

Volatility in Macroeconomics

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Volatility has gained lots of attention in finance literature, as, for example, in studies of the relation between stock market returns and risk, but it has been a much lower priority for applied macroeconomists. In general, the existing macroeconometrics research is concerned mainly with the first moment (or mean) of the variables, while systematically ignoring the second moment (or variance). However, a correct specification of variance is still important for two reasons, as is explained by Hamilton and Herrera [1]. First, the test of hypothesis under misspecified variance is invalid. Second, it is possible to improve the efficiency of the conditional mean estimates by incorporating the observed feature of heteroscedasticity into the estimation process.

Uncertainty (or volatility) is not directly observable. One approach to estimate volatility in asset markets is to use the standard Black-Scholes option pricing formula, which links the volatility of the underlying asset to the information contained in the option. In particular, given that the option price, time to maturity, risk-free interest rate, strike price, and the current price of the underlying asset are known, one can determine the volatility forecast over the lifetime of an option implied by the option's valuation. Option implied volatility estimates are then taken as the market's expectation of volatility over the option's maturity. Another approach, in the context of asset returns, for example, is to calculate the sample standard deviation of a set of returns for a particular period of time, usually assuming that the underlying return distribution is normal.

Over the years, a large number of research papers investigated volatility by proposing different models. The most popular approach is to estimate it by using statistical models such as the Engle's Autoregressive Conditional Heteroscedasticity (ARCH). ARCH is a very popular and widely used empirical tool in financial econometrics for describing how the conditional variance of a time series evolves over time and how it affects the conditional mean. Various extensions of Engle's original theme and their extensive applications in the last decade show a significant success of the ARCH concept in modelling financial volatility.

Theoretical works have already shown the importance of the second moment in explaining the behavior of the first moment. That is, how the second moment of a macroeconomic variable might be an important determinant of major economic activity. Bernanke [2] has demonstrated the depressing effect of increased energy price uncertainty on investment using theories of investment under uncertainty and real options. Similarly, a large number of theoretical studies have attempted to investigate the relationship between exchange rate volatility and trade. Some of these papers consider a hypothetical setting (either in discrete or continuous time) and attempt to show how a trading firm reacts to exchange rate volatility. They consider a number of issues, including specific characteristic of the economy or the economic agent (such as, for example, risk aversion and risk neutrality), the existence of multinational trading firms, the nature of the capital markets, and different expectation formation mechanisms. For a review of this literature, see Artus [3], Brodsky [4], Ethier [5], Franke [6], De Grauwe [7], Broll [8], Gagnon [9], Viaene and de Vries [10], and Secru [11].

There have also been interesting empirical studies that examine the relationship between volatility of time series --- such as exchange rates, oil prices, stock prices, interest rates, or inflation --- and aggregate real output. A number of studies, including Thursby and Thursby [12],

De Grauwe [7,13], Warner and Kreinin [14], and Kenen and Rodrick [15], found a robust and significantly negative effect of exchange rate volatility on trade. Lee et al. [16] and Elder and Serletis [17] examine the direct effects of oil price volatility on GDP, while Grier and Perry [18] and Fountas and Karanasos [19] conclude that inflation and output volatility can also depress real GDP growth.

It is possible that the researchers in this field can further move the empirical literature forward by using recent developments in multivariate volatility modelling. With improvements in the quality and quantity of data and state-of-the-art advances in the field of applied econometrics, there has been a renewed interest in examining the relationship between two moments of real time series data. Rahman and Serletis [20] investigated the effects of exchange rate uncertainty on exports as well as output effects of money growth uncertainty, using a multivariate framework in which a structural vector autoregression is modified to accommodate multivariate GARCH-in-Mean errors. In another paper, Rahman and Serletis [21] use an extremely general bivariate vector autoregression in output growth and oil price changes, which follow GARCH-in-Mean errors, as detailed in Engle and Kroner [22], Grier et al. [23], and Shields et al. [24], to examine the effects of oil price volatility on output growth.

It is also possible that the researchers can complement those earlier works linking volatility and macroeconomic growth, by investigating the asymmetric responses of some policy relevant variables as well as the response of uncertainty to standard macroeconomic shocks. This asymmetry refers to the possibility that the impact of random increases of policy variables on output need not be the converse of random decreases of those policy variables. Their work will differ from others in that they incorporate volatility in the empirical model to explain asymmetry, and attempt to find out if volatility has any contribution to this asymmetry.

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