

"Family-tree model" for wealth distribution

Z. NEDA,^{ab} RICARDO J. L. COELHO,^a JOSE J. RAMASCO^a AND MARIA AUGUSTA SANTOS^a

^aCentro de Física do Porto / Departamento de Física, Faculdade de Ciências, Universidade do Porto, PORTUGAL

^bBabeş-Bolyai University, Dept. of Physics, ROMANIA

ABSTRACT

A conservative model of wealth exchange is studied, where the main mechanisms of wealth transfer are "inheritance" and "social costs" associated with raising a new family. The structure of the network of social (economic) interactions is not predefined but emerges by the wealth dynamics. Monte Carlo simulations yield wealth distributions which agree with real data on personal income (for a range of parameter values). Statistical properties of the "families network" as well as node wealth-degree correlations are also investigated.

1 Model

1.1 Parameters

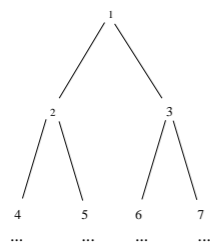
- N , the number of nodes (families) in the network
- $P1$, the part of the wealth given by one family to the new family
- W_{min} , the amount paid by a family to raise a child and be able to create a new family (this is distributed in 100 equal pieces and given preferentially to the nodes of the network)
- steps, number of generations studied (this is equivalent with the Monte Carlo steps, MCS) (N families die and re-appear)
- realizations, number of independent samples with the same parameters for a better statistical average

1.2 Conserved quantities

- N , total number of nodes (families)
- W_{tot} , total wealth in the system

1.3 Initial state

- W_i , wealth distributed at each node from a uniform distribution in the $[0, 1[$ interval
- create an initial network (tree-like)

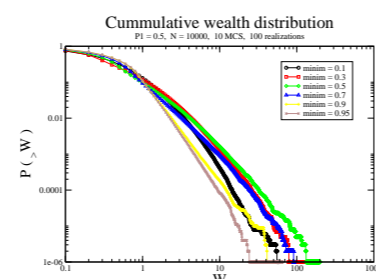
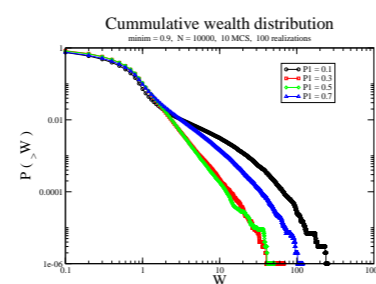


2 Algorithm

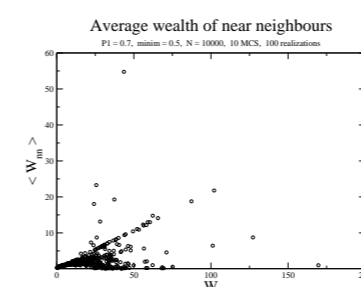
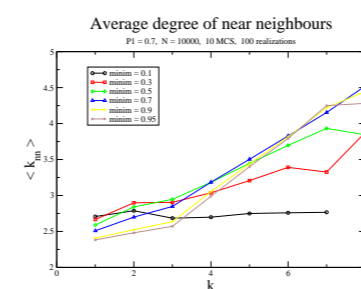
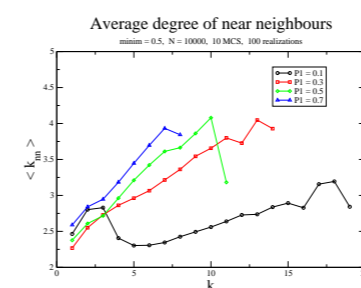
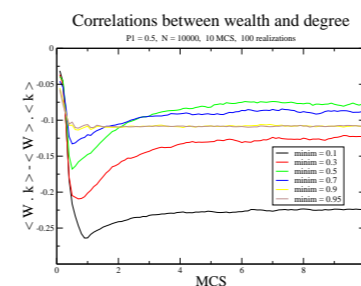
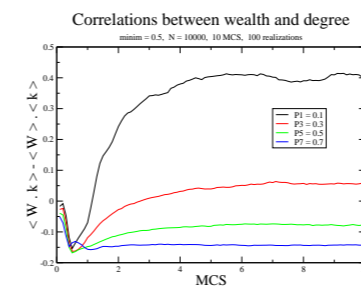
- At each time step the "oldest" node (number 1 in the beginning) dies and gives its wealth in equal amounts to the nodes it is connected to. If this node has no links then its wealth is distributed in 100 equal pieces and given preferentially to 100 nodes in the system. The preferential redistribution is according to the wealth of the nodes
- After the oldest node (1) dies it is re-born. It should attach to two nodes in the system that has wealth over the W_{min} value. The W_{min} value is subtracted from each of the two families and is divided in 100 equal amounts and preferentially redistributed in the system. This process models that creating a new family, two families have to raise a child which cost money. This money is paid for the members of the society. Those of them who has bigger wealth have more business and will get more out of it
- The families that are creating the new family will give a $P1$ portion of their wealth to help the start-up of the new family. This amount goes directly to the new family.
- Again the next oldest node dies and re-born (number 2 in the beginning) following the same rules. The process is than simulating for many cycles.
- One MCS (Monte Carlo Step) is one generation (when N node dies and re-born)
- We follow the system through many MCS, repeating the same algorithm

3 Results

3.1 Wealth Distribution

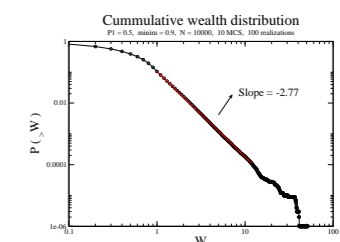


3.2 Correlations

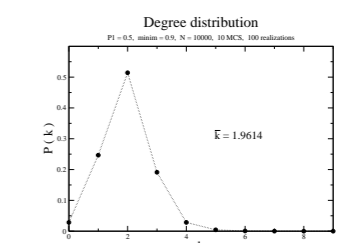


4 One Example

4.1 Wealth Distribution



4.2 Degree Distribution



5 Conclusions

- Families derived from rich ones are rich too.
- Families with high degree are connected to other families with high degree (normally rich families) when the "price" of creating families is high.
- When the price of creating families is low, there's no correlation in the degree of families.
- When a family gives more money to raise children ($P1$) then are not able to create many more families.
- Power law in the richest part of wealth distribution for higher values of W_{min} and not extreme $P1$, in agreement with empirical data [3].
- Assortative type of networks.

6 Further Work

- Statistical study of the two regimes in the wealth distribution.
- Study of the type of network in the steady state.

References

- [1] Bouchaud, J.-P. and Mézard, M., Physica A **282** (2000), 536
- [2] Solomon, S., Richmond, P., Physica A **299** (2001), 188
- [3] Souma, W., cond-mat/0202388