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Can economic policy uncertainty help to forecast the volatility: A multifractal perspective

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HIGHLIGHTS

- The EPU index has the multifractal feature.
- The impact of EPU on future volatility is significantly positive.
- Multifractal volatility models beat the GARCH-class models in forecasting.
- Multifractal volatility model with EPU achieve the higher accuracy.

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ABSTRACT

In this study, we investigate whether economic policy uncertainty (EPU) can impact on future volatility based on the multifractal insight. Our estimation results show that the impact of EPU on future volatility is significantly positive, which indicate that EPU can aggravate the future market risk. Moreover, Out-of-sample results tell us that adding EPU as explanatory variable to volatility models can indeed improve the forecasting performance. Furthermore, we also find evidence that the multifractal volatility models can beat the GARCH-class models in forecasting.

1. Introduction

As we all known, forecasting future volatility is crucial for derivative pricing, portfolio optimization and value-at-risk analysis. Thus, Brooks [1] point out that modeling and forecasting stock market volatility has been the subject of much recent empirical and theoretical investigation by academics and practitioners alike. To the best of our knowledge, many studies have been found some factors (see, e.g., volume [1–3], asymmetry [4,5], structural break [6,7], overnight returns [8–10], investor sentiment [11–13]), which can significantly impacted on future volatility in the framework of GARCH-type and RV-type models.

Recent, a new concept referred to economic policy uncertainty (henceforth EPU) have been paid attention to by many scholars. EPU is first proposed by Baker et al. [14], which is based on newspaper coverage frequency. To investigate the role of policy uncertainty, Baker et al. [14] first develop an index of economic policy uncertainty (EPU) for the United States and examine its evolution since 1985.2. Their index reflects the frequency of articles in 10 leading US newspapers that contain the following triple:"economic" or "economy"; "uncertain" or "uncertainty"; and one or more of "congress", "deficit", "Federal Reserve", "legislation", "regulation" or "White House". They extend their newspaper-based approach to measuring policy uncertainty along three dimensions: back in time, across countries, and to specific policy categories. Baker et al. [14] use this

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new measure to investigate the effects of policy uncertainty on stock price volatility and find that policy uncertainty raises stock price volatility. It is worth to note that news announcements and other policies can usually affect the investors, and thus cause the fluctuating asset price. Thus, EPU is a very important factor to describe the volatility.[1] The higher uncertainty of economics and politics may naturally result in more adverse effect for market participants and cause stronger volatile of oil futures price. Many scholars [15–18] have found that the impact of EPU on stock price volatility is significant in the mainstream models. In our study, we first investigate whether the EPU can also significantly impact on future volatility based on the multifractal perspective.

In the financial market, fractal was thought to be a stylized fact, since some scholars [19–22] have empirically found that significant and complex fractal characteristics existed in the financial market. Interestingly, fractal exists not only in mature stock markets, but also in emerging ones [23]. As early as in the 1997, Mandelbrot, ''father of the fractal theory'', forecasted the great prospects in the financial sector in his book *Fractals and Scaling in Finance* [24]. In addition, Mandelbrot [25] write in *Scientific American*, a globally leading scientific journal, illustrating that the multifractal was a more powerful and practical tool for depicting volatility complexities in financial markets, compared to monofractal. Given that multifractal is a powerful tool to depict complex objects' heterogeneous and anisotropic characteristics, Wei and Wang [26] put forward the measurement methods of multifractal volatility (MFV) based on the ideology of fractal. In addition, Andersen and Bollerslev [27] and Barndorff-Nielsen and Shephard [28] demonstrate that as the proxy of actual volatility, realized volatility has less noise than daily squared returns. Thus, it may be more reasonable to construct a volatility measure by rescaling the degrees of multifractality using the expectation of RV, since Chen and Wu [29] propose a new multifractal volatility (MV). Both of Wei and Wang [26] and Chen and Wu [29] use the autoregressive fractionally integrated moving average model (ARFIMA) to measure and forecast the volatility. Therefore, we add EPU as explanatory variable to ARFIMA-MFV and ARFIMA-MV model respectively and investigate the impact of EPU on multifractal volatility.

Moreover, the higher value of EPU index, which indicate a higher uncertainty and closer to the policy announcement day, may be during economic recessions or bad economic times [30]. Similarly, higher EPU index may be accompanied with higher volatility. Therefore, EPU, especially the data with higher values, should be a good predictor for future volatility. Considered the realistic background, we first divide EPU into two parts: extreme EPU and normal EPU in the framework of multifractal volatility models and further investigate whether the two parts EPU have different impacts on future volatility.

The major findings from this study are as follows. First, we dependent on the multifractal insight, we find that the impact of EPU on future volatility is significantly positive, which show that the fluctuation of EPU can increase the future market risk and further indicate that EPU is a very important factor to describe the volatility. Second, adding EPU as explanatory variable to multifractal volatility and GARCH-class models, we deserve that the volatility models with EPU can achieve the higher forecasting accuracies, which tell us that EPU should not be ignored when we forecast volatility. Third, compared to all volatility without and with EPU models, the empirical results further show that EPU can significantly improve the forecasting performance and the multifractal volatility model with EPU can have better performance than the rest of models.

The reminder of the paper is organized as follows. Section 2 is volatility measure and its model. Section 3 is the description of data. The empirical forecasting results are presented in Section 4. Section 5 concludes the paper.

2. Methodology

2.1. Multifractal volatility measurement and its volatility models

Previous studies [31,32] have found that the multifractal spectrum of high-frequency price fluctuations over the course of a trading day contains valuable volatility information Therefore, in this section, we simply discuss how to construct the multifractal volatility measure (MFV) from a multifractal spectrum and describe the MFV series using the autoregressive fractionally integrated moving average model (ARFIMA) based on the work of Wei and Wang [26]. In our analysis, we investigate whether the economic policy uncertainty (EPU) can help in forecasting multifractal volatility of the American stock market. In this work, we choose the S&P500 as our research object.

To make $\Delta\alpha$ comparable to realized volatility and other historical volatility measures, similar to the means of scaling realized volatility, Wei and Wang [26] formally define multifractal volatility measure (MFV) for day t as below

$$\mathrm{MFV}_t = \lambda_1 \Delta_{\alpha_t} \tag{1}$$

$$\lambda_1 = \frac{N^{-1}\sum_{t=1}^{N} R_t^2}{N^{-1}\sum_{t=1}^{N} \Delta_{\alpha_t}} \tag{2}$$

where the width of the multifractal spectrum can be expressed as $\Delta\alpha = \alpha_{\max} - \alpha_{\min}$, where $\alpha_{\max}$ and $\alpha_{\min}$ are the maximum and minimum of α. The $\alpha_{\min}$ indicates the highest ''price level'' in that trading day and $\alpha_{\max}$ indicates the lowest ''price level''

[1] The data about EPPU are available at monthly and daily frequencies on www.policyuncertainty.com and are carried by Bloomberg, Haver, FRED and Reuters.