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Global evidence on the distribution of economic profit rates☆

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HIGHLIGHTS

- We use global data to examine empirically the distribution of economic profit rates.
- We use the data to test eight theoretical distributions with EDF statistics.
- The consensus finding in the literature supports the Laplace distribution.
- We find economic profit rates are best fit by the heavier-tailed Cauchy distribution.

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ABSTRACT

Gibrat (1931) initiated the study of the distribution of firms' profit rates, suggesting the distribution was log-normal. Although initial empirical work supported that finding, a consensus has developed in the literature that the distribution of firm profit rates is best approximated by the Laplace distribution. Using a richer database than prior studies and testing for more theoretical distributions, we find that the distribution of firm profit rates is best approximated by the heavier-tailed Cauchy distribution.

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1. Introduction

How do dynamic, competitive processes affect firms' profit rates? Beginning with Gibrat [1], several studies have been conducted to test whether or not the distribution of firm profit rates could be approximated by a log-normal distribution (see, for example, Ref. [2]). More recent research suggests that firm profit rates display a tent-shaped Laplace distribution. This result has been obtained in several studies: Ishikawa [3], Ishikawa et al. [4], Wagner et al. [5], Ishikawa et al. [6], Alfarano et al. [7], Erlingsson et al. [8], Semieniuk and Scharfenaker [9], Mundt et al. [10], and Scharfenaker [11]. We explore the distribution of firm profit rates using a richer database than used in these prior studies. Our global database has 13,342 firms in 57 industries from 43 countries over the period 1999–2010. These firms had total 2010 revenues of $38.5 trillion or 61% of world GDP. In contrast to these earlier studies that all use firms' accounting profits, our database contains firms' economic profits.

We present empirical distribution function, or EDF, tests for the profit rates for eight distributions: Cauchy, exponential, gamma, Laplace, logistic, log-normal, normal, and Weibull. We find, in common with the consensus finding, that the Laplace distribution performs reasonably well in approximating the distribution of firm profit rates. However, we show that the distribution of firm profit rates is substantially better approximated by the heavier-tailed Cauchy distribution, a particular case

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of the Lévy α-stable family of densities.[1] Thus, our results agree, for example, with the empirical finding of Dosi and Nelson [13] that "the rates of change in profit margins display distributions which are again fat-tailed (at least exponential, or even fatter-tailed)", and Alfarano et al. [7] that "[t]he Laplace distribution obviously does not provide a perfect description of the data, but the tests certainly illustrate that the Laplacian is a very reasonable first approximation (or 'benchmark') for the distribution of firm profit rates".

Understanding the empirical distribution of firm profit rates is important because the distribution places constraints on theoretical models of firm profit. In turn, models of firm profit are generally based on dynamic models of innovation and investment (see, e.g., Refs. [14,15,7], and [11]). In order to be empirically relevant, such models should generate firm profit rate density functions consistent with the empirical densities. Williams et al. [16] show that the distribution of firm growth rates follows a Cauchy distribution. Together, our two results provide empirical guidance for a yet-to-be developed theory that would explain both the distribution of firm profits and the distribution of firm growth rates.

2. Data and calculation of firm profit rates

A firm's economic profits are measured by comparing investments in its operations to the cash flows generated by those operations. Information on the cash invested in operations, as well as the cash flow from operations, is contained in the transaction records of a company. A complete set of a company's transaction records is available to insiders but not to the public. (In the case of litigation, non-public transaction records are available on a confidential basis to experts.) Financial accounting measures of performance found in a firm's financial statements, such accounting profits as stated in financial statements meeting Generally Accepted Accounting Principles (GAAP), provide an inadequate measure of economic performance [17,18].

Still, financial accounting records themselves are derived from an accurate measure of the firm's transactions and cash flows. Since these publicly available accounting statements are based on a consolidation of the company's transaction records, one can derive information on a firm's cash flows by adjusting and re-categorizing publicly available financial accounting records. The firm's investments in its operations and returns on these investments can then be estimated.

A number of well-known problems exist regarding efforts to measure a firm's economic profits using accounting data (see, e.g., Refs. [19,20]). However, significant advances have been made in financial economics that enable estimates of a firm's economic profits to be made using data on its cash flows, thus avoiding the pitfalls associated with accounting measures of profitability. The framework for estimating a firm's economic profits derives from the work of Modigliani and Miller [21] and Miller and Modigliani [22]. They developed a discounted cash flow approach for firm valuation based on the firm's invested capital, cash flow, and cost of capital. Their approach was then adapted for real-world applications; important contributors include Solomons [23], Shwayder [24], Rappaport [25], Stewart [26], and Koller et al. [27].

We measure a firm's economic profits by its residual income or economic value added (EVA), which is based on the Miller and Modigliani methodology. A firm's EVA equals its net operating profits after taxes (NOPAT) minus its opportunity cost of capital (i.e., cost of capital (COC) times Capital) or $EVA = NOPAT - (COC \times Capital)$. Thus, a firm's economic profit rate is $EVA/Capital = NOPAT/Capital - COC$. (See Appendix for definitions of these variables.) Rogerson [28] presents a model showing why firms would use EVA as a criterion in order to incent managers to choose efficient investment levels. Rogerson [29] "provides an explicit formal model that justifies the use of residual income in the capital budgeting process and also specifically identifies the particular allocation rule that should be used to calculate residual income and how it depends on the depreciation pattern of the underlying assets".

Many large firms use the residual income methodology to estimate their economic profits. A survey of Fortune 500 firms published in 1997 found that 40% used the residual income methodology to make investment and compensation decisions based on estimates of economic profits [30]. A survey of Fortune 1000 firms published in 2002 found that 54% used the residual income methodology [31]. The percentage of both large and small firms using the residual income methodology has increased since 2002 [32]. Recently, China's State-Owned Assets Supervision and Administration Commission (SASAC) partially adopted the use of EVA [33]. The SASAC is state-owned holding company that governs more than 100 companies with $3 trillion in assets, $3 trillion in annual revenues, and 12 million employees. In 2010, SASAC adopted a system of executive compensation that places a 60% weight on sales growth and a 40% weight on EVA.

As a consequence of these actions, decisions by firms in the US and China, as well as numerous other countries, involving investments of hundreds of billions of dollars annually, as well as the compensation of senior executives at these companies, are now made using the residual income methodology. Empirical evidence suggests that firms adopting this methodology earn higher after-tax operating profits [34]. Sharma [35] provides a literature survey of 112 papers published between 1994 and 2008 that analyze the properties of EVA and reviews how companies use EVA to maximize their profits.

We obtain data on firms' profit rates using a unique, proprietary database that provides financial data for 13,342 firms spanning 57 different industries across 43 countries for the years 1999–2010.[2] Starting in 2010, a firm is included in the data as far back in time (through 1999) as it existed as an independent company. The same is true for 2009, 2008, etc. Let π_t^{ijk}

[1] The Lévy α-stable family ($\alpha \in (0, 2]$) includes the Gaussian, or normal, ($\alpha = 2$) and Cauchy ($\alpha = 1$) distributions as special cases. All non-Gaussian Lévy α-stable distributions (i.e., $\alpha < 2$) present heavy tails [12].

[2] Source: evaDimensions, www.evadimensions.com.