Quantitative Perspectives on Behavioral Economics and Finance

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Econophysics and Capital Asset Pricing

Splitting the Atom of Systematic Risk

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Once again, to Heather Elaine

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Summary

Despite the rise of multifactor models emphasizing value and firm size, beta remains the most explanatory element of the risk premium in most asset pricing models. Designed to define systematic risk, net of idiosyncratic risk that can be neutralized through diversification, beta measures volatility combined with correlation.

This book rehabilitates beta as a risk measure by splitting the atom of systematic risk. Much of the frustration with conventional uses of beta stems from the failure to disaggregate beta's discrete components. Conventional beta, as it were, is often treated as if it were "atomic" in the original Greek sense: uncut and indivisible. This book responds by developing the econophysics of beta.

Particle physics provides a fruitful framework for evaluating the components of financial risk. Quantum chromodynamics focuses on six flavors of quarks in three matched pairs: up/down, charm/strange, and top/bottom. Baryons are subatomic particles consisting of three quarks. They include protons and neutrons, which comprise most of the mass of the visible universe.

By analogy to the three families of quarks in quantum chromodynamics, I bifurcate beta as the basic unit of systematic financial risk along three vectors:

1. Up and down on either side of mean returns
2. Relative volatility (σ) and correlation (ρ) between asset-specific and market-wide returns

3. "Bad" cash-flow beta versus "good" discount-rate beta

A proper understanding of systematic risk demands the evaluation of beta beyond its conventional "atomic" sense and as coherent baryonic components that interact in quantifiable, predictable ways. The econophysics of capital asset pricing explains no fewer than four of the most significant anomalies and puzzles in mathematical finance:

1. Abnormal returns on value and small-cap stocks within the Fama-French three-factor model
2. The low-volatility anomaly, also known as Bowman's paradox
3. The equity premium puzzle
4. Stock momentum and post-earnings announcement drift

The econophysics of beta provides persuasive explanations for all of these anomalies. Furthermore, this book's three-way analysis of systematic risk connects mathematical finance with phenomena often attributed to behavioral influences on capital markets. Single-sided risk measures capture perceptions of risk on either side of expected returns. Careful disaggregation of volatility and correlation and of beta's cash flow and discount rate components harmonizes mathematical finance with labor markets, human capital, and macroeconomics.