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ROBUST TESTS FOR CHANGING VOLATILITY

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Abstract: This paper develops two modified CUSUM and QS tests to examine structural changes in volatility based on least absolute deviation (LAD) regression and consistent estimation of the long-run variance (LRV). We establish fairly mild conditions under which the new tests have standard null distributions and are consistent against any fixed alternatives that deviate from the null, including smooth changes, single or multiple breakpoints in volatility. In addition, the tests also have asymptotic unit powers against two classes of local alternatives approaching the null at different rates. Simulations are conducted to show better finite sample performance of the new tests relative to other popular tests especially in the presence of heavy-tailed innovations. Finally, two empirical applications to detection of structural changes in volatilities of U.S. dollar/Russian Ruble exchange rate and S&P 500 index highlight the usefulness of our tests in real datasets.

Key words and phrases: CUSUM test, heavy-tailed innovation, least absolute deviation, nonparametric estimation, QS test, structural change in volatility.

1. Introduction

Up to now, most popular macroeconomic and financial econometric models are constructed, whether explicitly or implicitly, under the assumption of global stationarity in unconditional volatility. While this assumption can help simplify inference and estimation procedures in time series analysis, it seems implausible over long periods of time since the underlying economic mechanisms are likely to be disturbed by various factors such as business cycles, institutional changes and technological progress. Numerous studies have demonstrated that structural changes in volatilities are widely existing in macroeconomic and financial data. For example, Sensier and Dijk (2002) report that about 80% of 214 USA macroeconomic time series displayed breaks in volatilities during the period 1959–1999. Kim and Nelson (1999), and Justiniano and Primiceri (2008) demonstrate that the volatilities of U.S. major macroeconomic variables, especially GDP, have declined since 1980s. Clark (2011) provides empirical evidence strongly suggesting that the volatilities of U.S. macroeconomic variables rise sharply during the severe recession of 2007–2009. Similarly, Andreou and Ghysels (2002) discover that the Asian and Russian financial crises have caused obvious structural breaks

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