CENTRO DE FÍSICA DO PORTO

Wealth Distribution Models

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Abstract

Conservative exchange market models are studied on Poissonian networks. The agents' wealth evolves according to an extremal dynamics which favours the poorest agent. By varying some parameters in the network, one can interpolate between a "local" and "global" type of economies. The inequality of the wealth distribution is characterized by Gini index.

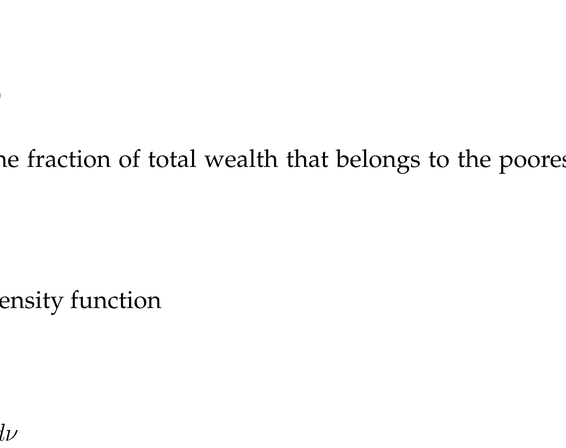
Model

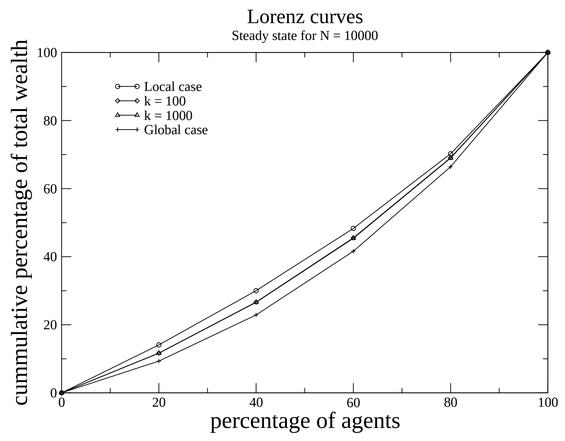
- Erdös-Rényi model of network:
  - Number of nodes, $N \sim 10^4$
  - Select a pair of nodes and generate a random number, $p_i \in [0, 1[$
  - If $p_i < p$, nodes connect ($p = \overline{k}/N$)
  - For large N, connectivity distribution follows a Poisson law
- Initial wealth for each agent w_i
- $w_i \in [0, 1[$ from a uniform distribution
- CEMM dynamic:
  - Find poorest agent, w_{min}
  - Generate a new wealth for the poorest agent, w_{new}
  - Conservative model: take (given) Δ from (to) the k_i (first neighbours of i)
    $\Delta = w_{new} - w_{min}$
    $w'_j = w_j - \frac{\Delta}{k_i}$

Definitions

- Lorenz curve is the fraction of total wealth that belongs to the poorest 100ν percentage of the society
  $L(\nu) = \frac{\int_0^\nu wp(w)dw}{\int_0^1 p(w)dw}$
  $\nu \in [0, 1]$
  $p(w)$ is a wealth density function
- Gini index
  $G = \frac{\int_0^1 (\nu - L(\nu))d\nu}{\int_0^1 \nu d\nu}$
  $G = 1 - 2\int_0^1 L(\nu)d\nu$
  - Assumes values between 0 percent (perfect equality) and 100 percent (perfect inequality)
- When Lorenz curve nearest to the perfect equality curve (small Gini index) means that we have a more equalitary economic system

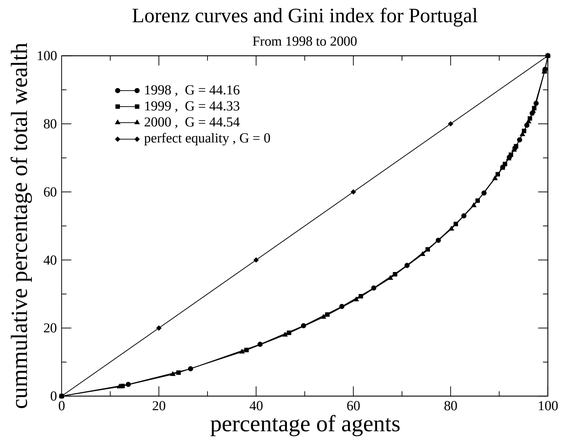
Simulations

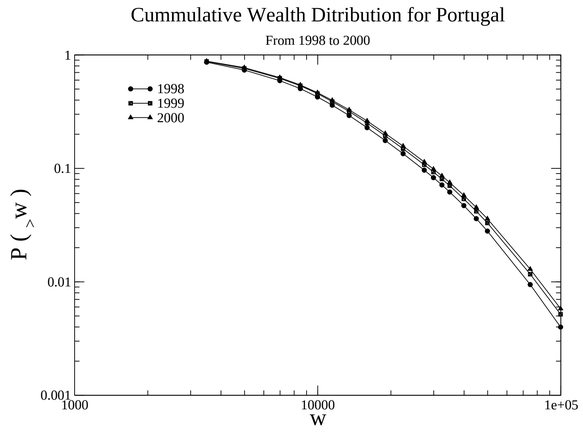




Discussion and further work

The existence of a *poverty line*, the size of the *middle class*, the amount of inequality in wealth and their dependence on the degree of *globalization* of the economy are well reproduced by minimal dynamic model. However, the model fails to exhibit the power-law (Pareto) tails usually observed in real (wealth/income) data for highest wealth values. Gini index for Portugal has been growing during the years.





- Future work: look for a more realistic type of wealth exchanges rules, possibly coupled to a dynamic network

References

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