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Recent Developments in Quantitative Finance: An Overview

Chia-Lin Chang and Shing-Yang Hu and Shih-Ti Yu

National Chung Hsing University, National Taiwan University, National Tsing Hua University

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An Overview*

Chia-Lin Chang

Department of Applied Economics
Department of Finance
National Chung Hsing University
Taiwan

Shing-Yang Hu

Department of Finance
National Taiwan University
Taiwan

Shih-Ti Yu

Department of Quantitative Finance
National Tsing Hua University
Taiwan

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Abstract

Quantitative finance combines mathematical finance, financial statistics, financial econometrics and empirical finance to provide a solid quantitative foundation for the analysis of financial issues. The purpose of this special issue on "Recent developments in quantitative finance" is to highlight some areas of research in which novel methods in quantitative finance have contributed significantly to the analysis of financial issues, specifically fast methods for large-scale non-elliptical portfolio optimization, the impact of acquisitions on new technology stocks: the Google-Motorola case, the effects of firm characteristics and recognition policy on employee stock options prices after controlling for self-selection, searching for landmines in equity markets, whether CEO incentive pay improves bank performance, using a quantile regression analysis of U.S. commercial banks, testing price pressure, information, feedback trading, and smoothing effects for energy exchange traded funds, actuarial implications of structural changes in El Niño-Southern Oscillation Index dynamics, credit spreads and bankruptcy information from options data, QMLE of a standard exponential ACD model: asymptotic distribution and residual correlation, and using two-part quantile regression to analyze how earnings shocks affect stock repurchases.

Keywords: Quantitative finance, Financial econometrics, Empirical finance, Equities, Portfolios, Quantiles.

JEL: C58, G11, G12, G21, G32.

1. Introduction

The rapidly expanding discipline of quantitative finance combines mathematical finance, financial statistics, financial econometrics and empirical finance to provide a rigorous quantitative foundation for the analysis of important financial issues. The purpose of this special issue of *Annals of Financial Economics* on "Recent Developments in Quantitative Finance" is to highlight some areas of research in which novel methods in quantitative finance have contributed significantly to the analysis of financial issues.

The papers cover a range of interesting topics by experts in the field, including fast methods for large-scale non-elliptical portfolio optimization (Paolella, 2014), the impact of acquisitions on new technology stocks: the Google-Motorola case (Gao, Wang and Hafner, 2014), the effects of firm characteristics and recognition policy on employee stock options prices after controlling for self-selection (Kuo and Yu, 2014), searching for landmines in equity markets (Chang, Chang and Hung, 2014), whether CEO incentive pay improves bank performance, using a quantile regression analysis of U.S. commercial banks (Chan, Lin, Liang and Chen, 2014), testing price pressure, information, feedback trading, and smoothing effects for energy exchange traded funds (Chang and Ke, 2014), actuarial implications of structural changes in El Niño-Southern Oscillation Index dynamics (Chen and Huang, 2014), credit spreads and bankruptcy information from options data (Tzeng, 2014), QMLE of a standard exponential ACD model: asymptotic distribution and residual correlation (Sin, 2014), and using two-part quantile regression to analyze how earnings shocks affect stock repurchases (Chi, Yu, Li and Lu, 2014).

The interesting, timely and novel contributions to this special issue should highlight and encourage innovative research in a variety of challenging areas in quantitative finance.

The plan of the remainder of the paper is as follows. An overview of each of the 10 papers is presented in Section 2, and some final remarks and acknowledgements are given in Section 3.

2.   Overview

The first paper is by Marc S. Paolella (Swiss Banking Institute, University of Zurich, Switzerland, and Swiss Finance Institute), and is entitled "Fast methods for large-scale non-elliptical portfolio optimization". Simple and fast methods for modelling the portfolio distribution corresponding to a non-elliptical, leptokurtic, asymmetric, and conditionally heteroskedastic set of asset returns are examined. Portfolio optimization via simulation is demonstrated and its benefits are discussed. An augmented mixture of normals model is shown to be superior to both the standard (no short selling) Markowitz and the equally weighted portfolios in terms of out-of-sample returns and Sharpe ratio performance.

The second paper is entitled "The impact of acquisitions on new technology stocks: The Google-Motorola case", by Renfei Gao (School of Management, Fudan University, China), Cindy S.H. Wang (Department of Quantitive Finance, National Tsing Hua University, Taiwan, and CORE, Université Catholique de Louvain, Belgium), and Christian M. Hafner (ISBA and CORE, Université Catholique de Louvain, Belgium),

The paper analyzes the impact of the recent acquisition of Motorola by Google on the subsequent performance of stock returns using an event study methodology. The authors obtain empirical results by a two-stage regression, by which the impact of market and industry effects can be controlled. The findings suggest that the Motorola takeover led to negative and significant excess returns to Google, but positive and highly significant excess returns to Motorola. Additionally, while the event led to significantly positive excess returns to direct competitors, it did not have a strong impact on indirect competitors, suggesting that the importance of the event was restricted to related industries.

Chii-Shyan Kuo (Department of Business Administration, National Taiwan University of Science and Technology, Taiwan) and Shih-Ti Yu (Department of Quantitative Finance, National Tsing Hua University, Taiwan) examine "The effects of firm characteristics and recognition policy on employee stock options prices after controlling for self-selection" in the third paper. The authors examine whether and how firm characteristics, including firm size and liquidity, affect the relation between employee stock option (ESO) grants (as approximated by disclosed ESO expenses) and firm value. They investigate how the implementation of a new share-based compensation recognition rule affects the pricing effect of ESOs. Prior studies have provided mixed results concerning how ESOs affect firm value. The authors argue that their findings could be attributable to self-selection and a non-uniform ESO-share price relation. The threshold model is used to address the research questions after controlling for self-selection bias. It is found that markets tend to price ESOs positively in the case of firms characterized by large size and low liquidity. In addition, it is found that, after the new rule came into effect, ESOs became positively associated with firm value. These results are congruent with ownership and symbolic value theories, the lifecycle

5

stages hypothesis, and the contention that an ESO expensing policy enhances the quality of financial statements.

The fourth paper is by Bi-Juan Chang (Graduate Institute of International Business, National Taiwan University, Taiwan), Jow-Ran Chang (Department of Quantitative Finance, National Tsing Hua University, Taiwan), and Mao-Wei Hung (Department of International Business, National Taiwan University, Taiwan), and is entitled "Searching for landmines in equity markets". Distressed firms in equity markets are like landmines in battlefields due to their undetectability and devastating effects. The paper is concerned with distressed firms forecasting by the distance to default and rare event logit models via publicly available data. Comparing these two models by Cumulative Accuracy Profiles and Receiver Operating Characteristic curves, the authors conclude that the rare event logit model performs better than the distance to default model. The data contain U.S.-listed firms on the S&P 500 for the period January 1986 to December 2012, including 2,138 companies and 271,912 firm months, with 444 distressed firms. The dynamic threshold is set as the last 6% of firms based on historical cross-section distress rates. Upon Bayesian posterior probability examination, the rare event logit model shows about 40% to 60% affinity with S&P Domestic Long Term Issuer Credit Rating records, on average, and the rate increases to 70% in some situations. It is concluded that the rare event logit model can be a good warning indicator at least three years ahead of distress in firms.

Min-Lee Chan (Department of Finance, Providence University, Taiwan), Cho-Min Lin (Department of Finance, Providence University, Taiwan), Hsin-Yu Liang (Department of International Trade, Feng-Chia University, Taiwan), and Ming-Hua Chen (Department of Information Management, Ling Tung University, Taiwan) consider the

question posed by "Does CEO incentive pay improve bank performance? A quantile regression analysis of U.S. commercial banks" in the fifth paper. The U.S. subprime crisis in 2008 raised concerns about bank performance and the incentive pay of CEOs, specifically whether the CEO's incentive compensation improved bank performance. The paper examines the improvement in bank performance by examining the CEO incentive pay of 68 U.S. commercial banks from 1993 to 2005 using quantile regression analysis. The empirical evidence indicates that the relationship between bank performance and incentive pay vies according to bank performance levels. The results show that CEO incentive compensation improves the performance of high-performing banks and that the accrued risks should be taken into account and controlled through the efficient monitoring of outside directors. For low-performing banks, it is found that outside directors have a significantly positive effect on performance, regardless of whether such performance is adjusted or not. It is suggested that banks with various performance levels require different mechanisms to enhance their performance. A "stick" approach consisting of efficient monitoring by outside directors may ensure that low-performing banks improve their performance improvements. Moreover, a "carrot" approach (that is, CEO incentive pay) is appropriate for high-performing banks under risk controls, which could also be accomplished through monitoring by outside directors.

In the sixth paper, entitled "Testing price pressure, information, feedback trading, and smoothing effects for energy exchange traded funds", Chia-Lin Chang (Department of Applied Economics and Department of Finance, National Chung Hsing University, Taiwan), and Yu-Pei Ke (Department of Applied Economics, National Chung Hsing University, Taiwan) examine the relationships between flows and returns for five Exchange Traded Funds (ETF) in the U.S. energy sector. Four alternative hypotheses

are tested, namely the price pressure hypothesis, information (or price release) hypothesis, feedback trading hypothesis, and smoothing hypothesis. The five ETF are the Energy Select Sector SPDR Fund (XLE), iShares U.S. Energy ETF (IYE), iShares Global Energy ETF (IXC), Vanguard Energy ETF (VDE), and PowerShares Dynamic Energy Exploration & Production Portfolio (PXE). A Vector Autoregressive (VAR) model is used to analyze the relationships between energy flows and returns. The empirical results show that energy ETF flows and subsequent returns have a negative relationship, thereby supporting the smoothing hypothesis. Moreover, the smoothing effect exists for XLE and IYE during the global financial crisis. Regardless of whether the whole sample period or the sub-samples before, during and after the global financial crisis are used, no empirical evidence is found in support of the price pressure hypothesis, information hypothesis, or feedback trading hypothesis.

Shu-Ling Chen (Department of Finance and Cooperative Management, National Taipei University, Taiwan), and Yu-Lieh Huang (Department of Quantitative Finance, National Tsing Hua University, Taiwan) analyse "Actuarial implications of structural changes in El Niño-Southern Oscillation Index dynamics" in the seventh paper. The influence of climate variability on agricultural production and financial risks faced by an individual or an institution has been at the center of public discussion in recent years. Changing weather patterns and environmental conditions can lead to substantial unpredicted economic losses. Failure to capture such changes would underestimate the insurance contract's expected indemnity and create a major obstacle for the insurance sector. The authors undertake a case study of El Niño-Southern Oscillation Index insurance for coastal Peru. They examined the behavior of the El Niño index and uncovered evidence that the conditional volatility of the index has changed over time. A fractionally integrated GARCH (FIGARCH) process is used to capture the long

memory behaviour of the dynamic conditional variance to design and rate the El Niño-Southern Oscillation Index insurance contract. The empirical results show that, with the time-invariant AR(2) model serving as a benchmark, the AR(2)-FIGARCH(1, d, 1) model outperforms the AR(2) model in both in-sample fit and out-of-sample forecasts for the El Niño index. Moreover, the time-invariant model could underestimate the premium rates, thereby exposing the insurer to undesired underwriting risk and ultimately causing the index insurance market to collapse.

The eighth paper, entitled "Credit spreads and bankruptcy information from options data", is by Chi-Feng Tzeng (Department of Quantitative Finance, National Tsing Hua University, Taiwan). Implied bankruptcy chances are applied to explain credit default swap (CDS) spreads during the financial crisis period. The chances are estimated from options data, under the assumption that the risk neutral density (RND) is comprised of lognormal densities with a bankruptcy chance. Market information from firm-level and index-level RNDs is used to explain CDS spreads. The empirical findings show that: firm-level information provides greater explanation than index-level information, and that firm-level volatility is an important determinant of CDS spreads. The implied bankruptcy chances are positively and significantly related to spreads, and firm-level skewness is positively associated with spreads. Finally, when the index level is low, the spreads tend to be high.

The topic of "QMLE of a standard exponential ACD model: Asymptotic distribution and residual correlation" is considered by C.Y. (Chor-yiu) Sin (Department of Economics, National Tsing Hua University, Taiwan) in the penultimate paper. Numerous studies have applied the autoregressive conditional duration, ACD(m,q), model to fit irregularly-spaced transactions data, including to claims in insurance. Many

of the papers in the literature have assumed that the standardized error follows a standard exponential distribution. In this paper, the author derives the asymptotic distribution of the quasi-maximum likelihood estimator when a standard exponential distribution is used, and provides the robust standard errors for the ACD model. The author derives the asymptotic distribution of the corresponding residual autocorrelation.

The final paper, by Chih-Yi Chi (Department of Finance, National Chung Hsing University, Taiwan), Shih-Ti Yu (Department of Quantitative Finance, National Tsing Hua University, Taiwan), Yi Tzu Li (Eastspring Securities Investment Trust Co. Ltd.), and Yu-Lung Lu (Department of Economics, National Tsing Hua University, Taiwan), is entitled "Using two-part quantile regression to analyze how earnings shocks affect stock repurchases". The authors examine whether firms tend to buy back their stocks to a greater extent when managers learn there will be positive earnings impacts. They use a two-part model to address the issue. First, the authors use a probit model to estimate the decision of stock repurchase, then quantile regression to estimate the dollar amount of stock repurchases. It is found that, when the earnings impacts are in the low quantiles, stock repurchases and earning impact are positively correlated. However, when the impacts are in the high quantiles, the relation becomes reversed.

3. Final remarks

The collection of interesting, timely and novel papers in this special issue of *Annals of Financial Economics* by some of the leading experts in the field of Quantitative Finance should highlight and encourage innovative research in a variety of challenging areas of quantitative finance.

It is our pleasure to acknowledge all the contributors for preparing their invaluable, interesting and innovative papers in a timely manner, and for their willingness to participate in the rigorous editorial review process, which was provided by expert reviewers in the field.

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