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KAP 414
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"*Title: Robust optimization problems for quantitative finance and insurance models under parameter ambiguity*"

Abstract: One of the most notorious problems in quantitative finance, particularly for portfolio optimization schemes, is the difficulty in estimating the mean rates of return (risk premiums) of risky assets. One classical solution has been to assume that rates of return are stochastic, driven by unobserved noise processes, thereby introducing additional risk factors which need to be accounted for to the best of the practitioners' ability. While this strategy has merit, we will explore a more recent, and in some sense more realistic assumption, by which the rate-of-return parameters are assumed constant yet non-probabilistically uncertain, as a way to model the fact that statistical estimation techniques seem inadequate to determine them for various reasons which could range from lack of sufficient data, to model misspecification, to unspecified non-stationarity of a non-stochastic nature. This is consistent with the principle of striving for parsimonious modeling. This idea is known as model ambiguity, and may contain a way of penalizing models to match various levels of investors' ambiguity aversion. Using a methodology proposed in the mid 2000's by Maenhout (see e.g. Maenhout, P.J., 2006. Robust portfolio rules and detection-error probabilities for a mean-reverting risk premium. Journal of Economic Theory v. 128, pp. 136-163), we investigate the mathematics and numerics of robust control for three decisions problems under estimation uncertainty: a risky investment problem for insurance surplus under Heston's stochastic volatility model, treated using utility maximization, a similar decision problem treated using mean-variance optimization, and a portfolio selection problem for pairs of misprices stocks under unobserved stochastic risk premium and model ambiguity. Generally speaking, our conclusions assert that ambiguity aversion and classical risk aversion are two non-interchageable and equally important aspects of how investors and insurer should deal with market risk. This should help in convincing practitioners that parameter ambiguity is not a stochastic risk factor (not a source of uncertainty in the classical sense), but a way to admit to modeling inadequacy, while proposing robust control

as a systematic method to deal with the problem. This is joint work with Bo Yi, Baron Law, Zhongfei Li, and Yan Zeng.