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# Structural Volatility Impulse Response Analysis

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## Abstract

In this paper, we make three contributions to the volatility impulse response function (VIRF) developed by Hafner and Herwartz (2006), the most widely applied impulse response function in the context of multivariate volatility models. First, we derive its law for multivariate generalized autoregressive conditional heteroscedasticity (MGARCH) models of the BEKK type. Second, we present a structural embedding of the VIRF by relying on recent developments concerning identification of MGARCH models. This broadens the use cases of the VIRF, which has previously been limited to historical analyses, by allowing for counterfactual and out-of-sample scenario analyses of volatility responses. Third, we show how to endow the VIRF with a causal interpretation. We illustrate the merits of a structural VIRF analysis by investigating the impacts of historical shock events as well as the consequences of well-defined future shock scenarios on the U.S. equity, government bond and foreign exchange markets. Our findings suggest that it is vital to be able to assess the statistical significance of volatility impulse responses.

## Keywords

causality in volatility, multivariate GARCH models, proxy identification, structural identification, volatility impulse response functions

## JEL Classification

**C32, C58, G17**