

Yard-Sale Model simulation of wealth distribution (Inherent Capitalistic Inequality)

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APL Germany — COVID-virtual



About

Type of presentation:

- general topic, possibly political
- simple implementation of Yard Sale model
- based on S.A. article by Bruce M. Boghosian

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- is wealth related to wisdom, ability, motivation, ... ?

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Outline

- 1 Yard-Sale Model and its setting
- 2 Parameters of Yard-Sale Model

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Outline of section on Yard Sale model

In this section we outline:

Sources articles and papers

Actors holders of wealth, also agents

Transactions interactions between actors

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A researcher on the topic

- Bruce M. Boghosian, professor at Tufts University
- mathematician, models economy
- article in S.A. 11/2019 describing inequalities of free market
- astoundingly simple model describes accurately real economies (Europe, U.S.A., ...)

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See [▶ article references](#)

Further reading

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- mathematical/physical papers on YSM
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Actors (or agents)

What does “actor” mean?

- actors stand in for natural persons (or other economical entities)
- each of the N actors has wealth w
- the mean wealth (per actor) is $\bar{w} = 1$
- it does not matter how much “1” actually is
- overall wealth is $W = \sum w = N$

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Attributes of actors

What attributes do actors have?

- almost none except wealth
- **no one** works more than others
- **no one** has a plan (to get rich)
- **no one** has a grasp of the market around them
- **no one** is more intelligent than others

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Transactions (or sales)

What does “transaction” mean?

- two actors pair off and exchange part of their wealth (in APL all actors pair off at once. . .)
- exchange can mean the sale of goods, services, participations, . . .
- model akin to a yard sale
- the summed overall wealth of the two actors stays the same
- in many cases the overall wealth of each actor stays the same
- in some cases one actor “wins” some wealth – only these transactions are interesting

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How does a “asymmetric” transaction work?

- which actor ends up with more wealth is determined **purely by luck**
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- the in-/de-crease of wealth of each actor in a pair is upper bound by a percentage of the poorer actors wealth

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Outline of section on model parameters

In this section we describe the model parameters:

Wealth change Δw how much wealth can be won or lost?

Redistribution χ does ex officio wealth redistribution (taxes) occur?

Advantage ζ are there advantages (opportunities, knowledge, connections) attained through wealth?

Debt κ what does allowing negative wealth (debt) mean?

Simulation alternatives algorithms used in APL simulation

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Meaning of subsequent transactions

What happens with parameters $\Delta w^P = .20$ and $\Delta w^R = .17$ and wealth 10:1?

- could $E^P = \frac{.20 - .17}{2} = .015$ mean “downward trickle”, poor become richer?
- but $1.20 \cdot 0.83 = 0.996$ (poor actors side)
- off course also $1 + 0.20 - (0.17 \cdot 1.20) = 0.996$ and $1 - 0.17 + (0.20 \cdot 0.83) = 0.996$ (poor actors side)
- and off course also $10 + 0.17 - (0.20 \cdot 0.83) = 10.004$ and $10 - 0.20 + (0.17 \cdot 1.20) = 10.004$ (rich actors side)
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Flat wealth tax

Introduce flat wealth tax rate χ and redistribute everything uniformly

- effectively wealth above average is taxed uniformly and without exemption
- effectively wealth below average is increased the same way
- actor with wealth 1 remains unchanged
- actor with wealth 10 is taxed $\chi \cdot 9$
- actor with wealth 0.1 is given $\chi \cdot 0.9$
- with taxes some deviation from equality but not oligarchy, fairly good approximation of real economies

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Wealth and advantages

How to incorporate advantages associated with wealth?

- in real life richer actors have for example more
 - opportunities (no need to accept bad deal)
 - knowledge (more sources available)
 - connections/offers (richer associates)
- privilege (enormously) profits richer actors
- real influence is very complicated

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Advantage as coin bias

Introduce “flat advantage” ζ

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- without bias expected value $E^p = \frac{\Delta w^p - \Delta w^r}{2}$
- especially $E^p = 0$ when universal Δw
- privilege (just) biases the transaction coin
- expected value $E^p = \frac{\Delta w^p - \Delta w^r}{2} - \zeta \cdot (w^r - w^p)$
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- this simple parameter significantly improves modelling of real economies

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Introduce “flat advantage” ζ

- always $E^r = -E^p$
- without bias expected value $E^p = \frac{\Delta w^p - \Delta w^r}{2}$
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See [▶ problem with bias](#)

Allowing negative wealth

How to incorporate debt?

- in modern economies debt possible
- easy to acquire, difficult to get rid off
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Allowing debt up to a maximum

Introduce debt “upper bound” κ

- introduce universal mean debt κ
- **nobody** starts with debt or is forced into it
- the mean debt is added to **everybody's** wealth before transaction and subtracted subsequently
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Different taxes and advantages

What was implemented in APL?

- wealth tax, advantage as transaction bias (1:unachievable bias, 2:rich actor always wins)
- wealth tax, rich-advantage depending on wealth (3:advantage for rich winners, 4:advantage for rich actors)
- transaction tax, advantage as transaction bias (5:flat tax rate, 6: tax rate depending on wealth)
- transaction and wealth tax, advantage as transaction bias (7:as 5 with added tax on wealth logarithm)

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Conclusion

Simplest reality description implies that:

- untethered capitalism leads to oligarchy/monarchy
- wealth distribution depends only on luck
- redistribution (taxes) necessary, flat tax as good as complex systems
- unavoidable wealth advantage (privileges) compound problem
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◀ begin

Overview of examples and illustrations

▶ article references

▶ further references

▶ problem with bias

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[← main source](#)

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◀ further reading

ERGO

Problems with bias advantage

$|E| \leq 1$ must hold, but possibly $(w^r - w^p) \gg 1$ holds.
 Implementation of fair coin as comparison $1/2N$ vs. $N/2$.
 Biased coin must use $N/2 - x$ with

$$x = N \cdot \zeta \cdot \frac{w^r - w^p}{\Delta w^r + \Delta w^p}.$$

Clearly $x \gg N/2$ possible, desired bias not achievable.

◀ advantage as bias