



Return versus hype – Are Islamic metaverse companies more profitable than general ones – A Chinese stock analysis

Klemens Katterbauer
Hassan Syed
Laurent Cleenewerck
Sema Yılmaz Genç*

Abstract: The metaverse, a virtual universe in which individuals and companies can interact, has become of paramount importance in China in recent years. While the metaverses are still in their infancy, there has been a growing interest and influx of capital into these universes. Shariah-compliant corporations have been gradually attracting significant funds from Islamic countries, given the growing strong engagement and trade. Similarly, metaverse corporations have been gaining significant sizes in the Chinese market and have become cornerstones of the investment landscape. For Islamic investors, questions arise whether these new metaverse corporations provide better returns given the massive hype and media attention they have attracted, and whether a portfolio investment into these corporations deliver the benefits promised. The article provides a comparative analysis between Chinese Islamic metaverse and Shariah-compliant enterprises, where all enterprises have either A or H-shares. The performance analysis over a timespan of 10 years demonstrates that the most optimal portfolios have similar expected returns while general Shariah-compliant enterprises provide significantly lower risks as compared to the metaverse ones. This implies that Shariah-compliant enterprises provide significantly more value for the risk they are attributed and are more sustainable.

Keywords: Metaverse, China, Shariah compliance, portfolio optimization, conditional value at risk, mean-variance optimization, CAPM

* Corresponding Author

Prof., EUCLID University, katterbauer@euclidfaculty.net, 0000-0001-5513-4418
Assoc. Prof., EUCLID University, hassan@euclidfaculty.net, 0000-0003-2114-2473
Pr. EU Assoc. Prof., Yıldız Teknik University, sygenç@yildiz.edu.tr, 0000-0002-3138-1622
CLID University, cleenewerck@euclid.int, 0000-0002-9267-0428

Katterbauer, K., Syed, H., Cleenewerck L. & Genç, S.M. (2024). Return versus hype – Are Islamic metaverse companies more profitable than general ones – A Chinese stock analysis. Turkish Journal of Islamic Economics, 11(2), 1-16.

DOI: 10.26414/A4079
TUJISE, 11(2), 2024, 01-16
tujise.org



Received: 12.05.2023
Revised: 22.08.2023
Accepted: 14.09.2023



Introduction

In recent years, the term ‘metaverse’ has gained widespread usage, exemplified by Facebook’s formal rebranding as Meta. According to the study conducted by Park and Kim (2022), it was found that... Non-fungible tokens (NFTs) have emerged as a prominent topic of discussion, garnering significant attention due to its integral role inside the virtual realm. Furthermore, the emergence of gamers and creators in this domain has contributed to its growing appeal among conventional consumers. Considerable focus has been directed into the virtual realm, necessitating a comprehensive comprehension of its underlying milieu and the resultant worth it engenders. The values of land pertaining to digital environments are experiencing an upward trend, as seen by the recent introduction of a fund by Republic Real Estate that enables investors to acquire virtual land (Narin, 2021). The fund will buy virtual properties in various online metaverses and convert them into hotels, shops and other uses. The aim is to increase the value of these properties to consumers.

The concept of virtual land has garnered substantial attention due to its association with tangible land, but the art industry connected to non-fungible tokens (NFTs) has experienced an even more noteworthy surge. Moreover, there is an anticipation that digital asset platforms built on blockchain technology could eventually accommodate the trading of equities and bonds. An additional significant aspect of the metaverse pertains to the progressive adoption of online-exclusive shopping and immersive encounters, wherein users engage in the acquisition of assets that exist just in virtual form. Numerous virtual retailers exclusively operate within the metaverse, offering a wide range of apparel and accessories for online purchase. In addition, there exist virtual fashion shoes that are exclusively developed for the virtual realm, and have garnered significant financial backing. The proliferation of remote work arrangements, along with the rising adoption of artificial intelligence and virtual technology, has facilitated the emergence of novel business models that provide clients with distinct virtual experiences. An additional significant transformation pertains to the adoption of remote working, wherein the metaverse has the potential to enhance the permanence and immersive nature of remote work, hence optimizing productivity and fostering increased interaction. This will facilitate enhanced staff contact and engagement (Wilson, Karg, & Ghaderi, 2021).

Given the growing importance of the metaverse, the financial industry has been exploring how value can be created in the metaverse space and how fintech solu-

tions can deliver financial services in this new environment. In addition, metaverse technology creates new business model opportunities that can strengthen the use of crypto technology as an alternative financial system.

The technologies behind the Metaverse combine technologies such as Virtual Reality (VR) and Augmented Reality (AR). The result is an interactive, immersive and collaborative 3D virtual universe. The idea is that these individual universes can be integrated with each other and connected across the world in different environments. This can be in the form of games, but also real estate, commerce and other related environments (Wohlgenannt, Simons, & Stieglitz, 2020).

As Facebook's transformation into Meta demonstrates, financial data and transaction management will become key parts of the metaverse, allowing individuals and businesses to transact and operate within these universes. For example, there are digital assets that can be purchased, such as World of Warcraft and the Habbo Hotel, and these assets can even be moved from one universe to the other (Park & Kim, 2022).

The current metaverse is an amalgamation of the capabilities of various social media and video game companies that build upon their user base and platform to connect these individuals. While at first glance the metaverse may appear to be all about gaming, it has become more of a virtual world in which individuals can become fully immersed and live most of their lives within the metaverse. This can range from dating to having their social interactions within the metaverse, but also conducting business within the metaverse. This may take the form of running a real business or a digital business within the metaverse. Overall, this will lead to someone being completely immersed in the Metaverse and living their daily life in that universe (Asif, 2018).

In China, the presence of major digital enterprises and digital innovations in retail and other industries have led to massive investments and new technologies into metaverse environments and applications. The growth of this market has been significant, and several companies have aimed at incorporating metaverse capabilities into their business models. Augmented reality (AR) and virtual reality (VR) have been of great attractiveness for many businesses to incorporate them into their business models. In the last two years, the major tech giants in China have filed the most patent applications happening primarily in the field of retail shopping, education, gaming, marketing, information display, and industrial manufacturing (Qin, 2022). In 2020 alone, the VR industry in China accounted for more than 44 percent of the global market, amounting to more than 8 billion USD. The main objective of

many major enterprises is to invest in smaller startups in order to acquire technical expertise as well as minimize risks arising from the failure of specific technologies (Knox, 2022). Mobile VR has been of significant importance given the more than 900 million smartphone users in China, and AR has assumed an even greater rate of growth than VR due to its integration with everyday life. There have been several new entries, such as Sight Plus, Hisense, and Mayitegong, that have entered the AR market and provide services related to AR. The major companies have been heavily investing in the metaverse and Baidu launched a metaverse application in December 2021, which allows users to engage in a virtual environment and is named the “Land of hope” (希壤). The users can create their own avatars and has received significant attraction. Tencent has focused on the QQ platform to launch some of its technologies, such as the Super QQ Show, which included a 3D interactive space where users can engage and play together. ByteDance has developed the Party Island application (派对岛), which enables them similarly to create virtual avatars, and they can then subsequently communicate with friends (Wilson C. , 2019).

While private enterprises have been at the forefront of driving the metaverse growth, several local governments, such as Shanghai, Wuhan and Hefei have included the metaverse in their government work reports in 2022 and aim to create such a metaverse for their jurisdictions. This incorporated also the attention to deal with various services and potential crimes that may arise from these applications. This has been emphasized by the Supreme People’s Protectorate. The Ministry of Industry and Information Technology (MIIT) published a paper on the acceleration of the development of the virtual reality industry. This roadmap stresses the importance of R & D and content service provision as a foundation for the development of VR. The Guangzhou government released measures on the promotion of innovation and the development of the metaverse. These include the promotion of innovation and the encouragement of enterprises in order to form clusters and achieve greater specialization. Furthermore, it supports the technological leadership, where institutions and businesses should address technical bottlenecks, and it strengthens the protection of intellectual property rights. Additionally, new talent shall be recruited and social capital shall be attracted via a dedicated metaverse industrial fund. There is a mixture between the attempts of local governments in establishing themselves in the metaverse, and governmental entities that outline security risks (Abu-Bakar, 2017).

In light of these substantial opportunities, inquiries emerge regarding the potential scope of financial services that can be offered within the metaverse. The pro-

vision of financial and transaction management is of utmost importance in order to meet the demands of consumers and deliver the necessary degree of interaction and services. Given that the metaverse is envisioned as a virtual representation of real-life experiences, encompassing various activities such as labor, earning income, and engaging in transactions involving assets like furniture, clothing, and vehicles, as well as the buying and renting of virtual land, it becomes imperative to establish both the financial infrastructure and legislative framework to support these operations. Moreover, the amalgamation of diverse financial services and technologies has the potential to give rise to a financial universe, commonly referred to as a “finverse.” (Katterbauer, Syed, & de Kiev, 2022; Xiao, Henderson, Nielsen, & Newall, 2022).

Islamic finance has been of significant interest across the world with several countries establishing a strong Islamic finance system. China has a significant Islamic minority in addition to a growing trade engagement with many Islamic countries in the Middle East and North Africa, as well as in Asia. This provides significant opportunities for Islamic finance and China to establish new financial products and enhance the stability of the financial system (Katterbauer, Syed, Cleenewerck, & Yilmaz Genç, 2022a).

Significant inquiries emerge regarding the supply of financial services in this context and the compatibility of existing financial rules with the introduction of novel financial services and products in China that adhere to Islamic principles. Moreover, there are inquiries regarding the pivotal function that artificial intelligence and blockchain technology play in enhancing the financial universe and aligning it with the principles of Shariah law (Lu & Chen, 2021; McDevitt, 2021). The study provides a critical outline how investors within the Chinese ecosystems can obtain strong returns while limiting their exposure, avoiding the hype that may surround metaverse enterprises that do not yield sufficient value. This has been a significant challenge in the Chinese investment environment that is driven significantly by retail’s investors preferences.

Islamic Finance in China

Collaborations and overseas investments of Chinese enterprises in the Muslim world has increased significantly in the last several decades. While there are differences in terms of political, cultural and economic aspects, China shares over its history many engagements and cultural exchanges between the Muslim world

and China. China has itself a sizeable Muslim population that lives mostly in the western parts of China, and developed a considerable tradition in Islam, which has assisted them in China to develop gradually an Islamic finance environment, and provide Shariah compliant financial services to its population (Katterbauer, Syed, Cleenewerck, & Yılmaz Genç, 2022b).

The major steps for Shariah compliant Islamic finance solutions started in around 2008 after the global financial crisis, where there has been significant focus on utilizing alternative financial products that can withstand better external shocks and the integrity of the system. Taiwan established the Taiwan Shariah Index in 2008 in order to focus on Shariah-compliant companies that are listed at the Taiwan Stock Exchange. Similarly, the Hong Kong financial authorities have been working intensively on trying to establish a center for Islamic bonds and the Arab Chamber of Commerce & Industry established an International Islamic Mediation and Arbitration center that may deal with disputes arising from the Hong Kong sukuk market (Katterbauer & Moschetta, A robo-advisory framework for Islamic and Environmental, Social and Governance (ESG) compliance—A benchmark study on the S&P 500 stock index, 2022). The Ningxia Hui Autonomous Region (NHAR) has been at the forefront of Islamic finance within China. The Bank of Ningxia (BON) in Yinchuan launched a pilot project for Islamic finance in 2009. This was driven by local Hui businesses that aimed to acquire Shariah compliant instruments via investment savings. The BON followed previous initiatives in Malaysia, and the BON provided Shariah compliant financial services at its branches. These financial instruments were approved by the China Banking Regulatory Commission, and the BON offered non-interest savings accounts that provided gifts (礼品) to the customers, and investment accounts that complied with Shariah law. Furthermore, Murabaha was utilized where the BON purchased the goods on behalf of the customer, and then resold the goods to the customers at a price in addition to profit. Challenges arose from the existing problems that relate to inadequate capitalization and the limited number of loans. Furthermore, there are restrictions on the investment into trust companies and prohibitions related to Islamic banking instruments, such as mudaraba and musharaka. The yields of these instruments were rather low, which made it economically challenging. However, there have been recent attempts at providing the provisioning of Islamic finance compliant funds to support foreign investment into Chinese entities. Malaysia and Hong Kong have become major markets for Islamic compliant funds that invest into Chinese enterprises (Katterbauer & Moschetta, 2022).

The acquisition of shares in the People's Republic of China (PRC) and investment represents a challenge for foreign investors. The Chinese capital market is fragmented and the purchase of shares is subject to restrictions, which leads to a differentiation in terms of share categories. The first category is the A-shares, that represent publicly listed companies that are listed on the Chinese stock exchanges and are denominated in yuan renminbi. The next category is composed of the B-shares that are foreign investment shares and listed in the domestic market and have foreign currency denomination (CBIRC, 2021). Finally, the H-shares are those that trade on the Hong Kong exchanges and are both regulated by Chinese law but are tradeable by anyone. As they are traded in Hong Kong, they are denominated in Hong Kong Dollar (HKD). A-shares are mostly listed on the Shanghai or Shenzhen stock exchanges, and are primarily available to mainland Chinese citizens only. There are options nowadays where foreign investment structures are permitted to invest into these entities via Qualified Foreign Institutional Investors (QFIIs). There is a limited number of institutional investors that have qualified for such investment status and can purchase and sell these A-shares (Hassanat & Al tarawneh, 2015). For any investor that is not QFII qualified, the sole option arises in the form of the acquisition via an emerging market fund or via American depositary receipts (ADR).

H-shares are another major way for investors to invest into Chinese companies that are listed on the Hong Kong Stock Exchange. These shares are issued in China under Chinese law and have to fulfill Hong Kong Stock Exchange listing requirements. Hence, the accounts have to comply with Hong Kong or international accounting standards. The articles of the company has also to clarify the varying nature of both domestic and foreign shares and the rights that are granted to each of the purchasers. Generally, there are price discrepancies between A-shares and H-shares that arise at the potential ability to access rights (Alam, Gupta, & Zamani, 2019).

Methodology

Islamic and Metaverse enterprises have gained significant attention in recent years, which has led to an increasing interest of investors into these companies for their investments. A crucial question that arises for most investors engaging into both Islamic and Metaverse enterprise investments is which one of those to prefer. Generally, metaverse companies are high growth with potential high returns, and have attracted significant attention. In contrast, Islamic enterprises have generally been considered to be of limited risk with a strong focus on fundamentals and adherence to Islamic principles. Given the growth of Islamic finance within Chi-

na and the strengthened engagement of China and members of the Organization of Islamic Cooperation, Chinese investors have seen strong interest in the investment in this sector. Simultaneously, the growth of metaverse companies within the Chinese ecosystem has been a great impetus for the Chinese economy, and have led to significant technological developments. A fundamental research question is whether metaverse enterprises that are also Shariah compliant combine the benefits of high returns from the metaverse in addition to risk limitations arising from the Islamic nature of the business and its operations (Katterbauer, Syed, Cleenewerck, & Yilmaz Genc, 2022c).

The article focuses on a multi-parameter comparison of the portfolio performance of Chinese metaverse and Islamic compliant enterprise shares, analyzing the two groups in terms of their portfolio and risk performance. The constituents for the metaverse and Islamic finance portfolios are taken from Islamic A Shares ETF issued by Value Partners and the Hang Seng metaverse ETF, ensuring that in both groups solely Shariah compliant enterprises are included.

The objective portfolio optimization is to select assets in such a way in order to maximize the return on the overall investment while minimizing the risk exposure. Generally, this requires the balancing of trade-offs between risk and return. The general idea of selecting various types of assets can reduce the risk than having solely ones that are similar in order to achieve the same return potentially. The most common form of portfolio optimization is the mean-variance optimization introduced by Harry Markowitz. The method assumes that the investors are risk-averse and selects a set of assets that have minimal correlation but high returns. Hence, for portfolios with the same return, the method will select the portfolio where the individual assets are least correlated with each other.

The technique implies that any investor may acquire high-risk assets or securities, as long as these high-risk investments are minimized by the underlying assets. The overall portfolio risk balances the high-risk together with lower-risk investments. Generally, the risk can be divided in systematic and unsystematic risk. Systematic risk refers to risk that is not reduceable through diversification. This can be in the form of general market and economic risks, which affect all of investments. The unsystematic risk, in contrast, is specific risk that is solely dependent on the individual investment. This implies that the overall risk can be diversified when investing into multiple investments. For diversified portfolios, the risk each asset poses to the overall portfolio risk is relatively limited.

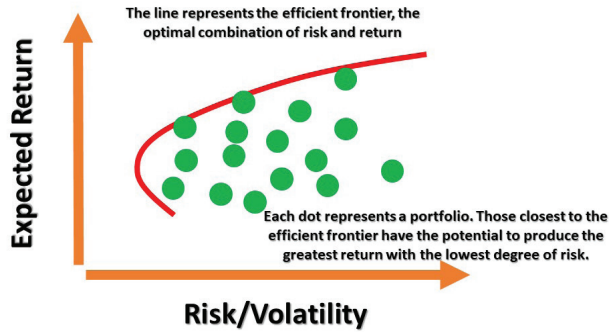


Figure 1: Efficient frontier graphical illustration

Given that there is a balance between risk and return leading to a multi-objective optimization problem where one has to determine either the targeted level of return or risk. In order to determine the optimal portfolio allocations, the efficient frontier represents all optimal level of returns given a particular level of risk. This implies that for every level of return, the portfolio on the efficient frontier has the lowest possible risk, and for every level of risk, the portfolio has the highest return. Hence, any portfolio that is outside the efficient frontier is generally sub-optimal in terms of either risk or return. The efficient frontier enables investments to be judged accordingly, and the points on the curve are denoted as efficient as they provide the maximum expected return for the given level of risk.

The mean-variance optimization approach suffers from several challenges. The first challenge is that the portfolio may lead to unstable results with minor changes in the inputs leading to significantly different portfolio allocations. This represents a challenge for investment corporations that have to readjust their portfolios significantly between different investment cycles. Furthermore, the optimal portfolios may be highly concentrated that do not offer adequate diversification benefits. The second challenge is that transaction costs when reallocating the portfolio are not taken into account. The third issue is the definition of risk as the volatility of stocks.

Besides the mean-variance approach, there are different methods such as the hierarchical risk parity (HRP) and the mean conditional value at risk (mCVAR). The HRP addresses some limitations of the mean-variance optimization method and the HRP does not require the inversion of the covariance matrix. For larger portfolios and depending on the covariance matrix, the inverse may lead to highly instable results. This makes the HRP more stable in terms of the results that it provides and is less dependent on the covariance matrix conditioning.

Another method is mCVAR that does not assume that the returns are normally distributed and so its not sensitive to extreme values like mean-variance optimization. This implies that if the stock experiences an anomaly in terms of its price increases, the mCVAR will considerably be more robust than the mean variance optimization. Mean variance optimization faces challenges with anomalous increases in price, which leads to a potentially disproportionate investment amount into these asset classes.

Data Analysis

For the comparison, the constituents of the Hang Seng Metaverse Index and the Value Partner Islamic A Shares index were utilized to qualify the enterprises that are compliant with Shariah law and those representing the metaverse environment. All stocks are either listed in Shanghai, Shenzhen or Hong Kong stock exchange and have their main business operations in the mainland of China. These stocks are representative for a comparison between Metaverse and Shariah-compliant enterprises and their investment return performances. Before evaluating the performance of optimal portfolios, the general statistics of the various enterprises for the two different areas are outlined. Figure 2 provides a comparison of annual dividend yields that demonstrate that the overall spread in yields is more significant for metaverse enterprises as compared to Shariah-compliant ones. Generally, the yields are higher for Shariah-compliant enterprises as compared to metaverse corporations with a few outliers. Another important parameter is the maximum drawdown that the stocks may experience based on the last 52 weeks. Generally, metaverse companies experience significantly higher drawdowns as compared to Shariah compliant companies that arise primarily from the hype-induced investment focus that most metaverse enterprises face. Furthermore, comparing the price to book ratio illustrates the challenges that metaverse corporations have encountered in the last year with a major outflow of funds from such stocks as well as a decrease in their respective stock prices. This has caused their price to book ratio decreasing significantly as compared to those of the metaverse corporations.

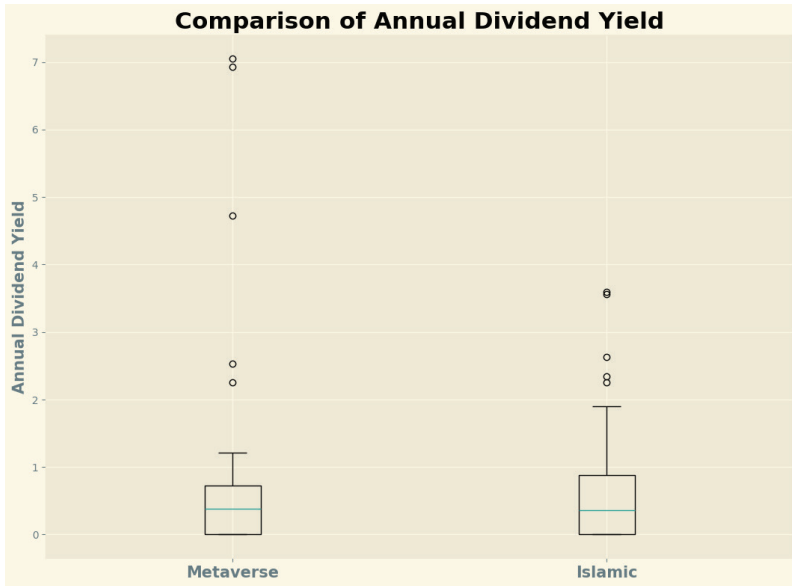


Figure 2: Comparison of annual dividend yields

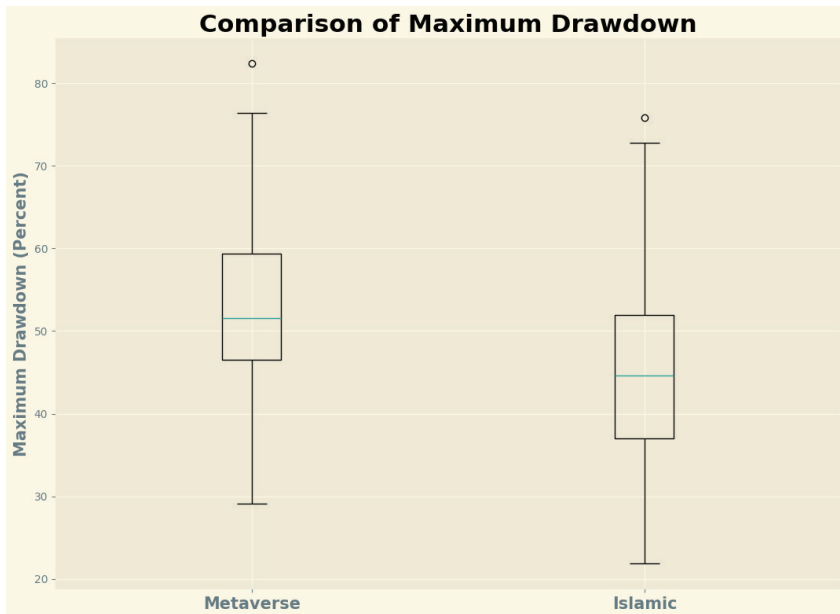


Figure 3: Comparison of maximum drawdown

The mean-variance optimization requires besides the expected returns the covariance matrix, which are under normal circumstances may lead to biases and not representative of the general performance. Furthermore, the challenge is that positive volatility is preferred as compared to downside volatility, which would lead to a loss in investment funds and performance. Hence, the mean-semivariance optimization approach only penalizes the downside volatility, while keeping the upside volatility in place and not affecting the portfolio allocation. In order to deal with mean-semivariance optimization problem, a first attempt is to utilize a heuristic for the conventional mean-variance optimization and then aim to approximate the best solution. The challenge with such an approach is that the portfolio may not be efficient in the mean-semivariance space. The optimization problem can be rewritten however in the form of a convex optimization problem that integrates a maximization of the target semivariance. Generally, these optimization problems can be efficiently solved given modern efficient optimization algorithms.

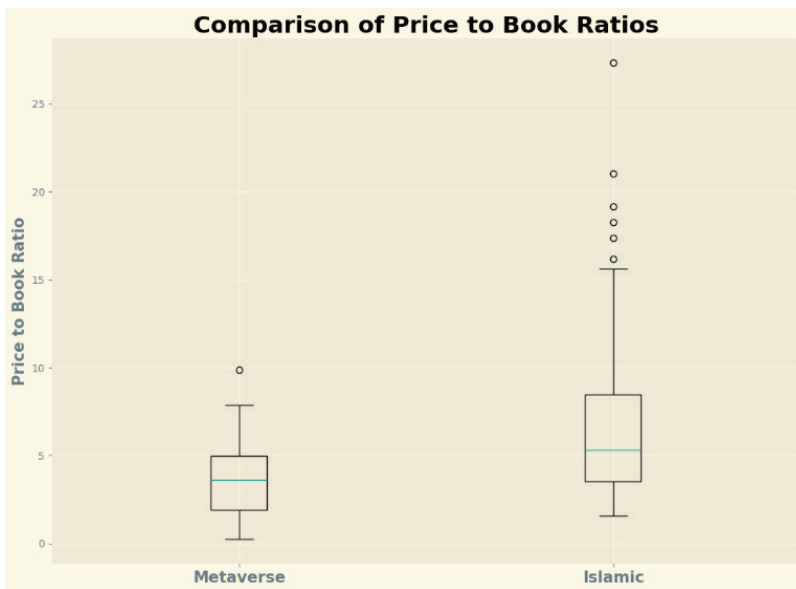


Figure 4: Comparison of price to book ratios

Another alternative optimization framework is the conditional value at risk. This is also called the expected shortfall and represents the tail risk. The CVaR can conventionally be considered as the average loss that may occur during extreme situations and is quantified by the conditional value at risk. Specifically, the confidence level has to be specified.

Another measure is the conditional drawdown at risk (CDaR) that measures the tail risk and aims to alleviate the challenges with the efficient semivariance and efficient CVaR that do not take into account the material decrease in value. Specifically, the CDaR aims to measure the average losses that may occur during difficult periods. The final is the hierarchical risk parity that aims to overcome some of the challenges of mean-variance optimization. First, the correlation of assets is utilized to create a distance matrix, and the assets are clustered into a tree via hierarchical clustering. Within each of the tree branches, the minimum variance portfolio is created, and the iteration then combines all the optimal mini-portfolios in order to determine the most optimal one.

In order to determine the overall performance of the portfolios between these investing into Metaverse and those investing into Islamic, one can observe that the average estimated expected annual return is significantly higher for those in the Islamic portfolio as compared to those in the metaverse. Specifically, Table 1 demonstrates that except for the mean-variance and hierarchical risk parity optimization, the Islamic portfolio significantly outperforms the Metaverse one. Given that the efficient semivariance, CVaR and CDaR penalize downside risk, the portfolio performs better due to the lower risk that may arise and the potential significant downside variations that occur for the metaverse enterprises.

Table 1

Estimated expected annual returns (in %) for the different portfolios

	Metaverse	Islamic
Efficient Semivariance	15.7	28.6
CVaR	15.4	29.1
CDaR	17.9	31.4
Mean-Variance Optimization	35.1	36.3
HRP	27.0	27.3

While the results are not comprehensive, they provide an important outline of the enhanced performance and lower risk of an Islamic portfolio in China as compared to an investment into metaverse corporations. This also demonstrates the necessity for metaverse corporations to mature in China in order to establish solid returns with limited risks. A similar experience can be observed from comparing the efficient frontiers as illustrated in Figure 5 and Figure 6 and the plotting of several random portfolios. Generally, the Islamic portfolios exhibit wider spread in terms of volatility as compared to those in the metaverse that experience a significant difference in the return rates.

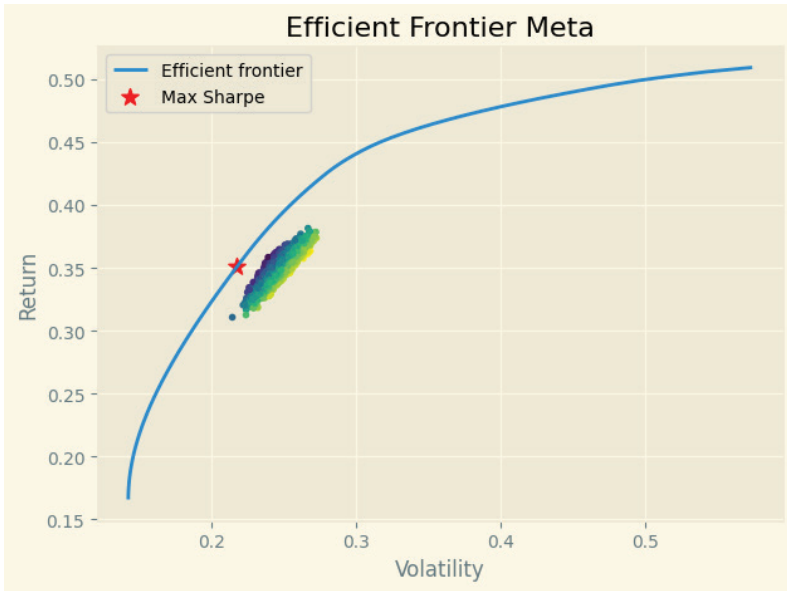


Figure 5: Efficient frontier and max sharpe for the metaverse portfolio with random portfolios colored by the sharpe ratio

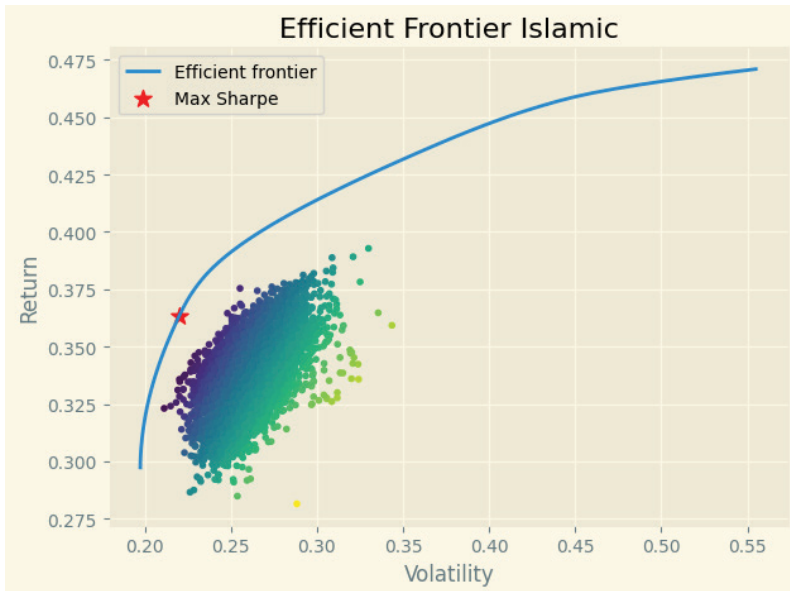


Figure 6: Efficient frontier and max sharpe ratio for the Islamic portfolio with random portfolios colored by the sharpe ratios

This is visible when analyzing the various sharp ratios and overall efficient frontier that exhibits for the metaverse portfolios a significantly lower return rate as compared to those in the Islamic portfolio.

Conclusion

The metaverse in China has become of paramount importance within the last several years, being a virtual universe where individuals and companies can interact. While the metaverses are still nascent, there has been increasing interest and capital inflow into these universes. Shariah-compliant corporations have been gradually attracting significant funds from Islamic countries, given the growing strong engagement and trade. Similarly, metaverse corporations have been gaining significant sizes in the Chinese market and have become cornerstones of the investment landscape. For Islamic investors, questions arise whether these new metaverse corporations provide better returns given the massive hype and media attention they have attracted, and whether a portfolio investment into these corporations deliver the benefits promised. The article provides a comparative analysis between Chinese Islamic metaverse and Shariah-compliant enterprises, where all enterprises have either A or H-shares. The performance analysis over a timespan of 10 years demonstrates that the most optimal portfolios have similar expected returns while general Shariah-compliant enterprises provide significantly lower risks as compared to the metaverse ones.

References

- Abu-Bakar, M. M. (2017). *Shariah Analysis of Bitcoin, Cryptocurrency and Blockchain*. Karachi: Blossom.
- Alam, N., Gupta, L., & Zamani, A. (2019). *Fintech and Islamic Finance: Digitalization, Development and Disruption*. Kuala Lumpur: Palgrave MacMillan.
- Asif, S. (2018). The halal and haram aspect of cryptocurrencies in Islam. *Journal of Islamic Banking and Finance*, 91-101.
- China Banking and Insurance Regulatory Commission (CBIRC) (2021). Circular of the General Office of the China Banking and Insurance Regulatory Commission on the Issuance of Measures for the Management of Project Companies of Financial Leasing Companies, No. 143.
- Hassanat, A., & Al tarawneh, G. (2015). Gambling-free lottery, a new Islamic lending ticket. *Journal of Islamic Accounting and Business Research*, 6(1), 42-54.

- Katterbauer, K., & Moschetta, P. (2022). A deep learning approach to risk management modeling for Islamic microfinance. *European Journal of Islamic Finance*, 35-43.
- Katterbauer, K., & Moschetta, P. (2022). A robo-advisory framework for Islamic and Environmental, Social and Governance (ESG) compliance—A benchmark study on the S&P 500 stock index. *The Journal of Muamalat and Islamic Finance Research*, 34-46.
- Katterbauer, K., Syed, H., & de Kiev, L. C. (2022). An innovative AI Blockchain framework for Islamic microfinancing. *Journal of Islamic Finance*, 67-80.
- Katterbauer, K., Syed, H., Cleenewerck, L., & Genc, S. (2022a). Sharia Compliance of Cryptocurrencies: Data-Driven Sharia Compliance Assessment. *Talaa: Journal of Islamic Finance*, 75-85.
- Katterbauer, K., Syed, H., Cleenewerck, L., & Genc, S. Y. (2022c). Robo-Sukuk pricing for Chinese equities. *Borsa Istanbul Review*, 854-860.
- Katterbauer, K., Syed, H., Cleenewerck, L., & Genc, S. Y. (2022b). A Distributionally AI Robust Islamic Portfolio Approach—A Case Study of The Impact of Sanctions on The Incorporation of Chinese Stocks into Islamic ETF. *Journal of Islamic Finance*, 41-50.
- Knox, J. (2022). The metaverse, or the serious business of tech frontiers. *Postdigital science and education*, 207-215.
- Lu, L., & Chen, H. (2021). Digital Yuan: The Practice and Regulation of China's Central Bank Digital Currency (CBDC). *Butterworths Journal of International Banking and Financial Law*, 601-603.
- McDevitt, C. (2021, October 27). *The Future of Crypto Assets Regulation in the UAE*. Retrieved from Hadeef & Partners: <https://www.lexology.com/library/detail.aspx?g=88c0f35c-7ea5-439b-90d7-df3fe4f70586>
- Narin, N. G. (2021). A Content Analysis of the Metaverse Articles. *Journal of Metaverse*, 17-24.
- Park, S.-M., & Kim, Y.-G. (2022). A Metaverse: taxonomy, components, applications, and open challenges. *IEEE Access*.
- Qin, Y. (2022). Investment Potential Analysis on Chinese Stock Market in Metaverse—Take VR Industry as a Sample. *2022 7th International Conference on Financial Innovation and Economic Development (ICFIED 2022)* (pp. 1001-1007). Atlantis Press.
- Wilson, C. (2019). Cryptocurrencies: The Future of Finance? *Contemporary Issues in International Political Economy*, 359-394.
- Wilson, K. B., Karg, A., & Ghaderi, H. (2021). . Prospecting non-fungible tokens in the digital economy: Stakeholders and ecosystem, risk and opportunity. *Business Horizons*.
- Wohlgenannt, I., Simons, A., & Stieglitz, S. (2020). Virtual reality. *Business & Information Systems Engineering*, 455-461.
- Xiao, L. Y., Henderson, L. L., Nielsen, R. K., & Newall, P. W. (2022). Regulating gambling-like video game loot boxes: A public health framework comparing industry self-regulation, existing national legal approaches, and other potential approaches. *Current Addiction Reports*, 163-178.