Stock price collective behavior in an emerging market

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Complex systems consist of a large number of interacting elements, giving rise to the emergence of organization without any external organizing principle being applied. Consequently, decomposing the system and studying its subparts in isolation does not contribute to our understanding of how it works. Fortunately, complex systems can be described, analyzed, and modeled using complex networks. To understand the structure of interactions among the elements in a financial market, physicists primarily focus on the spectral properties of the correlation matrix of stock price movements. Financial markets can be considered as complex systems having many interacting elements and exhibiting large fluctuations in their associated observable properties, such as stock price or market index. The state of the market is governed by interactions among its components, which can be either traders or stocks. In addition, market activity is also influenced significantly by the arrival of external information. Statistical properties of stock price fluctuations and correlations between price movements of different stocks have been analyzed by physicists in order to understand and model financial market dynamics. To investigate the universality of the structure of interactions in different markets, we analyze the cross-correlation matrix of stock price fluctuations in the Stock Exchange of São Paulo (BOVESPA), Brazil. We find that this emerging market exhibits strong correlations in the movement of stock prices compared to developed markets, such as the New York Stock Exchange (NYSE). This is due to the dominant influence of a common market mode on the stock prices. By comparison, interactions between related stocks, e.g., those belonging to the same business sector, are much weaker. This lack of distinct sector identity in emerging markets is explicitly shown by reconstructing the network of mutually interacting stocks. Spectral analysis of cross-correlation matrix for BOVESPA reveals that, the few largest Eigen values deviate from the bulk of the spectrum predicted by random matrix theory, but they are far fewer in number compared to, e.g., NYSE. This behavior is due to the relative weakness of intra-sector interactions between stocks, compared to the market mode, by modeling stock price dynamics with a two-factor model. These results suggest that the emergence of an internal structure comprising multiple groups of strongly coupled components is a signature of market development.

Keywords: Financial markets, cross-correlation matrix, spectral analysis.