



On universal precursors to extreme socio-economic events

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This study is aimed at universal behavior patterns of complex systems emerging as an extreme event – a fast major change – approaches. We demonstrate that extreme socio-economic events are preceded by increased occurrence of similar events of a smaller magnitude. This phenomenon – “micro-crises signal the approach of a major crisis” has been observed in many different systems. We hypothesize universal algorithmic definition of small events and their magnitudes, based on the previous studies in predicting American economic recessions, with decline of industrial production for a small event; and in predicting homicide surges in Los Angeles, with rise of the total number of offences for a small event. In each case these changes (decline or rise) are not monotonic, but occur sporadically, lasting few months. The frequency-magnitude relation for the small events is close to a power law – a universal distinctive feature of complex processes, seismicity included. We identified in the cases under consideration precursors to extreme events; definition of the precursors is taken from the previous studies in earthquake prediction, and from modeling of statistical mechanics kind. The precursors reflect the rise of activity of the small events that is measured by the number of the small events from a certain magnitude range in a sliding time window. Retrospective performance of these precursors is encouraging: they present before 78% of the extreme events under consideration and at no other time. We discuss implication of these results for predictive understanding of socio-economic systems and for prediction per se.