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Is the wealth of the world's billionaires Paretian?

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ABSTRACT

This paper investigates the issue of whether or not the top world wealth distribution is Paretian in nature. To this end, *Forbes*' data on the net worth of the world's billionaires for each of the ten years from 2000 to 2009 is used. The results of the Kolmogorov–Smirnov (KS), Anderson–Darling (AD) and chi-squared tests for Pareto power law conducted do not reveal any evidence of Paretian behavior at the conventional 5% level of significance.

1. Introduction

Numerous studies have reported that economic, social and technological phenomena are typically characterized by fat tails which can be well approximated using distributions with tails exhibiting Pareto power law (PPL). Examples of these phenomena include income and wealth [1–7], firm size [8], financial markets [9–13], city size [14,15] and the Internet [16].

PPL (or Paretian) behavior in wealth means that the wealth distribution follows a Pareto distribution, the density function of which is given by

$$p(w) = (\alpha/w_{\min})\,(w/w_{\min})^{-(\alpha+1)}, \quad w \geq w_{\min} \geq 0, \alpha \geq 0 \tag{1}$$

where the shape parameter α denotes the power law exponent (PLE) and the scale parameter $w_{\min}$ denotes minimum wealth.[1]

Four features of Eq. (1) are noteworthy: First, a plot of the logarithm of the number of wealth holders whose wealth exceeds some level w versus the logarithm of w is a straight line with slope $-\alpha$. Second, a plot of the logarithm of $r(w)$, the rank of w, where the ranks are assigned in descending order, versus the logarithm of w is a straight line with slope $-\alpha$. Third, the smaller the value of α, the greater is the degree of wealth inequality. Fourth, when $\alpha = 1$, the distribution conforms to the so-called Zipf's law.

In light of the aforementioned evidence of Paretian behavior in wealth, several economists and physicists [17–22] have developed theoretical models of wealth accumulation that give rise to PPLs. For some of these models, wealth is assumed to follow particular time dependent processes with Paretian outcomes. For others, Paretian behavior results from different modes of interaction (e.g., trade, investment) among the wealth holders.

Although several recent studies have examined the world income distribution, there are hardly any studies that have examined the world wealth distribution. There are compelling arguments in favor of examining world wealth distributions

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[1] The label Paretian credits the seminal contributions of Vilfredo Pareto, the Italian economist whose study of PPL behavior of the incomes for several European countries in the 1890s produced estimates of α that are close to 1.5.

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Table 1
Descriptive statistics of *Forbes*' data: 2000–2009.*

Year	n	Mean	Median	Min.	Max.	Standard deviation	Skewness	Excess kurtosis
2000	299	4.16	2.70	1.00	60.00	5.69	5.54	42.11
2001	538	3.21	1.90	1.00	58.70	4.43	5.99	54.12
2002	522	3.13	1.80	1.00	52.80	4.25	5.81	47.42
2003	476	2.95	1.70	1.00	40.70	3.71	4.89	33.59
2004	587	3.26	1.90	1.00	46.60	4.16	5.10	37.76
2005	691	3.24	2.00	1.00	46.50	4.10	5.02	36.96
2006	793	3.34	2.00	1.00	50.00	4.11	4.91	36.83
2007	971	3.60	2.10	1.00	56.00	4.73	5.19	40.02
2008	1125	3.95	2.20	1.00	62.00	5.51	5.08	37.30
2009	793	3.05	1.80	1.00	40.00	3.76	4.69	30.91

* The data are expressed in billions of US dollars.

Table 2
OLS, MOLS and ML estimates of the PLE (α) using *Forbes*' data.*

Year	OLS	MOLS	ML
2000	1.2155 (0.0994)	1.2457 (0.1019)	0.9580 (0.0554)
2001	1.3430 (0.0819)	1.3654 (0.0832)	1.2360 (0.0533)
2002	1.3896 (0.0860)	1.4137 (0.0875)	1.2463 (0.0546)
2003	1.3810 (0.0895)	1.4058 (0.0911)	1.3352 (0.0612)
2004	1.3531 (0.0790)	1.3734 (0.0802)	1.1870 (0.0490)
2005	1.3452 (0.0724)	1.3630 (0.0733)	1.2030 (0.0458)
2006	1.3434 (0.0675)	1.3592 (0.0683)	1.1558 (0.0410)
2007	1.3056 (0.0593)	1.3187 (0.0598)	1.0929 (0.0351)
2008	1.2404 (0.0523)	1.2514 (0.0528)	1.0352 (0.0309)
2009	1.3736 (0.0690)	1.3896 (0.0698)	1.2807 (0.0455)

* The standard errors are reported in parentheses. Following Gabaix and Ibragimov [29], the standard errors of both the OLS and MOLS estimates of α are obtained using the formula $SE(\hat{\alpha}) = \hat{\alpha}\sqrt{(2/n)}$ where n is the sample size.

as well [23,24]. Most empirical studies of Paretian behavior of top wealth distributions have so far focused on the distributions in individual countries, including the United States [5,6,25], India [7,26], China [27], the United Kingdom [2,21] and Canada [28]. It also seems sensible to investigate whether the top world wealth distribution is Paretian. The purpose of this paper therefore is to examine Paretian behavior of the top world wealth distribution using data on the net worth of the world's richest billionaires for all the years from 2000 to 2009, culled from the US business magazine *Forbes* (see http://www.forbes.com/billionaires/). In this examination, particular attention is paid to the importance of hypothesis testing.

The format of the remainder of this paper is as follows: In Section 2, the methodology and data are described and the PLE estimates based on *Forbes*' data are presented; Section 3 presents the results of three empirical tests for PPL using the same data; and Section 4 presents the conclusions and possible extensions.

2. Methodology, data and the PLE estimates

For several years in a row, *Forbes* magazine has released data on the net worth of the world's billionaires. Members of the various *Forbes*' 'billionaires' lists have made their fortunes by investing in diverse industries including oil and gas, real estate, software development and entertainment. As would be expected, the number of billionaires on *Forbes*' lists fluctuates over the business cycle. For example, the 2008 list comprised of 1125 billionaires whereas the 2009 list comprised of only 793 billionaires owing to the global economic downturn. The composition of the list has also changed over time.

In this study, we utilize *Forbes*' data on the net worth of the world's billionaires for every year from 2000 to 2009. Table 1 reports the descriptive statistics for the data for all these years. The positive skewness, which is characteristic of many wealth distributions, is apparent from the table since the mean wealth for each year exceeds the corresponding median wealth.[2]

Table 2 presents various estimates of α. The reported OLS estimates of α are based on the traditional rank regression

$$\ln(r(w)) = K - \alpha \ln(w) \tag{2}$$

where $r(w)$ denotes the wealth rank assigned from highest ($r(w) = 1$) to lowest ($r(w) = n$) and K is a normalization constant.

It is well known [30,31,29] that the OLS estimator of α based on Eq. (2) is downward biased. Following Gabaix and Ibragimov [29], we also report the OLS estimates of α based on the following modified rank regression which corrects for

2 The positive skewness is also evident from the corresponding kernel nonparametric density estimates which are not reported owing to space constraints but are available from the author upon request.