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Agent-based model of the effect of globalization on inequality and class mobility

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We consider a variant of the Bouchaud-Mézard model for wealth distribution in a society which incorporates the interaction radius between the agents, to model the extent of globalization in a society. The wealth distribution depends critically on the extent of this interaction. When interaction is relatively local, a small cluster of individuals emerges which accumulate most of the society's wealth. In this regime, the society is highly stratified with little or no class mobility. As the interaction is increased, the number of wealthy agents decreases, but the overall inequality rises as the freed-up wealth is transferred to the remaining wealthy agents. However when the interaction exceeds a certain critical threshold, the society becomes highly mobile resulting in a much lower economic inequality (low Gini index). This is consistent with the Kuznets upside-down U shaped inequality curve hypothesis.

1. INTRODUCTION

Changes in societal structure are driven in large part by the forces of globalization. There is a continuing debate on the effect of globalization on wealth distribution. The relationship is complex and depends on a multitude of factors, including the type of globalization [1] and the level of the country's development [2]. Kuznets [3] postulated a famous hypothesis that the economic inequality generally follows an inverted-U shape as a function of development. Recent studies [4–6] have proposed that the inequality as a function of society's "openness" has a similar shape.

One of the simplest agent-based models of wealth distribution is the kinetic or "gas-collision" model motivated by ideal gas distribution in physics [7, 8]. Consider a society of n individuals, each having a certain amount of dollars to start with. At each instant, a "winner" and a "loser" are chosen at random, with the winner receiving one dollar from the loser, provided that the loser has at least a dollar to give. After many such trades, the wealth distribution settles to an exponentially decaying distribution, identitcal to Boltzmann's distribution for free gases. Variants of this model, where the amount of trade scales with the winner's wealth, lead to algebraically decaying tails (e.g. Pareto distribution) [9, 10]. Many related agent models have been proposed, which lead to similar distributions [10–12]; see e.g. [13–15] for a recent surveys.

While kinetic models capture realistic wealth distributions [16, 17], these models do not capture the degree of mobility within a society. There is a high correlation between intergenerational mobility and inequality [18–20] – the so-called "Great Gatsby" curve. On the other hand, simulations of trader models such as [8, 10, 11] show a continual upwards and downwards mobility of individuals, even when the overall Gini index[1] is high. That is, while the overall distribution remains roughly the same with time, each individual's wealth fluctuates, so that the long-time average wealth of each individual is the same.

Here, we use a variant of the Bouchaud-Mézard model [11] to capture the transition from high class mobility to a highly stratified society using an agent-based framework. This is done by incorporating the notion of spatial distance between the agents. Instead of pairwise interactions as in the gas-collision model of wealth, or all-to-all interactions as in the original Bouchaud-Mézard model, we consider interactions of neighbours within a certain radius R. By considering the mean-field limit, we examine how the inequality level depends on R. A key finding of this model is that for sufficiently low R and when the return on investments is sufficiently high, the society is highly stratified with little or no class mobility and high inequality. As the connectivity is increased past a certain critical threshold, an instability is triggered resulting in a sudden drop of inequality and high class mobility. This effect is similar to the upside-down U Kuznets curve.

2. ALL-TO-ALL CONNECTEDNESS

Before presenting a model with partial connectivity, let us start by considering a simple model of "wage earning", which is a variant of the Bouchaud-Mézard model. Choose an agent j at random and increase its wealth x_j by w_j where

$$w_j = ax_j + b\bar{x}. \tag{1}$$

Here, $\bar{x} = \frac{1}{n}\sum_{j=1}^{n} x_j$ is the average wealth of the society and parameters a, b represent wealth generation through investements and fixed income, respectively. We assume that both a, b are positive. Since we are interested in the relative wealth between the agents, after each step, we rescale each agent's wealth so that the overall total wealth is conserved. Since the total amount of money T is increased by w_j, this means rescaling the wealth of every agent by the amount $T/(T + w_j)$. This can be thought as an inflationary decrease of the value of money. Repeating this process multiple times yields a stationary distribution which depends on a, b.

The model (1) is very similar to the Bouchaud-Mézard model [11]. The difference is where the randomness

[1] The Gini index is the standard measure of inequality in a population. For n individuals with wealth x_j, the Gini index is $\sum_i \sum_j |x_i - x_j|/(2n \sum_j x_j)$.