
Testing for structural breaks in GARCH models

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We study the ability of traditional diagnostic tests and LM and CUSUM structural break tests to detect a range of different types of breaks in GARCH models. We find that Wooldridge's (1990) robust LM tests for autocorrelation and ARCH have no power to detect structural breaks in GARCH models. However, CUSUM- and LM-based structural break tests have excellent size when the data is Gaussian, but the CUSUM tests tend to overreject even in quite large samples when returns have fat tails. However, the LM-based tests have approximately the correct size and exhibit impressive power to detect a range of breaks in the dynamics of conditional volatility. We apply these tests to a range of financial time series using returns starting only in 1990 and find that many GARCH models that pass standard specification tests fail the structural break tests.

I. Introduction

Volatility modelling and the GARCH model in particular have become important tools in many areas of both economics and finance. However despite its widespread application in the literature there is a distinct paucity of structural break tests applied. Structural break tests are an essential diagnostic tool in econometrics. To appeal to standard distributional properties of common econometric estimation methods (i.e., maximum likelihood, least squares, generalized method of moments, etc.) the model must be well specified which in turn requires that the model's parameters to be constant through time. When modelling time-varying volatility we require that the parameters which describe the data generating process of volatility be stable through time. Parameter instability is evidence of model miss-specification and standard econometric theory no longer applies. It is particularly curious that relatively few structural break tests are conducted given the popularity

of regime-shifting GARCH models (Gray, 1996; Dueker, 1997; Klaassen, 2002; Haas *et al.*, 2004; Pérignon and Smith, 2007).

Given the importance placed on structural break tests when specifying means, it is curious that despite literally thousands of empirical applications of the GARCH models, only a handful of structural break tests have been implemented. Early work by Lamoureux and Lastrapes (1990) demonstrated that breaks in the unconditional level of volatility drove the estimated persistence of volatility towards integrated GARCH model of Engle and Bollerslev (1986) for a sample of 30 individual stocks. They partitioned the sample into a fixed number of equally spaced volatility episodes in which unconditional volatility is fixed. The point estimates of volatility persistence is greatly reduced after allowing for these 'breaks' in volatility. Malik (2003) develops a structural break test based on the iterated cumulated sums of squares algorithm (ICSS) and analyses five exchange rates from January 1990 to September 2000 using this test.