Preface and Acknowledgments

In recent years, after a long period of decline, inequality in the distribution of income and wealth has increased. In the major OECD countries the Gini index went from 0.30 to 0.35; 0.1 % of the super-rich in the US in 2013 have 22 % of the country's wealth (note that from 1946 to 1988 the share was less than 10 %). To have similar levels one must go back to the years of the Great Depression.

The interest in income and wealth distribution is exemplified by the recent works of Stiglitz (2012, 2015a), Piketty (2014), and Atkinson (2015). It seems to have two separate causes: slow growth and its unsustainability. The first element is almost trivial: when the cake is growing a lot, one can legitimately worry less about its distribution. Conversely, now that millions of Europeans are at risk of poverty the problem of distribution arises strongly. And even more so when one considers global development, since it is incompatible with the current mode of production and consumption. Redistribution becomes a necessity.

The economic crisis has translated, also, into a crisis of economic theory. In particular, the hypothesis of micro-founded equilibrium (i.e., based on methodological individualism) and the absence of interaction between heterogeneous agents, which as we will see are the determinants of the distribution, imposes a straightjacket on the mainstream box of tools which inhibits it from any application on distribution. The interaction among agents can be identified with the *causa causans* of the nonlinearity that originates the distribution as an emergent phenomenon.

The laws of thermodynamics, among the most certain laws we have in physics, are the result of chance: random behavior determined by the interaction of billions of billions of molecules resulting in macroscopic regularity. This is what happens to the distribution of income and wealth, but in economics molecules are atoms in society and their dimensions are heterogeneous, so that there is the effect of St. Matthew (Mt 13:12): "Whoever has will be given more, and they will have an

abundance. Whoever does not have, even what they have will be taken from them."[1] The heterogeneous interacting agents distribute themselves in a distribution characterized by a statistical equilibrium because of a self-organizing process with some technological and institutional constraints.

A natural starting point in this area of enquiry was the observation that the number of persons in a population whose incomes exceed x is often well approximated by $Cx^{-\alpha}$, for some real C and some positive α, as Pareto argued over 100 years ago. However, theoretical and empirical work rapidly pointed to the fact that it is only in the upper tail of the income distribution that a Pareto-like behavior can be expected, while the bulk of the income, the 95 % or so of the population, is governed by a completely different law. Therefore, many recent papers within this literature have sought to characterize the distribution of income by a mixture of known statistical distributions, even if there is a dispute about what these distributions are: indeed, while it seems to be generally acknowledged that the top 1–5 % of incomes follows the Pareto law, an exact and unequivocal characterization of the low to medium income region of the distribution is still evasive. Some scholars claim that this is lognormal; others maintain that the distribution of personal income for the majority of the population should follow the exponential law. In this book we address the issue of data analysis related to the size distribution of income by adopting a statistical mechanics approach introduced by Kaniadakis (2001, 2002, 2005), based on the one-parameter generalization of the exponential function. As we will show, our cumulative distribution function can describe the whole spectrum of the size distribution of income, ranging from the low region to the middle region, and up to the power-law tail, pointing in this way toward a unified approach to the problem.

The parameter k interacts with the layers one by one on the space of probabilities; k is a characteristic parameter, a something intrinsic element, a sort of "specific weight" of an element. All variables characterized by that parameter will be described by the same distribution; only the parameters of scale and form vary, because the data are different samples which come from different populations. In short, the k-distribution outperforms all other distributions: idiosyncratic characteristics of the data, as well as economic policy, influence constraints by changing the position of the distribution, but not its shape.

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[1]Endless wealth accumulation is well represented by the following anecdote: the not any more Cavalier B. once asked his 5-year-old son: "How old are you?"; at his reply he said: "Well, at your age I was 12."

discussions with our group in Ancona, in particular Ruggero Grilli, Antonio Palestrini, Luca Riccetti, and Alberto Russo, have been very stimulating. They survived brilliantly the meetings in which this book was discussed. Hopefully, the readers will too.

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