

Toward Maximum Diversification Choueifaty

Towards Maximum Diversification Optimization Methods in Finance PRICAI 2019: Trends in Artificial Intelligence Recent Advances in Theory and Methods for the Analysis of High Dimensional and High Frequency Financial Data Successful Investing Is a Process Properties of the Most Diversified Portfolio Business Periodicals Index Diversification Management of a Multi-Asset Portfolio Rao's Quadratic Entropy, Risk Management and Portfolio Theory Optimal Portfolio Selection with Transaction Costs Risk-Parity and Ambiguity Risk Portfolios Yves Choueifaty Gérard Cornuéjols Abhaya C. Nayak Norman R. Swanson Jacques Lussier Yves Choueifaty Christoph Kind Nettey Boevi Gilles Koumou N'Golo Koné Alexey Medvedev David Ardia

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along with the ongoing effort to build market cap independent portfolios the authors explore the properties of diversification as a driver for portfolio construction they introduce a measure of the diversification of portfolios that they term the diversification ratio the measure is then employed to build risk efficient portfolios the most diversified portfolios and theoretical properties of the resulting portfolios are discussed per se and compared to other popular methodologies market cap weights equal weights minimum variance empirical results confirm that those popular methodologies are dominated by risk efficient portfolios in many aspects the implication is that in the long run actively managed portfolios which maximize diversification are strong candidates for achieving consistently better results than commonly used passive index tracking methodologies the message is clear investors and their trustees cannot afford to ignore the

benefits of maximal diversification

optimization methods play a central role in financial modeling this textbook is devoted to explaining how state of the art optimization theory algorithms and software can be used to efficiently solve problems in computational finance it discusses some classical mean variance portfolio optimization models as well as more modern developments such as models for optimal trade execution and dynamic portfolio allocation with transaction costs and taxes chapters discussing the theory and efficient solution methods for the main classes of optimization problems alternate with chapters discussing their use in the modeling and solution of central problems in mathematical finance this book will be interesting and useful for students academics and practitioners with a background in mathematics operations research or financial engineering the second edition includes new examples and exercises as well as a more detailed discussion of mean variance optimization multi period models and additional material to highlight the relevance to finance

this three volume set lnai 11670 lnai 11671 and lnai 11672 constitutes the thoroughly refereed proceedings of the 16th pacific rim conference on artificial intelligence pricai 2019 held in cuvu yanuca island fiji in august 2019 the 111 full papers and 13 short papers presented in these volumes were carefully reviewed and selected from 265 submissions pricai covers a wide range of topics such as ai theories technologies and their applications in the areas of social and economic importance for countries in the pacific rim

recently considerable attention has been placed on the development and application of tools useful for the analysis of the high dimensional and or high frequency datasets that now dominate the landscape the purpose of this special issue is to collect both methodological and empirical papers that develop and utilize state of the art econometric techniques for the analysis of such data

a process driven approach to investment management that lets you achieve the same high gains as the most successful portfolio managers but at half the cost what do you pay for when you hire a portfolio manager is it his or her unique experience and expertise a set of specialized analytical skills possessed by only a few the truth according to industry insider jacques lussier is that despite their often grandiose claims most successful investment managers themselves can t properly explain their successes in this book lussier argues convincingly that most of the gains achieved by professional portfolio managers can be accounted for not by special knowledge or arcane analytical methodologies but proper portfolio management processes whether they are aware of this or not more importantly lussier lays out a formal process oriented

approach proven to consistently garner most of the excess gains generated by traditional analysis intensive approaches but at a fraction of the cost since it could be fully implemented internally profit from more than a half century s theoretical and empirical literature as well as the author s own experiences as a top investment strategist learn an approach combining several formal management processes that simplifies portfolio management and makes its underlying qualities more transparent while lowering costs significantly discover proven methods for exploiting the inefficiencies of traditional benchmarks as well as the behavioral biases of investors and corporate management for consistently high returns learn to use highly efficient portfolio management and rebalancing methodologies and an approach to diversification that yields returns far greater than traditional investment programs

this article expands upon toward maximum diversification by choueifaty and coignard 2008 we present new mathematical properties of the diversification ratio and most diversified portfolio mdp and investigate the optimality of the mdp in a mean variance framework we also introduce a set of portfolio invariance properties providing the basic rules an unbiased portfolio construction process should respect the mdp is then compared in light of these rules to popular methodologies equal weights equal risk contribution minimum variance and their performance is investigated over the past decade using the msci world as reference universe we believe that the results obtained in this article show that the mdp is a strong candidate for being the un diversifiable portfolio and as such delivers investors with the full benefit of the equity premium

it is a well known fact in finance that classical mean variance optimization often leads to highly concentrated portfolios giving equal weights to all portfolio assets will instead allow for maximum nominal diversification more sophisticated ways of nominal diversification are the maximum diversification approach proposed by choueifaty and coignard 2008 or the equal weighting of total risk contributions known as risk parity instead of looking for nominal diversification investors may prefer a diversification of the risk factors that drive portfolio returns in recent papers risk factors have been modelled by principal components following partovi and caputo 2004 meucci et al 2013 show that principal components may not be the best way to model risk factors and propose minimum torsion bets instead the present paper discusses different ways of managing diversification and backtests these strategies in a multi asset portfolio

this thesis is about the concept of diversification and its measurement in portfolio theory diversification is one of the major components of portfolio theory it helps to reduce or ultimately to eliminate portfolio risk

thus its measurement and management is of fundamental importance in finance and insurance domains as risk measurement and management consequently several measures of portfolio diversification were proposed each based on a different criterion unfortunately none of them has proven totally satisfactory all have drawbacks and limited applications developing a coherent measure of portfolio diversification is therefore an active research area in investment management in this thesis a novel coherent general and rigorous theoretical framework to manage and quantify portfolio diversification inspiring from rao 1982a quadratic entropy rge a general approach to measuring diversity is proposed more precisely this thesis demonstrates that when rge is judiciously calibrated it becomes a valid class of portfolio diversification measures summarizing complex features of portfolio diversification in a simple manner and provides at the same time a unified theory that includes many previous contributions next this thesis presents two applications of the proposed class of portfolio diversification measures in the first application new formulations of maximum diversification strategy of choueifaty and coignard 2008 is provided based on the proposed class of measures these new formalizations clarify the investment problem behind the md strategy help identify the source of its strong out of sample performance relative to other diversified portfolios and suggest new directions along which its out of sample performance can be improved in the second application a novel and useful formulation of the mean variance utility function is provided based on the proposed class of measures this new formulation significantly improves the mean variance model understanding in particular in terms of asset pricing it also offers new directions along which the mean variance model can be improved without additional computational costs

the optimal portfolio selection problem has been and continues to be a subject of interest in finance the main objective is to find the best way to allocate the financial resources in a set of assets available on the financial market in order to reduce the portfolio fluctuation risks and achieve high returns nonetheless there has been a strong advance in the literature of the optimal allocation of financial resources since the 20th century with the proposal of several strategies for portfolio selection essentially motivated by the pioneering work of markowitz 1952 which provides a solid basis for portfolio analysis on the financial market this thesis divided into three chapters contributes to this vast literature by proposing various economic tools to improve the process of selecting portfolios on the financial market in order to help stakeholders in this market the first chapter a joint paper with marine carrasco addresses a portfolio selection problem with trading costs on stock market more precisely we develop a simple gmm based test procedure to test the significance of trading costs effect in the economy regardless of the form of the transaction cost in fact most of the studies in the literature about trading costs effect depend largely on the form of the frictions assumed

in the model dumas and luciano 1991 lynch and balduzzi 1999 lynch and balduzzi 2000 liu and loewenstein 2002 liu 2004 lesmond et al 2004 buss et al 2011 gârleanu and pedersen 2013 heaton and lucas 1996 to overcome this problem we develop a simple test procedure which allows us to test the significance of trading costs effect on a given asset in the economy without any assumption about the form of these frictions our test procedure relies on the assumption that the model estimated by gmm is correctly specified a common test used to evaluate this assumption is the standard j test proposed by hansen 1982 however when the true parameter is close to the boundary of the parameter space the standard j test based on the χ^2 critical value suffers from overrejection to overcome this problem we propose a two step procedure to test overidentifying restrictions when the parameter of interest approaches the boundary of the parameter space in an empirical analysis we apply our test procedures to the class of anomalies used in novy marx and velikov 2016 we show that transaction costs have a significant effect on investors behavior for most anomalies in that case investors significantly improve out of sample performance by accounting for trading costs the second chapter addresses a multi period portfolio selection problem when the number of assets in the financial market is large using an exponential utility function the optimal solution is shown to be a function of the inverse of the covariance matrix of asset returns nonetheless when the number of assets grows this inverse becomes unreliable yielding a selected portfolio that is far from the optimal one we propose two solutions to this problem first we penalize the norm of the portfolio weights in the dynamic problem and show that the selected strategy is asymptotically efficient however this method partially controls the estimation error in the optimal solution because it ignores the estimation error in the expected return which may also be important when the number of assets in the financial market increases considerably we propose an alternative method that consists of penalizing the norm of the difference of successive portfolio weights in the dynamic problem to guarantee that the optimal portfolio composition does not fluctuate widely between periods we show under appropriate regularity conditions that we better control the estimation error in the optimal portfolio with this new procedure this second method helps investors to avoid high trading costs in the financial market by selecting stable strategies over time extensive simulations and empirical results confirm that our procedures considerably improve the performance of the dynamic portfolio in the third chapter we use various regularization or stabilization techniques borrowed from the literature on inverse problems to estimate the maximum diversification as defined by choueifaty 2011 in fact the maximum diversification portfolio depends on the vector of asset volatilities and the inverse of the covariance matrix of assets distribution in practice these two quantities need to be replaced by their sample counterparts this results in estimation error which is amplified by the fact that the sample covariance matrix

may be close to a singular matrix in a large financial market yielding a selected portfolio far from the optimal one with very poor performance to address this problem we investigate three regularization techniques such as the ridge the spectral cut off and the landweber fridman to stabilize the inverse of the covariance matrix in the investment process these regularization schemes involve a tuning parameter that needs to be chosen so we propose a data driven method for selecting the tuning parameter in an optimal way the resulting regularized rules are compared to several strategies such as the most diversified portfolio the target portfolio the global minimum variance portfolio and the naive 1 n strategy in terms of in sample and out of sample sharpe ratio

we show that risk parity and risk based models in general can be rationalized as an optimal decision under ambiguity risk based framework represents an extension of maximum diversification approach of choueifaty and coignard 2008 in the presence of ambiguity in risk adjusted expected returns

riskportfolios is an r package for constructing risk based portfolios it provides a set of functionalities to build mean variance minimum variance inverse volatility weighted leote de carvalho lu and moulin 2012 equal risk contribution maillard roncalli and teiletche 2010 maximum diversification choueifaty and coignard 2008 and risk efficient amenc et al 2011 portfolios optimization is achieved with the r packages quadprog weingessel 2013 and nloptr ypma 2014 long or gross constraints can be added to the optimizer as risk based portfolios are mainly based on covariances the package also provides a large set of covariance matrix estimators

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Introduction

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