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The Forbes 400 and the Pareto wealth distribution

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Abstract

Statistical regularities at the top end of the wealth distribution are examined using the Forbes 400 lists during 1988–2003. We find that the wealth is distributed according to a Pareto (power-law) distribution with an average exponent of $\alpha = 1.49$.

Keywords: Wealth distribution; Pareto; Market efficiency

JEL classification: D31; 016

1. Introduction

Once a year Forbes magazine publishes the list of 400 richest people in the United States (see www.forbes.com/lists). The list includes the net worth of each individual as well as background information about the businesses that have lead to this prosperity. The list is amazingly diverse including individuals involved in all sectors of the economy, such as computer software (Bill Gates, Paul Allen and Larry Ellison), financial investments (Warren Buffet), retailing (the Walton family), computer hardware (Michael Dell) as well as media, entertainment, communication, real estate and many other sectors.

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Although the people included in the Forbes 400 list made their fortunes in various different ways, the distribution of their wealth exhibits a striking statistical regularity. This regularity describes not only the wealth distribution at the very top of the wealth range, but also provides insight about the distribution of wealth at wealth levels many orders of magnitude below this range. These empirical findings may shed light on the nature of the wealth accumulation process, and on its relation to the central issues of market efficiency and market fluctuations.

2. Empirical findings

The wealth distribution is typically studied by employing data about the number of individuals within each wealth range (e.g., the number of individuals with wealth between \$100,000 and \$150,000). Here we employ a different approach. We use the Forbes 400 lists to study the distribution of wealth at the top wealth range. This approach has the advantage of employing very specific data on the wealth of each of the individuals on the list, and avoiding the aggregation problems of the standard approach. The disadvantage, of course, is that this approach is limited to the very top of the wealth distribution. However, as we argue below, the results obtained with this approach may shed light on a much wider range of the wealth scale and on the capital investment process in general.

A Pareto (power-law) distribution of wealth implies the following relationship between the rank of an individual in the wealth hierarchy and her wealth:

$$w_{\mathrm{r}} = Ar^{-\beta}, \tag{1}$$

where r is the rank ($r=1$ being the wealthiest person, etc.), w_{r} is the wealth of the individual with rank r, A is a constant, and the exponent β is related to the Pareto exponent, α, as $\beta=1/\alpha$ (for a derivation this relationship, see for example, Takayasu, 1990; Levy and Solomon, 1997; Levy, 2005). This implies that when wealth is plotted against rank on a log–log scale a linear relation is observed for a Pareto distribution. The exponent α quantifies the level of wealth inequality. As α decreases, the wealth distribution becomes more uneven, with a larger share held by fewer individuals.

Fig. 1 depicts the wealth, w_{r}, of each of the 400 richest individual in the US in 2003, as a function of their rank, r, on a log–log scale. The data on this graph, known as the Zipf plot (Zipf, 1949), are fitted very closely by a straight line with $\beta=0.82$ ($R^2>0.99$), for the range $10\le r\le 400$. This indicates an excellent agreement of the empirical data with a Pareto wealth distribution. The value of 0.82 for β corresponds to a Pareto exponent $\alpha=1.22$. We repeated this analysis separately for each year in the period 1988–2003, and obtained the values of α for these years, shown in Fig. 2. The value of α gradually decreases from about 1.6 in 1988, followed by a faster decline in the late 1990s down to about 1.1, after which it starts to increase again.

Wealth inequality, and the temporal variation in inequality have been investigated in many studies. Wolff (1995), Laitner (2001), and Piketty et al. (2004), for example, investigate the wealth distribution throughout the entire economy. In contrast, here we focus on the Pareto exponent, and as the Pareto distribution is appropriate for the wealth distribution at the medium and high wealth ranges, our results reflect the inequality in these ranges. Some studies document variations in the wealth inequality over periods much longer than the 16-year period investigated here (see, for instance, Steckel and Moehling, 2001; Piketty et al., 2004). In addition to the wealth distribution, several studies have also investigated the income distribution (Slottje, 1989; Kahn, 1998; Atkinson, 1999; Piketty, 2003) and

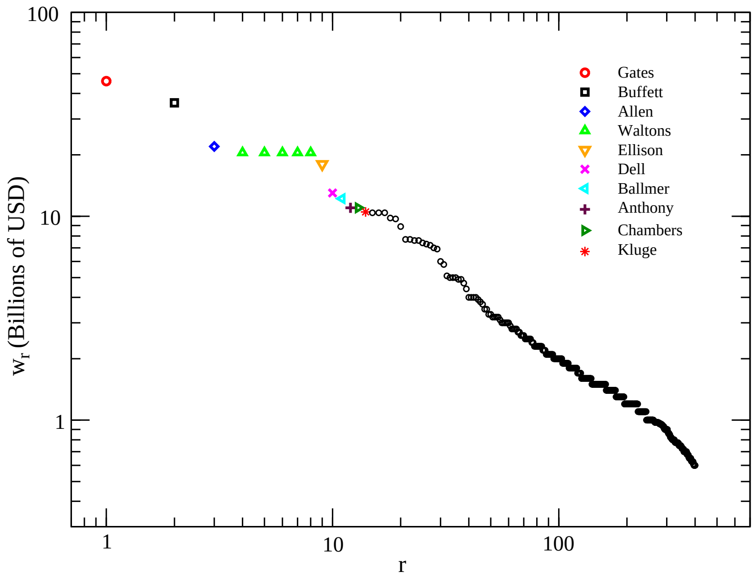

Fig. 1. Zipf plot of the wealth w_r of the investors in the Forbes 400 list of 2003 vs. their rank r. The power-law fit, using Eq. (1), with $\beta=82$ was obtained in the range $10 \leq r \leq 400$. This value of β implies a Pareto exponent of $\alpha=1.22$.

found significant temporal variations in inequality. The following analysis may shed light on the observed fluctuations in α.

Consider the average wealth

$$\overline{w}(t) = \sum_{r=1}^{400} w_r(t)/400 \quad (2)$$

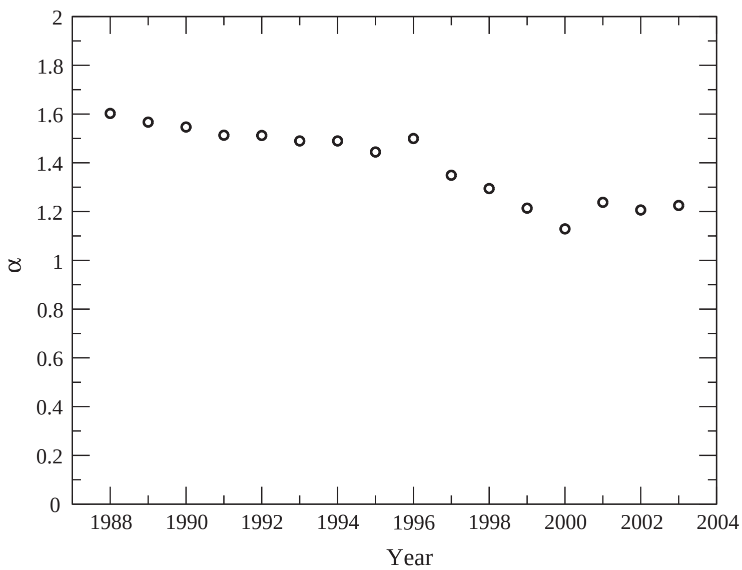

Fig. 2. The Pareto exponent α, obtained from the Zipf analysis, as a function of the year: 1988–2003.

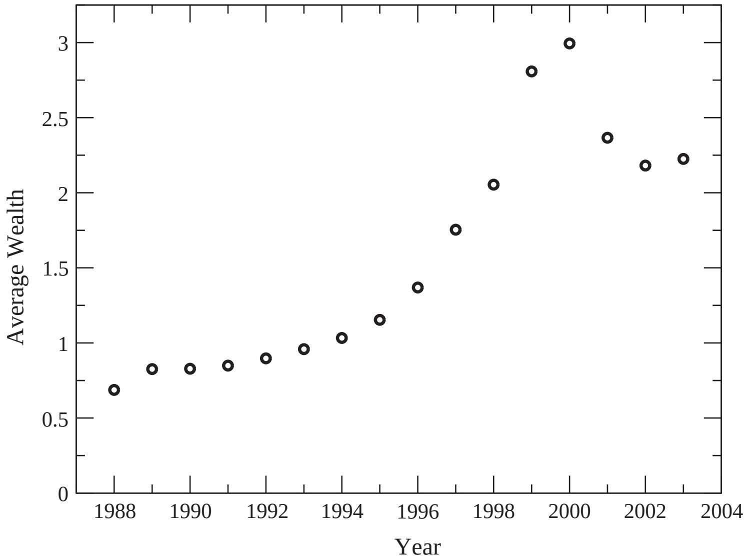

Fig. 3. The average wealth $\bar{w}(t)$ of the Forbes 400 investors as a function of time: 1988–2003.

of the 400 investors at year t. This average wealth may help explain the fluctuations in inequality, and also provides the key to the multi-year analysis of the data described below. The time dependence of $\bar{w}(t)$ for the Forbes 400 investors between 1988 and 2003 is shown in Fig. 3. It reflects the technology bubble of the late 1990s, its aftermath in 2001, and the beginning of recovery in 2003. Interestingly, one observes a negative association between $\alpha(t)$ and $\bar{w}(t)$. In

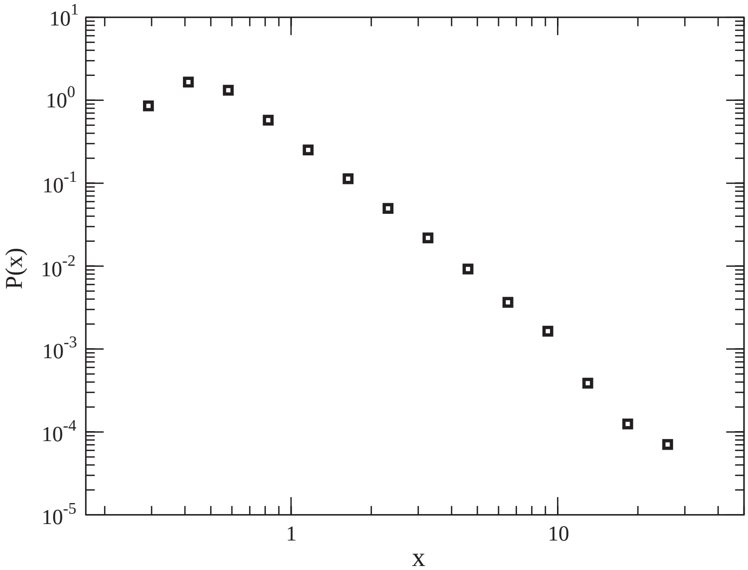

Fig. 4. The distribution $P(x)$ of the normalized wealths of the Forbes 400 investors, showing a power-law (Pareto) distribution with $\alpha = 1.49$ and $R^2 > 0.99$.

particular, α is lowest (namely, inequality is highest) at the peak of the bubble in 2000, when $\bar{w}(t)$ is maximal. It is, indeed, reasonable to expect that in periods of a stock market boom the wealth inequality will increase, as not all investors "ride the boom" to the same extent, and this increases the dispersion in wealth.

Note that due to the relatively small number of data points in the Zipf analysis the distribution turns out to be rather noisy (Fig. 1). To obtain more reliable results we also perform a multi-year analysis by combining the data of the Forbes 400 lists from the entire sixteen-year period (1988–2003) to construct a much larger data set. The multi-year analysis requires using the normalized wealth variables $x_r(t) \equiv w_r(t)/\bar{w}(t)$, in order to put the data points from different years on a common footing. Fig. 4 shows the probability density $P(x)$ as a function of x. Despite of the variations in the economic climate and the fluctuations in α during these sixteen years, the wealth distribution is in excellent agreement with the Pareto power-law distribution given by

$$P(x) = kx^{-(1+\alpha)}, \tag{3}$$

with an exponent of $\alpha = 1.49$ and correlation coefficient $R^2 > 0.99$. This value of α can be considered as the typical value for the period that was studied, and it is indeed close to the average value of α in the period 1988–2003, which is 1.40.

3. Discussion

The observed striking regularity of the wealth distribution at the high wealth range confirms the hypothesis made over a century ago by Pareto (1897). During the century since Pareto's work, empirical evidence has been accumulated in support of his hypothesis (see, for example, Steindl, 1965; Atkinson and Harrison, 1978; Persky, 1992). This is a remarkable result because power-law distributions exhibit the special property that they have no characteristic scale. It may indicate that the same dynamical rules of gains/losses apply across the entire economy independently of the particular sector or the wealth and sophistication of different investors (Anderson, 1997). Thus, the Forbes 400 data may provide useful information not only about the richest individuals, but also about the wealth of people in wealth percentiles far away from the top 400. These findings raise the broader question about the origins of this form of the wealth distribution. While the physical properties of humans (such as height) as well as their mental and social abilities approximately follow Gaussian distributions that tend to be rather narrow, their wealths are very widely distributed and span over seven orders of magnitude (which, in terms of other human properties such as IQ or height, would correspond to observing an individual with an IQ of 10^9, or an individual who is 10,000 mi tall). What is the underlying reason for the empirically observed power-law distribution of wealth? It has been suggested that the Pareto wealth distribution is a consequence of the fundamental nature of the capital market, namely, of market efficiency and the multiplicative nature of the process of wealth accumulation via capital investment (Levy and Solomon, 1996; Levy, 2003). Thus, the empirical finding of a Pareto wealth distribution at the very top wealth range is consistent with the results of previous studies employing different methodologies to analyze the wealth distribution, and with the fundamental notion of market efficiency.

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