Provide an Optimization Model for Assessing Entry Risk Digital Currency to the Islamic Banking Currency Portfolio in Iran[1]

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ABSTRACT

Digital currency is a virtual form of currency that relies on encryption principles to authenticate transactions. It represents the first decentralized electronic payment system, successfully addressing the challenge of double-spending in virtual currencies. The primary objective of digital currency is to streamline financial and monetary processes without the need for intermediaries like banks. In this context, governments and banks are unable to exert significant control over this form of currency. As of now, Iranian Islamic banking lacks established regulations regarding the use of digital currencies, leading to various risks associated with the use of foreign currencies by banks and the country as a whole. The research conducted initially evaluates the risks linked to a currency portfolio utilized by banks in Iran, employing the value-at-risk approach. Subsequently, the study incorporates digital currency into the portfolio and reassesses the associated risks, ultimately presenting an optimal hybrid portfolio model. The research findings indicate a reduction in the risk of the hybrid portfolio compared

to the original mixed portfolio. This suggests that the inclusion of digital currency in the portfolio has a risk-mitigating effect, emphasizing its potential benefits in financial strategies and risk management.

INTRODUCTION

The adoption of digital currency in Islamic banking in Iran aims to address the risks associated with traditional currency transfer methods, such as different prices, lengthy transfer processes, and high SWIFT fees. Digital currency offers advantages such as enabling quick and low-cost payments irrespective of geographical locations through the internet. Moreover, the decentralized nature of digital currency transactions makes them less susceptible to tracking, potentially easing international financial transfers under sanctions.

Some authorities have acknowledged the use of digital currency as a means of ensuring economic integrity and compliance with the law. Given these considerations, the research seeks to explore the potential of safe investment in digital currency within the context of Islamic banking in Iran. This involves evaluating the impact of digital currency on currency portfolios within Iranian banks, considering factors such as risk, efficiency, and optimization.

The primary objectives of the research are as follows:
1. Assess the risk and return associated with the existing currency portfolio.
2. Examine the impact of incorporating digital currency into the currency portfolio in terms of risk and return.

By addressing these questions, the research aims to provide insights into the optimal combination of digital currency with other currencies in the portfolios of Iranian banks. This analysis will contribute to understanding the risk-return profile and potential benefits of integrating digital currency into traditional currency portfolios.

MATERIALS AND METHODS

To conduct the research, first, the price changes of digital currency and other currencies used in Iranian banking have been extracted. Then, the price changes of digital currency and the currencies of EUR, CNY, TRY, AED, INR, RUB, KRW, and JPY were extracted in terms of USD in the 3-year period from 2016 to 2018. Considering the fluctuations of exchange rates during a three-year period, the aim is to estimate the amount of VaR for a time horizon of 10 days in the future. It is also assumed that the desired level of confidence is 95%. The steps of measuring the value at risk and creating an optimal portfolio for investing in digital currencies will be as follows (Rai and Saeedi, 2013).

Step 1) The rate of return based on the daily price is calculated discretely based on the formula of equation (4) $R_{i,t}$ is the return of asset (i) on the (t) day and $P_{i,t}$ is the price of the asset (i) on the (t) day

$$R_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \qquad (4)$$

Step 2) After calculating the daily yield of each currency, the statistical indicators of the mean and standard deviation of the daily yield of currencies will be determined.

Step 3) Using equation (5), the value at risk is calculated:

$$VAR_i = M_i \sigma_i Z_\alpha \sqrt{T} \qquad (5)$$

(i,j) are the number of currencies (assets), VAR_I is the value at risk for investing in the (i) currency, M_i is the market value of the (i) currency or the (i) currency rate on the last day for which information is available, σ_i is the standard deviation of the daily return for the (i) currency, Z_α is a point on the normal probability diagram for which the desired error will be α% ($Z_{0/05} = Z_\alpha = 1/645) = 1.645$), $\sqrt{T}$ is the studied time interval in the future ($\sqrt{T}$ is equal to 10 days in the future has been)

Step 4) Calculating the covariance of the daily return of two currencies

Step 5) Calculate the total return of the existing portfolio using equation (6)

$$R_T = \sum_{i=1}^{5} W_i \bar{R}_i \qquad (6)$$

R_T is the total return of the existing currency portfolio, W_I is the current share (weight) of the (i) currency (for i=1,2,3,3,4,5) in the currency portfolio, $\bar{R}_i$ is the average daily return of the (i) currency (for i=1,2,3,3,4,5)

Step 6) The optimal value at risk for the entire currency portfolio can be calculated using the following relationship (7):

$$VaR = \sigma_p^2 = \sum_{i=1}^{5} \sigma_i^2 W_i^2 + \sum_{j=1}^{5} \sigma_j^2 W_j^2 + 2 \sum_{i=1}^{5} \sum_{j=1}^{5} W_i W_j COV(i,j) \qquad (7)$$

$VaR = \sigma_p^2$ value at risk of the entire currency portfolio, $\sum W_i$, the total share or weight of currencies (assets (i) (for i = 1,2,3,4,5) in the optimal portfolio that must be calculated. (Rai and Saeedi, 2013).

Step 7) Calculate the optimal value of σ_p^2 and W_i using model (2)

In the implementation of the linear programming model (2), the goal is to take into account the share (weight) of each currency and calculate the total return of the existing currency portfolio (R_T), what is the weight of each currency (w_i) so that the total risk of investment in the currency portfolio reaches the lowest level. Therefore, by placing the relevant numbers in the above model, it is possible to minimize the amount of investment risk in the currency portfolio. (Rai and Saeedi, 2013).

$Min \quad S_P^2$

S.t

$$\sum_{i=1}^{5} W_i \bar{R}_i \geq R_T$$

$$\sum_{i=1}^{5} W_i = 1 \qquad\qquad (2)\text{Model}$$

$$w_i \geq 0 \qquad i = 1,2,\dots,n$$

After obtaining the optimal weight value used in the portfolio of currencies based on covariance coefficients using Lingo software, it is placed in the value at risk formula $VAR_i = M_i \sigma_i Z_\alpha \sqrt{T}$ and The minimum loss or risk is obtained based on the desired time horizon.

RESULTS AND DISCUSSION

The average, standard deviation of daily returns, and value at risk related to 8 currencies and digital currencies separately have been calculated using Excel software and are presented in Table (1). In Table (1), digital currency exhibits the highest average daily return. Additionally, the value at risk for 8 foreign currencies and digital currency, with an error margin of 0.5% over the next 10 days, has been calculated using the last daily rate of 2018 and is expressed in USD.

Table 1. Statistical indicators and value at risk of foreign currencies and digital currency in the period of 3 years from 2016 to 2018 (10^{-3}) (research findings)

Name of Currency	AED	INR	RUB	TRY	KRW	JPY	CNY	EUR	Digital Currency
Days studied	1097	1097	1097	1097	1097	1097	1097	1097	1097
Average daily yield	0/0	0/0	0/6	0/6	0/1	0/1	0/1	0/1	2/7
Standard deviation	0/1	7/3	2/2	4/3	10/8	0/4	4/5	3/4	40/7
Value at risk	2/9	2657	823/2	119/8	6296	277/5	161/7	15/6	7933

After calculating the value at risk, the covariance related to the return of two currencies was calculated, which can be seen in table (3).

Table 2. Variance-covariance matrix of daily returns of currencies and digital currency from 2016 to 2018 (10^{-6}) (research findings)

	EUR	CNY	JPY	KRW	TRY	RUB	INR	AED	Digital Currency
EUR	21/5	3/9	9/1	11/7	-5/0	-1/7	-0/3	0/0	2/9
CNY		5/6	0/20	0/48	-0/26	-0/05	0/04	0/0	-1/4
JPY			33/3	6/1	-1/0	-2/8	0/1	0/0	-3/6
KRW				30/3	-9/8	-0/3	1/2	0/0	5/4
TRY					131/5	-1/5	-1/13	0/0	-48/6
RUB						84/6	1/1	0/0	-10/7
INR							9/5	0/0	-3/6
AED								0/002	0.0
Digital Currency									1658

After calculating the variance-covariance matrix, we first measured the total return and optimal risk values related to the weights of 8 currencies using Lingo software. Then, we added the digital currency to the portfolio of 8 currencies and again calculated the total return and optimal risk values of the created portfolio. The results of the calculations are presented in Table (4). It should be noted that the weight of the 8 currencies is considered equal to 0.125, and the weight of the 8 currencies with the digital currency is considered equal to 0.111.

Table 3. Total portfolio return and optimized values extracted from Lingo software for currencies with digital currency between 2016 and 2018 (research findings)

Name of Currency	AED	INR	RUB	TRY	KRW	JPY	CNY	EUR	Digital Currency	Total
Currency return $W_i \bar{R}_i (10^{-4})$	0/0	0/0	0/75	0/75	0/125	0/125	0/125	0/125	-	2.0
optimal weights of currencies $\langle W_i^* \rangle$	0/170	0/0	0/234	0/0	0/0	0/0	0.595	0/0	-	6/379
portfolio return with digital currency $W_i \bar{R}_i (10^{-4})$	0/0	0/0	0/667	0/667	0/111	0/111	0/111	0/111	3/0	4/78
Optimum portfolio weights with digital currency $\langle W_i^* \rangle$	0/0	0/083	0/332	0/0	0/0	0/0	0.511	0/0	0.07	1/861

According to the optimal values obtained in table (4), the measurement of the value at risk related to 8 currencies and the portfolio created with digital currency will be according to the following calculations:

Value at risk related to 8 currencies:

VAR= √6/3795×1/645×√10 = $13.1390

Value at risk related to the portfolio created with digital currency:

VAR= √1/861×1/645×√10 = $7.0981

The above results indicate that with a 95% probability in a time horizon of 10 days in the future for the portfolio of 8 currencies in the amount of 13.1390 dollars, and for

the portfolio created in combination with digital currency in the amount of 7.0981 will not bring more losses.

The difference between these two values at risk indicates that, with the addition of digital currency to the portfolio of foreign currencies, the amount of risk has decreased to 6/0409$.

Table 4. The amount of difference in the value at risk related to the portfolio of 8 currencies and the portfolio created with digital currency (research findings)

VAR (8 currencies)	VAR ((8 currencies in combination with digital currency	Amount of difference
13/1390$	7/0981$	6/0409$

CONCLUSION

As observed in the calculations related to the findings of the research, adding digital currency to the portfolio of currencies in Iranian banks reduced the overall risk of the portfolio. The research results confirm that investing in digital currencies by Iranian banks can help reduce the risk in their currency investments when combined with foreign currency portfolios. According to the research, incorporating digital currency into the portfolio of foreign currencies led to a reduction in the value at risk by $6.0409.

The absence of laws related to digital currency transactions in Iran may prevent investors from benefiting from the advantages of these currencies. The enactment of laws pertaining to the use of digital currencies can influence the risk and return of the bank's currency portfolio. In times of political sanctions, these types of currencies can be leveraged to counteract political restrictions.

Suggestions for future research:
- Calculate the value at risk related to the digital currency portfolio using different methods and compare them with the current method.
- Evaluate different types of digital currencies in the currency portfolio of banks in terms of their impact on risk and return.

Keywords: Digital currency, Islamic Banking, Portfolio Optimization, Foreign Exchange Portfolio, Risk.

JEL Classification: G110, E40, F310.