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# The Rise and Fall of Business Firms

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**The Rise and Fall of Business Firms: A Stochastic Framework on Innovation, Creative Destruction and Growth**, by Sergey V. Buldyrev, Fabio Pammolli, Massimo Riccaboni and H. Eugene Stanley, Cambridge University Press (2020). Hardback. ISBN 9781107175488.

## Introduction

The book “The Rise and Fall of Business Firms: A Stochastic Framework on Innovation, Creative Destruction and Growth” by S.V. Buldyrev, F. Pammolli, M. Riccaboni and H. E. Stanley presents an original and powerful new framework shedding light on how innovation and competition affect the growth and decline of firms. The book covers research, methodologies and concepts at the intersection between statistical physics and econometrics analysis. One crucial aspect of the book is the attention to empirical regularities detected from the analysis of real data and to their use in the falsification (in Popperian terms) of assumptions used in the setting of growth models. The book primarily considers four prominent “stylized facts”, i.e., widespread and persistent statistical regularities, of firms dynamics. The first is about the size distribution of firms and in particular the fact that size distributions are highly skewed in their tails. The second is about the probability of small and young firms to grow and survive and, for survival small firms, grow faster than large firms. The third is about the shape of the distribution of firms’ growth rates and, in particular, about deviations from the lognormal profile expected from classic models. The fourth stylized fact is about the volatility of the growth rate and on its dependence on the firm size. These four stylized facts are simultaneously used to test candidate stochastic models of firm growth. The underlying idea is that by simultaneously considering prominent statistical regularities one can substantially reduce the set of proposed generative processes.

The book elaborates from considering celebrated Gibrat (Gibrat 1931) and Ijiri and Simon (Ijiri and Simon 1964, 1977) models and by combining these two models in a generalized proportional growth (GPG) model that is based on specific features outlined by the authors in previous publications (Fu *et al.* 2005, Growiec *et al.* 2008, 2018). The GPG model has a limited number of parameters and therefore allows for a direct and robust check of its ability in reproducing the above discussed stylized facts. The modeling approach also allows a model - empirical data comparison at multiple levels of aggregation. Therefore presenting an original and unique modeling describing business firms growth at several scales of details. In addition to the introduction, discussion and computer simulations of the GPG model the book investigates how the stochastic outputs of the several variants of the GPG model are consistent with empirical “stylized facts”. These empirical regularities are obtained by investigating a rather unique database collecting the historical data sales of pharmaceutical industry worldwide (the database covers about one million

products of several thousands firms) and several other widely investigated datasets such as the ORBIS, Compustat, and FICUS datasets.

The book is therefore developing and empirically testing a stochastic framework that is specialized in a variety of settings with the aim to reproduce empirical regularities on the size and growth of business firms. The model is based on three informative ingredients. The first is innovation that is stylized as arrival, exploitation, and loss of novel business opportunities. The second ingredient is proportional growth that is hypothesized at the level of each elementary business unit of the firm. The last ingredient is diversification across products, markets, and technologies. This third ingredient turns out to be essential to explain the dependence of the variance of the firm growth on its size.

The book is organized into six chapters and five appendices. Chapter one introduces the scope of the book and discusses the selected four stylized facts. It also describes the basic ingredients of the stochastic framework used in the book and their relation with the classic models of Gibrat and Ijiri & Simon. Chapter two provides the descriptive statistics on the size and growth of business firms. The emphasis is given to the empirical aspects directly related to the four prominent stylized facts introduced in Chapter one. Chapter three presents the generalized proportional growth model and develops analytical (exact or approximated) solutions for six different variants of the model. Some of these variants are further simplified obtaining a total of eleven variants. The simplest versions of these variants coincide with the classic models of Gibrat and Ijiri & Simon. The predictions obtained in Chapter three are tested in Chapter four primarily in the Pharmaceutical Industry Database. The characteristics of this database allow authors to investigate model predictions at different hierarchical levels. Chapter five tests the validity of assumptions used to formulate the GPG model and chapter six briefly concludes. The book has also a rich set of appendices detailing the model of proportional growth, the growth rate distribution, computer simulations of size-variance relationships, a hierarchical-tree model of a company, and brief description of some relevant statistical distributions.

In conclusion, the book by S.V. Buldyrev, F. Pammolli, M. Riccaboni and H. E. Stanley is a rather unique and successful example of interdisciplinary research involving statistical physicists and economists on an economic problem of primary interest. It is an excellent example on how state of the art research can be rigorously and fruitfully performed at the interface of the two disciplines. It is providing one of the best examples of econophysics research of the last years. The success of the book lies on the knowledge and experience of the team of authors. Gene Stanley is one of the founding fathers of econophysics with seminal contributions in statistical physics, Sergey Buldyrev is a statistical physicist with broad interests in the theoretical and computational modeling of complex systems. Fabio Pammolli is an economist with research interests and contributions on industrial dynamics and financial instabilities investigated in a large number of complex economic systems. Massimo Riccaboni is an economist with a background on industrial organization, network analysis and the economics of innovation. The team of authors is therefore perfectly balanced and cover the two disciplines of statistical physics and economics at the highest level of competence. The book is therefore a must-read text for those researchers and research groups fascinated by interdisciplinary and original approaches to the analysis and modeling of economic complex systems. Lovers of Herbert Simon approaches and contributions will recognize the presence of unique cultural traits that are crucial for a successful modeling of complex systems.

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