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Are Islamic Gold-Backed Cryptocurrencies Bridging Digital and Traditional assets in OIC Emerging Markets?

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Abstract. *This research explores the financial role of Hello Gold (HGT) and X8X Token (X8X) as Islamic gold-backed cryptocurrencies to bridge digital (Bitcoin, Ethereum, UCRY Price, UCRY Policy, and ICEA) and traditional (conventional stock indexes, government bonds, foreign exchange, and Islamic stock indexes) assets. Quantile via moment by Machado and Santos Silva (2019) was utilized as the main methodology, followed by a feasible generalized least square (FGLS) and a difference generalized method of moment (Diff-GMM) as robustness testing. The research term spanned from August 6, 2018 until June 30, 2023 within five emerging countries in the Organization of Islamic Cooperation (OIC) including Nigeria, Turkey, Indonesia, Malaysia, and Pakistan. It was found that Hello Gold and*

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X8X Token primarily bridge the function as strong diversifiers, particularly for Bitcoin and Ethereum. However, Hello Gold performs strongly as a safe haven for Islamic stock indexes in bearish conditions and as a strong diversifier during high cryptocurrency price uncertainty.

Keywords: *digital assets, financial role, Islamic gold-backed cryptocurrencies, quantile via moment, safe haven, traditional assets*

1. Introduction

Despite the significant volatility of conventional cryptocurrencies, investor interest remains strong (Almeida & Gonçalves, 2023). This is reflected in a remarkable 1,238% [1] increase in the revenue of cryptocurrency in the times of the pandemic. During the pandemic, El Salvador pioneered by becoming the first nation to officially adopt cryptocurrency as a lawful tender (Patel, 2024). Investor enthusiasm has, in turn, spurred governmental attention towards adopting digital financial systems, specifically through the advancement of Central Bank Digital Currencies (CBDCs). However, the design and implementation of these digital assets are still uncertain (Luu et al., 2023). Cambodia is alone in successfully launching a blockchain-based CBDC called Bakong (Ueda & Hay, 2024). Amidst the widespread interest in cryptocurrencies, concerns about their compliance with sharia law have emerged, particularly among faith-based investors. Due to the lack of tangible asset backing and high speculative activities, conventional cryptocurrencies are deemed impermissible for these investors (Siswantoro et al., 2020). During this challenge, Islamic gold-backed cryptocurrencies have arisen as viable investment opportunities for faith-based investors. Unlike conventional cryptocurrencies, their value is backed by gold, a recognized *rabawi* commodity in Islamic finance (Mnif & Jarboui, 2022). This led to the introduction of three notable Islamic gold-backed cryptocurrencies: One Gram Coin (OGC), Hello Gold (HGT), and X8X Token (X8X). In 2018, investor interest soared with X8X Token (X8X) experiencing a price increase of 170% [2] a few months after its establishment, while Hello Gold (HGT) saw a substantial rise of 37.735% [3].

Financial attributes studies have expanded in recent years, especially on conventional cryptocurrencies like Ethereum and Bitcoin. They have proven to be effective hedges during the times of market uncertainty and have outperformed traditional stock indexes as safe havens (Corbet et al., 2020a; Mariana et al., 2021). As exploration of Islamic gold-backed cryptocurrencies is gaining traction, Aloui et al. (2021) initiated their research by examining the potential safe haven properties of these cryptocurrencies during the times of economic instability. Moreover, Yousaf and Yarovaya (2022) examined their correlation with gold. Furthering this research, Ali et al. (2024) analyzed how Islamic gold-backed cryptocurrencies are interconnected within GCC countries. The growing interest in cryptocurrencies has led to the development of new indexes (Lucey et al., 2022), such as the Cryptocurrency Price Uncertainty Index (UCRY Price)

and the Cryptocurrency Policy Uncertainty Index (UCRY Policy), which measure the extent of unpredictability in cryptocurrency price and policy movements related to cryptocurrency. Furthermore, Wang et al. (2022a) introduced the Index of Cryptocurrency Environmental Attention (ICEA) to assess cryptocurrencies environmental impact as reported by the media. Thus far, only three studies have explored and employed the UCRY Price Index (Hasan et al., 2022; Widjaja et al., 2024).

Within the existing literature, several research gaps have been identified: (1) none of the prior works have addressed the comprehensive Islamic gold-backed cryptocurrencies' role (diversifier, safe haven, and hedge) against digital and traditional assets; (2) no research has focused on Islamic gold-backed cryptocurrencies within OIC countries, which are predominantly composed of faith-based investors; (3) thus far, academic research has yet to employ cryptocurrency indexes (UCRY Price, UCRY Policy, and ICEA) collectively in financial role studies; and (4) the implication of Islamic gold-backed cryptocurrencies on the advancement of digital assets, i.e. CBDCs, has not yet been investigated.

Therefore, this research tries to contribute by (1) investigating the financial role of Islamic gold-backed cryptocurrencies on both digital (Bitcoin, Ethereum, UCRY Price, UCRY Policy, ICEA) and traditional assets (conventional stock indexes, government bond, foreign exchange, Islamic stock indexes); (2) drawing samples from OIC countries to better understand the conditions and behaviors of faith-based investors; (3) employing cryptocurrency indexes to appraise Islamic gold-backed cryptocurrencies' behavior during the uncertainty times and environmental issues, and (4) exploring Islamic gold-backed cryptocurrencies' practical implication and their potential adoption by governments for developing CBDCs.

The structure of this research is delineated as follows. Section 2 details an overview of the literature. Section 3 provides the data and research methodology. Section 4 analyzes the results. Finally, Section 5 offers conclusions, limitations, and recommendations.

2. Literature Review

2.1 Theory of Investment Portfolio

Markowitz (1952) introduced the Theory of Modern Portfolio as an investment strategy for portfolio optimization by diversifying assets to minimize risk and maximize return. A key principle in developing an effective portfolio is maintaining low or no correlation between assets to minimize and eliminate risk (Markowitz, 1971). Previously, three types of asset diversification (i.e., diversifiers, safe havens, and hedges) have been empirically testable in an investment portfolio (Baur & Lucey, 2010; Baur & McDermott, 2010).

2.2 Islamic Finance and FinTech

Islam has the legal aspect of utilizing money which is known as Islamic law (Sharia). It stresses the morality of financial transactions. The guidance on the monetary value of haram (impermissible) or halal (permissible) in utilizing money has been given. It is considered as halal when the money is utilized lawfully. The most concerning thing in Sharia is the currency exchange value and legitimacy. Further, commodity and money are treated differently in Islam. Commodities can be exchanged/sold at an agreed price between the seller and buyer. On the other hand, when money has no intrinsic value, the process of money exchange that is not on the spot will lead to riba (interest), and it is forbidden according to Sharia rulings. The commodities that have been recognized by Sharia law are gold, silver, dates, rice, barley, wheat, and salt. An Islamic law standard No. 57 has been issued by AAOIFI and World Gold Council and Amanie Advisors, saying that gold is considered as Sharia-compliant asset and can be utilized as asset based or medium of exchange for Islamic financial transaction (sharia investment) (Alam et al., 2020).

Islamic financial assets have been transforming following the needs of investors who consider sharia investment. Islamic capital markets have categorized Islamic assets including (a) Sukuk (Islamic bonds), which have also transformed to green sukuk; (b) Islamic stocks; (c) Islamic mutual funds. These sharia-traditional assets have a strong foundation, but the rise of technology, thus the Islamic FinTech leads to significant growth in the market, especially among the young population (Hassan et al., 2022a).

When FinTech adopts Islamic values and Sharia principles, it is referred to as Islamic FinTech. Those values and principles emphasize providing the products, in this case investment, by meeting the sharia requirements at a reasonable cost. Islamic FinTech is transparent, comprehensive, favorable, and ethical to all stakeholders (Hassan et al., 2022b).

In 2021, the Global Islamic FinTech Report presented the countries that are well prepared for the Islamic FinTech ecosystem and market growth. It was reported that 90% comes from Organization of Islamic Cooperation (OIC) countries, which have a Muslim majority population with a flourishing ecosystem of Islamic FinTech, including rapid growth of the FinTech sector (Hassan et al., 2022b). Saudi Arabia, Iran, United Arab Emirates, Malaysia and Indonesia take the lead on Islamic FinTech based on the transaction volumes, with a documented 76% FinTech market size in 2020 (Hassan et al., 2022a).

2.3 Islamic Gold-backed Cryptocurrencies

Considering cryptocurrency fluctuations, investors encounter difficulties in preserving their investment values. As a result, stablecoins have arisen as an approach to hedge cryptocurrency market risks (Wang et al., 2020). Islamic gold-backed cryptocurrencies are recognized as stablecoins, anchored to the gold's value. Within the framework of

Islamic finance, gold is identified as part of *rabawi* commodity (Trichilli & Boujelbéne, 2023). Conventional cryptocurrencies (Bitcoin, Ethereum, among other altcoins) lack backing from physical assets and function according to the principles of market demand and supply (Wang et al., 2020). Inversely, Islamic gold-backed cryptocurrencies are crafted to adhere to Islamic law (Aloui et al., 2021) by prohibiting speculative activities and riba (Wiwoho et al., 2024). Thereby, the Islamic gold-backed cryptocurrencies provide a reliable and secure type of digital asset, appealing to Muslim investors (Wang et al., 2020). Currently, over 62 companies are engaged in the operation of gold-backed cryptocurrencies, with One Gram Coin (OGC), Hello Gold (HGT), and X8X Token (X8X) emerging as prominent examples that adhere to Islamic laws (Ali et al., 2024).

HGT generates a gold-backed token stored in a vault in Singapore, with transactions required to be completed within a designated timeframe (Vizcaino, 2018). Meanwhile, X8X was designed as a liquid cryptocurrency, backed not only by gold but also by eight flat currencies from the following countries: United States, Australia, Japan, Canada, Switzerland, New Zealand, United Kingdom, and Eurozone countries (Emna & Anis, 2020). In relation to gold, Islamic gold-backed cryptocurrencies show a significant positive correlation, while conventional cryptocurrencies reveal a comparatively weaker and negative association (Aloui et al., 2021). During the COVID-19 period, Yousaf and Yarovaya (2022) identified heightened return and volatility linkages between Islamic gold-backed cryptocurrencies (OGC and X8X) and Islamic stocks as well as gold. This observation underscores Islamic gold-backed cryptocurrencies' capability as a secure financial asset amid economic uncertainty (Baur & Hoang, 2021).

2.4 Prior Studies on Cryptocurrencies' Financial Role

The investigation of the financial role of cryptocurrencies has attracted both the investors' and researchers' attention. Utilizing GARCH with monthly data, Bitcoin (BTC) exhibits strong hedging against five major stock indices (Chan et al. 2019). Będowska-Sójka and Kliber (2021) employed DCC-MSV to find that BTC shows a safe haven characteristic against S&P 500, STOXX 600, and FTSE 250. Conversely, Mariana et al., (2021) used DCC and cDCC to reveal that Ethereum (ETH) can be regarded as a safe haven against the S&P500 and serves as a more reliable safe haven than Bitcoin during a brief and severe decline in the stock market. Khaki et al. (2023) used mean-variance optimization and found greater diversification benefits of BTC and ETH, especially during alternative seasons for ETH. Multiple studies which employed quantile via moments, wavelet quantile correlation, econometric model, and GARCH have confirmed a consistent pattern of Ethereum-based assets as diversifier tools across non-fungible token (NFT) that enhance portfolio investment opportunities (Havidz et al., 2024a; Kumar & Padakandla, 2023; Ko & Lee, 2023; Meshcheryakov & Ivanov, 2020).

Amidst COVID-19, Widjaja et al. (2024) employed panel quantile regression to find out UCRY Price's strong safe haven traits toward bond and conventional stocks

but weak for Islamic stocks during bearish conditions. The positive impact of the UCRY Policy on the Dow Jones Islamic index, Sukuk returns, and gold indicates their safe haven asset or hedge capability, which was examined by quantile-on-quantile regression (Hasan et al., 2022). Concerning the environmental impact, Stoll et al. (2019) employed IPO filings and mining pool. They discovered that cryptocurrencies' mining produces higher emissions compared to traditional mining, leading to increased energy consumption and CO_2 emissions. Qi et al. (2020) have discovered through granger causality that ICEA is positively correlated with various indexes including Bitcoin, volatility index (VIX), UCRY indexes, and Brent crude oil (BCO).

Although the use of Quantile via Moment remains limited in cryptocurrency studies, this methodology has been extensively applied in other areas of financial studies. Previously, Quantile via Moment was applied to acknowledge significant relationships between investor interest and emotions to Bitcoin returns and volatility (Dias et al., 2022). Gozgor and Karakas (2023) also used it to confirm the positive effect of gold returns on Green Bond returns, followed by Akande Raifu et al. (2023) in studying the effect of financial development on the unemployment rate in MENA countries. Several recent studies also employed the same methodology, focusing on investigating the effects of macroeconomic and financial factors on the financial deepening in Africa (Sanga & Aziakpono, 2024) and examining the asymmetric effect of several variables on the financial and green growth of emerging economies (Afshan et al., 2024).

3. Data and Methodology

3.1 Data

Statista has found 56 countries that predominantly use cryptocurrencies [1]. However, only nine countries were affiliated with the Organization of Islamic Cooperation (OIC) [4], among which three countries did not have an Islamic stock index. Also, government bond data was unavailable for one of these countries. Therefore, five countries were selected as the research sample (Table 1).

Table 1
Sample Selection

No.	Criteria	Countries
1.	Countries with a wide usage of cryptocurrencies	56
2.	Countries without affiliation with OIC	47
3.	Countries without Islamic stock index	3
4.	Countries with unavailable Government Bond data	1
5.	Countries selected as the research sample	5

This research focuses on OIC countries due to their predominantly Muslim population leading to a high demand for Islamic financial assets (Kim et al., 2018). Since its establishment in 1971, the OIC has prioritized promoting Islamic solidarity, particularly in the economic area, enhancing the Islamic market [5]. This research investigates two dependent variables, Hello Gold (HGT) and X8X Token (X8X), and nine independent variables, which are categorized into digital and traditional assets. The digital assets include Bitcoin (BTC), Ethereum (ETH), Cryptocurrency Price Uncertainty Index (UCRY Price), Cryptocurrency Policy Uncertainty Index (UCRY Policy), and Index of Cryptocurrency Environmental Attention (ICEA). The traditional assets consist of conventional stock indexes (CS), government bonds (GB), foreign exchange (FX), and Islamic stock indexes (IS).

Table 2

Data Source and Descriptive Summary

Variable	Mean	Std. Dev.	Min	Max	Obs.
HGT	0.193	2.538	-0.994	39.678	1,280
X8X	0.013	0.212	-0.51	1.815	1,280
BTC	0.009	0.081	-0.31	0.275	1,280
ETH	0.012	0.106	-0.331	0.509	1,280
UCRY Price	0.0005	0.013	-0.053	0.05	1,280
UCRY Policy	0.0005	0.014	-0.077	0.052	1,280
ICEA	0.0002	0.009	-0.037	0.058	1,280
CS	0.002	0.028	-0.271	0.125	1,280
GB	0.003	0.048	-0.312	0.82	1,280
FX	-0.002	0.024	-0.282	0.535	1,280
IS	0.012	0.255	-0.97	7.303	1,280

Note. Data of HGT was acquired from Investing.com. X8X, BTC, ETH were obtained from Coinmarketcap.com. UCRY Price, UCRY Policy, and ICEA were collected from Brianmlucey.wordpress.com. CS, GB, FX, IS were gathered from the Bloomberg terminal.

All variables for each country involved in this research (Nigeria, Turkey, Indonesia, Malaysia, and Pakistan) were assessed using their return value denominated in USD currency. Consequently, a variable (government bond) with different currency units was eventually converted to USD utilizing the applicable exchange rate. Concerning cryptocurrencies indexes (UCRY price, UCRY policy, and ICEA) calculated on a weekly basis (Lucey et al., 2022; Wang et al., 2022a), several variables (HGT, X8X, BTC, and ETH) were transformed into weekly series by averaging their daily price (Cholette & Chhab, 1991). The remaining variables (CS, GB, FX, and IS) are already

in weekly series. Out of three notable Islamic gold-backed cryptocurrencies (OGC, HGT, and X8X), HGT and X8X were chosen, as OGC data has been unavailable since 2022. The emergence of X8X as an Islamic gold-backed cryptocurrency to the public on August 6, 2018 marked the initiation of the research period. Therefore, the research term spans from August 6, 2018 to June 30, 2023, following the latest data available on UCRY Price, UCRY Policy, and ICEA. Table 2 provides the data source and descriptive summary for each variable.

3.2 Preliminary Tests: Slope Homogeneity, Cross-sectional Dependence, and Unit Root Test

Several preliminary tests were conducted before proceeding with the main methodology (refer to Table 3). Firstly, the slope homogeneity test by Pesaran and Yamagata (2008) was utilized, implying a presence of heterogeneity within the data. Secondly, cross-sectional dependency tests by Frees (1995), Friedman (1937), and Pesaran (2004) were also performed, acknowledging the absence of cross-sectional dependence. Thirdly, the unit root test by Im et al. (2003) was conducted, which disclosed that all variables are stationary at level.

Table 3
Slope Homogeneity, Cross Dependence, and Unit Root Tests

		Cross-sectional dependence	
Test	Pesaran	Frees	Friedman
Prob	0.000	0.000	0.000
Variables	Slope homogeneity		Unit root test
HGT	-3.766***		-26.539***
X8X	-3.875***		-25.456***
BTC			-21.091***
ETH			-20.751***
UCRY Price			-28.507***
UCRY Policy			-29.235***
ICEA			-27.867***
CS			-25.127***
GB			-24.554***
FX			-24.983***
IS			-25.475***

Note. ***=significant at the 1% level.

3.3 Quantile via Moment

Following the existence of heterogeneous panel, the quantile via moment regression model by Machado and Santos Silva (2019) was proposed. It was employed to consider the performance of HGT and X8X in different quantile levels. Studies by Widjaja et al. (2024) and Zhang (2017) have found the effectiveness of quantile regression in providing comprehensive statistical modeling compared to traditional mean regression. It enabled the examination of how the dependent variable responds to shifts to the changes in the independent variable under different market conditions. Expanding the prior work of Gutenbrunner and Jureckova (1992), He (1997), Koenker and Bassett (1982), and Zhao (2000), Machado and Santos Silva's (2019) regression model presents a novel approach in accommodating heterogeneous panel data (Akande Raifu et al., 2023). It also provides insight into the way predictors can influence the conditional distribution entirely, especially when the endogenous exploratory variable and the entrenchment of individual effects are found in the model (Awosusi et al., 2022).

The model of quantile regression can be expressed as follows:

$$Q_y(\theta/X_{it}) = \alpha_i + \delta_i q(\theta) + X'_{it}\beta + Z'_{it}\gamma q(\theta) \quad (1)$$

where X_{it} represents the vector of independent variables, $\alpha_i + \delta_i q(\theta)$ signifies the quantile – θ fixed effect for an individual country (i). Given the above model, the quantile regression via moment applied can be formed as follows:

$$(HGT|X8X)Q_y(\theta/X_{it}) = \alpha_i + \delta_t + \beta_1 BTC_{it} + \beta_2 ETH_{it} + \beta_3 UCRY\ Price_{it} +$$
$$\beta_4 UCRY\ Policy_{it} + \beta_5 ICEA_{it} + \beta_6 CS_{it} + \beta_7 GB_{it} + \beta_8 FX_{it} + \beta_9 IS_{it} + {}_{it} \quad (2)$$

Subsequently, each model was examined across various quantiles (5%, 10%, 25%, 50%, 75%, 90%, 95%), divided into three market conditions – bearish (5%–25%), normal (50%), and bullish (75%–95%), following the studies by Raifu et al. (2023), Nusair and Olson (2019), and Widjaja et al. (2024). The quantile regression result interprets how assets (HGT and X8X) perform within varying market conditions, either as diversifiers, safe haven, or hedging assets (Widjaja et al., 2024). The roles of HGT and X8X are interpreted as follows: (1) a significant (insignificant) positive coefficient represents a strong (weak) diversifier in bullish, normal, and bearish markets; (2) a significant (insignificant) negative coefficient represents a strong (weak) safe haven in bearish conditions; (3) a significant (insignificant) negative coefficient represents a strong (weak) hedge in normal and bullish conditions. However, their interpretations toward UCRY price and UCRY policy differ: (1) a significant (insignificant) negative coefficient represents a strong (weak) diversifier in bullish, normal, and bearish markets; (2) a significant (insignificant) positive coefficient represents a strong (weak) safe haven in bearish conditions; (3) a significant (insignificant) positive coefficient represents a strong (weak) hedge in normal and bullish conditions.

3.4 Robustness Tests

Two stages of the robustness test involving Feasible Generalized Least Square (FGLS) and difference Generalized Method of Moment (GMM) were conducted to verify the result's consistency and accuracy across different conditions. FGLS (Fomby et al., 1984) was utilized in response to the detection of heteroskedasticity problems, evidenced by the BreuschPagan/Cook-Weisberg test (Breusch & Pagan, 1979) with a p-value of 0.00. It is typically more effective than Ordinary Least Squares (OLS) and enables the accommodation of both cross-sectional and serial correlation (Bai et al., 2020). Moreover, difference GMM (Arellano & Bond, 1991) was employed in the following stages. The Arellano and Bond difference GMM model enables the estimation of dynamic panel data by utilizing lagged dependent variables as instruments for the endogenous variable, differing from the approach by Blundell and Bond (1998). As a robustness measure, difference GMM remains resilient against failures in auxiliary distributional assumptions that are not directly associated with parameter underestimation and is effective in addressing dynamic panel bias (Ullah et al., 2017).

4. Results and Discussions

4.1 Quantile via Moment Result

In Table 4, the ordinary least squares (OLS) results were found to be aligned with the findings from quantile regression via moment. In the examination of HGT, a positive (negative) significant correlation of HGT with BTC (UCRY Price) in the normal market (50%) was uncovered, highlighting the role of HGT as a strong diversifier. It aligned with a strong diversification role of HGT towards ETH, exhibiting a consistently positive significant result across all market conditions (5%–90%). It follows the earlier research by Akinlaso et al. (2023) emphasizing Islamic gold-backed cryptocurrencies' role as diversifier tools.

Conversely, HGT demonstrated a strong hedging effect against the UCRY Policy in a normal market (50%), evidenced by the significantly positive coefficient corresponding to Mnif and Jarboui (2021) concerning the effectiveness of HGT under high uncertainty conditions. However, relating to ICEA, HGT tended to function as a relatively weak diversifier (hedge) across bearish (5%–25%), normal (50%) and bullish (75%–95%) markets as the results were insignificant, aligning with Erdogan et al. (2022).

For traditional assets, HGT exhibited a significantly negative coefficient (10%–90%) toward Islamic stock indexes, indicating its strong trait as a safe haven (hedge) across the bearish (normal and bullish) market, following Zaman et al. (2023). It is consistent with Ali et al. (2022), which explores Islamic gold-backed cryptocurrencies' attributes to perform as a strong safe haven toward Islamic equities. Meanwhile, no significant relationship was discovered between HGT and other traditional assets (CS, GB, FX). During bearish conditions (5%–25%), HGT only served as a weak diversifier for those

assets. However, in normal conditions (50%), it demonstrated a weak hedging (diversifier) effect for CS and FX (GB) and a weak diversifier (hedging) effect for FX (CS and GB) in a bullish condition (75%–95%). This corroborated Yousaf et al. (2024), who observed a weak influence of Islamic cryptocurrencies on traditional assets.

Consistent with the findings in HGT, a positive significant relationship was also discovered between X8X and BTC (ETH) during normal (50%) and bullish (75%–90%) conditions, indicating its strong diversifier attributes. Meanwhile, its association with UCRY Price, UCRY Policy, and ICEA yielded an insignificant outcome, suggesting limited influence of X8X. In a bearish market (5%–25%), X8X performed as a weak diversifier (safe haven) toward UCRY Price (UCRY Policy and ICEA). Conversely, in

Table 4

Quantile via Moment

	BTC	ETH	UCRY Price	UCRY Policy	ICEA	CS	GB	FX	IS
HGT									
OLS	3.317**	4.781***	5.082	-5.893	6.393	-4.467*	1.027	6.592	-0.163
0.05	-0.154	**0.609***	-3.044	-0.071	2.587	0.286	0.148	0.309	-0.112
0.1	-0.049	**0.423****	2.457	-3.253	1.203	0.171	0.02	-0.031	***-0.126*****
0.25	0.268**	**0.389*****	0.143	-1.15	0.344	0.097	0.169	0.302	***-0.144*****
0.5	**0.415*****	**0.404*****	**-0.78*****	*0.486**	-0.253	-0.019	0.021	-0.001	*-0.114****
0.75	0.32***	**0.532*****	-0.543	0.467	0.25	-0.11	0.019	0.069	*-0.12****
0.9	0.318	**0.507*****	-1.38	2.832	-1.355	-0.28	-0.031	0.493	*-0.137***
0.95	1.263	-0.802	-0.855	6.248	-1	-0.541	-0.423	1.132	-0.167
X8X									
OLS	0.233**	0.365***	-0.818	-0.027	1.047	0.086	0.021	0.151	-0.005
0.05	0.475**	-0.149	-4.779**	1.857	2.077*	0.005	-0.051	-0.0128	0.035
0.1	0.188	0.237	0.148	-1.496	2.341	0.226	-0.156	-0.743	0.024
0.25	0.173	0.384***	0.893	-1.033	0.115	0.454*	-0.064	-0.042	0.009
0.5	**0.347*****	**0.38*****	-0.659	-0.244	0.274	**0.237***	0.026	0.229	-0.003
0.75	0.228*	**0.533*****	-1.599	1.116	-0.88	0.06	0.041	0.171	-0.014
0.9	0.051	**0.826*****	5.556***	-5.688***	1.422	0.015	0.032	0.061	-0.028
0.95	0.433	0.533	0.272	1.103	-3.224	-0.258	0.078	0.459	-0.045

Note. ***, **, * represent significance at the 1%, 5%, and 10% levels, respectively; strong diversifier is marked **in bold**; strong hedge is marked *in italic*; strong safe haven is marked *in **bold and italic***.

normal (50%) and bullish (75%–95%) conditions, X8X exhibited a harmonious role as a weak diversifier and hedge for those indexes. It can be inferred that X8X can serve as both a diversifier and hedge during times of uncertainty (Husain, 2023).

In terms of traditional assets, a positive and significant coefficient between X8X and CS was observed during normal (50%) conditions, which shows the role of X8X as a strong diversifier. Meanwhile, in the bearish (5%–25%) and bullish (75%–95%) markets, X8X only serves as a weak diversifier. X8X also showed a weak connection with GB, FX, and IS. In this case, X8X acts similarly toward GB and FX as a weak safe haven during a bearish market (5%–25%), also a weak diversifier during a normal (50%) and a bullish (75%–95%) market. However, X8X behaves differently toward IS, serving as a weak diversifier in bearish conditions (5%–25%) and a weak hedge in normal (50%) and bullish (75%–95%) conditions, aligning with Ali et al. (2022).

4.2 Robustness Test Result

In Table 5, a coherence of direction and significance between FGLS and diff-GMM was found compared with OLS and quantile regression results. It indicates that the results are robust and remain reliable under various conditions.

Table 5
FGLS and Diff-GMM as Robustness Results

	HGT		**X8X**	
	FGLS	GMM	FGLS	GMM
BTC	3.317**	3.373***	0.234**	0.253**
ETH	4.781***	4.797***	0.366***	0.357***
IS	-0.163	-0.222	-0.006	-0.006
UCRY Price	5.083	4.956	-0.818	-0.841
UCRY Policy	-5.894	-5,814	-0.027	-0,051
ICEA	6.394	6.551	1.047	1.076
CS	-4.468*	-5.518***	0.087	0,101
GB	1.028	1.191	0.021	0.021
FX	6.592*	7.862	0.152	0.185
IS	-0.163	-0.222	-0.006	-0.006
No obs	1280	1280	1280	1280
wald Chi^2	32.25	63.25	102.343	110.03
Prob>Chi^2	0.00	0.00	0.00	0.00

Note. ***, **, * show significance at the 1%, 5%, and 10% levels.

4.3 Discussion

The quantile via moment (Table 4) demonstrated the notable effectiveness of HGT and X8X as strong diversifier tools (Akinlaso et al., 2023). Their significant roles as potential diversifiers, particularly toward Bitcoin and Ethereum, were closely tied to their direct affiliation with Ethereum. HGT and X8X were known as cryptocurrencies supported by the Ethereum environment, employing smart contracts as their blockchain technologies (Hu et al., 2021). Relating to this situation, several studies have highlighted a similar trend in the efficiency of Ethereum-based assets to serve as effective diversifiers toward several financial assets, including the US Dollar and the NFT (Khaki et al., 2023; Kumar & Padakandla, 2023; Havidz et al., 2024a; Meshcheryakov & Ivanov, 2020; Ko & Lee, 2023). Concerning UCRY Price and UCRY Policy, HGT exhibited a strong potential as a reliable diversifier and hedge, especially during normal market scenarios. This efficacy was rooted in the gold-backing nature of Islamic gold-backed cryptocurrencies, which were considered a steady investment amidst the uncertainty (Gubareva et al., 2022; Widjaja et al., 2024). Wu et al. (2019) have highlighted gold's capability in maintaining value stability during the global financial crisis, alongside its positive correlation with the economic policy uncertainty (EPU). In conclusion, gold has the ability to function as a diversifier in the normal market (Wu et al., 2019), aligning with our results. Nevertheless, HGT and X8X exhibited a limited association with environmental concerns, represented by ICEA. With increasing concerns among investors regarding environmental sustainability, it can be inferred that neither HGT nor X8X have contributed positively regarding energy consumption or climate change mitigation. This finding was justified by their reliance on Ethereum, which contributes to high energy consumption and environmental degradation (Erdogan et al., 2022; Corbet et al., 2020b). However, Havidz et al. (2023) anticipated significantly upgrading Ethereum 2.0 to address these environmental problems.

Generally, HGT and X8X displayed a weak correlation with traditional assets, especially with GB and FX. This trend was attributed to the contrasting principles and regulatory framework governing Islamic gold-backed cryptocurrencies in comparison to GB and FX. Islamic gold-backed cryptocurrencies were classified as halal commodities complying with the Sharia principles, which prohibited the receipt of benefit/interest/riba and involvement of speculation (Wiwoho et al., 2024). Conversely, GB represents a loan from investors to the government with the expectation of earning interest (fixed or floating rate) (Diebold & Li, 2006). Similarly, FX involves the currency exchange utilizing the floating exchange rate that is often associated with speculation (Dominguez & Panthaki, 2006; Frankel, 1982; Lyons, 2002). Therefore, the involvement of riba reception and speculation in GB and FX has contradicted Islamic law, justifying the weak association toward HGT and X8X. HGT and X8X also behave differently with IS, especially in normal and bullish markets. It is largely attributed to the inadequate regula-

tory framework and limited governmental oversight governing the former (Wiwoho et al., 2024). It undermines legal protections and diminishes investor and consumer confidence, preventing Islamic gold-backed cryptocurrencies from being perceived with the same level of stability as IS (Abdullahi, 2021; Havidz et al., 2024b).

An intriguing finding was made regarding the tendency of HGT as a strong safe haven (hedge) during bearish (normal and bullish) periods for Islamic stock indexes, following OGC (Ali et al., 2022). Meanwhile, X8X demonstrated a propensity to function as a strong diversifier for conventional stock indexes under normal conditions. The differing behavior between HGT and X8X was attributed mainly to their distinct characteristics. Unlike HGT, which was solely backed by gold, X8X was backed by both gold and eight flat currencies, resulting in different price dynamics and risk profiles (Mnif & Jarboui, 2021). Previously, Dobrynskaya (2014) affirmed the ability of flat currencies to hedge against the fluctuations of conventional stock index value. Therefore, the incorporation of flat currencies in X8X indirectly influences the inclination of X8X toward conventional stock indexes. The integration of flat currencies in X8X not only highlights X8X as an alternative investment but also introduces a novel framework for developing a new digital asset, i.e., Central Bank Digital Currencies (CBDCs).

4.4 The Potential of Central Bank Digital Currencies (CBDCs)

As the central bank begins to advance its digital currency project, Islamic gold-backed cryptocurrencies can be a key lesson to boost confidence in the development process. The principle of linking stable coins as digital assets to other financial assets underpins the concept of both Islamic gold-backed cryptocurrencies and central bank digital currencies (CBDCs). Amid rising concerns about gold's volatility and limited supply (Shafiee & Topal, 2010), along with environmental issues in the cryptocurrency ecosystem (Corbet et al., 2020b; Erdogan et al., 2022), connecting blockchain-based stablecoins to local currencies will enhance stability and sustainability. The pseudonymous nature of blockchain systems will play a crucial role in offering anonymity to enhance users' security (Kus Khalilov & Levi, 2018). Bakong, the first live blockchain-based national payment system developed by Soramitsu for Cambodia, has demonstrated how tying currencies' value to a digital system could facilitate the creation of domestic stable coins that enhance cross-border payment efficiency and reduce the reliance on foreign currencies (Vollmar & Wening, 2024). Meanwhile, countries like the Bahamas, China, and Uruguay have implemented or piloted CBDCs, reporting benefits such as (1) reduced payment costs; (2) improved monetary data regulation; and (3) greater financial stability. However, challenges remain, including (1) financial uncertainty during crises; (2) disruption to traditional banking; and (3) privacy risks tied to anti-money laundering efforts (Wang et al., 2022b).

To successfully integrate Islamic principles into CBDC frameworks, it is critical for policymakers to develop supportive regulatory environments. The growing Islamic fi-

nance can further support this integration by contributing to the design of Sharia-compliant monetary policies, enhancing institutional capacity, and strengthening financial markets. Several key areas such as banking regulation, monetary policy, and ensuring equitable access to digital financial services that align with Sharia will ultimately contribute to the successful implementation of Islamic CBDCs [6].

5. Conclusions, Limitations, and Recommendations

Islamic gold-backed cryptocurrencies have been part of the digital asset landscape since 2017. However, the growth of digital assets has often outpaced the government's ability to regulate them effectively. This regulatory lag creates uncertainty. The government and regulator support are crucial in building investor's trust, thus boosting the investor's confidence up (Havidz et al., 2023).

At the end of 2020, 1,235 sharia scholars represented Islamic Financial Institutions (IFIs). Although the number of sharia scholars is increasing, it is a very small number compared to the total Muslim population. Different aspects and understanding of sharia compliance in regulating the immediate area of Islamic financial systems have also raised the government's concern (Hassan et al., 2022a). The intervention of local ulama (Muslim scholars) also plays a crucial role, as their point of view might lead to the final investment decision-making. The scholars should not only focus on the Islamic law but also open their minds to the emergence of digital assets within the Islamic finance space. Therefore, they can issue new fatwa (Islamic rulings) regulating what can be considered as halal or haram for digital assets. The new entrance of Islamic digital assets is a bright signal to the high-risk profile of faith-based investors.

Rather than being confined to a specific religion, Islamic asset studies emphasize socioeconomic aspects, especially for non-Islamic countries. As adopting new technologies is essential for financial market stability (Soepriyanto et al., 2023), this research could shape the government's stance on Islamic digital assets. Policymakers could also craft regulations that secure these assets, such as Sharia compliance certification. A definitive government position, supported by firm regulations, will enhance investors' confidence in decision-making. The uncovered roles of HGT and X8X serve not only as investment alternatives for faith-based investors but also shed light on the broader development of digital assets.

This research is limited by (1) its exclusive focus on OIC countries, overlooking insights from other regions; (2) emphasizing HGT and X8X, which may not fully represent the broader landscape given their limited utility for B2B and internal transactions in 2024; (3) comparisons restricted to Islamic gold-backed cryptocurrencies; (4) limited policy and regulatory establishment; and (5) involving a limited range of financial assets. Therefore, future research could (1) broaden its scope to other regions, especially non-OIC countries, where digital asset adoption is more pronounced; (2) utilize the latest Islamic cryptocurrencies, i.e., Islamic Coin (ISLM); (3) compare Islamic gold-

backed cryptocurrencies with non-sharia compliance gold-backed cryptocurrencies; (4) conduct comprehensive surveys to understand investor behavior and digital asset adoption; and (5) incorporate other financial assets, such as Islamic bonds to assess the potential financial attributes of Islamic gold-backed cryptocurrencies toward Islamic assets.

Notes

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