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Pareto law and Pareto index in the income distribution of Japanese companies

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Abstract

In order to study the phenomenon in detail that income distribution follows Pareto law, we analyze the database of high income companies in Japan. We find a quantitative relation between the average capital of the companies and the Pareto index. The larger the average capital becomes, the smaller the Pareto index becomes. From this relation, we can possibly explain that the Pareto index of company income distribution hardly changes, while the Pareto index of personal income distribution changes sharply, from a viewpoint of capital (or means). We also find a quantitative relation between the lower bound of capital and the typical scale at which Pareto law breaks. The larger the lower bound of capital becomes, the larger the typical scale becomes. From this result, the reason there is a (no) typical scale at which Pareto law breaks in the income distribution can be understood through (no) constraint, such as the lower bound of capital or means of companies, in the financial system.

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1. Introduction

It is well known that personal high income distribution follows power law [1]:

$$N_P(\geqslant x) \propto x^{-\alpha} \tag{1}$$

with high accuracy [2]. Here x is the income and $N_P(\geqslant x)$ is the number of persons with the income larger than or equals to x, and the power law and the exponent α is called Pareto law and Pareto index, respectively.

For instance in Japan, persons who paid annual income tax more than 10 million yen are announced publicly as "high income taxpayers" every year. It is reported that their income distribution follows Pareto law [2]. In Ref. [3], it is also reported that Pareto index annually changes around 2.0, and especially changed sharply ($1.8 \Rightarrow 2.1$) when the economic bubble collapsed in Japan.

In addition, it is well known that, not only the personal high income distribution, but also the company high income distribution follows Pareto law. For instance in Japan, companies having annual income more than 40 million yen are announced publicly as "high income companies" every year. It is reported that their income distribution follows Pareto law and the Pareto index hardly changes around 1.0 annually [4–6]. Power law with exponent -1 is especially called Pareto–Zipf law. Furthermore in Refs. [4,5], it is reported that income distributions in most job categories follow Pareto law, however, those Pareto indices scatter around 1.0.

On the other hand, it is well known that personal or company distribution with low–middle income region does not follow Pareto law [2,7–9].

The research on income distribution is well investigated in econophysics [10], and many models to explain the income distribution are proposed (for instance Refs. [3,5,6,9]). There are, however, several unsolved problems. The first biggest question is why Pareto law appears (breaks). We want to clarify the reason that the high income distribution follows Pareto law, while the low–middle income distribution does not follow Pareto law. The second question is why Pareto index changes (does not change). For instance, in recent annual income distribution in Japan, we want to understand the reason that Pareto index of personal high income distribution changes sharply, while Pareto index of company high income distribution hardly changes. The third question is whether there is any economical variable related to Pareto index. If we find an answer to the third question, we may be able to solve the second and the first questions.

In order to clear these problems, we should examine Pareto law in detail. In this paper, we analyze the database of high income companies in recent Japan. The reason is as follows. The information in the database of high income taxpayers is limited, only income tax, individual name and the address. The database of high income companies, however, includes rich financial information, not only income, company name and the address, but also capital, number of employees, sales and profits. We analyze the database published by Tokyo Shoko Research, Ltd. (TSR) [11].

By analyzing this database, we obtain the following several relations between Pareto law and capital: Firstly, by classifying companies into job categories, we find