

The Stock Market as a Complex Adaptive System with Self-reference – The Functional Role of the Index

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Abstract

Investigation of the market dynamics within the framework of Complex Adaptive Systems (CAS) is a promising new approach that might lead to important practical implications in several areas (e.g. in earnings expectations game and risk management). The hall mark of CAS is that new system level features emerge from the interactions of constituents which in turn are regulated by top-down feedback mechanisms. According to this approach the processes and dynamics of the stock market can not be understood and predicted based on the analyses of individual stocks. Instead one has to devise methods to analyze the stock market as a whole and to decipher top-down feedback mechanisms (downward causations).

Motivated by the above we devised a new system level analysis of the stock market in terms of the correlations between the changes in the daily adjusted closing prices of the individual stocks and between the stocks and the index. We analyzed over a time period of about 7 years the New York Stock Exchange (NYSE) as a representative of mature (old), large market, and the Tel Aviv Stock Exchange (TASE) as a representative of a small young market. For the NYSE, we used two indices, the S&P500 (Standard & Poor) and the DJIA (Dow Jones). For the Tel Aviv market we used TA25 and the general index.

Our analysis revealed hidden dynamical motifs of the stock market and special functional role of the index as a top-down feedback mechanism: 1. For both markets we observed the existence of bursting events - time windows marked by higher correlations. 2. Studying the correlation matrices by clustering algorithms, we found the existence of functional subgroups (clusters) of stocks (that are related but not identical to the sector partitioning) with high mutual correlations in the NYSE, but not in the TASE. 3. Analysis of the standard deviations (STD) of the correlations revealed that, for the NYSE, the correlations bursting events corresponded to maxima in the STD but not for the TASE. We propose that this phenomenon is related to the existence of stock clusters in the NYSE. 4. We found that the observed correlations between stocks are largely due the strong correlation of each individual stock with the index which is indicative of the functional role of the index as an external driving force and as an important feedback mechanism. 5. The index has a stronger effect on the ungrouped stocks (those that do not belong to functional clusters) relative to the clustered ones and on the TASE relative to the NYSE. It might imply that the clustered stocks have stronger functional relations which make them less sensitive to the index effect.

Our findings suggest that: 1. the functional role of the index should be included in market analyses. 2. The functionally clustered stocks and the ungrouped ones are subject to somewhat different dynamical motifs, hence different analyses methods and investment strategies should be applied to each case. 3. For similar reasons, different methods and strategies should be applied to small and young markets.

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