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Non-linear Analysis of Shocks when Financial Markets are subject to Changes in Regimes.

Financial markets alternate sudden and violent moves with calm period. The Index of Market Shocks (IMS) has been recently designed and applied on stock markets (see Maillet et Michel, 2003) for quantifying the extent of crises. The index is built on an analogy with the Richter scale used in geophysics for assessing the gravity of an earthquake and corresponds to a positive inverse function of the aggregated volatility observed on the market at the time the analysis is done. The aim of this paper is to characterize the series of IMS, computed on a large world stock index (MSCI World Equity), using the idea that strong turbulence may change the nature of the market and participant behaviours. A natural candidate for modelling a crisis index is an Hidden Markov Chain model (HMC model). Furthermore, given the alleged non-linear dependence of the volatility upon its past, the use of a MultiLayer Perceptron is coupled with the Markov chain in order to provide a description of the variability of the IMS in an hybrid framework. This model is first presented, estimated on the data and compared to classical linear and non-linear models. A separation of the market periods (and their related characteristics) is then provided using a Kohonen map.