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EDITORIAL
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Editorial: Granularity in Econophysics and Macroeconomics

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Editorial on the Research Topic

Granularity in Econophysics and Macroeconomics

Research suggests that economies throughout the world are dominated by a few major companies that coexist alongside a huge number of smaller firms. The presence of such large "grains" implies a heavy right tail for the firm size distribution, which contradicts the widely held belief in macroeconomics that the activity of a single company has minimal impact on the economy as a whole.

The current macroeconomic theory holds that the activity of millions of firms tends to cancel each other out so that the impact of a single firm on the aggregate is negligible. However, if the distribution of firm sizes is heavy-tailed, the assumption of a smooth continuum of firms fails.

Furthermore, there is evidence that the input-output network's structure is asymmetric. All of this empirical study led to the "granularity" hypothesis, which states that idiosyncratic shocks at the firm level can have an aggregate effect. Shocks at the firm level do not cancel out and have an impact on the business cycle.

The empirical cornerstones of the granularity hypothesis, namely the firm size distribution and the input-output network, are reinforced in this Research Topic by four publications.

Bottazzi, in his paper in this Research Topic (*On the Pareto Type III Distribution*), revisits the firm size distribution and proposes that a Pareto type III distribution provides a better fit than the literature's simple power law. He uses the Fortune 500 database, which contains the annual revenue of the world's largest 500 companies. The author notes that Vilfredo Pareto proposed the now-known Pareto Type III distribution in 1896 as one alternative distribution for wealth in the Grand Duchy of Oldenburg. However, this variant has received little attention.

The distribution has the same shape as the traditional two-parameter Pareto. Furthermore, its exponential asymptotic shape ensures that all statistical moments exist. The new parameter is a dispersion parameter that explicitly accounts for the possibility of a typical scale, which influences the estimation of the power and exponential coefficients. Because of the exponential dampening in the upper tail, the Pareto type III–which is relatively simple and analytically tractable–is especially well suited to account for power behavior in intermediate values and exponential decay in large values. Due to the possibility that firm size distributions exhibit this property, the Pareto type III may provide a better fit for data.

Bottazzi's paper tacitly invites us to revisit the literature on the firm size distribution and consider the Pareto type III distribution as an alternative model for the existing data. This endeavor may be fruitful because changes in the power-law tail of firm size distribution have significant implications for business cycle modeling.

In their paper in this Research Topic *Statistical Properties of Labor Productivity Distributions*, Ishikawa et al. build on the finding that the productivity of firms calculated using firm-size

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variables follows a power law in the large-scale range and a lognormal distribution in the mid-scale range. The authors accurately point out that there has not been enough discussion on where the productivity distribution comes from, whether it is labor, capital, or total factor productivity.

They chose one of these firm-size factors, physical labor productivity, which is defined as each firm's operational revenues per unit employee. The researchers then use the world's largest corporate financial database to quantify the statistical features of physical labor productivity, using the number of employees and operating revenues as a metric. They identify three key characteristics.

First, in the large and mid-scale ranges, the probability density function of labor productivity also follows power-law and lognormal distributions. Second, they discovered a time-reversal symmetry in the correlation of labor productivities over two consecutive years, as well as a regularity in the initial-value dependence of the growth-rate distribution. Interestingly, they demonstrate and show using data that the power-law and lognormal distributions in large- and mid-scale labor productivity can be derived from these two properties. Finally, the third property is that the labor productivity distribution is independent of the number of employees. This means that regardless of firm size, the shape of the labor productivity distribution is the same. This conclusion contradicts the standard economics argument that larger firms have higher labor productivity.

In the paper *Measuring the Competitive Advantage of Countries Along the Belt and Road From the Perspective of Complex Social Networks*, Wang et al. present a complex network model of the global value chain division of labor using a multi-regional input-output table. They intend to use a national competitive advantage index to determine the competitiveness trends of industrial sectors and economies on the network. Their findings support the goals of China's Belt and Road Initiative, demonstrating that it is a win-win situation for the Asian and African countries involved.

Tan et al.'s paper *Network Analysis of SIFIs Based on Tail Systemic Linkage* is also included in this Research Topic, and it uses network analysis to address systemic risk interdependencies between the United States and China. The systemic risk indicator and its systemic connection subcomponent are calculated using equity returns. Because of their size, complexity, and systemic interconnection, their focus is on systemically important financial institutions whose failure causes considerable disruption to the entire financial system. The authors construct dynamic systemic risk spillover networks between these institutions in the United States and China. The dependency and dynamics of the entire network are addressed using a tail event-driven network quantile regression model.

They discover that when the financial market is subjected to severe negative shocks, systemic linkages become significantly stronger. In times of financial distress, network factors respond more strongly. This fact can assist market regulators in detecting early warning signs of a crisis and acting accordingly. The authors' combination of systemic linkages and conventional network topology enriched the existing network analysis literature.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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