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Wealth distribution and Pareto's law in the Hungarian medieval society

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Abstract

The distribution of wealth in the medieval Hungarian aristocratic society is studied and reported. Assuming the wealth of a noble family to be directly related to the size and agricultural potential of the owned land, we take the number of owned serf families as a measure of the respective wealth. Our data analysis reveals the power-law nature of this wealth distribution, confirming the validity of the Pareto law for this society. Since, in the feudal society, land was not commonly traded, our targeted system can be considered as an experimental realization of the no-trade limit of wealth-distribution models. The obtained Pareto exponent ($\alpha = 0.92$–0.95) close to 1, is in agreement with the prediction of such models.

Keywords: Wealth distribution; Econophysics; Pareto's Law

1. Introduction

At the end of the XIX century the economist Vilfredo Pareto [1] discovered a universal law regarding the wealth/income distribution in societies. His measurement results on several European countries, kingdoms and cities for the XV–XIX centuries revealed that the cumulative distribution of income (the probability that the income of an individual is greater than a given value) exhibits a universal functional form. Pareto found that in the region containing the richest part of the population, generally less than 5% of the individuals, this distribution is well described by a power-law (see for example Ref. [2] for a review). The exponent of this power-law is denoted by α and named Pareto index. In the limit of low and medium wealth, the shape of the cumulative distribution is fitted by either an exponential or a log-normal function.

The power-law revealed by Pareto has been confirmed by many recent studies on the economy of several corners of the world. The presently available data is coming from so apart as Australia [3], Japan [4,5], the US [6], continental Europe [7,8], India [9] or the UK [10,11]. The data is also spanning so long in time as ancient Egypt [12], Renaissance Europe [13] or the XX century Japan [14]. Since it is difficult to measure *wealth*, most

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of the available data comes from tax declarations of individual *income*. Empirical results are also available, which are based on a direct estimate of the wealth of individuals or institutions. The area of the houses in ancient Egypt [12], the inheritance taxation or the capital transfer taxes [15,11], the size/wealth of firms [7] or wealth rankings provided by some popular magazines [9,16] are examples of such studies. While wealth and income are related, one has to note that this relation is not a simple proportionality. The distribution of wealth is usually broader than the distribution of income, or equivalently, the Pareto index for wealth distribution is smaller than the corresponding one for income (see Ref. [9] as an example). In the present paper, we present and discuss empirical studies of wealth distribution in a medieval society—the Hungarian aristocratic society around the year 1550. In those times, the wealth of a nobleman was directly related to the size and agriculture potential of the lands he owned. To quantify this wealth, we take the number of owned serf (villein) families—a measure generally used by historians and for which well documented data exist. In a feudal society, land was not commonly traded. Moreover, in the Hungarian society, the family land was not divided among the children nor given as dowry—almost everything was inherited by the eldest son. The case under study offers thus a somehow idealized example of a system without a relevant wealth-exchange mechanism and may be taken as an experimental realization of the *no-trade* limit of current wealth-distribution models. Our results also give further evidence for the universal nature of Pareto's law.

2. Statistical physics approach to Pareto's law

Typically, the presence of power-law distributions is a hint for the complexity underlying a system, and a challenge for statistical physicists to model and study the problem. This is why Pareto law is one of the main problems studied in Econophysics. Since the value found by Pareto for the scaling exponent was around 1.5, Pareto law is sometimes related to a generalized form of Zipf's law [16] and referred to as Pareto–Zipf law. According to Zipf's law, many natural and social phenomena (distribution of words frequency in a text, population of cities, water level of rivers, users of web sites, strength of earthquakes, income of companies, etc.) are characterized by a cumulative distribution function with a power-law tail with a scaling exponent close to 1. It is, however, important to notice that in contrast to what happens with most exponents in statistical physics, the Pareto index α, may change from one society to another, and for the same society can also change in time depending on the economical circumstances [5,14]. The measured values of α for the individuals income distribution span a quite broad interval, typically in the 1.5–2.8 range; studies focusing on the wealth distribution show, however, smaller Pareto index values, usually in the 0.8–1.5 interval [17]. This large variation of α indicates the absence of universal scaling in this problem—a feature which models designed to describe the wealth or income distribution in societies should be able to reproduce.

Models for wealth distribution are defined by a group of agents, usually placed on a lattice, that interchange money following pre-established rules. In most cases the system will eventually reach a stationary state where some quantities, for instance the cumulative distribution of wealth $P_>(w)$, may be measured. Following these ideas, Bouchaud and Mézard [18] and Solomon and Richmond [19,20] separately proposed a very general model for wealth distribution. This model is based on the existence of multiplicative fluctuations acting on each agent's wealth plus a mechanism for wealth exchange among agents, which depends linearly on the agents' wealth.In a mean-field scenario (interactions of strength J among all the agents) the model predicts that α should increase linearly with J, with $\alpha = 1$ in the case of independent agents ($J = 0$). Similar conclusions were obtained for other interaction topologies and for a nonlinear version of the model [21].

Another large category of models recently considered are random asset exchange models (see Ref. [22] for a review). In these models, pairs of randomly chosen agents exchange part of their money while saving the remaining fraction. Trade (wealth exchange) is thus a crucial ingredient in these models. For randomly distributed (quenched) saving factors, a Pareto-type wealth distribution with $\alpha = 1$ is found [23,24]. Variants of this model with asymmetric exchanges (with respect to wealth) can yield $\alpha < 1$, by tuning the asymmetry parameter or its distribution [25]. These models are thus able to explain different Pareto index values by appropriately choosing the free parameters in the wealth-exchange rule.

From the modeling efforts made by the statistical physics community, one can conclude that the emergence of Pareto law can be explained from many different approaches. Reproducing the power-law like wealth distribution and reasonable values for the Pareto index does not seem to be a problem. Much more debate is