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## Nonlinear Effects in Financial Markets

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The classical theory of financial markets rests to a large extent on assumptions of linearity. The value of a portfolio is a linear function of asset prices and holdings. Optimal portfolios are often found by maximizing expected utility, with respect to a given reference probability. In frictionless markets and with a known model, this linear theory works well and has been used very successfully in the past. However, recent developments have made it clear that this classical theory has started to reach its limits. Nonlinear effects are appearing and play increasingly important roles — sometimes because nonlinear systems provide realistic descriptions or convincing replications of market behaviour; sometimes because deviations from standard financial market theory can be ascribed to nonlinear mechanisms in actual markets. Our goal is to advance financial market theory by systematically studying nonlinear effects and how they can be dealt with. This lays the foundations for new treatments of optimal portfolio choice, risk management, and hedging. The resulting new theory will be more realistic, and we hope its results will be more robust and less risky.

Main areas where nonlinearities appear are transaction costs, models of price impact, and model uncertainty. There are other sources of nonlinear effects; but the above are especially important, lead to many challenging questions, and can be studied by partly similar and partly well-complemented techniques. We therefore expect very fruitful interactions and positive results from this combination. Our approach is analytic. We take market imperfections as given and aim to introduce systematic approaches towards quantifying and handling the resulting risks in a clear and conceptual way. (This is more constructive and robust than trying to propose or develop some kind of ultimate theoretical description.) We want to develop, at a fundamental level, concepts, tools and techniques that (by their design) work in a multitude of situations. They can then be used in a second step as basic building blocks to be adapted and implemented if one has a specific setting or problem to deal with. Portfolio management as well as option pricing and hedging, all in situations with transaction costs, price impact or model uncertainty, are the key topics we want to study. Techniques include among others asymptotic analysis for small parameters as well as new approaches to stochastic analysis under volatility uncertainty.

### Research Team

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### Fields of Research

Quantitative Methods in Finance, Other topics in Financial Economics, Financial Regulation