

Stochastic Dominance and Portfolio Selection of Quoted Nigerian Conglomerates: A Behavioural Finance Approach

Oghenero Godday Oboro, Ph.D1, Enaikpobomene Mina Irejeh, Ph.D.2, Solomon Onyeogo, MSc. 3

1Lecturer, Department of Banking and Finance, Delta State University of Science and Technology, Ozoro, Delta State, Nigeria

oborogo@dsust.edu.ng

Orcid Id: <https://orcid.org/0009-0008-1366-6481>

2Lecturer, Department of Banking and Finance, Nigeria Maritime University, Okerenkoko, Delta State, Nigeria
irejehmina@gmail.com

3Lecturer, Department of Banking and Finance, Delta State Polytechnic Ogwaishi-Uku, Delta State, Nigeria
ulogwa@gmail.com

ABSTRACT: *This paper examined the relevance of stochastic dominance to the selection of six conglomerates' portfolios from 2012 to 2021. The study extended the Markowitz mean-variance (MMV) approach. The estimation technique considered is 1st, 2nd, and 3rd order stochastic dominance. The study evidenced that two conglomerate stocks were first-order dominant, while four were second-order dominant and five were third-order dominant. The study concludes that, while stochastic dominance-STOD is useful for determining asset dominance, it does not accurately represent investors' risk preference behavior, unlike the MMV approach. Hence, investors should consider both stochastic dominance approaches. This study was able to contribute to the existing knowledge as it conducted an empirical investigation on the relevance of stochastic dominance techniques on portfolio selection in the Nigerian context, thereby increasing investors' knowledge on the subject matter. Unlike previous studies, the current study was able to state how different types of investors can harmonize the assertions of both stochastic dominance techniques with those of the stochastic dominance technique on portfolio selection.*

Keywords: Stochastic Dominance; Portfolio Selection; Nigerian Exchange Group

1. INTRODUCTION

When it comes to the language of finance, one of the most well-known axioms is that the more the returns increase, the more the risk increases and vice versa. This axiom may be both comforting and unsettling. This assumption is based on the Markowitz method of selecting securities, which takes mean and variance into account. However, the mean and variance method of risk analysis has become less sophisticated over the course of time since it does not show the conditions under which one financial asset may dominate another (Kinnunen, 2018). Justifiably, it fails to highlight the circumstances under which one financial asset could dominate another. Osamwonyi (2022) emphasized that the stochastic dominance approach to risk pricing and asset selection, which is often employed in decision-making to compare and rank two (2) stochastic distributions, is preferred over the mean-variance method for risk pricing and asset selection. According to Kinnunen (2018), stochastic dominance-STOD is defined as the preference for one asset's utility over another when only a limited amount of information about the decision maker's utility function is available.

In light of the disadvantages linked with the MMV approach to portfolio (security) selections, the 1st, 2nd, and 3rd order dominances are used in the process of selecting the securities that will go into a portfolio basket. To put it another way, the first-order stochastic dominance (FOSD) emphasizes that every investor is not yet saturated.. Specifically, the SOSD places an emphasis on a connection that is more dangerous and emphasizes a preference order that is generally accepted by all rational investors who favor more to less and who are risk averse (Kinnunen, 2018). In addition to this, the 3rd order dominance (TOSD) emphasizes that investors who favour positive skewness will attach a bigger weight to upside potential and will retain a less diversified portfolio that has significant upside potential.

The preceding points make clear that it is impossible to place an adequate value on the use of STOD in the process of selecting investments for a portfolio, even in the presence of risk and unpredictability. Kinnunen (2018) contends that it is paramount to build stochastically dominant stock and portfolio combinations since a stochastically dominant portfolio inherently indicates better returns without higher risk, lower risk without lower returns, or both has high risk and returns concurrently. According to Kinnunen (2018), a data set (say Security A) will always dominate the other if a variable is higher than the other (Say Security B). Nevertheless, the primary reason for worry that prompted this investigation was the question of whether or not stochastic dominance applies to investors make more profits rather than avoid a loss alongside other types of investors.

There have not been many empirical studies done on the topic in the Nigerian environment, which is another thing that's giving people cause for worry. It is evident that Qiao, Wong, and Clark (2016) & Kinnunen (2018) are domiciled in other nations because

of their stochastically dominant financial assets (portfolios); however, it is not the case of other emerging countries. Even though the studies were carried out in a Nigerian setting, their primary emphasis was on the Nigerian insurance sector, and their scope was limited to the year 2020. Meanwhile, the current research is concentrated on conglomerates because of the diverse character of their portfolios. As a direct result of the aforementioned deficiencies, the purpose of this research is to particularly investigate the applicability of the STOD on portfolio selection. This research will act as a guide for stock brokers on how and when to investors in the stock market. Also, it will assist investors in enhancing their investment choices regardless of the level of risk they are willing to take. Lastly, it will provide scholars and academics with resource material that can be used in further research endeavors.

2. Literature Review

2.1. Conceptual Clarification

2.1.1. Stochastic Dominance-STOD

When referring to random variables, the concept of STOD may be in partial order. Therefore, it may be thought of as a type of stochastic ordering. The idea originates in decision theory and decision analysis gamble may be evaluated as superior to another. It is based on preferences that are held in common for sets of probable outcomes and the probability that is linked to them. To determine who is dominant, all that is necessary is a basic understanding of their preferences. Only the second degree of dominance has a role for risk aversion as a factor (Osamwonyi, 2022). In addition, STOD does not provide a complete order but rather only a partial one since different decision-makers have different opinions that are equally appealing. Historically, STOD is traced to Blackwell (1953), despite the fact that it was not invented until 1969–1970.

This approach stressed that is investors generally has a low tolerance for risk (Osamwonyi, 2022). Fong et al. (2004) classified STOD into the First-order (FOSD), second-order (SOSD) and third-order dominance (TOSD). The FOSD is presupposes non-satiation (Fong et al. 2004). This makes it the most straightforward of the three. For example, Kinnunen (2018) suggests that we let F and G represent the cumulative distributions of two hazardous assets such as shares and bonds, x represent an uncertain return, and U represent a utility function. In addition, if a variable is random such variable is said to have recorded FOSD another random. The basic rule here is that security X cannot dominant security Y if security X is lower than security Y . By implication, all rationale investors always desire to growth their utility (satisfaction) function. As such, they will always desire to choose a security that is higher than the one that is lower (Kinnunen, 2018).

Furthermore, the Second-order STOD relates to a connection that is stochastically more dangerous and is most preferred as rational agents that avoid high risk (Kinnunen, 2018). According to Kinnunen (2018), a random variable X is said to second-order dominates another random variable- Y . This posits that 1st-order dominance which is a requirement for 2nd-order dominance is a precondition.

According to Kinnunen (2018), this order of dominance contributes to risk aversion. Therefore, investors who favor positive skewness will attribute a bigger weight and will keep a portfolio that is less diversified but has a large potential for upside. Osamwonyi (2022) asserts that STOD is significant in optimum portfolio selections various choices that have been pre-specified and are limited. When traditional economic theory is unable to provide a reliable prediction about the preferences of decision-makers and the distribution of the available options, this method might be used as an alternative. The author makes the observation that STOD is useful in situations when there are large data sets of high quality that are accessible to restrict sampling error & make it possible to use non-parametric methods. In a similar vein, when it is not possible to determine how a portfolio's returns are distributed, STOD emerges as a useful and accessible tool.

The conclusion that can be drawn from the information presented so far is that STOD is a genuine instrument used by individuals who are both risk averse and risk seekers to choose the optimum portfolio.

2.2. Theoretical Foundations

The STOD hypothesis of risk takers and risk avoiders serves as the foundation for our investigation. Kahnemann and Tversky (1979) stressed that the majority of investors place a higher value on taking risks than they do on maximizing profits (Fong et al. 2004). Consequently, this theory proposes that rational agents are able to optimize anticipated utility (Akan, Ighosewe, & Temile, 2021), with the exception of situations in which the utility functions exhibit unusual features (such as greater risk for higher returns and lower risk level, in which case rational agents are unable to maximize expected satisfaction level.

2.3. Empirical Review

Eburajolo and Ogbeide (2021) evaluated the effect of STOD on portfolio selection in the Nigerian stock market. To investigate the possibility of STOD occurring, the daily stock prices in December for ten (10) different listed insurance companies between the years 2014 and 2020 were chosen and analyzed. According to the results, the choice of company stock was made according to the MMV and risk preferred. It also demonstrates that during the time following the stock market crash in Nigeria, two (2) firm stocks were FOSD, four (4) firm stocks were SOSD, and nine (9) firm stocks were TSD.

Kinnunen (2018) conducted research to evaluate the efficacy of a STOD-based portfolio selection model in the Nordic stock market. The research made use of eight years' worth of daily return data from the Nordic stock market. They affirmed that returns on optimized portfolios are greater while risk is lower when compared to the index.

Lean, Wong, and Wing-Keung (2016) investigated the dominance links between the spot and futures markets in Hong Kong using SD. Also, they evaluate the options available to risk avoiders, risk takers, prospective investors, and mean-variance investors in both the spot & futures markets. The study confirmed that risk averse investors prefer spot investments over futures investments.

Qiao, Wong, and Clark (2016) use STOD tests to investigate investors' preferences for the Taiwan stock index and the index futures that correlate to it. They discovered that spot prices are more important to risk-averse investors than futures prices.

3. METHODOLOGY

The descriptive research design was chosen to carry out this investigation as the appropriate method of inquiry to use. The six mentioned conglomerates in Nigeria on December 31, 2021, make up the research's population. The data used to calculate the average stock price (ASP) came from the annual reports of the six mentioned conglomerates and covered the period from 2012 to 2021, resulting in a total of one hundred observations. The periods were selected to evaluate how the sampled firms were dominant even after the market meltdown of 2007 & 2008 (Orjinta & Ighosewe, 2022). The stock returns were calculated by adding the previous ASP to the current ASP and then multiplying the result by 100. The census sampling method was selected as the one to use. In addition, the FOSD, the second-order STOD, and the TOSD were used to estimate the dominance using E-views 9.0 version and using summary statistics of mean-risk.

The study was patterned after stochastic modeling from the 1st to the 3rd Order. They are expressed in equations 1 to 3:

A FOSDB if $\Pr A > z \Pr B > z$ for all z returns------(1).

XSSDY, if $\Pr X > xdx \geq \int \Pr \{Y > y\} dy$ for all k variables -----(2)

$U(x) \geq 0$, $U'(x) = 0$ and $U(x) = 0$ if and only if security $F > G$ and $m > 0$ -----(3)

According to the equation (1) that was shown earlier, a rational investor would not choose random variable A, which has lower stock returns but a larger risk, over random variable B, which has higher returns but a lower risk (Elton & Gruber, 2002). The MMV was used so that we could determine which stock was dominant. The rule states that in order for Stock A to be considered to demonstrate FOSD over Stock B, the anticipated return (mean value) that is associated with Stock A must be above that which is associated with Stock B. However, in terms of SOSD, only if the risk (standard deviation) associated with Stock A is above Stock B is it considered to be dominant. Last but not least, a positive TOSD exists if the mean of stock B is greater than zero and it has a positive skew.

RESULTS AND DISCUSSIONS

This part of the investigation is focused on the use of STOD in the context of portfolio selection via the use of the stocks of oil and gas businesses in Nigeria. Evidently, the selection of the portfolio is determined by the MMV Criterion, while the stochastic dominance is determined in conjunction with the 1st, 2nd, and TOSD dominance methods. This is done in accordance with the selection criteria that are outlined in Section 3 of this study.

4.1. Portfolio Selection Determination

Using the Markowitz mean variance criteria, Table 1 provides a clear selection of the stocks (security) of listed manufacturing businesses in Nigeria. These companies are located in Nigeria. This is in line with the maxim in the financial industry that the more the risk increase, the more the return increase. Based on the information shown in Table 1, investors who are interested in taking on more risk will find it more appealing to put their money into Honeywell Group, UACN Plc, and Dangote Conglomerate rather than the other three conglomerates. That is, such investors often choose to put their money into businesses that have a larger potential for loss (measured in standard deviations) but also have higher anticipated profits. However, this proposal could not go over well with investors who are reluctant to take risks since these people choose to invest in the shares of companies that have relatively little risk but bigger returns on their investments.

Table 1: Portfolio Selection Using MMV Criterion

S/N	Company	Expected (Mean)	Return	Standard Deviation	Risk Behaviour	Preference
1	A.G. Leventis Nigeria Plc	6.18		3.72	Risk seeking	
2	Honey Well Group	8.15		7.97	Risk seeking	
3	SCOA Nigeria Plc	16.06		15.01	Risk averse	

4	Transnational Corporation Plc	11.12	17.06	Risk averse
5	UACN Plc	16.02	14.63	Risk seeking
6	Dangote Conglomerate	26.20	21.53	Risk seeking

Source: E-Views 9.0 Output (2023)

4.2. Schocastic Dominance Determination Pairwise

The details of each of the 30 pairwise comparisons of first-order dominance (FOSD), second-order dominance (SOSD), and third-order dominance (TOSD) are indicated in Table 2.

Table 2 provided evidence that, among the six conglomerate stocks, only Dangote Conglomerate's stocks were dominant. According to Eburajolo and Ogbeide (2021), first-order STODs experimentally difficult to see due to its limited discriminating power in forming decisions when compared when the firms' stocks recorded higher level of dominance. This data confirms that assumption. These firms are Dangote Conglomerate, UACN Plc, and SCOA Nigeria Plc. The strength of the first-order stochastic dominant (FOSD) has improved as a result of this. In the meantime, Dangote Conglomerate, UACN Plc, SCOA Nigeria Plc., and Honeywell were 3rd order dominants leaving Transnational Corporation Plc. The findings of the STOD experiment are extremely fascinating. The outcome clearly indicates the market is dominant; but does not reflect that most investors are risk lovers, in contrast to the MMV criteria as established in Table 2.

Table 2: Pairwise Correlation

Pairwise Correlation	Company	FOSD	SOSD	TOSD
A.G. Leventis Nigeria Plc vs.	Honey Well Group	Adopt	Adopt	Adopt
	SCOA Nigeria Plc	Adopt	Adopt	Adopt
	Transnational Corporation Plc	Adopt	Adopt	Adopt
	UACN Plc	Adopt	Adopt	Adopt
	Dangote Conglomerate	Adopt	Adopt	Adopt
Honey Well Group vs.	A.G. Leventis Nigeria Plc	Neither	Neither	Neither
	SCOA Nigeria Plc	Adopt	Adopt	Adopt
	Transnational Corporation Plc	Adopt	Adopt	Adopt
	UACN Plc	Adopt	Adopt	Adopt
	Dangote Conglomerate	Adopt	Adopt	Adopt
SCOA Nigeria Plc vs.	A.G. Leventis Nigeria Plc	Neither	Neither	Adopt
	Honey Well Group	Neither	Neither	Adopt
	Transnational Corporation Plc	Neither	Adopt	Adopt
	UACN Plc	Neither	Adopt	Adopt
	Dangote Conglomerate	Adopt	Adopt	Adopt
Transnational Corporation Plc vs.	A.G. Leventis Nigeria Plc	Adopt	Neither	Adopt
	Honey Well Group	Adopt	Neither	Adopt
	SCOA Nigeria Plc	Neither	Neither	Adopt
	UACN Plc	Neither	Neither	Neither
	Dangote Conglomerate	Neither	Adopt	Adopt
UACN Plc vs.	A.G. Leventis Nigeria Plc	Adopt	Neither	Adopt
	Honey Well Group	Adopt	Neither	Adopt
	SCOA Nigeria Plc	Adopt	Neither	Adopt
	Transnational Corporation Plc	Adopt	Adopt	Adopt
	Dangote Conglomerate	Neither	Adopt	Adopt
Dangote Conglomerate vs.	A.G. Leventis Nigeria Plc	Neither	Adopt	Adopt
	Honey Well Group	Neither	Adopt	Adopt
	SCOA Nigeria Plc	Neither	Adopt	Adopt
	Transnational Corporation Plc	Neither	Adopt	Adopt
	UACN Plc	Neither	Adopt	Adopt

Source: Data Collected from the Nigerian Exchange Market Fact Book (2022)

5. CONCLUSIONS AND POLICY IMPLICATIONS

The purpose of this research was to investigate the applicability of the STOD approach to portfolio selection in the context of the Nigerian exchange group, with a particular emphasis on the country's conglomerates. According to the research that was examined,

STOD continues to be an effective method for picking random variables that rank higher than others. This is accomplished by defining a condition that must be satisfied by the difference in the variables' respective choices. There were a total of six (6) identified conglomerates under consideration. The primary takeaways from this research are summarized in the study's conclusion, which states that STOD is a useful method for evaluating which asset is dominant over others, but, in contrast to the MMV approach, it does not simply reflect investors' behavior with regard to their risk preferences. As a result, the research suggests that in order for investors to make judgments that are based on accurate information, they need to take into account both the MMV method and the stochastic dominance approach when making their investment choices. The study contributes to extant studies in the following manner:

1. This study contribute to the existing knowledge as it conducted an empirical investigation on the relevance of STOD techniques on portfolio selection in the Nigerian context, thereby increasing investors' knowledge on the subject matter.
2. Unlike previous studies, the current study state how different types of investors can harmonize the assertions of both stochastic dominance techniques with those of the stochastic dominance technique on portfolio selection.

REFERENCES

- Akan, D.C. Ighosewe E. F, & Temile, S.O. (2021). Determinants of profitability in the Nigerian oil sector. *PalArch's Journal of Archaeology of Egypt / Egyptology*, 18(4), 3157-3173. Retrieved from <https://archives.palarch.nl/index.php/jae/article/view/6777>
- Eburajolo, C.E. & Ogbeide, S.O. (2021). An empirical analysis of stochastic dominance and portfolio selection in the stock market: evidence from Nigeria. *Izvestiya Journal of Varna University of Economics*, 65 (4), 412 – 428.
- Kinnunen, J. (2018). Measuring performance of a stochastic dominance based portfolio selection model in Nordic stock markets. <https://aaltodoc.aalto.fi/handle/123456789/32213>.
- Lean, H.H., Wong, W.K., & Zhang, X. (2015). The sizes and powers of some stochastic dominance tests: A Monte Carlo Study for correlated and heteroskedastic distributions. *Mathematics and Computers in Simulation*, 79(1), 30-48. 13.
- Lean, L.H., Wong, H.H., & Wing-Swung, U. (2016). Stochastic dominance and investors' behavior towards risks: the HongKong stocks and futures markets', Department of Finance, College of Management, Asia University, Lioufeng road, Wufeng, Taiching, Taiwan. 14.
- Markowitz, H. (1952). Portfolio selection. *The Journal of Finance*, 7(1), 77- 91.
- Orjinta, H. I., & Ighosewe, E. F. (2022). Market Risks Management and Performance of Deposit Money Banks in Nigeria: The Challenges of 4th Industrial Revolution. *Modern Economy*, 13(11), 1508-1520.
- Osamwonyi, I.O. (2022). Portfolio optimization and derivatives class notes for PhD Finance students. Department of Banking and Finance, University of Benin, Benin City, Nigeria.
- Post, T. (2003). Empirical tests for stochastic dominance efficiency. *The Journal of Finance*, 58(5), 1905-1931.
- Qiao, Z., Wong, W.K., & Clark, E.A. (2016). 'Theories of risk: testing investor behaviour on the Taiwan stock and stock index futures markets. Forthcoming in *Economic Inquiry*'. 20.
- Rothschild, M. & J. Stiglitz (1970). Increasing risk: a definition. *Journal of Economic Theory*, 2, 225 243. 21.
- Rothschild, M. & J. Stiglitz (1971). Increasing risk II: its economic consequences. *Journal of Economic Theory*, 3(1), 66-84. 22.
- Whitmore, G.A. (1970). Third degree stochastic dominance. *American Economic Review*, 60(3), 457-459. 25.