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Effect of External Economic Field and Market Temperature on Stock-Price Hysteresis and Price-Return Distribution: Monte Carlo simulation on the Ising Agent-Based Model.

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In this work, the stock price variation in a form of dynamic hysteresis was investigated via Monte Carlo simulation. The Ising spin Hamiltonian was considered as the level of 'disagreement'(in the social economic) which has to be minimized for the market sustainability. The Ising spin directions (either +1 and -1) were considered to refer to an agent's intention to perform his action on trading (either to buy or to sell) in the stock market. The effect of economic variation in a form of periodic cycle was also considered via the external field term in the Ising Hamiltonian. The stochastic Monte Carlo simulation was performed on this Ising system to elucidate the market trends on the overall. The single spin flip Metropolis algorithm was used to update the spin directions. Waiting until the system was in steady state, the excess demand and supply were then extracted via the Ising magnetization. After that, the stock price were calculated from this magnetization to observe its variation with a function of time and external economic field. From the results, it was found that the external field parameters (the economic influence strength and period) and market temperature have significant effect on the stock price changes, resulting in different characteristic of price-return distribution. Specifically, the return distribution becomes broader in shape with increasing the external influence strength, which is due to that the higher encouragement in price changing causes larger gaps among stock-price intervals. On the contrary, the distribution becomes less broad with increasing the market temperature, which is caused by a higher level of 'monetary'fluctuation which inspires more frequent trading. Consequently, the price gap becomes less in size and hence the distribution broadness. This reason can also be applied to describe how the distribution evolves with changing the economic period. After that, the non-linear empirical fit was performed on judging applicability of the considered Ising model on describing real markets. However, due to available states in the Ising model are only +1 and -1 whereas there could be many more in real system, this could be the reason why the distribution was too narrow to extract diversity of time-lag in the return-distribution for drawing constructive fits (i.e. too few data points to achieve fine R-squares). However, the exponent values obtained from the fits still give suggestive results how the market reacts when changing the external influence parameter and temperature for the specified system, i.e. the system where each agent has only intention to buy or to sell with the same magnitude. For instance, these results can be used as a basis for further analysis of how external economic parameters and market temperature affect the price-distribution and its time-lag availability.

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