LGEM: A Lattice Boltzmann Economic Model for income distribution and tax regulation

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Econophysics in an interdisciplinary research field which applies statistical physics methods for solving problems in economics and finance. The term "econophysics" was first introduced by the theoretical physicist Eugene Stanley at the Conference *Dynamics of Complex Systems* held in Calcutta in 1995, as an analogy with similar terms such as "astrophysics" or "biophysics" [1]. This novel discipline uses mathematical methods developed in statistical physics to study statistical properties of complex economic systems consisting of a large number of humans, and it can be considered as a branch of applied theory of probabilities [2]. In this sense, econophysics has much common ground with agent-based modeling and simulation [3].

In this paper, a new econophysic model based on a Lattice Boltzmann Automata is presented. This model represents economic agents (people, countries…) as particles of a gas moving on a 2D lattice and interacting with each other. Economic transactions are modeled by particle-to-particle interactions in which money is conserved. If only particular transactions are considered (free market) the money distribution quickly converges to a Boltzmann-Gibbs distribution. But the model also introduces a third step of global income distribution that can be used for exploring tax regulation strategies. The model is presented, and some examples of income distribution are given. One of the most interesting features of the model is the fact that it is completely discrete, and it can be exactly implemented on any computational resource, leading to very fast, yet powerful simulations, especially when parallelization resources are available. Some results of these simulations, as well as performance data, are given.

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[2] R.N. Mantegna, H.E. Stanley. An introduction to econophysics: correlations and complexity in finance. Cambridge University Press, 1999.

[3] V.M. Yakovenko. Econophysics, Statistical Mechanics Approach To. In R.A. Meyers (ed.) Encyclopedia of Complexity and Systems Science, pp. 2800-2826. Springer, 2009.