecasting stock returns, which Bollerslev, Tauchen, and Zhou (2009) and Bekaert and Hoerova (2013) showed is attributable to the variance risk premium (difference between realized variance and implied volatility or VIX), whereas the remaining component (conditional stock market variance) can predict economic activity. Caporale, Gil-Alana, and Plastun (2018) find that changes in VIX are not persistent during normal times and become more persistent during crisis.

A negative and asymmetric relationship between changes in VIX and stock returns is well documented (e.g., Fleming, Ostdiek, and Whaley 1995; Giot 2005; Whaley 2000, 2009). This is consistent with greater demand for portfolio insurance as stock prices fall and investors demanding higher rates of returns as expected market volatility increases. An analogous relationship is identified between firm-specific news sentiment and stock market volatility (Atkins, Niranjan, and Gerding 2018, Johnman, Vanstone, and Gepp 2018). In this nascent field of textual sentiment analysis, Ho, Shi, and Zhang (2013) demonstrated that news sentiment accounts for a greater proportion of volatility persistence than even macroeconomic news. Garcia (2013) used a century of stock returns to confirm that the effect is concentrated in recession, when volatility tends to increase (Bloom 2014) as firm's borrow more (increase leverage) or investors purchase more portfolio insurance (higher risk aversion). If news sentiment is able to explain changes in VIX, then it may also help to explain changes in the VIX futures basis.

In focusing on the VIX futures basis, we contribute by examining an aspect of an increasingly important market that has received little attention to date. We propose news sentiment as one explanation for changes in the basis. Our results suggest that increases in VIX (investor fear") are associated with a narrowing of the futures basis and a flattening of the futures curve. We confirm the negative asymmetric relationship between news and the VIX index found in the literature, and we extend this to show that there is a positive asymmetric news effect on the VIX futures basis. The magnitude of the news sentiment impact is most pronounced for extreme values and is concentrated in periods of recession (or crisis).

The article proceeds as follows. The second section introduces the data used in the study. The third section reports our empirical results, and the fourth section concludes.

DATA

VIX Futures Basis

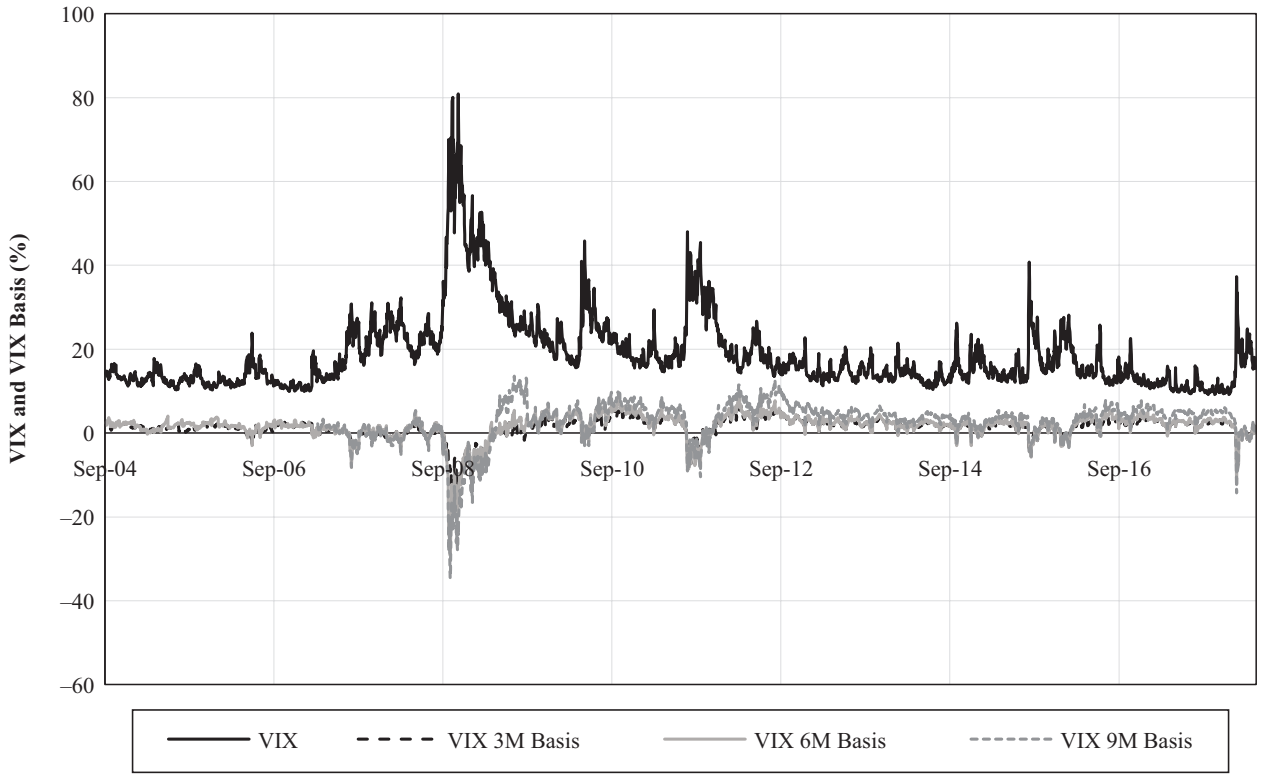
VIX estimates the level of implied stock market volatility by averaging the weighted prices of S&P 500 Index puts and calls over a wide range of strike prices. VIX is quoted in percentage points and translates, approximately, to the expected volatility in the S&P 500 Index over the next 30-day period. Typically, portfolio insurers have a large demand for put options, responsible for the colloquial index term "fear gauge," and for providing a VIX premium (VIX tends to overestimate future realized volatility).

VIX futures contracts are cash settled with a contract multiplier of $1,000 and a dollar value per tick of $50. CBOE may list futures for trading up to 6 near-term expiration weeks, and 9 near-term serial months. The difference between the spot and futures price is referred to as the futures *basis*. In this case, the basis represents the difference between expectations for short- and long-term volatility (in addition to a term premium). As the VIX index is nontradable, the basis cannot easily be eliminated by arbitrage. We compute VIX futures basis using the difference between spot VIX Index (*VIX*) and a constant maturity time series of 3-month ahead (*VIX 3M Basis*[1]), 6-month ahead (*VIX 6M Basis*) and 9-month ahead (*VIX 9M Basis*) futures prices computed

[1] For example, VIX 3M Basis = constant maturity 3-month future price − VIX index level (*VIX*).

EXHIBIT 1

Changes in Chicago Board Options Exchange Volatility Index (VIX) and the VIX Basis



Note: M = month.

via interpolation of serial month futures.[2] Together, the 3-, 6-, and 9-month basis can be used to construct a forward curve. Our sample period runs from April 2004 (coincident with the introduction of VIX futures) to April 2018.

Exhibit 1 illustrates how the VIX index and VIX futures basis have moved during this sample period and provides an initial indication that the basis tends to narrow (invert) when VIX is higher. For instance, during the financial crisis, the VIX 9M Basis hit a low of −34.62 in November 2008 as the VIX index reached a high of 80.86.

Descriptive statistics in Exhibit 2 show that the average level of VIX is 18.55 with the mean daily change is close to zero. The future basis is generally positive, and the forward curve is upward sloping. Standard deviations are large and a high degree of kurtosis ("fat tails"), typical of financial variables, is present.

Explanatory Variables

We obtain a measure of news sentiment (*News*) using Ravenpack's Multi-Classifier for Equities (MCQ).[3] This news analytics tool assigns a sentiment score (negative, neutral, positive) to news items posted on the Dow Jones newswire and in the *Wall Street Journal*. We create an aggregate measure of daily *news* for the S&P 500 Index by value-weighting firm-specific MCQ for the constituent firms of the index. News sentiment is slightly negative on average during the sample period (Exhibit 2).

[2] Our results are qualitatively similar regardless of whether we compute the basis in this way, use the nearest to maturity futures contract in place of the index, or use the prices of the serial futures contracts without adjusting for time.

[3] Our news sentiment sample ends in June 2014.

EXHIBIT 2
Descriptive Statistics

	Level		Change (Δ)						
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Skew**	**Kurtosis**	**Unit Root**
VIX	18.55	9.01	−0.00040	1.77	−17.36	20.01	1.03	24.96	−27.68*
VIX 3M Basis	1.36	2.38	0.00028	0.56	−9.04	7.72	−0.76	42.97	−63.91*
VIX 6M Basis	1.62	3.11	−0.00049	0.82	−11.91	9.08	−0.68	32.59	−48.76*
VIX 9M Basis	2.85	4.84	−0.00028	1.09	−14.89	9.66	−0.93	27.17	−42.59*
News	−0.01	0.08	−0.00003	0.09	−0.37	0.35	−0.02	3.88	−22.65*
3M Rate	1.24	1.68	0.00026	0.05	−0.81	0.76	−0.89	74.99	−41.36*
Term Premium	1.42	0.84	−0.00051	0.04	0.28	0.21	−0.02	6.80	−58.71*
Credit Spread	1.07	0.49	0.00000	0.03	−0.75	0.80	2.01	326.02	−13.53*

Notes: Exhibit 2 presents summary data for the variables of interest used in this study. This includes daily changes in the Chicago Board Options Exchange Volatility Index (VIX), and the VIX futures basis computed using the difference between the VIX index and a constant maturity time series of 3-month ahead (VIX 3M Basis), 6-month ahead (VIX 6M Basis), and 9-month ahead (VIX 9M Basis) futures prices computed via interpolation of serial month futures. In addition, the variables include a measure for changes in aggregated news sentiment (News), 3-month interest rates (3M Rate), a term-premium computed as the difference between 2-year and 10-year Treasury rates (Term Premium), and a credit spread reflecting the difference between yields on corporate bonds rated Aaa and Baa by Moody's (Credit Spread). Unit root tests are conducted using Augmented Dickey– Fuller with trend and intercept.

**Rejection of* the *null of a unit root at the 1% level. Sample period: April 2004–April 2018.*

In addition to changes in the VIX Index, we incorporate several additional explanatory variables that may explain changes in the VIX futures basis. This includes the 3-month T-Bill rate (*3M Rate*), a term-premium computed as the difference between the 2-year and 10-year Treasury yields (*Term Premium*), and a credit spread reflecting the difference between yields on corporate bonds rates Aaa and Baa by Moody's (*Credit Spread*). Recession is a dummy variable indicating whether the US economy is experiencing (1) or not experiencing (0) a National Bureau of Economic Research (NBER)-defined recession. The single recession period in our sample coincides with the financial crisis of 2008–09. Exhibit 1 shows that 3M Rate, Term Premium, and Credit Spread have averaged 1.24%, 1.42%, and 1.07%, respectively. All demonstrate relatively high volatility and "fat tails."

EMPIRICAL RESULTS

Baseline Model

We first investigate whether changes in VIX influence the magnitude of the VIX futures basis using ordinary least squares (Equation 1):

$$\Delta VIX\_BASIS_t = \beta_c + \beta_1 \Delta VIX_t + \sum_{i=1}^{3} \gamma_i \Delta M_{i,t} + \delta_1 Recession_t + \delta_2 Recession \times \Delta VIX_t + \varepsilon_t, \quad (1)$$

where ΔVIX_BASIS is the daily change in the VIX futures basis, ΔVIX is the change in VIX, M is a set of macroeconomic variables (3M Rate, Term Premium, and Credit Spread), *Recession* is an economic state variable, and ε is the robust standard error term. Because the pricing of VIX futures is related to expectations (Jones and Allen 2015) we can interpret changes in the futures basis as changes in expectations of future VIX levels.

Exhibit 3 reports the estimated coefficients, with the first column for each futures basis representing the univariate regression, and the second incorporating the macroeconomic variables and recession indicator. In each case, the overall regression is significant and appears to explain a large proportion of the variance in the basis.

The key result is the estimated ΔVIX coefficient, which is highly significant and negative. That is, the futures basis narrows (widens) significantly as VIX increases (falls). The narrowing of the basis when VIX

EXHIBIT 3
Relationship between Market-Based Fear (VIX) and the VIX Futures Basis

	ΔVIX 3M Basis		ΔVIX 6M Basis		ΔVIX 9M Basis	
Constant	0.000	−0.001	−0.000	−0.002	0.000	−0.004
	(0.003)	(0.005)	(0.004)	(0.006)	(0.007)	(0.009)
ΔVIX	−0.212***	−0.231***	−0.314***	−0.333***	−0.406***	−0.430***
	(0.017)	(0.020)	(0.017)	(0.024)	(0.029)	(0.031)
Δ3M Rate		0.148		0.302		0.220
		(0.290)		(0.557)		(0.623)
ΔTerm Premium		0.234		0.158		0.190
		(0.265)		(0.489)		(0.592)
ΔCredit Spread		−0.177		−0.448		−0.010
		(0.451)		(0.655)		(0.626)
Recession		0.005		0.010		0.034
		(0.034)		(0.046)		(0.057)
ΔVIX × Recession		0.050		0.054		0.068
		(0.030)		(0.050)		(0.068)
Adj. R^2	0.452	0.458	0.475	0.478	0.527	0.529
F Statistic	2926.3	498.7	3101.6	523.7	3107.1	523.0
DW Statistic	2.183	2.175	2.252	2.241	2.287	2.279
No. Obs.	3541	3541	3423	3423	2789	2789

Notes: This exhibit presents estimated coefficients for the relationship between changes in Chicago Board Options Exchange Volatility Index (VIX) and the VIX future basis. The dependent variables are the daily change in the VIX futures basis computed using the difference between the VIX index and a constant maturity time series of 3-month ahead (VIX 3M Basis), 6-month ahead (VIX 6M Basis), and 9-month ahead (VIX 9M Basis) futures prices computed via interpolation of serial month futures. The explanatory variables include the daily change in VIX (ΔVIX) which can be thought of as a change in market-based sentiment, and changes in the 3-month interest rate (Δ3M Rate), the 2-year to 10-year term-premium (ΔTerm Premium), and the Baa–Aaa credit spread (ΔCredit Spread). Recession is a dummy variable indicating whether the economy is (1) or is not (0) in a National Bureau of Economic Research–defined recession. Sample period: April 2004–April 2018.

****p = 0.001.*

rises suggests that investors typically believe "fear" will not persist and is consistent with an element of mean reversion being incorporated into volatility expectations. Because the magnitude of the estimated Δ*VIX* coefficient is larger as the maturity increases from 3M to 6M to 9M, we can interpret this as a flattening (steepening) of the VIX futures curve when VIX increases (declines).

The economic control variables are not statistically significant, but the signs of the estimated coefficients are consistent with the basis widening as the economic outlook improves (interest rates rise and credit spreads fall)—a situation typically corresponding with declining VIX. *Recession* does not appear to have a significant influence in this specification, even though volatility tends to be higher during this period.

Explaining Changes in the VIX Futures Basis with News Sentiment

As prior literature has demonstrated a link between news sentiment and investor fear (e.g., Smales 2014; Yang et al. 2015; Uhl 2018), we explore whether changes in news sentiment offer an explanation for results identified in the prior section. We adjust our regression specification to include an aggregate measure

EXHIBIT 4
Relationship between News Sentiment and the VIX Basis

	ΔVIX		ΔVIX 3M Basis		ΔVIX 6M Basis		ΔVIX 9M Basis	
Constant	0.006	0.006	0.000	−0.001	−0.002	−0.004	−0.003	−0.013
	(0.032)	(0.028)	(0.009)	(0.008)	(0.014)	(0.010)	(0.028)	(0.023)
ΔNews	−6.640***	−3.242	1.005***	0.247	1.885***	0.897***	3.611***	1.453**
	(1.018)	(0.764)	(0.017)	(0.226)	(0.411)	(0.253)	(0.700)	(0.596)
Δ3M Rate		−3.602***		0.555***		1.419**		1.723**
		(1.192)		(0.211)		(0.592)		(0.806)
ΔTerm Premium		−3.947***		0.675		1.312		1.998
		(1.900)		(0.717)		(1.282)		(1.684)
ΔCredit Spread		3.536**		−0.757		−0.411		−1.179*
		(1.853)		(0.741)		(0.756)		(0.632)
Recession		0.014*		0.007		0.013		0.044
		(0.114)		(0.025)		(0.059)		(0.078)
ΔNews × Recession		−13.80***		3.119**		3.705**		5.163***
		(2.780)		(1.247)		(1.482)		(1.653)
Adj. R^2	0.086	0.174	0.022	0.066	0.034	0.070	0.056	0.095
F Statistic	181.7	68.1	44.0	23.5	64.3	23.5	69.4	21.2
No. Obs.	2583	2583	2583	2583	2465	2465	1949	1949

Notes: This exhibit presents estimated coefficients for the relationship between news sentiment and changes in the Chicago Board Options Exchange Volatility Index (VIX) and the VIX futures basis. The dependent variables are the daily change in the VIX Index (ΔVIX), the VIX futures basis computed using the difference between the VIX index and a constant maturity time series of 3-month ahead (VIX 3M Basis), 6-month ahead (VIX 6M Basis), and 9-month ahead (VIX 9M Basis) futures prices computed via interpolation of serial month futures. The explanatory variables include the daily change in news sentiment (ΔNews), and changes in the 3-month interest rate (Δ3M Rate), the 2-year to 10-year term-premium (ΔTerm Premium), and the Baa–Aaa credit spread (ΔCredit Spread). Recession is a dummy variable indicating whether the economy is (1) or is not (0) in a National Bureau of Economic Research–defined recession. Sample period: April 2004–June 2014.

**p = 0.01. **p = 0.05. ***p = 0.001.*

of news sentiment, computed using Ravenpack, and report the results in Exhibit 4. In the first two columns, we confirm the negative relationship between sentiment and ΔVIX observed in the literature; VIX declines (increases) when sentiment improves (falls). The estimated Δ*News* coefficient for the basis (our key result) is positive and significant; a widening (narrowing) basis in the presence of improving (declining) news sentiment aligns with the results reported earlier. Once again, the magnitude of the estimated coefficient increases as the maturity of the futures contract increases, indicating a steepening (flattening) when news is more positive. The recession interaction term emphasizes the importance of changes in sentiment during recession. This is consistent with the heightened response to sentiment during recession highlighted by Garcia (2013).

Prior literature has also found that the effect of news on financial markets is asymmetric, whereby negative news has a greater impact than positive news. We examine this effect by disaggregating our measure of news sentiment into negative and positive components. The negative (positive) sentiment variable takes a value equal to the news sentiment variable when the sentiment score is less (greater) than 0 and a value of 0 otherwise.

The estimated coefficients are shown in Exhibit 5. We find that both news types have a statistically significant

EXHIBIT 5
Disaggregating Impact of News Sentiment on the VIX Basis

	ΔVIX		ΔVIX 3M Basis		ΔVIX 6M Basis		ΔVIX 9M Basis	
Constant	0.000	−0.003	0.001	0.001	0.000	−0.001	0.001	−0.004
	(0.022)	(0.019)	(0.010)	(0.008)	(0.013)	(0.011)	(0.023)	(0.019)
ΔNews_Neg	6.999***	3.650***	−0.980***	−0.318	−1.971***	−1.128***	−3.876***	−2.206***
	(1.179)	(0.921)	(0.259)	(0.255)	(0.338)	(0.289)	(0.708)	(0.742)
ΔNews_Pos	−5.843***	−2.311*	1.066**	0.116	1.671**	0.386	3.040**	0.196
	(1.802)	(1.257)	(0.433)	(0.345)	(0.670)	(0.517)	(1.186)	(0.941)
Δ3M Rate		−3.771***		0.654**		1.522**		1.882**
		(1.151)		(0.276)		(0.734)		(0.862)
ΔTerm Premium		−6.233***		1.176***		2.046***		3.052***
		(1.422)		(0.425)		(0.743)		(0.961)
ΔCredit Spread		−2.632*		−0.626		−0.369		−1.033
		(1.444)		(0.560)		(0.834)		(0.977)
Recession		0.003		0.004		0.009		0.033
		(0.115)		(0.047)		(0.066)		(0.085)
ΔNews_Neg ×Recession		10.38***		−1.929***		−2.272***		−2.487*
		(3.261)		(0.680)		(0.868)		(1.340)
ΔNews_Pos × Recession		−23.78***		6.482***		7.755***		12.04***
		(6.925)		(1.483)		(2.315)		(2.850)
Adj. R^2	0.060	0.138	0.018	0.067	0.029	0.072	0.046	0.099
F Statistic	113.2	71.7	25.0	24.3	37.8	25.0	45.5	26.0
No. Obs.	2583	2583	2583	2583	2465	2465	1949	1949

Notes: Exhibit 5 presents estimated coefficients for the relationship between news sentiment and changes in the Chicago Board Options Exchange Volatility Index (VIX) and the VIX futures basis. The dependent variables are the daily change in the VIX Index (ΔVIX), the VIX futures basis computed using the difference between the VIX index and a constant maturity time series of 3-month ahead (VIX 3M Basis), 6-month ahead (VIX 6M Basis), and 9-month ahead (VIX 9M Basis) futures prices computed via interpolation of serial month futures. The key explanatory variables are disaggregated daily changes in news sentiment (ΔNews_Neg; ΔNews_Pos), where the neg (pos) variable takes a value equal to the news sentiment score if the sentiment is negative (positive) and zero otherwise. Other variables are changes in the 3-month interest rate (Δ3M Rate), the 2-year to 10-year term-premium (ΔTerm Premium), and the Baa–Aaa credit spread (ΔCredit Spread). Recession is a dummy variable indicating whether the economy is (1) or is not (0) in a National Bureau of Economic Research–defined recession. Sample period: April 2004–June 2014.

**p = 0.01. **p = 0.05. ***p = 0.001.*

impact, but the asymmetry appears to vary by economic state. Negative news is associated with a rising VIX index and a narrowing VIX futures basis, whereas positive news is associated with a widening basis. For the 3M basis, the effect of news sentiment is entirely centered in recession. For the 6M and 9M bases, negative news has a significant impact across all time intervals, in addition to a supplementary influence during recession. The importance of news during recession is again emphasized. However, our finding for the news-effect asymmetry differs from the prior literature. We find that positive news has the greater impact on both VIX and the futures basis during recession. One explanation may be that positive news is less prevalent during recession and so elicits a greater surprise response from market participants. This seems to differ from prior results for stock returns.

We have identified that news sentiment has a greater influence during the recessionary period that coincides with the financial crisis. It is also a stylized fact that financial asset returns are skewed (typically toward the left tail) during crisis periods. Allen et al. (2009) suggest that, during crisis, ordinary least squares regression may not be effective in analyzing the extremes of a distribution. They suggest quantile regression (Bassett and Koenker 1978; Koenker and Hallock 2001) as an alternative that is able to quantify the behavior of the tail distribution and thus offer better insights into risk

EXHIBIT 6
Effect of News Sentiment on VIX Basis across Quantiles

	Quantile	ΔVIX	ΔVIX 3M Basis	ΔVIX 6M Basis	ΔVIX 9M Basis
ΔNews	0.1	−5.847***	0.979***	2.232***	3.873***
		(0.479)	(0.237)	(0.352)	(0.591)
	0.2	−3.459***	0.712***	1.412***	2.798***
		(0.374)	(0.148)	(0.209)	(0.517)
	0.3	−2.832***	0.607***	0.964***	2.498***
		(0.358)	(0.100)	(0.139)	(0.401)
	0.4	−2.227***	0.540***	0.773***	2.253***
		(0.348)	(0.090)	(0.122)	(0.385)
	0.5	−2.077***	0.492***	0.748***	2.108***
		(0.367)	(0.088)	(0.126)	(0.356)
	0.6	−2.581***	0.503***	0.883***	2.172***
		(0.448)	(0.094)	(0.144)	(0.350)
	0.7	−3.122***	0.626***	1.247***	2.448***
		(0.417)	(0.111)	(0.171)	(0.353)
	0.8	−4.501***	0.971***	1.459***	3.037***
		(0.657)	(0.191)	(0.205)	(0.427)
	0.9	−7.033***	1.200***	1.675***	4.837***
		(1.006)	(0.230)	(0.233)	(0.618)

Notes: Exhibit 6 presents estimated coefficients for the quantile regression on the relationship between news sentiment and changes in the Chicago Board Options Exchange Volatility Index (VIX) and the VIX futures basis. The dependent variables are the daily change in the VIX Index (ΔVIX), the VIX futures basis computed using the difference between the VIX index and a constant maturity time series of 3-month ahead (VIX 3M Basis), 6-month ahead (VIX 6M Basis), and 9-month ahead (VIX 9M Basis) futures prices computed via interpolation of serial month futures. The key explanatory variable is the daily change in news sentiment (ΔNews). Coefficients for the following set of control variables are not reported: changes in the 3-month interest rate (Δ3M Rate), the 2-year to 10-year term-premium (ΔTerm Premium), and the Baa–Aaa credit spread (ΔCredit Spread). Sample period: April 2004–June 2014.

****p = 0.001.*

measurement. Quantile regression extends least square estimation to a set of models on conditional quantile functions. This offers a more complete view on the effect of explanatory variables across the distribution of the response variable.

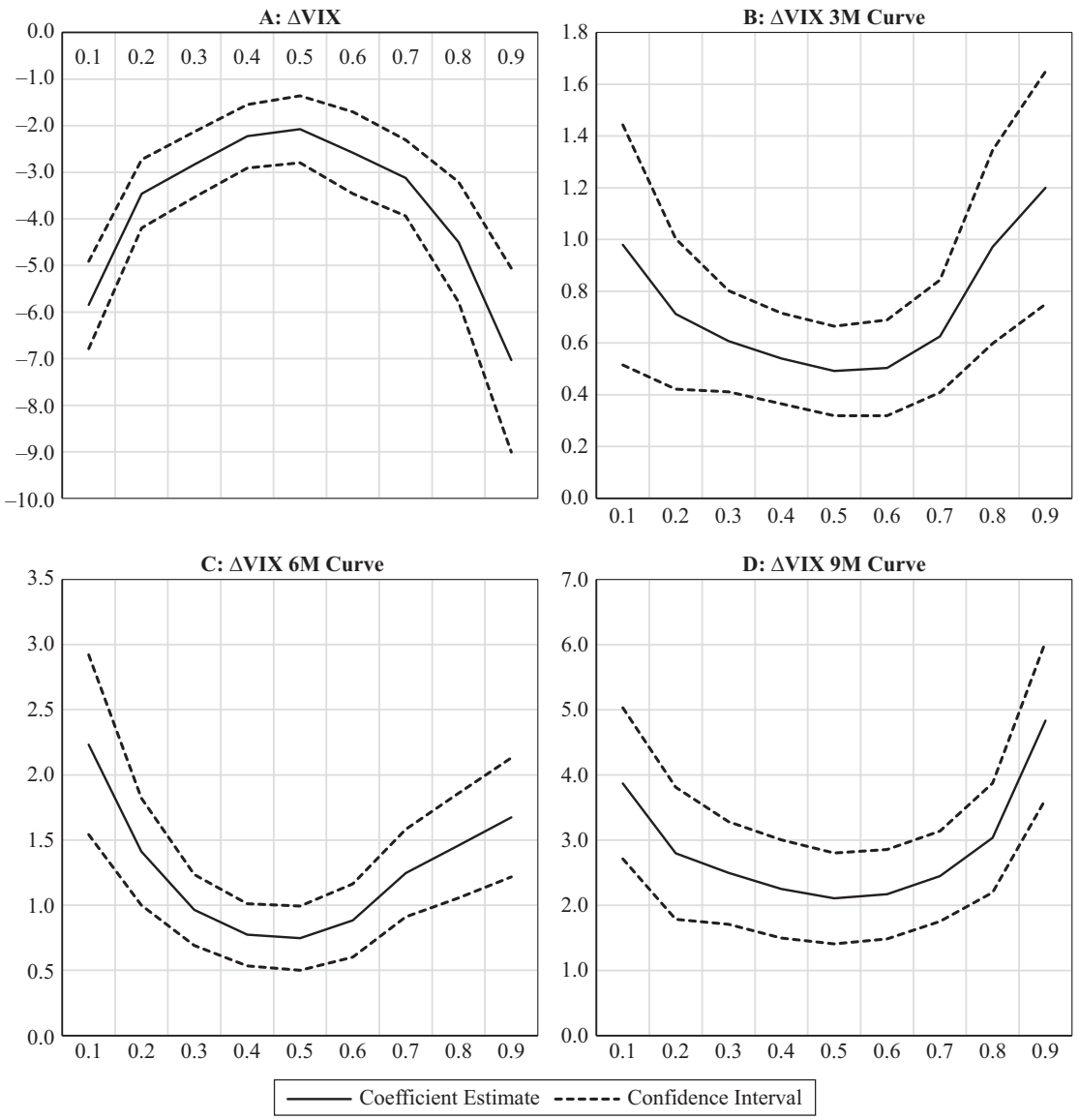
We follow this suggestion and apply quantile regression analysis to our testing to gain a more nuanced understanding as to the impact of news sentiment on changes in VIX and the VIX basis. The estimated results are reported in Exhibit 6 and shown graphically in Exhibit 7. Clearly, the estimated coefficients change across quantiles and, although they are significantly different from zero across the distribution, are most pronounced at the extremes. Because the extreme values tend to occur during recession (or crisis) periods, this is consistent with the earlier result regarding the magnitude of the news sentiment effect during recession. This result emphasizes that investors then need to be aware that the impact of news sentiment is greatest in the tail of the distribution.

CONCLUSION

This article examines the relationship between changes in VIX and the VIX futures basis. We demonstrate that higher levels of VIX (elevated levels of investor fear) are associated with a narrowing of the futures basis, and a flattening of the futures curve. This suggests that investors view fear as temporary in nature. We propose news sentiment as one plausible explanation for the identified results. A wider (narrower) VIX futures basis accompanies the more positive (negative) news associated with a falling (rising) VIX index. We demonstrate that news sentiment has an asymmetric

EXHIBIT 7

Quantile Process Estimates (95% confidence interval)



Note: M = months; ΔVIX = daily change in the Chicago Board Options Exchange Volatility Index (VIX).

effect whereby negative news has a more pronounced impact in general but positive news has a greater impact during recession. Further, the identified relationships are most pronounced for extreme values of the distribution and concentrated in recession. The results are relevant to the multitude of investors incorporating VIX-related products in their portfolios.

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ADDITIONAL READING

Relationships between Implied Volatility Indexes and Stock Index Returns

PIERRE GIOT

The Journal of Portfolio Management

https://jpm.pm-research.com/content/31/3/92

ABSTRACT: *There is a negative and statistically significant relationship between the returns of the S&P 100 and the Nasdaq 100 stock indexes and their corresponding implied volatility indexes, VIX and VXN. For the S&P 100, the relationship is asymmetric,*

as negative stock index returns are more associated than positive returns with greater changes in VIX. VIX changes when negative stock index returns are observed are greater in low–volatility periods. For the Nasdaq 100, the asymmetric effect is rather weak, but the VXN and underlying index co–movement is also somewhat muted in high–volatility trading environments. There is some evidence that positive forward–looking returns are to be expected for long positions triggered by extremely high levels of the implied volatility indexes.

A Note on the Premiums and Discounts Embedded in VIX Futures Prices

Travis L. Jones and Marcus T. Allen

The Journal of Investing
https://joi.pm-research.com/content/24/2/69

ABSTRACT: *This article illustrates the volatile nature of the premiums and discounts embedded in the prices of VIX (Chicago Board Options Exchange Market Volatility Index) futures contracts. The fact that the underlying VIX index cannot be traded leads VIX futures to be priced more on expectations of market participants than on a typical cost-of-carry relationship. As they near expiration, VIX futures, in the aggregate, tend to trade at an increased premium, when trading in contango, and at an increased discount, when trading in backwardation. In addition, the premium in these contracts tends to peak as the VIX index nears a low, and the discount in the contracts tends to bottom as the index nears a high.*

Volatility Aversion in the Options Market Based on News Sentiment

Matthias W. Uhl

The Journal of Derivatives
https://jod.pm-research.com/content/25/4/24

ABSTRACT: *The perennial question of efficient markets is whether investors respond rationally to new information. If they "overreact" or "underreact" to a news release, is it a simple error or systematic bias? A major problem in testing this is the need to be clear on what "news" is and when investors learn it. This is especially hard because evaluating new information is inherently subjective and may have its largest impact on what is typically called investor sentiment. In this article, the author focuses on news about the macroeconomy, using textual analysis on news items carried by Thomson Reuters to explore the impact of positive and negative news on implied volatilities (IVs) from SPX options. What should move the market is a change in sentiment, which the author measures by the change in the incidence of positive and negative words in relevant news items. Coefficient estimates across moneyness and maturity are uniformly negative for positive sentiment (good news makes IVs go down) and positive for negative sentiment. Differences show up between puts and calls and across moneyness. Interestingly, the impact is significant in most cases for positive but not negative news. Short maturity out-of-the-money put IVs are particularly sensitive to positive macro information, while negative news affects both calls and puts at the money.*