Does Markowitz's Mean–Variance Model Matter During Turmoil Periods? Lessons from the COVID Crisis

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Abstract

Purpose : This paper examined the effects of higher-order moments on the performance of optimal portfolios during the crisis period of the COVID-19 pandemic.

Design/Methodology/Approach : This paper employed the nonparametric model of data envelopment analysis (DEA) to assess performance using the shortage function as the measure of performance. Three higher-order moment parameters were included in the model: skewness and kurtosis.

Findings : The results showed that in contrast to the traditional mean–variance selection model, the measures of skewness and kurtosis did not lead to better performance during the COVID-19 pandemic despite the substantial departure from normalcy in asset returns. Additionally, the results showed that the sector rankings aligned with investor expectations regarding the economic activity sectors in high demand or less demand during the pandemic period in the American, French, and Moroccan markets.

Practical Implications : The study's conclusions suggested that, rather than considering higher-order moments, investors and portfolio managers would find it advantageous to concentrate their investing strategy on return and risk considerations during an unexpected market crisis. It didn't seem that taking skewness and kurtosis measurements into account enhanced portfolio performance.

Originality/Value : This study filled a knowledge vacuum in the literature about portfolio selection and generating asset returns, particularly during market crashes. It offered insightful information about the relationship between the higher-order moment allocation method and other factors.

Keywords : **asset allocation, data envelopment analysis, shortage function, COVID-19**

JEL Classification Codes : C67, G11, G15

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In recent decades, portfolio and market theory has been pivotal in advancing tools and practices for capital allocation. Because it helps investors and fund managers allocate their portfolios more effectively, the mean and variance model has become extremely popular in the financial sector. Nevertheless, the literature demonstrated that the mean–variance model's dependence on the asset returns' normal distribution is a serious disadvantage (Kraus & Litzenberger, 1976). To address this shortcoming, several scholars have proposed extending the investment allocation criterion to incorporate higher-order moments to capture other preference structures in addition to risk aversion. One such example is the research done by Kerstens et al. (2011a), which evaluated mutual fund performance using the first six higher moments. An additional illustration is a study conducted by Mounir (2021), which examined the effects of skewness and kurtosis on the optimal portfolio outcomes for Shariah-compliant investments.

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The higher number of contributions stressing the need for higher-order moments inclusion as an investment criterion demonstrates their importance in the portfolio allocation process. Furthermore, they provide a complete picture of the risk and investor preferences. In financial crises like the COVID-19 epidemic, their significance became even more apparent when asset returns typically displayed left-skewed and flat distributions. Therefore, this paper aims to fill this gap by exploring the skewness and kurtosis contributions to portfolio performance during the COVID-19 pandemic crisis. For this purpose, this paper uses three data envelopment analysis (DEA) model specifications, with the shortage function as a performance measure. The data used in the analysis represent sectoral indices from developed US and French markets and developing Moroccan markets.

Literature Review

Scholars studying finance have shown considerable interest in how the COVID-19 pandemic may affect the dynamics of financial markets. Goodell and Huynh (2020) found that the pandemic's effects on several industries have received special emphasis in their analysis. Moreover, Aloui et al. (2020) used a structural vector autoregressive (VAR) model, illustrated by time-varying coefficients and stochastic volatility, to evaluate the consequences of the pandemic on energy futures markets. In the same direction, Filipe (2020) studied the COVID-19 impacts on different stock markets using the "drop of honey effect." Similarly, Syed et al. (2021) investigated how COVID-19 affected India's financial and commodity markets. In their analysis, gold and oil prices served as stand-ins for commodity markets, which used data from the National Stock Exchange of India to represent financial markets.

Similar studies have given greater attention to corporate and business perspectives. For example, Mohania and Mainrai (2020) observed how the pandemic affected the financial industry, whereas Mangala Minutha and Jagannathan (2022) focused on alternative investment funds in India. Dey and Brown (2021) concluded the topic in parallel with these works by analyzing how the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE) handled the COVID-19 pandemic in India. They also demonstrated how it affected the sectoral indices of the S&P BSE Sensex. Naveen and Mallikarjunappa (2021) investigated the impact of the COVID-19 pandemic on equity funds classified as big, mid-, small-, and multi-cap funds, both before and following the pandemic.

An additional area of inquiry was the influence of diversification among emerging asset classes, such as cryptocurrency. For instance, Conlon et al. (2020) examined cryptocurrencies' features from investors' perspectives in global equity indexes. With the same objective but using different asset classes, many scholars have investigated the connection between corporate performance and environmental, social, and governance (ESG) standards in the context of the pandemic. As a noteworthy example, Kaur Makkar et al. (2023) checked whether ESG-responsible businesses performed better than others before and during COVID-19. Soni (2023) focused on mutual funds in India, their performance throughout the crisis, and their ESG scores.

The last area of investigation connected the pandemic implications on markets with equilibrium and asset pricing models. Adjusting for the skewness dimension, Delis et al. (2020) proposed a new equilibrium model to better understand the behavior of markets and investment strategies during the pandemic crisis. Many aspects of COVID-19 have received significant attention in the financial literature that is currently available. These include how the virus affects the dynamics of the financial markets, how to diversify by adding new asset classes, and how to use risk and return models focusing on crises. However, there is a lack of investigation regarding the validity of the mean–variance model as an investment allocation tool, specifically during the pandemic. This raised important questions about relying on the mean–variance model during crisis periods.

Notably, the probability distribution of assets is typically flat and left-skewed, suggesting that there are other risk considerations to consider when making investment decisions. Moreover, during the pandemic, financial

markets experienced a positive correlation in asset returns, as illustrated by the simultaneous decline in market indices worldwide. This restricts the mean–variance model's potential benefits for lowering risk in certain situations.

Given these drawbacks, more research is required to develop alternative investment criteria that consider the particularities of crisis times, like highly correlated asset classes and skewed asset returns. By doing this, investors can make stronger and more informed decisions in times of crisis.

Prior research under typical investment conditions has highlighted the importance of considering extra factors like skewness and kurtosis when allocating a portfolio. Hung et al. (2014), for example, used a variety of explanatory variables, such as size, book-to-market ratio, momentum, liquidity, and higher-order systematic co-moments, to explore the intertemporal pricing equilibrium of common equity returns for all NYSE, AMEX, and NASDAQ firms. Their findings indicated the importance of market beta and co-moments in determining the cross-section of stock returns. Similarly, Kerstens et al. (2011a) evaluated the performance of mutual funds by incorporating the first six higher moments. Their findings showed that fund operating fees and higher-order moments impact mutual fund performance and ranking. Moreover, in a more recent study, Nekhili and Bouri (2023) provided evidence of the significance of considering spillovers in volatility as well as higher-order moments and co-moments (skewness, kurtosis, covariance, co-skewness, and co-kurtosis) when hedging risk.

While it is known that higher-order moments are important for allocating a portfolio when asset returns are not normal, the research has not yet examined how these moments affected portfolio performance during the COVID-19 pandemic. This paper addresses this research gap by examining the contribution of skewness and kurtosis dimensions to optimal portfolio performance. By doing so, it aims to provide a comprehensive understanding of how these additional criteria can enhance portfolio decision-making and performance in the context of the pandemic.

Data and Research Methods

Data

Data are based on sectoral indices instead of individual assets or a specific asset class. This choice allows us to test the contribution of higher-order moments in portfolio performance during the COVID-19 crisis and examine which sectors investors appreciate and dislike. The dataset covers three distinct markets characterized by varying volume trading dynamics and the economic development of their respective countries. The US market is represented through sectoral indices of the S&P 500, the French market with CAC 40 sub-indices, and the Moroccan market with Moroccan All Stock Index (MASI) sectoral indices[1]. Various markets in terms of development and maturity are considered to investigate the possible relationship between economic development and its effects on stock investments during the pandemic. This research analyzes daily prices of sectoral indices to focus on the crisis from July 2019 to July 2020, unlike Delis et al. (2020), who used data from January 1990 to mid-May 2020. Figure 1 shows the observed declining trend.

Figure 1 illustrates the notable decline observed in the three indices, which coincided with the announcement of the public health emergency of international concern in early March 2020. But there were indications of improvement within a few weeks, beginning in early April. Table 1 shows that, although the downturn trends lasted a few weeks, the statistical characteristics of returns showed a considerable divergence from the assumptions of normality.

[1] All sectoral indices prices are public and were obtained from the internet website of the corresponding exchanges.

Figure 1. ***S&P 500, CAC 40, and MASI Indices Dynamic During COVID-19 Pandemic***

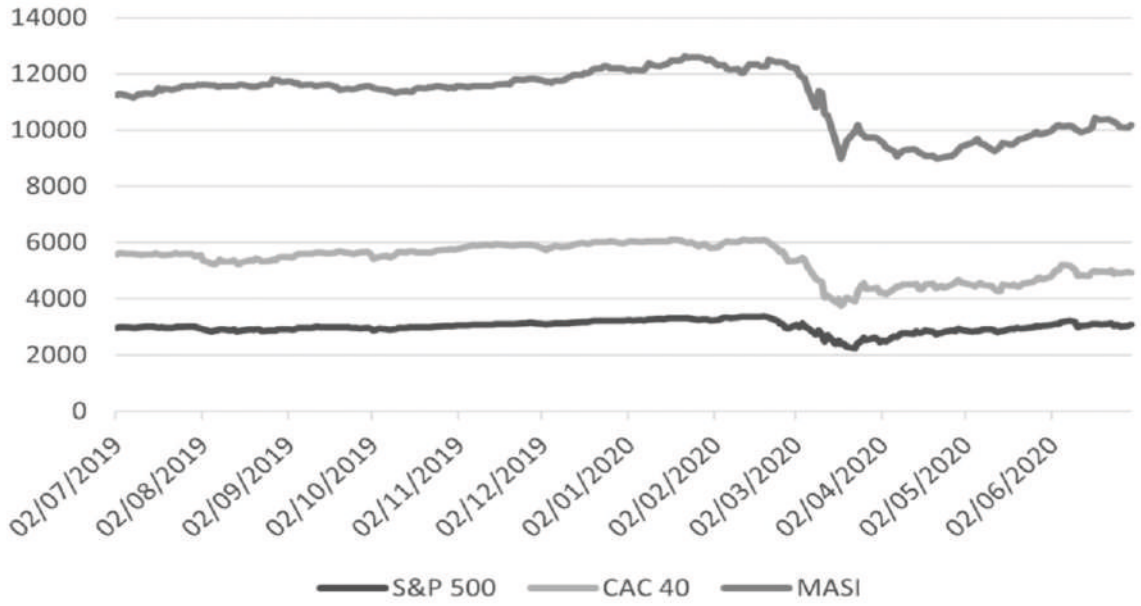

Table 1. ***S&P 500, CAC 40, and MASI Daily Return Descriptive Statistics***

	S&P 500	CAC 40	MASI
Average Return (*)	0.0004	–0.0003	–0.0003
Variance	0.0004	0.0004	0.0001
Skewness	–0.5239	–1.2925	–2.0253
Kurtosis	9.2563	9.9259	17.216

Note. (*) Daily Basis.

It is important to note that the sectoral indices in the three markets are classified differently. The US S&P 500 comprises 11 sectors, the CAC 40 includes 10, and the MASI index comprises 24 sectors[2].

Higher-Order Moments Selection Models

According to (Markowitz, 1952), a portfolio containing N assets can be represented by a weight vector $x = (x_1, x_2,.., x_N)$ with a sum of weights equal to $\sum_{i=1}^{n} x_i = 1$. If short selling is excluded, meaning that all weights are positive numbers, $x_i \geq 0$ for all $i \in \{1, 2, \ldots, N\}$, portfolios universe is represented by:

$$\Im = \{x \in \mathbb{R}^N ; \sum_{i=1}^{n} x_i = 1, x \geq 0\} \qquad (1)$$

characterized by an expected return $E[R_i]$ for $i \in \{1, 2, \ldots, N\}$, and by variance–covariance matrix Ω:

[2] While the sector classification is different in the three market indices, the resulting correspondence is straightforward from the sector specification. Any attempt to reconstruct similar indices is misleading due to asset weight allocation used by stock exchange authorities.

$$\Omega_{ij} = Cov[R_i, R_j] = E[(R_i - E[R_i])(R_j - E[R_j])] \text{ for } i, j \in \{1,..,N\} \quad (2)$$

In the case of the non-normal return distribution, assets are characterized by higher co-moments (Briec & Kerstens, 2010): co-skewness Λ and co-kurtosis Φ:

$$\Lambda_{ijk} = E[(R_i - E[R_i])(R_j - E[R_j])(R_k - E[R_k])] \text{ for } i, j, k \in \{1,..,N\} \quad (3)$$

$$\Phi_{ijkl} = E[(R_i - E[R_i])(R_j - E[R_j])(R_k - E[R_k])(R_l - E[R_l])] \text{ for } i, j, k, l \in \{1,..,N\} \quad (4)$$

The expected return of portfolio x, its variance, skewness, and kurtosis are defined as follows:

$$E[R(x)] = \sum_{i=1}^{N} x_i E[R_i] \quad (5)$$

$$Var(R(x)) = E[(R(x) - E[R(x)])^2] = \sum_{i,j=1}^{N} x_i x_j \Omega_{ij} \quad (6)$$

$$Sk(R(x)) = E[(R(x) - E[R(x)])^3] = \sum_{i,j,k=1}^{N} x_i x_j x_k \Lambda_{ijk} \quad (7)$$

$$Ku(R(x)) = E[(R(x) - E[R(x)])^4] = \sum_{i,j,k,l=1}^{N} x_i x_j x_k x_l \Phi_{ijkl} \quad (8)$$

In portfolio theory, the Markowitz optimal portfolio in the mean–variance space is determined by a combination of weights that result in the maximum contraction of risk for a given level of desired return or the maximum return expansion with a fixed risk level. The optimization process traditionally relies on considering only the first two moments of the return distribution, assuming a normal distribution. Nonetheless, it is commonly known that asset and portfolio returns have distributions that differ greatly from normality, as shown by Mandelbrot (1963) and covered by Campbell et al. (1997). As such, while making decisions about asset allocation, it becomes imperative to consider higher-order moments. This study employs a non-parametric modeling approach to investigate the relevance of skewness and kurtosis during the crisis period. The choice of input/output variables is determined by the dimension under investigation, enabling a thorough investigation of the influence of these higher-order moments on portfolio performance.

This study computes optimal portfolios in the mean–variance (MV), mean–variance–skewness (MVS), and mean–variance–skewness–kurtosis (MVSK) spaces using the data envelopment analysis (DEA)[3], a non-parametric methodology. The shortage function is used to gauge these portfolios' efficiency. Because DEA finds the best weight combination for portfolios and generates efficiency scores for rating and ranking, it is suitable for a multicriteria optimization approach. This efficiency feature is especially useful because it allows portfolio performance to be assessed using predetermined standards in the optimization program instead of depending only on conventional performance metrics like Treynor or Sharpe ratios, which concentrate only on returns and risks.

The shortage function is frequently employed as a performance metric in assessing financial products. Expected utility (EU) theory holds that investors favor portfolios with concurrently increasing odd moments and declining even moments. This seems to be consistent with the theory's underlying assumptions. Briec and Kerstens (2010) provided a framework that aligns with the preferences of a wider range of investors by expanding the use of the shortage function to include greater moments in portfolio selection.

The shortage function looks for a simultaneous movement in input-like and output-like variables. The shortage function shows a score between 0 and 1 if an optimal portfolio is obtained. An efficient asset is on the efficient frontier when it has a score of 0. On the other hand, an asset or portfolio is seen as far from the efficient frontier for

[3] This method has been widely used in literature to appreciate the performance of decision-making units. For example, Jhaveri et al. (2021) used to it evaluate the efficiency using financial data of 11 years of all the 13 S&P BSE 500 listed textile firms in India.

its particular coordinates (MV, MVS, or MVSK, for example) if its score is 1. Consistent with the general investor preferences, the mean and skewness are inputs, while variance and kurtosis are outputs.

This paper uses the mathematical notations and models Briec and Kerstens (2010) set to compute the shortage function and detect optimal portfolios. These models provide a framework with three specifications for determining optimal portfolios and computing the shortage function scores.

Mean–Variance Model (MV) (P1)	**Mean–Variance–Skewness Model (MVS) (P2)**	**Mean–Variance–Skewness–Kurtosis Model (MVSK) (P3)**
Max β	Max β	Max β
$s.t.\ E(R_x) \geq E(R_i) + \beta \lvert E(R_i) \rvert$	$s.t.\ E(R_x) \geq E(R_i) + \beta \lvert E(R_i) \rvert$	$s.t.\ E(R_x) \geq E(R_i) + \beta \lvert E(R_i) \rvert$
$Var(R_x) \leq Var(R_i) - \beta \lvert Var(R_i) \rvert$	$Var(R_x) \leq Var(R_i) - \beta \lvert Var(R_i) \rvert$	$Var(R_x) \leq Var(R_i) - \beta \lvert Var(R_i) \rvert$
$\sum_{1}^{N} x_i = 1$	$Sk(R_x) \geq Sk(R_i) + \beta \lvert Sk(R_i) \rvert$	$Sk(R_x) \geq Sk(R_i) + \beta \lvert Sk(R_i) \rvert$
$x_i \geq 0$ for $i \in \{1..N\}$ and $\beta \geq 0$	$\sum_{1}^{N} x_i = 1$	$Ku(R_x) \leq Ku(R_i) - \beta \lvert Ku(R_i) \rvert$
	$x_i \geq 0$ for $i \in \{1..N\}$ and $\beta \geq 0$	$\sum_{1}^{N} x_i = 1$
		$x_i \geq 0$ for $i \in \{1..N\}$ and $\beta \geq 0$

Analysis and Results

The findings presented in this section are derived from implementing DEA programs[4] using three specific specifications: MV, MVS, and MVSK Models.

The efficiency score results for sectoral indices of the S&P 500, CAC 40, and MASI index are presented in Tables 2, 3, and 4, respectively. These tables provide a comprehensive overview of the efficiency scores obtained for each sectoral index.

The results for the S&P 500's 11 sectoral indices are shown in Table 2. The names of these sectoral indices are listed in the first column. The DEA efficiency scores in the MV space are shown in the second column; the

Table 2. ***Efficiency Scores for S&P 500 Sectoral Indices with MV, MVS, and MVSK Specifications***

S&P Sectoral Indices	**MV-β**	**MVS-β**	**MVSK-β**
S&P 500 Information Technology	0	0	0
S&P 500 Consumer Staples	0.02	0.02	0.02
S&P 500 Health Care	0.08	0.08	0.08
S&P 500 Consumer Discretionary	0.11	0.11	0.11
S&P 500 Communication Services	0.12	0.12	0.12
S&P 500 Materials	0.45	0.45	0.45
S&P 500 Utilities	0.48	0.48	0.48
S&P 500 Industrials	0.49	0.49	0.49
S&P 500 Real Estate	0.51	0.51	0.51
S&P 500 Financials	0.62	0.62	0.62
S&P 500 Energy	0.74	0.74	0.74

[4] All the computations are evaluated using Maple v 2021.

efficiency scores in the MVS and MVSK spaces are shown in the third and fourth columns, respectively. As explained in the previous section, these efficiency scores range from 0 to 1.

For the first sectoral index, "S&P 500 Information Technology," the efficiency score in the MV space is 0. This suggests that the shortage function did not identify any proportional improvement regarding this index's expected return and variance, implying that it lies on the efficient frontier. On the other hand, the S&P 500 consumer staples index can achieve higher efficiency than its initial parameters in the MV space. It has the potential to enhance its expected return while simultaneously reducing its variance by approximately 2%. In contrast, the S&P 500 energy index exhibits the highest level of inefficiency. It can significantly amplify its return and reduce its risk by approximately 74%.

The presentation of performance scores is crucial for ranking purposes as it enables the identification of sectors that attracted investments and those that investors less favored during the COVID-19 pandemic. Analyzing the performance scores in the MV space, we observe that information technology, consumer staples, and healthcare equities were, to some extent, appreciated. At the same time, real estate, financials, and energy stocks faced less enthusiasm during the crisis. This aligns with investor expectations regarding sectors in demand or less required during the pandemic period.

Transitioning from the MV to the MVS setting, the performance results across all S&P sectoral indices remain unchanged. This result may be unexpected since assets and sector prices exhibit different skewness values compared to normal distribution asset returns, suggesting a potential trade-off between model constraints. However, considering the skewness dimension in portfolio selection does not contribute to the efficiency score for all S&P sectors.

To save space, the numerical results are reported with two decimal places. However, slight differences are noted between MV and MVS distribution scores. For instance, when considering the skewness dimension in the S&P 500 Consumer Staples performance, the efficiency score decreases marginally from 0.01772300115 to 0.01772300106. The efficiency score of S&P 500 Financials improved marginally from 0.6159401154 to 0.6159401157. Although these differences appear statistically insignificant, further in-depth analysis is necessary to determine their economic implications.

Taking the kurtosis dimension into account yields results that follow the same pattern. The efficiency scores derived from the MVSK model are shown in Table 2's fourth column, which makes this clear. Interestingly, the performance ratings for every S&P sectoral index match those determined by the MV or MVS standards. These findings indicate that incorporating skewness and kurtosis in portfolio selection does not result in higher performance compared to the expectations based on the MV criteria in the US Market, even during the COVID-19 pandemic period characterized by significant changes in asset prices.

The sign of the co-moments matrix and tensors can explain this result. Specifically, all sectors exhibit a negative co-skewness[5] relation when considering the skewness dimension. This implies that the optimal portfolio is consistently undervalued from a third-moment perspective. This situation is analogous to the scenario where the covariance matrix solely consists of positive values, which means that any attempts to diversify the portfolio will lead to an unfavorable movement in risk.

Efficiency results for CAC 40 sectoral indices are presented in Table 3. CAC Technology emerges as the most efficient sector across all three models in the MV space. Conversely, CAC energy exhibits the highest level of inefficiency. This sector has the potential to significantly improve its coordinates in two-, three--, and four-dimensional spaces by approximately 77%. This improvement entails increasing return and skewness while simultaneously decreasing variance and kurtosis.

[5] To save space, co-skewness and co-kurtosis tensors are not reported. Co-skewness for S&P sectoral indices presents more than 1,300 entries while co-kurtosis counts more than 14,600 values.

Table 3. ***Efficiency Scores for CAC 40 Sectoral Indices with MV, MVS, and MVSK Specifications***

CAC Sectoral Indices	MV-β	MVS-β	MVSK-β
CAC Technology	0	0	0
CAC Health Care	0.01	0	0
CAC Telecommunications	0.36	0.36	0.36
CAC Consumer Staples	0.38	0.38	0.38
CAC Consumer Discretionary	0.39	0.39	0.39
CAC Basic Materials	0.52	0.52	0.52
CAC Utilities	0.56	0.56	0.56
CAC Financials	0.67	0.67	0.67
CAC Industrials	0.68	0.68	0.68
CAC Energy	0.77	0.77	0.77

Interestingly, the influence of skewness and kurtosis on efficiency scores for CAC sectoral indices is consistent with the previous findings. These factors do not significantly impact the efficiency scores, and the conclusions drawn from the MV efficiencies remain valid. There are slight differences when contrasting MVS scores with MV efficiencies; however, the performances are the same in the MVS and MVSK models. Despite these small differences, the rankings of the sectors remain unaffected. During the COVID-19 pandemic, investors were more interested in CAC technology, healthcare, and telecommunications firms than in financial, industrial, or energy stocks.

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Table 4 presents the efficiency results for Moroccan market sectoral indices using the MV, MVS, and MVSK models. The Moroccan market, administered by the local Casablanca Stock Exchange authority, exhibits a more extensive sector classification than the S&P and CAC 40.

Table 4. ***Efficiency Scores for MASI Sectoral Indices with MV, MVS, and MVSK Specifications***

MASI Sectoral Indices	MV-β	MVS-β	MVSK-β
Hardware, Software, & IT Services	0	0	0
Distribution	0.39	0.39	0.39
Pharmaceutical Industry	0.41	0.41	0.41
Chemistry	0.77	0.77	0.77
Financing Company & Other Financial Activities	0.81	0.81	0.81
Insurance	0.82	0.82	0.82
Agri-food and Production	0.83	0.83	0.83

Telecommunications	0.86	0.86	0.86
Banks	0.88	0.88	0.88
Electronic & Electrical Equipement	0.89	0.89	0.89
Real Estate Investment Companies	0.9	0.9	0.9
Transport Services	0.9	0.9	0.9
Electricity	0.9	0.9	0.9
Drinks	0.91	0.91	0.91
Building & Construction Materials	0.92	0.92	0.92
Transport	0.92	0.92	0.92
Mines	0.92	0.92	0.92
Oil and Gas	0.93	0.93	0.93
Community Services	0.94	0.94	0.94
Engineering & Industrial Equipment	0.95	0.95	0.95
Holding Companies	0.95	0.95	0.95
Real Estate	0.96	0.96	0.96
Leisure and Hotels	0.96	0.96	0.96
Forestry and Paper	0.98	0.98	0.98

Although the Moroccan market is characterized by lower trading volume and less dynamism, it experienced a similar downtrend as observed in the S&P 500 and CAC 40 markets by the beginning of March 2020. All MV, MVS, and MVSK sectors have the same efficiency scores despite the variations in market dynamics. This suggests that higher-order moments do not significantly impact performance and that the MV model produces similar results even in a less dynamic market context.

In terms of sector ranking, aligning with the S&P and CAC 40 benchmarks, the technology, telecommunication, distribution, and pharmaceutical industries were favored by investors during the COVID-19 pandemic crisis in Morocco. Conversely, the real estate, leisure and hotels, and forestry and paper sectors were less favored during this period.

For a few weeks during the COVID-19 pandemic, the S&P 500, CAC 40, and MASI saw a severe crash market with a large deviation from the normalcy assumption. Skewness return has negative values in the three markets, and kurtosis displays a wide tail. However, in portfolio selection, higher-order moments do not impact optimal portfolio performances during the pandemic crisis. This finding can be attributed to the constraints imposed by the co-skewness and co-kurtosis tensor entries in both higher dimensions. These entries, which exhibit negative and positive signs, limit the potential improvements that could be achieved through higher dimensions.

Efficiency scores in the three markets revealed similar patterns in sectors attracting more investment or experiencing over-allocation during COVID-19. Specifically, sectors such as technology, healthcare, and telecommunication assets were positively regarded and appreciated by investors, while the financials and energy sectors were comparatively less favored.

These findings align with investor expectations regarding economic activity sectors that were either required or less in demand during the pandemic period. The increased focus on sectors such as technology, healthcare, and telecommunication can be attributed to their perceived resilience and potential for growth in the face of unprecedented challenges posed by the pandemic. Conversely, sectors like financials and energy were perceived as less desirable or faced greater uncertainty, leading to investor aversion.

Managerial and Theoretical Implications

Investors and fund managers encounter unique challenges when their assets under management are subjected to significant market risk. This issue prompts investors to reassess their portfolios and seek alternative strategies to minimize the crisis's adverse effects. As discussed in this article, one common approach is concentrating investments in specific sectors or exploring safer assets, as suggested in the existing literature. These solutions ultimately lead investors to adopt concentration strategies on targeted sectors or assets. Notably, this approach aligns with the skewness-based asset allocation framework, as outlined by Kerstens et al. (2011b). This study demonstrates that in times of crisis, particularly during the COVID-19 pandemic, incorporating higher-order moments in portfolio allocation does not necessarily result in superior performance. Instead, the traditional mean–variance model is an effective allocation tool during turbulent periods.

Conclusion

This article explores the role of higher-order moments in portfolio selection, specifically within the context of the COVID-19 pandemic crisis. More specifically, we investigate the influence of skewness and kurtosis dimensions on the performance of optimal portfolios. Previous literature has emphasized the importance of higher moments in capturing various investor risk preferences beyond risk aversion under different market conditions.

Our analysis of three distinct markets shows that dimensions, including skewness and kurtosis, do not produce superior portfolio performance compared to the traditional mean–variance selection model. We adopt a comprehensive framework combining optimization with efficiency computation to assess portfolio performance, utilizing the DEA approach's shortage function.

The empirical evidence suggests that the added value of higher-order moments in portfolio selection performance is marginal. This is primarily due to the observed negative and positive values of co-skewness and co-kurtosis tensors in the studied markets. Diversifying within similar data structures does not yield improvements in higher-order moments. A consensus among investors is also revealed by analyzing the sector's efficiency scores across the three markets. Amidst the COVID-19 pandemic crisis, certain sectors received favorable treatment while others were not.

Limitations of the Study and Scope for Further Research

The findings presented in this contribution are quite remarkable from a theoretical standpoint. Prior literature had widely advocated for the significance of higher-order moments in portfolio allocation during crisis periods. However, this empirical study, encompassing three different markets, reveals that models incorporating higher-order moments yield comparable efficiency to the traditional mean–variance model. This unexpected outcome raises doubts about the relevance of higher-order moments as decisive investment criteria in tumultuous periods. Therefore, further investigation in this direction is warranted. It is important to note that this study only examines one crisis period, namely the COVID-19 pandemic, which poses a limitation. Exploring other crises, such as the global financial crisis of 2008, may provide additional insights into the suitability of incorporating higher-order moments in portfolio allocation during periods of turmoil.

Author's Contribution

Dr. Amine Mounir did the conceptualization, formal analysis, methodology, and writing. Computations et optimization results (Efficiency scores) were obtained using Maple v 2021.

Conflict of Interest

The author certifies that he has no affiliations with or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.

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