

# Preface

This book, part of a two-volume work, is motivated by the interest to understand some of the aspects that result from the real-life interactions among different types of investors in incomplete markets where psychological biases and other market frictions play a role in the valuation and trading of financial assets.

Bubbles are an intrinsic element of the financial markets' dynamics. They are born by chance, and/or with the help of the apathy and unethical disregard of regulators, or they may be created on purpose by some interest groups to benefit specific sectors of the societies. Contagion is the mechanism that feeds, grows, and transmits these events within the various segments of the economy and among different geographical areas.

Bubbles are often welcome as if large enough during the first phases of their lives they provide an impulse to the affected sectors and even the economy overall. However, soon thereafter the dislocation of resources bubbles create when outsized and persistent may equally bankrupt whole industries and regions. They certainly do not help create sustainable economic systems or growth.

The aim of these volumes is to escape a narrow exploration of these events in financial markets and look beyond into macroeconomics, monetary policy, risk aggregation, psychology, incentive structures, and many more subjects which are in part co-responsible for these episodes.

Thus, in these volumes, the concepts, intuition, theory, models, mathematical and statistical background, and alternative thoughts related to bubbles and contagion in financial markets are explored. The aspiration is to give readers a broad conceptual and informational background to help

them understand theoretical and practical matters related to the subjects addressed within these pages. The key objective is to ensure a comprehensive understanding of the aspects that can potentially create the conditions for the formation of bubbles, the mechanisms that grow them and make them bubble burst, and the inner workings of the aftermath of such event: the contagion of macroeconomic processes and the ensuing recession.

The first volume covered general aspects related to the history of bubbles, their life cycle, the key macroplayers in their formation and contagion processes, the connectivity system and risk sharing of the modern financial world together with systemic risk and transmission mechanisms, and feedback effects between financial sector risk and sovereign risk, the idiosyncrasies of the markets and investors' psychology and incentives which are vital to these processes and provided an introduction to valuation, bubbles and contagion models. Those pages also introduced an overview of rational and near-rational growing bubble models like "sunspots," "fads," and "information bubbles."

This second volume focuses on explaining the philosophy and thought processes that guide some of the models which analyze these developments. Hence, we devote the first chapter to reviewing some of the statistical and mathematical background needed to understand the models presented ahead in the ensuing pages. Here, we uncover asset price dynamics and stochastic processes including differential aspects of the treatment of time series versus cross-sectional and panel data; trading mechanisms such as limit orders, dealer floor markets and auctions; price prediction and associated relevant circumstances such as transparency and liquidity; the various models to estimate prices and returns; and finally the analysis and forecast models such as regression models, and aspects of time series including serial dependence, stationarity, and white noise processes. Within this section, we also look at random walks with and without drift and moving average and autoregressive processes MA, AR, and ARMA ARIMA ARCH, GARCH processes and modeling.

Our second chapter inspects the concept of stylized facts and some of the stylized facts found in financial markets and bubbles as well as the relationships among them.

The third chapter conceptualizes contagion and bubbles and provides an overview of the Rational Choice Theory and the Bayesian learning tools. Utility maximization, binary choice and prediction tasks, Kolmogorov probability and the history of the philosophy of probability calculus is summarized, objectivism, frequentism and Bayesian probability and inference for discrete and continuous probability spaces are discussed.

The fourth chapter introduces the subject of rational social learning as well as non-rational learning, and we begin to dig in issues related to objective and subjective probabilities, convergence of beliefs, martingales, and the key assumptions of rational social learning models and the personalities and biases of the market agents. We introduce key concepts such as the state of nature, or that of private information, opinion formation, beliefs, moods and speculation, and provide two contexts: a binary context and a Gaussian context.

The fifth chapter uses a number of well-known papers to analyze key issues pertaining to rational, deterministic, and stochastic bubbles under rational expectations and both static and dynamic equilibrium contexts considering different conditions such as heterogeneous and homogenous information. Within this chapter, we look at a no-trade theorem, asset bubbles and overlapping generations, bubbles and fads, stock prices and social dynamics, and explosive rational bubbles. We also review the impact of market inefficiencies such as noise trader risk, the limits to arbitrage, fundamental and synchronization risks, financial intermediation, financial instability and fragility, and overconfidence. We finally look at dynamic speculation in discrete time, no free lunch vanishing risk (NFLVR) and full theorem of asset pricing (FTAP), bubbles in complete markets, the impact of Merton's no dominance constraint and the bubbles decomposition theorem.

Our first five chapters argue that expected returns are notoriously difficult to predict for many reasons, including modeling and econometric problems. Thus, to wrap up our brief walk about the literature of the models that under a number of different hypotheses have pondered the investigation of what variables explain the observed volatility of asset prices in financial markets, in the sixth chapter we present the findings of one last piece of research. The work presented "Fundamentals versus contagion variables to explain changes in asset prices" seeks to answer if bubbles were present in the S&P500 during the period of the analysis. The key goal of this work is to establish whether fundamentals are explanatory of price changes or whether it is the analyzed contagion variables those which have higher explanatory value of these changes. In that quest, this paper uses mean and semiparametric methods to analyze the explanatory value of these fundamentals and contagion proxies and to ascertain their differential impact throughout the distribution of returns. The findings presented ahead suggest that none of the twelve different models used to proxy fundamentals have any explanatory value for price changes. Nonetheless, the three models used to proxy contagion variables are found significant regardless of the methodology used: OLS,

panel data, or quantile regression. Furthermore, in the latter model, the effect of the independent variable is found to increase with the quantile.

Eight decades have passed since Keynes first wrote his *General Theory of Employment, Interest and Money*<sup>1</sup> dedicating some chapters to the “workings” of the capital markets as well as investor psychology and behavior. During this time, a sequence of bubble events have taken place in various markets around the world. Most recently this has happened in China, but we can expect some additional episodes erupting elsewhere in the world, maybe even before the publication of this title.

However, even though the resources dedicated to the research and analysis of these phenomena is flabbergasting, still no uniform economic theory exists to explain stock market bubbles, or contagion for that matter. Furthermore, the key questions posed today are the same Keynes used to introduce his study: How and why do price bubbles form and burst? And what are the necessary and sufficient conditions for these events to take place?

This two-volume work approaches these questions by providing a well-rounded synthesis of the different aspects of bubbles. In addition, this outlook is extended to contagion and the infection mechanisms that work to extend these crises beyond their initial epicenters.

These pages explore the existing main models and their conclusions; issues such as share price development in the presence of symmetric and asymmetric information in the context of rational expectations, fundamental value, and herding; key aspects related to behavioral finance; and the empirical findings pertinent to decision-making or behavioral patterns that trigger market price and volume changes.

The results of empirical economics, carried out through simulations in laboratories, add valuable insights. But no less relevant is the speculative behavior of not fully rational noise traders and chartists, and the feedback and learning mechanisms that surge within the markets and which help transmit crises. In addition to exposing the most common trading techniques followed by speculators and their impacts on the bubble formation processes, typical biases such as overconfidence, accessibility, and other psychological mechanisms and traits which influence decision-making in trading are also considered.

A rational bubble is defined when the differences between the market price of an asset and the fundamental value of that asset are justified on the

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<sup>1</sup> *The General Theory of Employment, Interest and Money*, John Maynard Keynes, Palgrave Macmillan, 1936.

bases of the rational expectations of the market players. However, in the event of speculative bubbles, the market price and the fundamental value differ to a point that no dividend income that could be realistically expected can support the current market price of an asset. Consequently, some chapters are dedicated to the issues of valuation and value growth, including related aspects of technical trading and fundamental valuation principles.

Given the breadth of subjects discussed in these volumes, it is my hope that anyone interested in learning more about bubbles and contagion will find this work enlightening, including undergraduate, masters, and Ph.D. students in business administration, as well as those specializing in economics, finance, and accounting. Students in areas as diverse as mathematics, physics, statistics, and computer engineering may also find it of value. It goes without saying that I hope to attract the interest of the financial industry itself: the practitioners, analysts, and researchers with an academic interest in investment banking, hedge funds, and risk management institutions and organizations.

Achieving a better understanding of the formation of bubbles and the impact of contagion will no doubt determine the stability of future economies. Perhaps these two volumes will help provide a rational approach to mastering these seemingly irrational phenomena.

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