Complex Behavior of Stock Markets: Processes of Synchronization and Desynchronization during Crises

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Abstract

This paper investigates the dynamics of the S&P500 index from daily returns for the last 30 years. Using a stochastic geometry technique, each S&P500 yearly batch of data is embedded in a subspace that can be accurately described by a reduced number of dimensions. Such feature is understood as empirical evidence for the presence of a certain amount of structure in the market. As part of the inquiry into the structure of the market we investigate changes in its volume and shape, and we define new measures for that purpose. Having these measures defined in the space of stocks we analyze the effects of some extreme phenomena on the geometry of the market. We discuss the hypothesis that collective behavior in periods of crises reinforces the structure of correlations between stocks, but that it also may have an opposite effect on clustering by similar economic sectors. Comparing the crises of 1987 and 2001, we discuss why the expansion of the ellipsoid describing the geometry of the distances in the market, which occurs in the latter period, is not homogeneous through sectors. The conclusions from this research identify some of the changes in the structure of the market over the last 30 years.

Keywords: financial markets, stochastic geometry, complexity, market spaces, market structures.

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