Journal of Econometrics ▮ (▮▮▮▮) ▮▮▮–▮▮▮

Contents lists available at ScienceDirect

Journal of Econometrics

journal homepage: www.elsevier.com/locate/jeconom

Resolution of policy uncertainty and sudden declines in volatility

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ARTICLE INFO

Article history:
Received 13 February 2017
Received in revised form 22 August 2017
Accepted 1 December 2017
Available online xxxx

JEL classification:
G12
G13

Keywords:
Non-affine derivative pricing models
Log volatility models
Quadratic volatility models
Downward volatility jumps
Variance swaps

ABSTRACT

We introduce downward volatility jumps into a general non-affine modeling framework of the term structure of variance. With variance swaps and S&P 500 returns, we find that downward volatility jumps are associated with a resolution of policy uncertainty, mostly through statements from FOMC meetings and speeches of the Federal Reserve's chairman. Ignoring such jumps may lead to an incorrect interpretation of the tail events, and hence biased estimates of variance risk premia. On the modeling side, we explore the structural differences and relative goodness-of-fits of factor specifications. We find that log-volatility models with at least one Ornstein–Uhlenbeck factor and double-sided jumps are superior in capturing volatility dynamics and pricing variance swaps, compared to the affine model prevalent in the literature or non-affine specifications without downward jumps.

1. Introduction

Volatility responds to news. It rises dramatically and immediately following the occurrence of unexpected bad events.[1] Moreover, volatility not only jumps upward but also moves downward rapidly. Sudden declines in volatility are sometimes related to stock market rallies stimulated by unexpected good news from economic indicators or earning announcements. Yet they are also very often triggered by the resolution of policy uncertainty that shifts investors' sentiment. Recent news headlines bring this fact into the spotlight. In particular, as can be seen from Fig. 1, the VIX dropped 35% on May 10, 2010, as a result of Europe's emergency loan plan; another 27% on Aug 9, 2011, due to Federal Reserve's rate statement on keeping interest rates at a record low through mid-2013; and finally 23% on Dec 31, 2012, in anticipation of lawmakers making a deal to avert the "fiscal cliff".

Despite the size and scope of their bailout is uncertain, the government and Federal Reserve often intervene in the midst of hard times, which effectively provides a put protection on asset prices.[2] Our hypothesis is that many downward volatility jumps are ex-post market reactions to these policy measures, and that they are important sources of risk for volatility traders ex-ante. This type of variance risk should be priced in volatility derivatives, and could be an important part of the total variance risk premia. Therefore, ignoring downward volatility jumps may lead to an incorrect interpretation of the price of tail events. The goal of this paper is to provide a systematic investigation of where downward volatility jumps originate, how they affect asset prices, and whether they are priced risk factors.

These questions invite us to search for appropriate derivatives to investigate the asset pricing implications of volatility shocks. While the S&P 500 options offer a developed battlefield for volatility trading, volatility derivatives have thrived on the demand for volatility hedging and speculation since their inception. The over-the-counter index variance swap contract is one particular example of these popular derivatives. As with most swaps, the fixed leg of variance swaps pays a pre-determined amount at maturity in exchange for the realized variance that the floating leg commits to offer. Despite the path-dependence of realized variance, the payoff structure of variance swaps is appealing for studying the term structure of variance and variance risk premia, as opposed to the exchange-traded VIX derivatives, in that variance swaps directly reflect investors' expectation on future uncertainty.[3] Moreover,

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[1] For instance, the terrorist attack on September 11, 2001 sent the VIX near what had been its historical high.

[2] We use "put protection" to refer to the monetary policy approaches that Alan Greenspan, former Chairman of the Federal Reserve Board, exercised from 1987 to 2000 and during recent financial crisis.

[3] Since 2004 and 2006, the Chicago Board Options Exchange (CBOE) has introduced VIX futures and VIX options, respectively, offering investors additional instruments for volatility trading. These contracts are written on the VIX, which

https://doi.org/10.1016/j.jeconom.2017.12.003
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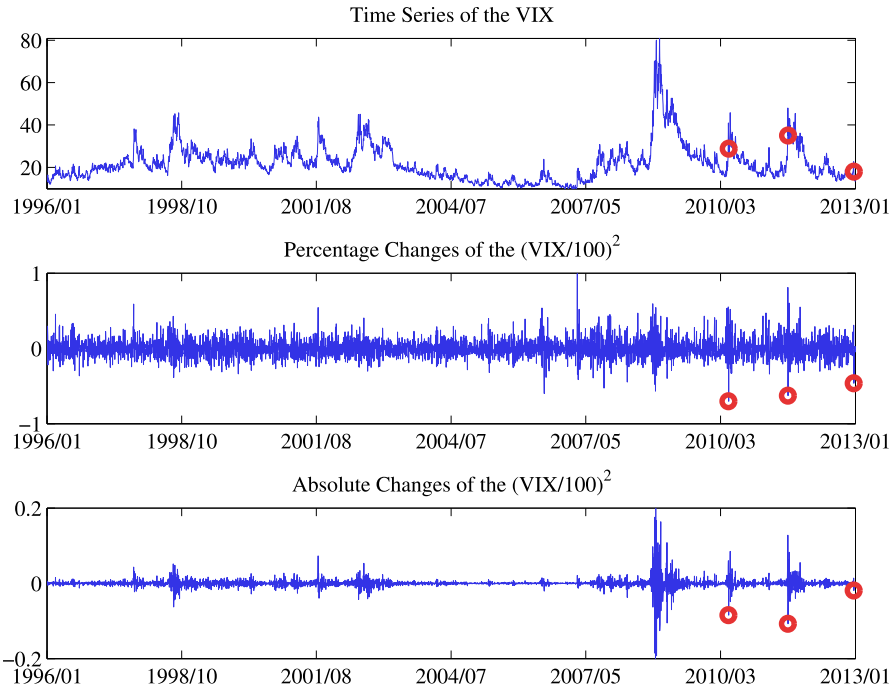

Fig. 1. Negative jumps in the VIX. Note: In this figure, we highlight three days corresponding to the following media headlines: VIX, Vstoxx Drop by Records as Stocks Soar on Europe's Emergency Loan Plan. - Bloomberg, Monday May 10, 2010; VIX Index Driven to Second-Biggest Percentage Drop (−27%) on Fed's Rate Statement. - Bloomberg, Tuesday Aug 09, 2011; The CBOE Volatility Index, or the VIX, Wall Street's Favored Measure of Anxiety, Posted its Biggest One-Day Decline since August 2011, as Lawmakers Closed in on a Deal to Avert the "Fiscal Cliff." -Reuters, Monday Dec 31, 2012.

a variance swap can be replicated using a portfolio of S&P 500 options, which is very similar to the VIX itself. Therefore it is very sensitive to volatility jumps.

Despite their existence, whether and how these volatility jumps affect asset prices and risk premia remain largely unknown, particularly in the case of the large downward jumps. This is partially due to the absence of derivative pricing models that allow for downward volatility jumps in the mainstream finance literature. Popular affine models such as the square-root volatility models can only incorporate upward jumps in order to ensure the positivity of variance. We incorporate downward volatility jumps and other potentially negative latent factors into a non-affine framework that guarantees the positivity of variance.

With this new and general non-affine framework, we price variance swaps in (quasi) closed form, and identify downward volatility jumps along with two latent volatility factors from 17 years of variance swap data and S&P 500 returns. We find that volatility jumps are often triggered by unexpected macro announcements.[4] In particular, sudden declines in volatility are mostly associated with the resolution of policy uncertainty, such as monetary policy changes that are explicit or implicit from Federal Open Market Committee (FOMC) statements or the speeches of the Federal Reserve's chairman, as well as fiscal policy decisions and compromises made by Congress.

Among several alternative specifications, we provide compelling evidence in favor of log-volatility models with at least one Ornstein–Uhlenbeck factor. The Ornstein–Uhlenbeck process provides sufficient persistency required for the long-term volatility factor. Our regression analysis shows that latent volatility factors are not only related to excess market returns, but also to liquidity and credit factors, as well as policy news. In particular, policy news are important for the short-term factor, whereas the default risk is paramount for the long-term. In addition, we find that downward volatility jumps are mostly related to the short-term volatility factor, yet have insignificant impacts on the long-term factor.

Unlike prevalent parametric affine models in the literature, our volatility dynamics provide a more flexible specification of variance risk premia. We find that the size of downward volatility jumps is smaller under the risk neutral measure, suggesting that market participants are pessimistic about the scale of the intervention ex-ante. In addition, our estimates conform with the existing model-free estimates that the total variance risk premia are negative most of the time, yet they tend to be insignificant or even positive at the inception of crises. This finding is a puzzle as it is in conflict with a representative agent model widely adopted in the literature.

There is a growing amount of theoretical and empirical work relating political uncertainty to asset pricing. In particular, Pástor and Veronesi (2013) relate the stock market risk premia, volatility, and correlation to the policy uncertainty index constructed by Baker et al. (2013) which is based on the frequency of newspaper references to economic policy uncertainty and other indicators. The regression results of Pástor and Veronesi (2013) agree with all the predictions of their learning model, see also Pástor and Veronesi (2012) for another related model of government policy choice. Boutchkova et al. (2012) investigate how local and global political risks affect industry return volatility. Kelly et al. (2016) find evidence for government guarantee premia by examining the basket-index spread from out-of-the-money put options. Bernanke and Kuttner (2005) study stock market reactions to Federal Reserve policy and find that the effects of unanticipated monetary policy actions on expected excess returns account for the largest part of the responses of stock prices. In turn, Beber and Brandt (2009) investigate the link between ex-ante macroeconomic uncertainty and ex-post uncertainty resolution in financial markets, using the prices of some options whose underlying is

is very similar to a 1-month variance swap. However, they are more complicated than variance swaps.

[4] While many macro announcements are pre-scheduled, their impact remains unexpected. As a result, the literature resorts to Poisson processes for modeling jumps, with notable distinctions by Maheu and McCurdy (2004), Piazzesi (2005), Dubinsky and Johannes (2006) and Beber and Brandt (2009).

Please cite this article in press as: Amengual D., Xiu D., Resolution of policy uncertainty and sudden declines in volatility. Journal of Econometrics (2018), https://doi.org/10.1016/j.jeconom.2017.12.003.