ABACUS A Journal of Accounting, Finance and Business Studies

ABACUS, Vol. 49, Supplement, 2013 doi: 10.1111/j.1467-6281.2012.00378.x

D. J. JOHNSTONE

The CAPM Debate and the Logic and Philosophy of Finance

Finance, and particularly financial decision making, has much in common with the discipline of statistics and statistical decision theory. Both fields involve conceptual models and related methods by which to make numerical assessments that are meant to assist users to draw inferences about future states and to make choices between possible actions. In both fields, inferences and decisions are reached by implementing quantitative methods, and in both fields those methods require either empirical or subjective inputs (e.g., sample estimates of relevant input parameters or human estimates of the same sorts of variables).[1]

This is not merely saying that finance theory makes use of statistical theory. That is incidental, as is the fact that statistics now adopts the language and ideas of finance in some of its important applications. Rather, the point is that the two disciplines are fundamentally analogous in their purposes and construction. They differ markedly, however, in their states of philosophical introspection, as is natural given that finance arose as a field only in the 1960s or later, and has therefore had much less time to mature and look back at itself and its development in a critical philosophical way.

A stark difference between the two fields is that in statistics there exists a formalized branch of enquiry called 'the logic, methodology and philosophy of statistical inference and decision theory', whereas in finance there is as yet no equivalent well-defined or orchestrated subfield. The philosophy of statistics is a highly developed discipline, built upon hundreds of papers and books, written by statisticians, logicians, philosophers of science and practitioners in applied fields (e.g., psychology, medicine, economics) since the early 1900s. All of the great names in statistical theory, including Karl Pearson, R. A. Fisher, Neyman, Savage, von Neumann and de Finetti, have contributed philosophically as well as technically to the field we know as statistics, and indeed virtually all of the empirical work that is done in finance today is licensed by one or other of these philosophers. Similarly, very influential modern statistical theorists such as Lindley, Kadane, Bernardo, Seidenfeld and Berger have contributed numerous papers and books to the big-picture philosophical issues in statistics.

By comparison, the philosophy, logic and methodology of finance are yet to expressly emerge, or to obtain the overarching respect and influence that such work

---

D. J. Johnstone (david.johnstone@sydney.edu.au) is a Professor of Finance in the University of Sydney Business School.

[1] For example, applications in finance of portfolio theory and the CAPM require an *ex ante* joint probability distribution of the future returns on all firms in the market. That distribution is usually estimated empirically but is in principle a subjective probability distribution.

has in statistics. This of itself is something for explanation from positivist and sociological perspectives. In the early years of finance, there was a great deal of such work published, but in later years the majority of published research in finance has been predominantly descriptive or empirical (data driven) rather than conceptual or philosophical. There are some obvious practical reasons for this, such as for example the modern availability of excellent unexplored data bases and fast inexpensive computing. More fundamentally, however, there has been a cultural shift away from critical philosophical analysis of financial logic and financial methods within finance.

As one simple example, early generations of students in finance spent much time trying to understand the NPV versus IRR debate, and the mathematical explanations of how these techniques can coincide or clash. Theoretical papers were written on this topic, not just in finance but also in economics and engineering. By comparison, current finance students are not asked to think about the logical foundations of DCF analysis, and are mostly unaware of the related debate and mathematical enquiry that once took centre stage. The most that a modern finance student can be expected to know of the issue is that undergraduate textbooks list some important problems of IRR and conclude that NPV does not have the same troubles, and that essentially the case is closed. Generally this superficial appreciation comes from pre-scripted lecture slides rather than from any individual research or thought on the issue. Most textbooks give no academic references to the related historical literature and no inkling of how subtle matters of interpretation of NPV and IRR can be.

Research students might once have discovered such issues for themselves, through curiosity and unstructured background reading, but the modern way of PhD research is much narrower and usually involves a substantial commitment of time and thought to learning statistical techniques, and how to implement them using different software packages, and to cleaning, merging and reconstructing large data files. There is obviously less time and appetite for philosophical critique, out of which potential research outcomes are no doubt less 'safe' than those from a well-conceived empirical investigation.

The NPV versus IRR issue is merely a good illustration of what kinds of things are not discussed much anymore in finance journals. The deepest logical dispute in the history of finance is almost equally little mentioned in current finance research programs. This dispute arose after Markowitz (1952, 1959) set down the theory of portfolio choice (decision making) under mean-variance, for which in 1990 he was awarded the Nobel Prize in Economic Sciences. Mean-variance led quickly to the capital asset pricing model (CAPM) and gave rise to an entirely new field in universities and in financial markets and the investment industry. Despite its immediate conceptual appeal and influence over practice, mean-variance attracted persistent philosophical critique from the established normative forces in economics and statistics, where expected utility theory was deeply rooted as the model of economically rational decision making. The eventual product of this conceptual divide was an unprecedented development in financial thinking, yielding fundamental mathematical and practical insights into how and under what conditions mean-variance (MV) and subjective expected utility (SEU) are mutually inconsistent or formally reconcilable.

There is no doubt that SEU and MV theories were both enhanced by this period of intense cross-scrutiny. Opinions are widely divided on whether expected utility is 'too normative' to be practical or mean-variance is too 'practical' to be respectable. The pragmatists' perspective is summed up by another economics Nobel Laureate, James Tobin (1969, p. 14), who suggested that a business practitioner will not be amused by the instruction that 'he should consult his utility and his subjective probabilities and then maximize'. Yet contrary to Tobin's mockery, there is intensive theoretical and empirical study in current finance research devoted explicitly to investment portfolio selection by optimization of certain expected utility functions, both directly and by their expression through higher moments (e.g., MacLean *et al.*, 2005; Cremers *et al.*, 2005; Sharpe, 2007; Adler and Kritzman, 2007; Hagstromer *et al.*, 2008).

A conciliatory note among the seminal contributors to the MV versus SEU literature was struck by Meyer (1987, p. 426). He saw that MV offered a way of re-expressing a subset of expected utility theory that not only simplified the notions of risk and return, but which also uncovered previously unstated relationships between the risks and returns of individual assets and their combinations in weighted portfolios. This gave rise to the new language of the 'efficient frontier' and ultimately the mean-variance CAPM. More fundamentally, it revealed interesting and often counterintuitive investment principles. In part, these have been transported back into SEU theory, and then generalized to suit different possible utility functions. Observe for example the development of capital asset pricing models under various families of utility functions apart from the usual quadratic utility (with which MV is commonly paired).

A highly admirable aspect of the MV versus expected utility SEU literature is that Markowitz himself became involved, along with renowned theorists such as Tobin, Feldstein, Fishburn, Levy and many of the other leaders in financial economics of the 1970s. Indeed Markowitz (1991) took the scholarly stance that SEU remains the hallmark of economic rationality, and that the question is therefore how it can be that MV coincides with SEU or adds to SEU as a theoretically respectable as well as practical tool.[2] Markowitz (2006) has in recent times proclaimed that it was in fact de Finetti (1940) who first invented mean-variance, which if so (cf. Rubinstein, 2006; Pressacco and Serafini, 2007; Barone, 2008) is more than a little ironic, since de Finetti is the most revered of all subjectivist Bayesian probability theorists, and is therefore a patron saint of the SEU school of decision theorists (many of whom still either reject or ignore MV).

Despite its scholarship and unquestionable theoretical merit, the MV versus SEU literature is now regrettably little discussed or even mentioned by finance students, and does not figure heavily in modern finance textbooks apart from the more highly theoretical works in financial economics (e.g., Mossin, 1973; Ingersol, 1987; Huang and Litzenberger, 1988; Cochrane, 2001; Barucci, 2003; Lengwiler, 2004; Pennacchi, 2008) that relatively few finance students, even PhD students, have cause to absorb.

2 'There is no inevitable connection between the validity of the expected utility maxim and the validity of portfolio analysis based on, say, expected return and variance' (Markowitz, 1959, p. 209).

To further illustrate this curious aspect of how finance as a field has largely retreated from its philosophical frontier, and to that extent has arguably let go an element of old-fashioned (you might say fogyish) scholarship and fascination, consider the following delightful yet forgotten counter-example against MV that became widely known to the post-1970s generation of financial economics theorists as the Borch paradox.

Borch (1969, 1974, 1978), pronounced 'Bork', was a Norwegian insurance theorist and economist who took an immediate theoretical dislike to MV:

> I shall continue to use mean-variance analysis in teaching, but I shall warn students that such analysis must not be taken seriously and applied in practice. (Borch, 1974, p. 430)

Borch's (1969) assault on MV goes as follows. Imagine that you feel indifferent between two assets with mean-variance parameters $(\mu_1, \sigma_1^2) = (10{,}225)$ and $(\mu_2, \sigma_2^2) = (20{,}625)$, which seems plausible enough. Now consider two comparable lottery tickets, ticket A and ticket B. Ticket A pays 25 with probability $p = 0.5$ and -5 with probability $(1 - p)$. Similarly, ticket B pays 45 with probability $p = 0.5$ and -5 with probability $(1 - p)$. The mean-variance parameters of these two lotteries are (10,225) and (20,625) respectively. Yet contrary to any thought that two assets with these parameters are indifferent, ticket B is obviously preferred because it has the same probability of winning as ticket A, and the same payoff if it loses, yet pays 45 instead of 25 when it wins. Borch used this apparent contradiction to prove as a general proposition that a decision maker cannot logically be indifferent between two investments by reference merely to their means and variances. The inner workings of Borch's paradox and its eventual resolution by Baron (1977) and others are pieced together by Johnstone and Lindley (2012).

The discussion above is intended to first support the claim that finance research can make for more interesting academic discourse if philosophical work is given renewed importance. The second point is to dwell on MV, from which the CAPM arises as essentially a mathematical corollary.

Borch (1979) was of course well aware of the CAPM, which he described in his usual entertaining way as having something like the status in finance circles of $E = mc^2$. He criticized the CAPM on the basis that it stands on an MV footing and is therefore open to the same 'nonsense results' as MV decision making generally (for another one of these 'nonsense' results, see Hanoch and Levy, 1969). Anticipating what has more recently become widely accepted, Borch (1979) noted that the CAPM did not perform well when fitted to actual market price data. This was his suspicion long before the CAPM came under the heavy empirical fire of Fama and French (1992) and various other important studies exhibiting small-firm and book-to-market effects.

The issue nearly 50 years after its invention is where finance stands on the CAPM. The papers published in this issue contain the unedited positions on the CAPM of well-known finance researchers. They are reactions to the main paper of Dempsey, who adopts a critical and therefore provocative standpoint. Consistent with the sentiments expressed above, it is my belief that the free and frank academic discussion provoked by Dempsey's paper is not only essential to a mature field but is also of great academic and communal enjoyment. Those who have provided comments on Dempsey's paper did so willingly and apparently with the thought that it would be worthwhile to put in print some ideas and opinions that are usually reserved for informal or unguarded tearoom conversations.

By chance, this issue of *Abacus* on the status of the CAPM coincides with the publication of a wonderful book on the same subject, written by one of the founders of the field. This book by Haim Levy (2012) titled *The Capital Asset Pricing Model in the 21st Century* covers much of the history and debate over the CAPM and its theoretical, empirical and practical validity. Readers will likely be interested in how the arguments advanced by Dempsey and others in this issue of *Abacus* compare with the position taken by Levy. There is in fact a great deal of reinforcement between Levy and some of the commentators. Levy's essential conclusion is that the CAPM stands, in his words, 'alive and well'. This is for philosophical reasons, including particularly that the CAPM is a model of *ex ante* decision making and hence does not need to be, and cannot be expected to be, mirrored neatly by historical data. Levy's faith in the CAPM is also for practical reasons, particularly for the close approximation with which it mimics *ex ante* optimal investment, and the returns thereof, over a wide class of utility functions.

I conclude this introduction to Dempsey and others on the topic of the CAPM in the twenty-first century with the spur that only when we openly discuss what is inadequate or questionable with our own theories can we lay claim to scientific 'objectivity'. Technical or empirical positions adopted routinely, untempered by philosophical scepticism or appreciation, can prove greatly inadequate, misleading and ultimately costly to users and to the scientific reputation of the field, even when used for strictly practical purposes (such as choosing investments).

Finance as a field embodies more than sufficient theoretical substance to warrant its own subfield in philosophy—the logic and philosophy of finance. By nature, philosophical critique is normative, so any aversion in principle to normative research needs to be overcome. I began this introduction with the claim that finance and statistics are like twins. Note, however, that published research in statistics is predominantly normative (e.g., Bayes versus non-Bayes, etc.) whereas most finance research is largely empirical. If we look more closely, however, empirical finance, which is sometimes championed as 'positive' and 'anti-normative', is replete with normative discussion about matters such as how to construct an experiment or a statistical test, or how to define a key measure such as the cost of capital. There should therefore be no in-principle resistance to the reinvigoration of normative or philosophical thought concerning finance theory proper.

REFERENCES

Adler, T., and M. Kritzman, 'Mean-Variance Versus Full-Scale Optimization: In and Out of Sample', *Journal of Asset Management*, Vol. 7, No. 5, 2007.

Baron, D. P., 'On the Utility Theoretic Foundations of Mean-Variance Analysis', *Journal of Finance*, Vol. 32, No. 5, 1977.

Barone, L., 'Bruno de Finetti and the Case of the Critical Line's Last Segment', *Insurance: Mathematics and Economics*, Vol. 42, No. 1, 2008.

Barucci, E., *Financial Markets Theory: Equilibrium, Efficiency and Information*, Springer, 2003.

Borch, K., 'A Note on Uncertainty and Indifference Curves', *Review of Economic Studies*, Vol. 36, No. 1, 1969.

——, 'The Rationale of the Mean-Standard Deviation Analysis: Comment', *American Economic Review*, Vol. 64, No. 3, 1974.

——, 'Portfolio Theory is for Risk Lovers', *Journal of Banking and Finance*, Vol. 2, No. 2, 1978.

——, 'Equilibrium in Capital Markets', *Economics Letters*, Vol. 2, No. 2, 1979.

Cochrane, J., *Asset Pricing*, Princeton University Press, 2001.

Cremers, J. H., M. Kritzman and S. Page, 'Optimal Hedge Fund Allocations', *Journal of Portfolio Management*, Vol. 31, No. 3, 2005.

de Finetti, B., 'Il Problema dei "pieni" ', *Giornale dell'Instituto Italiano degli Attuari*, Vol. 11, 1940. English translation by Luca Barone in *Journal of Investment Management*, Vol. 4, No. 3, 2006.

Fama, E. F., and K. R. French, 'The Cross-Section of Expected Stock Returns', *Journal of Finance*, Vol. 47, No. 2, 1992.

Hagstromer, B., R. G. Anderson, J. M. Binner, T. Elger and B. Nilsson, 'Mean-Variance Versus Full-Scale Optimization: Broad Evidence for the UK', *The Manchester School*, Vol. 76, Supplement, 2008.

Hanoch, G., and H. Levy, 'The Efficiency Analysis of Choices Involving Risk', *Review of Economic Studies*, Vol. 36, No. 3, 1969.

Huang, C.-F., and R. H. Litzenberger, *Foundations for Financial Economics*, Prentice Hall, 1988.

Ingersoll, J. E., *Theory of Financial Decision Making*, Roman and Littlefield, 1987.

Johnstone, D. J., and D. V. Lindley, 'Mean-Variance and Expected Utility: The Borch Paradox', *Statistical Science*. In press.

Lengwiler, Y., *Microfoundations of Financial Economics: An Introduction to General Equilibrium Asset Pricing*, Princeton University Press, 2004.

Levy, H., *The Capital Asset Pricing Model in the 21st Century: Analytical, Empirical, and Behavioral Perspectives*, Cambridge University Press, 2012.

MacLean, L., W. T. Ziemba and Y. Li, 'Time to Wealth Goals in Capital Accumulation and the Optimal Trade-off of Growth Versus Security', *Quantitative Finance*, Vol. 5, No. 4, 2005.

Markowitz, H. M., 'Portfolio Selection', *Journal of Finance*, Vol. 7, No. 1, 1952.

——, *Portfolio Selection: Efficient Diversification of Investments*, John Wiley, 1959.

——, 'Foundations of Portfolio Theory', *Journal of Finance*, Vol. 46, No. 2, 1991.

——, 'de Finetti Scoops Markowitz', *Journal of Investment Management*, Vol. 4, No. 3, 2006.

Meyer, J., 'Two-Moment Decision Models and Expected Utility', *American Economic Review*, Vol. 77, No. 3, 1987.

Mossin, J., *Theory of Financial Markets*, Prentice Hall, 1973.

Pennacchi, G., *Theory of Asset Pricing*, Pearson, 2008.

Pressacco, F., and P. Serafini, 'The Origins of the Mean-Variance Approach in Finance: Revisiting de Finetti 65 Years Later', *Journal of Decisions in Economics and Finance*, Vol. 30, No. 1, 2007.

Rubinstein, M., 'Bruno de Finetti and Mean-Variance Portfolio Selection', *Journal of Investment Management*, Vol. 4, No. 3, 2006.

Sharpe, W. F., 'Expected Utility Asset Allocation', *Financial Analysts Journal*, Vol. 63, No. 5, 2007.

Tobin, J., 'Comment on Borch and Feldstein', *Review of Economic Studies*, Vol. 36, No. 1, 1969.