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Research paper

Pareto lévy in Islamic stock markets: a research agenda for Islamic finance

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Abstract

This research note suggests an alternative approach to study the characteristics of Islamic financial markets in ways allowing one to observe the actual characteristics of the market and to model its characteristics analytically while avoiding incorrect postulations especially during high market volatility. It unfolds the non-Gaussian truth when managing Islamic portfolios to pave ways for prudent portfolio approaches. We present this approach using mathematical illustrations and specific structures in physics to reinforce new orientation and strategy in Islamic equities management. Our observation suggests that future investigations should consider anomalous volatilities in modeling the financial markets for enhanced portfolio management.

Keywords: *Islamic Finance; Pareto Lévy; Portfolio; Risk; Statistical Physics.*

1. Introduction

How Islamic Financial Institutions were able to outperform their conventional competitors in liquidity and credit risk management during the 2007 and 2008 financial crisis have prompted several research questions that spurred interests to investigate this phenomenon among researchers and academicians around the world (Archer and Karim, 2006; Hassan and Mahlknecht, 2011; Smolo and Mirakhor, 2010; Williams and Nguyen, 2005). This phenomenon was an exceptional experience to the financial industry since it challenged the norms historically and theoretically about how financial management should evolve from grounded sciences to management and practical empiricisms (Feyerabend, 1999, p. 11). This approach requires one to consider the evolution of financial economics as a scientific field with its particular tools, assumptions, concepts and fundamentals that have been recently extended through the advent of what is nowadays named "econophysics" (Schinckus, 2016, Jovanovic and Schinckus, 2017). Roughly speaking, this new area of knowledge can be defined as the application of statistical physics to finance and economics.

Working to resolve financial crises queries in silo without considering other paradigms of knowledge and sciences will lead to inaccurately less precise solutions and preventive measures to curb future financial downturns (Bailer-Jones, 2009; Chaturvedi, 2010; Knuuttila, 2011 and Levy, Levy and Solomon, 2000, p.184). This research note provides a conceptual justification for the use of Pareto Lévy framework in Islamic Finance and it offers a research agenda for such application. With this purpose, we focus on investigating the patterns and volatility during economic shocks (known as financial sunspots) using the concepts developed in econophysics. This is because financial sunspots characterizing the unique financial shocks found during crises have been observed to resemble the Pareto Lévy distribution, one of the fundamental concepts in econophysics (Jovanovic and Schinckus, 2013). This research agenda paves the way for a future investigation in Islamic Finance and more precisely regarding Islamic fund management since it suggests alternative methods in the portfolio diversification strategies.

2. Background of the study

The mainstream findings and discussions in the field of Islamic finance were mostly on the benefits of riba (interest or usury) avoidance to curb greed among economic agents engaged in Islamic financial contracts. Apart from riba, Islam prohibits mysr (uncertainty) and gharar (speculation). This is because gharar or mysr may lead to unnecessary losses arising from additional risks due to greed and/or financial speculation. This type of risk can be avoided if both gharar and mysr elements are minimized.

One way of minimizing the volatility or market risk is to have greater accuracy in market predictions and financial forecasting (Rees, 2008, pp. 169-172). Alternatively, this approach can be performed with the concept of econometrics. However, the fundamentals of econometrics are derived from experimental finance and computational mathematics (Levy, Levy and Solomon, 2000, p.16). Acknowledging the limitation of traditional econometric approaches, several authors worked on what is now labeled 'econophysics' in the literature. The field of econophysics has long been in existence before modern finance created its first history in 1940 by scientists like Fischer Black, Stewart Myers, John Cox, as well as Nobel Laureates Paul Samuelson, Robert Merton, Myron Scholes, and Franco Modigliani more specifically in financial market analyses (Jovanovic and Schinckus (2013, p.8). To our knowledge, there is no empirical work nor

findings on Islamic financial market relating to Pareto Lévy (we define this framework in the following section). Hence, with reference to this objective, this paper is to explore the possibility and suggest a research agenda for the Lévy concept in Islamic financial market. One might raise an interesting question about the Lévy characteristics which could potentially be found in Islamic financial market although Shari'ah compliant funds are less volatile and more conservative compared to the interest-based financial markets funds management. This is supported by the notion that Shari'ah practices enhance prudent investments with higher conservatism in Islamic investment management. The level of conservatism can be observed in the processes of investment screenings and proper asset selection by fund managers accountable in managing Islamic portfolios. It is undeniable that even with prudent approaches and general assumptions in financial modeling with classical concepts of the Gaussian law in financial markets, would still be insufficient to improve notably financial market predictions and portfolio management especially in times of financial shocks. Those who believe in pure Gaussian concepts are constantly avoiding extreme volatilities in equities (i.e. common stocks) (Levy, Levy and Solomon, 2000).

Nevertheless, a more robust risk management should consider these volatilities in financial portfolios. In addition to capturing the potential Lévy characteristics in Islamic financial markets during financial crises, the aim of this research is to provide empirical findings to enlighten the industry practitioners and Islamic fund managers on the existence of volatility shocks during financial crisis. These shocks have adverse impacts on Shari'ah investment portfolios. Therefore, it should not be ignored as opposed to classical Gaussian approximation assumptions made by economists on financial markets. It suggests a more solid mathematical illustration using particular structures in physics to reinforce new orientation and strategy in Islamic equities management. It also aims to unfold the non-Gaussian truth when managing Islamic portfolios.

3. Portfolio management and financial mathematics

A Retrospective Harmonization between the Two Sciences.

The applications of concepts coming from physics in the studies of economics are numerous. This approach has echoed its way through literatures till date although many researchers of these two fields are still debating about the independence between these concepts. Besides differing methodologies, tools and concepts employed by the researchers of these two fields are different and even the way they define a phenomenon, or an event is different.

Despite these differences, economists and physicists also have common perception of financial markets and they generally agree on the necessity to deal with a more volatile modeling to describe their dynamics. Since the 1960s, economists, mathematicians and physicists worked to extend the technical tools used in finance. Harrison and Kreps (1979) through their modern probability theory gave further opportunity to financial economist such as Fama and Merton (1972) and Engle (1982) to pursue their interest in financial market studies with reference to modern mathematics with modified domains in economic concepts. The evolution was initiated by the well-known random-walk hypothesis formed to define the variations in the stock market (Fama, 1963) which was motivated by the concepts of mathematics and modern probability theory founded by the American probability school in 1960s. The research continued with more findings of random walks explained in alternative ways under the Martingale process (Fama, 1963, Markowitz, 1952 and Roy, 1952). These methods gained fame only after more studies were published in this field.

In line with these works extending mathematics and physics to finance, this research note explores the possibility of a new paradigm in Islamic portfolio and risk management by applying Pareto-Lévy processes in Islamic Finance. Jovanovic and Schinckus (2017) explained this possibility with demonstrations capturing intraday prices to substitute monthly prices for a clearer Pareto distribution.

3.1. Theoretical foundations of the stable lévy processes

The article by Bradley and Taqqu (2003) presented empirical tests on the characteristics of the NASDAQ composite index and obtained statistical findings which refuted the assumptions of the normal Gaussian. Their findings have led to more prominent works in this field for example, by De Vries (2005), Dimakos and Aas (2004), Rosenberg and Schuermann (2006), Scherer and Martin (2005) who were among the others with findings that favour the heavy-tailed characteristics in financial returns and market variables. These stylized facts are particularly well-known in classical finance. Generally, a heavy-tailed distribution is defined as the possibility for significant deviations from the mean than Gaussian distributions (Bradley and Taqqu, 2003, p. 10).

Basically, stable Lévy processes are presented as a generalization of the Gaussian framework due to a statistical property called stability. This statistical stability implies that the statistical characteristics do not change with the time horizon Such characteristics suggests that a statistical analysis of annual data can also be applied to another time horizon. Lévy's stable processes are independent and stationary dynamics exhibiting a α-stable law of type $P(X > x) = x^{-\alpha}$ in which there is a constant parameter α (between 0 and 2). These laws can be visually illustrated as followed:

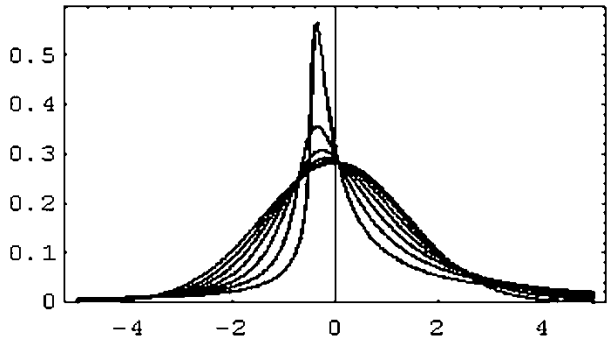

Fig. 1: Heavy-Tailed Distributions of the Financial Market Returns.

Source: Graphical illustrations adopted and combined from Mantegna and Stanley (2007, p. 69).

Figure 1 shows that Gaussian distribution (α = 2) is a specific case of stable Lévy processes. Basically, the parameter α refers to the leptokurtosis of the distribution and it also describes the statistical stability. The lower this exponent is, the fatter the tail is (i.e. extreme

events then have a higher probability of occurring). Different values of this parameter refer to different well-known statistical distributions: $\alpha = 3/2$ it is a Pareto distribution while $\alpha = 1$ it is a Cauchy distribution; $\alpha = 2$ refers to a Gaussian distribution.

It is worth mentioning that this statistical parameter is important since the p^{th} moment exists if and only if $p < \alpha$ (Nolan, 2005). Lévy processes with $\alpha > 2$, are said to be non-stable (meaning that their statistical characteristics can change with the time horizon). Interestingly, these statistical characteristics might potentially be interesting in Islamic fund management. The following section will provide a fist discussion about the potential application of the Pareto-Lévy framework in Islamic Finance.

4. Research agenda for Islamic finance

Despite the theoretical assumptions of classical finance, Mandelbrot (1963) made an audacious statement that the financial stock market is not following the Gaussian distribution which has been claimed by many researchers from the field of finance and economics (Hasbourck, 2007). Later, Mandelbrot presented his empirical findings in 1963 that the relative change in the stock prices resembles the 'peaked' non-normal distribution and these empirical studies generated an important literature (see Jovanovic and Schinckus, 2017 for further information on this aspect). The reality is that these findings were made on stocks of companies investing in possibly non-Shari'ah compliant assets. This begs the question about how judicious Islamic financial institutions are managing their Shari'ah compliant investments. Although there is no doubt for the existence of prudent measures in investment portfolio management within these institutions. Although markets might be assumed to be relatively quiet, the market volatility should not be ignored for a better financial forecast to have further risk reduction of a prudent investment portfolio.

The idea of this research note is to outline a way to enlighten Islamic financial market analysts on the existence of volatility that could affect investment decisions and diversification strategies by the Shari'ah portfolio managers. This research note aims at sketching a research agenda for a future implementation of Pareto-Lévy in Islamic Finance. Here are the objectives and hypotheses of this research:

1) To determine the distribution of the Shari'ah compliant stocks listed within the Shari'ah EMAS list between 1990 2018. This objective will be implemented by assuming that distribution of the Islamic financial stocks follow a normal Gaussian distribution implying that there isn't diffusion in the distribution of the Islamic equity returns and shocks do not exist in Shari'ah compliant funds - and if there are shocks, the shocks should be eliminated and focus should only be given to equities complying with the Gaussian law.
2) In the case data do not exhibit a clear Gaussian distribution, an alternative method based on a Lavalette law (Zipf law) whose probability density function can be analytically derived. As Jovanovic and Schinckus (2017) explained, the identification of a Levy process might sometimes be tricky due to the absence of statistical tests. This pitfall can be solved by using a statistical method based on a 2 and 3 parameter free Lavalette law (Ausloos, 2014).
3) The third objective is to explore the possibilities of a Lév-Pareto based method for Islamic Equity risk management for portfolio of Shari'ah compliant. This objective will be studied through the lens of the long-term properties that a stable Lév framework offers. If the Shari'ah EMAS stocks exhibit Gaussian distribution, this Gaussian law can be presented as a specific case of the stable Levy framework (Schinckus, 2013) from which a long-memory analysis can be applied. A long-term perspective makes sense for Shari'ah compliant stocks since these funds usually promote a real and long-term implication of investment in real economy.

Intraday indices from the Shari'ah EMAS list of compliant securities from Thomson Reuters' DataStream will be sampled. These indices will be adjusted to remove the dividend announcement effects. Data cleaning, filtration and preparation will be performed to eliminate incomplete or missing data series. Statistical presentation of data, data analysis, Gaussian law tests data preparation and Lévy process tests involving Lavalette law-based tests. In case of the identification of Stable Lév processes; a treatment of infinite variance will be implemented. Precisely, a gradually decaying truncation method will be applied in such potential case.

Volatility charts and distribution graphs will be generated for patterns observation in order to determine the further Pareto analysis. To do this, the research proposes the use of a statistical software known as SAS. SAS is a software that provides analytics with business intelligence and data management. It is a useful tool for state-of-art statistical analyses. Then, the filtered data series and the new sets of empirical data will be analyzed by referring to the concept of modern probability theory pioneered by Harrison and Kreps (1979) and Harrison and Pliska (1981). This process also considers the evolved probability theory by Von Plato (1994). Von Plato (1994) proposed a set of customized algorithms using SAS for the Pareto tests. These algorithms are designed in connection with concepts of the new branch of financial mathematics.

5. Contribution and conclusion

A proposed method using the modern probability theory in Islamic equity management is suggested. This approach has not been discussed or documented clearly in the literature alike. It is not in the knowledge of the researcher this far that there is any likened methodology or work. The contribution of the current findings will enlighten both academicians and industrial practitioners who are accustomed to traditional ways in portfolio management. This particular combination of tools will help the project to explore the relevance of the Lévy framework in Islamic Finance context.

The Islamic stock market like its conventional counterpart (interest transacting institutions) would share similar equity price distribution. This could lead to the need for the Shari'ah complying (assumed to be more conservative) approach to fund management in a way proposed by this research. It is nevertheless the fiduciary role of the Islamic asset manager to invest in profitable assets with long run strategy avoiding excessive risk taking to prevent unwanted portfolio losses for their shareholders. This research note suggests a way to explore potential alternative practices or policies of an Islamic financial institution.

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References

[1] Ausloos, M. (2014), Toward fits to scaling-like data, but with inflection points & generalized Lavalette function, Journal of Applied Quantitative Methods, 9, 2014) 1-21

[2] Bachelier, L. (1900). *Théorie de la spéculation*. Gauthier-Villars. https://doi.org/10.24033/asens.476.

[3] Bradley, B. O., & Taqqu, M. S. (2003). Financial risk and heavy tails. *Handbook of Heavy-Tailed Distributions in Finance, ST Rachev, ed. Elsevier, Amsterdam*, 35-103. https://doi.org/10.1016/B978-044450896-6.50004-2.

[4] De Vries, C. G. (2005). The simple economics of bank fragility. *Journal of banking & finance*, *29*(4), 803-825. https://doi.org/10.1016/j.jbankfin.2004.08.003.

[5] Dimakos, X. K., & Aas, K. (2004). Integrated risk modelling. *Statistical modelling*, *4*(4), 265-277. https://doi.org/10.1191/1471082X04st079oa.

[6] Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica: Journal of the Econometric Society*, 987-1007. https://doi.org/10.2307/1912773.

[7] Fama, E. F. (1963). Mandelbrot and the stable Paretian hypothesis. *The journal of business*, *36*(4), 420-429. https://doi.org/10.1086/294633.

[8] Fama, E. F., & Miller, M. H. (1972). *The theory of finance*. Holt Rinehart & Winston.

[9] Harrison, J. M., & Kreps, D. M. (1979). Martingales and arbitrage in multiperiod securities markets. *Journal of Economic theory*, *20*(3), 381-408. https://doi.org/10.1016/0022-0531(79)90043-7.

[10] Harrison, J. M., & Pliska, S. R. (1981). Martingales and stochastic integrals in the theory of continuous trading. *Stochastic processes and their applications*, *11*(3), 215-260. https://doi.org/10.1016/0304-4149(81)90026-0.

[11] Hasbrouck, J. (2007). *Empirical market microstructure* (Vol. 250). New York: Oxford University Press.

[12] Hassan, K., & Mahlknecht, M. (2011). *Islamic capital markets: products and strategies* (Vol. 609). John Wiley & Sons. https://doi.org/10.1002/9781119206040.

[13] Jovanovic, F. (2008). The construction of the canonical history of financial economics. *History of Political Economy*, *40*(2), 213. https://doi.org/10.1215/00182702-2008-001.

[14] Jovanovic, F. (2010). Efficient markets theory: Historical perspectives. *Encyclopedia of quantitative finance*. https://doi.org/10.1002/9780470061602.eqf01031.

[15] Jovanovic, F., & Schinckus, C. (2013). Econophysics: a new challenge for financial economics? *Journal of the History of Economic Thought*, *35*(03), 319-352. https://doi.org/10.1017/S1053837213000205.

[16] Jovanovic, F., & Schinckus, C. (2017). Econophysics and Financial Economics: An Emerging Dialogue. *OUP Catalogue*. https://doi.org/10.1093/acprof:oso/9780190205034.001.0001.

[17] Levy, H., Levy, M., & Solomon, S. (2000). *Microscopic simulation of financial markets: from investor behavior to market phenomena*. Academic Press. https://doi.org/10.1016/B978-012445890-1.50006-6.

[18] Mandelbrot, B. (1963). New methods in statistical economics. *Journal of political economy*, *71*(5), 421-440. https://doi.org/10.1086/258792.

[19] Mantegna, R. N., & Stanley, H. E. (2007). Introduction to Econophysics. *Introduction to Econophysics, by Rosario N. Mantegna, H. Eugene Stanley, Cambridge, UK: Cambridge University Press, 2007*.

[20] Markowitz, H. (1952). Portfolio selection. *The journal of finance*, *7*(1), 77-91. https://doi.org/10.1111/j.1540-6261.1952.tb01525.x.

[21] Resnick, S. I. (2007). *Heavy-tail phenomena: probabilistic and statistical modeling*. Springer Science & Business Media.

[22] Rosenberg, J. V., & Schuermann, T. (2006). A general approach to integrated risk management with skewed, fat-tailed risks. *Journal of Financial economics*, *79*(3), 569-614. https://doi.org/10.1016/j.jfineco.2005.03.001.

[23] Roy, A.D. (1952). Safety First and Holding the Assets. *Econometrica* 20(3), 431-449. https://doi.org/10.2307/1907413.

[24] Scherer, B., & Martin, R. D. (2005). *Modern Portfolio Optimization with NuOPT™, S-PLUS®, and S+ Bayes™*. Springer Science & Business Media. https://doi.org/10.1007/978-0-387-27586-4.

[25] Schinckus, C. (2009). La finance comportementale ou le développement d'un nouveau paradigme. *Revue d'Histoire des Sciences Humaines*, (1), 101-127. https://doi.org/10.3917/rhsh.020.0101.

[26] Schinckus, C. (2013), "How do Econophysicists make stable Levy Processes physically plausible", Brazilian Journal of Physics, vol 43(4), 281-293. https://doi.org/10.1007/s13538-013-0142-1.

[27] Schinckus, C. (2016), "1996-2016: Two decades of econophysics: Between methodological diversification and conceptual coherence" (on invitation), Special Topics issue 'Discussion & Debate: Can economics be a physical science? The European Physical Journal (Q2), Vol. 225, p 3299–3311. https://doi.org/10.1140/epjst/e2016-60099-y.

[28] Smolo, E., & Mirakhor, A. (2010). The global financial crisis and its implications for the Islamic financial industry. *International Journal of Islamic and Middle Eastern Finance and Management*, *3*(4), 372-385. https://doi.org/10.1108/17538391011093306.

[29] Von Plato, J. (1994). *Creating modern probability: Its mathematics, physics and philosophy in historical perspective*. Cambridge University Press. https://doi.org/10.1017/CBO9780511609107.