

# Effect of punctuated equilibrium on wealth distribution of two simple exchange models [1]

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## Abstract

We study the effect of Punctuated Equilibrium (PE) [2, 3] on two well known asset exchange models: The Yard Sale (YS) and the Theft and Fraud (TF) models [4]. The corresponding wealth distributions are characterized using the Gini index. PE is introduced in the simulation as a perturbation with probability  $\rho$  of being applied. We found that in the case of the TF model, the Gini index reduces as  $\rho$  increases; while for YS we observe a phase transition which happens around certain value  $\rho_c$ . For  $\rho < \rho_c$  Gini index reaches the value of one as time increases (an extreme wealth condensation state), whereas for  $\rho \geq \rho_c$  the Gini index becomes different to one, avoiding the system reaches this extreme state. We show that both simple exchange models coupled with PE dynamics give more realistic results. In particular for the YS model, we observe wealth distribution decays as a power law.

**Keyword:** Econophysics, Evolutionary Economics, agents exchange models, punctuated equilibrium, wealth distribution, Gini index

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## References

- [1] N. Bagatella-Flores, M. Rodríguez-Achach, H.F. Coronel-Brizio and A.R. Hernández-Montoya, “Wealth distribution of simple exchange models coupled with extremal dynamics”, *Physica A*, in press (2014).
- [2] S. J. Gould and N. Eldredge, “Punctuated equilibria; the tempo and mode of evolution reconsidered”, *Paleobiology* 3 (2), 115-151 (1977).
- [3] P. Bak, K. Sneppen, “Punctuated equilibrium and criticality in a simple model of evolution”, *Phys. Rev. Lett.* 71, 4083-4086 (1993).
- [4] B. Hayes, “Follow the money”, *American Scientist* 90 (5), 400-405 (2002).