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Management Science, Economics and Finance: A Connection

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Abstract

This paper provides a brief review of the connecting literature in management science, economics and finance, and discusses some research that is related to the three disciplines. Academics could develop theoretical models and subsequent econometric models to estimate the parameters in the associated models, and analyze some interesting issues in the three disciplines.

JEL: A10, G00, G31, O32

Keywords: Management science; Economics; Finance; Theoretical models; Econometric models

Introduction

There are many studies that link management sciences, economics, and finance. In this paper, we will discuss different types of utility functions, stochastic dominance (SD), mean-risk (MR) models, and portfolio optimization (PO) as these topics are popular in the three disciplines. Academics could develop theoretical models and thereafter develop econometric models to estimate the associated parameters to analyze some interesting issues in management science, economics, and finance.

The plan of the remainder of the paper is as follows. In Section 2, we discuss interesting papers that have been published in the leading journals in management science, economics and finance. In Section 3, some theoretical models are discussed. Alternative statistical and econometrics models are analyzed in Section 4. A brief discussion of empirical models is presented in Section 5. Some concluding remarks are given in Section 6.

Brief Literature Review

The theory for different types of investors, SD, MR and OP models are popular areas in management science, economics, and finance. For example, Markowitz [1] proposes the mean-variance (MV) selection rules for risk averters. Quirk and Saposnik [2], Hanoch and Levy [3] study SD rules for risk averters. Bawa, et al. [4] develop an algorithm to obtain the SD admissible sets by stock selection. Hammond [5] suggests SD rules for risk seekers. Aboudi and Thon [6] present an equally efficient technique for third-degree SD. Gotoh and Konno [7] develop a third-order SD rule to obtain efficient portfolios associated with the efficient frontiers generated by mean-lower semi-standard deviation and mean-absolute deviation models. Post and Kopa [8] develop the theory of portfolio choice based on third-order SD.

There are different types of investors. For example, Markowitz suggests that investors' utility could be convex and concave in both the positive and negative domains. Traditional SD theory supports concave utility functions, while the theory of reverse SD supports convex utility functions. The findings from Pennings and Smidts support the existence of investors with reverse S-shaped utility functions [9].

The findings in Currim and Sarin [10] and Thaler and Johnson [11] support the existence of investors with S-shaped utility functions. Levy and Levy [12-14] and others extend the SD theory to Markowitz SD (MSD) and Prospect SD (PSD) for investors with S-shaped and reverse S-shaped utility functions, respectively.

Leshno and Levy [12] extend SD theory to the theory of almost stochastic dominance (ASD) to reveal a preference for "most" decision makers. Tzeng, Huang, and Shih [15] find that the almost second-degree stochastic dominance (ASSD) does not possess the property of expected-utility maximization, so they modify the ASSD definition to acquire this important property.

Theoretical Models

It is important to commence any rigorous research in management science, economics, and finance by developing appropriate theoretical models. We have been developing some theories to extend those that have been discussed in a number of existing literature reviews.

We will first discuss the theory developed in SD. Li and Wong [16] extends SD theory by developing some SD theorems for risk seekers and risk averters. Wong and Li [17] extend Fishburn 1974's [18] convex SD theorem by including any distribution function, develop the results for both risk seekers as well as risk averters, and including third order SD. They also extend the theory developed by Bawa, Bodurtha. Rao, and Suri [19] on the comparison between convex combinations of several continuous distributions and a single continuous distribution.

Wong [20] also extends the SD theory by introducing the first three orders of both SD and RSD to decisions in business planning and investment to risk-averse and risk-seeking decision makers, so that they can compare both returns and losses. He also introduces a MV rule for risk seekers. By incorporating both majorization theory and SD, Egozcue and Wong [21] develop a general theory for determining the diversification preferences of risk-averse investors and conditions under which they would unanimously judge a particular asset to be superior. Guo and Wong [22,23] extend the (univariate) SD theory to multivariate SD for both risk averters and risk seekers, respectively, when the attributes are assumed to be independent and the utility function is assumed to be additively and separable.

Levy and Levy develop the PSD and MSD theory for investors with S-shaped and reverse S-shaped utility functions. Wong and Chan [24]

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extend their work by developing the PSD and MSD to the first three orders, link the corresponding S-shaped and reverse S-shaped utility functions to the first three orders, and develop some properties for both MSD and PSD. The prospect theory based on S-shaped utility functions is different from the von Neumann and Morgenstern (NM) theory based on concave utility functions.

Broll, Egozcue, Wong, and Zitikis [21] show that it is possible to convert NM theory into prospect theory. For example, unlike the NM theory, they show that the monotonicity of indifference curves depends on the underlying mean in the prospect theory. Egozcue, Fuentes García, Wong, and Zitikis [25] study rankings of completely and partially diversified portfolios and also of specialized assets when investors follow Markowitz preferences. They find that, for Markowitz investors, preferences toward risk vary depending on their sensitivities toward gains and losses.

Both expected-utility maximization and the hierarchical property are very important in SD. Leshno and Levy proposes a definition, and Tzeng, Huang, and Shih modify it to provide another definition for ASD. Guo, Zhu, Wong, and Zhu [26] show that the former has the hierarchical property but not the expected-utility maximization, whereas the latter has the expected-utility maximization but not the hierarchical property. Guo, Post, Wong, and Zhu [27] establish necessary moment conditions for ASD criteria of various orders.

Guo, Wong, and Zhu extend the ASD theory (for risk averters) by including ASD for risk-seeking investors. They also study the relationship between ASD for risk seekers and ASD for risk averters. In addition, Tsetlin, Winkler, Huang, and Tzeng [28] develop the theory of generalized ASD (GASD). Guo, Wong, and Zhu briefly discuss the advantages and disadvantages of ASD and GASD.

Wong and Ma [29] generalize the theory on the location-scale (LS) family to the multivariate setting for both risk averters and risk seekers. They also examine some non-expected utility functions defined over the LS family, and develop some properties for the partial orders and dominance relations defined over the LS family. Ma and Wong [30] establish some behavioural foundations for various types of Value-at-Risk (VaR) models, including VaR and conditional-VaR (C-VaR), as measures of downside risk. They also show that the VaR criterion is equivalent to the first-order SD while the C-VaR, is shown to be equivalent to the second-order SD.

Statistical and econometric models

Another suggestion is to develop statistical and econometric models in the areas related to management science, economics, and finance. After developing mathematical models, one might consider developing some related statistical and econometric models. We have developed several econometrics papers in SD, MR and PO theory, and discuss some contributions in the development of econometrics for SD.

The SD theory for both risk averters and risk seekers was developed by Wong and Li and others, and the SD theory for investors with S-shaped and S-shaped utility functions was developed by Levy and Levy and other, as discussed in Section 3. Subsequently, Bai, Li, McAleer, and Wong [31] extend the work of the SD test for risk averters, developed by Davidson and Duclos, to derive the limiting process of SD statistics for risk averters as well as risk seekers when the underlying processes can be either dependent or independent.

Bai, Li, Liu, and Wong develop SD tests for investors with S-shaped utility functions of the first three orders. These statistics provide a tool to examine the preferences of investors with S-shaped utility functions, as proposed by Kahnemann and Tversky in their prospect theory, and investors with RS-shaped investors proposed by Markowitz [32,33]. They derive the limiting distributions of the test statistics to be stochastic processes, and propose a bootstrap method to decide the critical points of the tests and prove the consistency of the bootstrap tests. Leshno, Levy and others have developed ASD theory, but there do not seem to be any statistical tests for ASD. In order to bridge the gap, Guo, Levy, and Wong develop tests for ASD.

In addition to SD tests, several MR tests have been developed. For example, Leung and Wong (2008) develop a multivariate Sharpe ratio statistic to test the hypothesis of the equality of multiple Sharpe ratios, and derive the asymptotic distribution of the statistic and its properties. Results in optimal stopping theory have shown that a “bang-bang” (buy or sell immediately) style of trading strategy is, in some sense, optimal provided the asset’s price dynamics follow certain familiar stochastic processes.

Wong, Wright, Yam, and Yung [34] construct a reward-to-variability ratio (that is, the mixed Sharpe ratio) that is necessary for this strategy’s implementation. They apply the mixed Sharpe ratio to compare the performances of the “bang-bang” and “buy-and-hold” trading strategies, and find that the former is significantly more profitable. In order to circumvent the limitations of the tests for the coefficient of variation and Sharpe ratios, Bai, Wang, and Wong develop the mean-variance ratio (MVR) statistic for testing the equality of mean-variance ratios, and prove that their proposed statistic is the uniformly most powerful unbiased (UMPU) statistic.

Bai, Hui, Wong, and Zitikis develop a MVR statistic for comparing the performance of prospects after the effect of the background risk has been mitigated. They investigate the performance of the statistic in large and small samples, and show that, in the non-asymptotic framework, the MVR statistic produces a UMPU test. Bai, Phoon, Wang, and Wong provide evidence that the MVR test is superior to the Sharpe ratio (SR) test by applying both tests to analyze the performance of commodity trading advisors (CTAs).

Tests have also been developed in portfolio optimization. The traditional estimated return for Markowitz MV optimization has been demonstrated to depart seriously from its theoretical optimal return. Bai, Liu, and Wong prove that this phenomenon is natural, and that the estimated optimal return is always larger than its theoretical counterpart. Thereafter, they develop new bootstrap-corrected estimates for the optimal return and its asset allocation, and prove that these bootstrap-corrected estimates are proportionally consistent with their theoretical counterparts.

Bai, Liu, and Wong extend the work of Markowitz [35], Korkie and Turtle [36] and others by proving that the traditional estimate for the optimal return of self-financing portfolios always over-estimates its theoretical value. In order to circumvent the problem, they develop a bootstrap estimate for the optimal return of self-financing portfolios, and prove that this estimate is consistent with its counterpart parameter. Bai, Li, McAleer, and Wong extend the theory further by developing the spectrally-corrected estimates for Markowitz MV portfolio. They find that the spectrally-corrected estimates consistently outperform the traditional and bootstrap-corrected estimates.

Empirical Studies

Yet another suggestion is to apply statistical and econometric models to examine the relationships among the variables in some important issues in management science, economics, and finance. As there are several important applications of the theories developed in SD, MR, and PO theory, several are discussed below.

Broll, Wahl, and Wong [37] apply MV rules to analyze export production in the presence of exchange rate uncertainty, and present the elasticity of risk aversion. Broll, Wong, and Wu [38] apply both MV and SD rules to examine a banking firm investing in risky assets and hedging opportunities. Broll, Guo, Welzel, and Wong [39] analyze a bank's risk taking in a two-moment decision framework. They find that the bank's optimal behaviour to a change in the standard deviation or the expected value of the risky asset's or portfolio's return can be described in terms of risk aversion elasticities.

In terms of SD relationships, Gasbarro, Wong, and Zumwalt [40] find that SD test can identify dominant iShares, which are indistinguishable when using the Sharpe ratio. Lean, Smyth, and Wong [41] use the SD statistic test to test for the existence of day-of-the-week and January effects for several Asian markets, and find the existence of week day and monthly seasonality effects in some Asian markets, but first-order SD for the January effect has disappeared.

Wong, Phoon, and Lean apply the SD test to compare the performance of different Asian hedge funds, and find both first-order and higher-order SD relationships among the funds. Lean, Phoon, and Wong [42] use the SD test to rank the performance of commodity trading advisors (CTA) funds, and find both first-order and higher-order SD relationships among the CTA funds.

However, some studies have found that there is no dominance among the different markets. For example, based on West Texas Intermediate crude oil data for the sample period 1989-2008, Lean, McAleer, and Wong [43-45] apply both MV and SD tests and find that: (i) there is no arbitrage opportunity between these two markets; (ii) spot and futures do not dominate one another; (iii) investors are indifferent to investing spot or futures; and (iv) spot and futures oil markets are efficient and rational.

Chan, de Peretti, Qiao, and Wong [45-48] apply both SD and likelihood ratio tests to examine the efficiency of the UK covered warrants market. Their SD findings suggest that neither covered warrants nor the underlying shares stochastically dominate one other, and that the UK covered warrants market is efficient. Their LR test results show that the UK covered warrants returns efficiently reflect the returns information of the underlying shares.

One could use SD to examine the preferences of both risk averters and risk seekers. For example, Qiao, Clark, and Wong [49,50] apply SD tests for risk averters and risk seekers to examine investors' preferences with respect to the Taiwan stock index and its corresponding index futures. They find that spot prices dominate futures for risk averters, whereas futures dominate spot for risk seekers.

Qiao, Wong, and Fung [51-53] apply SD tests for risk averters and risk seekers to compare the performance of stock indices and their corresponding index futures for 6 developed countries and 4 developing countries. They find that there are no SD relationships between spot and futures markets in the mature market. However, for the emerging markets, spot dominates futures for risk averters and futures dominate spot for risk seekers in the second- and third-order SD. These results suggest that mature markets are more efficient, and there are potential gains in expected utilities for risk averters (seekers) if they switch their investment from futures (spot) to spot (futures) in emerging markets.

Lean, McAleer, and Wong [54] apply SD and other tests to examine risk-averse and risk-seeking investor preferences for oil spot and futures prices. Their SD results reveal that risk-averse investors prefer the spot index, whereas risk seekers are attracted to the futures index to maximize expected utility, though not their expected wealth for the entire period or for the sub-period (pre-GFC) before the 2008 Global Financial Crisis (GFC) and the sub-period during and after the GFC (GFC).

It is also possible to apply the SD test to examine the preference of risk averters, risk seekers, and investors with S-shaped and reverse S-shaped utility functions. For example, Fong, Lean, and Wong (2008) study the preferences of investors with S-shaped and reverse S-shaped utility functions for internet versus "old economy" stocks. Gasbarro, Wong, and Zumwalt [55] examine the preferences for investors with S-shaped and reverse S-shaped utility functions on iShares.

Clark, Qiao, and Wong [56] evaluate the preferences of risk averters, risk seekers, and investors with S-shaped and reverse S-shaped utility functions for the Taiwan spot and futures markets. They find that risk averters prefer spot to futures, whereas risk seekers prefer futures to spot. Moreover, investors with S-shaped utility functions prefer spot (futures) to futures (spot) when markets move upward (downward), and investors with reverse S-shaped utility functions prefer futures (spot) to spot (futures) when markets move upward (downward).

SD can also be used to example important issues and anomalies. For example, Abid, Leung, Mroua, and Wong [57] apply PO and SD test to examine preferences for international diversification *versus* domestic diversification in the U.S. market. Their PO results imply that the domestic diversification strategy dominates the international diversification strategy at a lower risk level, and the reverse is true at a higher risk level. The SD analysis shows that: (i) there is no arbitrage opportunity between international and domestic stock markets; (ii) domestically diversified portfolios with smaller risk dominate internationally diversified portfolios with larger risk and *vice versa*; and (iii) at the same risk level, there is no difference between the domestically and internationally diversified portfolios. They do not find any domestically diversified portfolios that stochastically dominate all internationally diversified portfolios, but find some internationally diversified portfolios with small risk that dominate all the domestically diversified portfolios.

Fong, Wong, and Lean [58-62] apply the SD test to examine the momentum effect in stock returns. They find that winner portfolios stochastically dominate loser portfolios at the second and third orders. Sriboonchitta, Wong, Dhompongsa, and Nguyen [63] find that risk losers prefer losers than winners. Fong, Lean and Wong, apply the SD test to find that risk averters and risk seekers show a distinct difference in preferences for internet versus "old economy" stocks. This difference is most evident during the bull market period (1998-2000) where internet stocks stochastically dominate old economy stocks for risk seekers but not for risk averters. In the bear market, risk averters show an increased preference for old economy stocks, while risk seekers show a reduced preference for Internet stocks. These results are not consistent with prospect theory, and indicate that investors exhibit reverse S-shaped utility functions [64-68].

Hoang, Wong, and Zhu [69] examine gold, stock, and bond markets in China and find that, in general, risk averters prefer portfolios without gold, while risk seekers prefer those with gold. Their findings confirm the safe haven characteristic of gold in the Chinese context. They also obtain a very interesting finding that risk-averse investors prefer portfolios from the efficient frontier, while risk seekers prefer the equally-weighted one.

Qiao and Wong [70] adopt SD tests to compare the yields of five property size classes in the Hong Kong residential property market. They find evidence that, in general, the yields of smaller property classes stochastically dominate the yields of bigger property classes in the second order, suggesting that risk averters will obtain higher expected utility but not higher expected wealth when buying smaller properties. In addition, Tsang, Wong, and Horowitz show that, regardless of whether the buyers are risk averse or risk seeking; they will not only achieve higher expected utility but also obtain higher expected wealth when buying smaller properties [71].

SD can also be used to study income inequality. For example, Chow, Lui, Valenzuela, and Wong apply SD tests to analyze relative welfare levels of income distributions for the poor and the rich of different groups of individuals. Bai, Valenzuela, Wong, and Zhu extend the theory by applying MSD and PSD to develop SD tests for the poor (test for poorness), the rich (test for richness), and for the middle class (test for middle class) to achieve a more robust analysis of relative welfare levels in the analysis of income distributions.

Concluding Remarks

In this paper, we discussed different types of utility functions, stochastic dominance, mean-risk models, and portfolio optimization as these topics are popular in Management Science, Economics, and Finance in terms of theory and econometric analysis. Authors could also extend their work to link the three disciplines. Although we have discussed the contributions in SD, MR, and PO related to management science, economics, and finance, there are theoretical contributions in other areas that could also be useful in these disciplines. Readers may refer to Chang, McAleer, and Wong for contributions in other areas that might be useful in management science, economics, and finance [72].

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