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MODELING A CRYPTOCURRENCY INVESTMENT PORTFOLIO AND EFFECTS OF ADDING CRYPTOCURRENCIES TO PORTFOLIO

Introduction

Globalization, unrestrained growth of money markets, general computerization and development of IT technologies have led to the emergence in our society of a great number of additional institutions, financial instruments and new forms of human interaction. One of such institutions in the modern world is digital money. This paper deals with the subtypes of digital currencies — the category of "cryptocurrencies". The growing importance of the problems of assessing and analyzing risks in the cryptocurrency markets for direct or portfolio investment necessitates the use of mathematical methods and rigorous theoretical approaches to the problems of risk assessment using modern information technologies to process large volumes of information and timely issue of investment decisions. The distribution of funds between different securities leads to the formation of an investment portfolio. Due to this the investor reaches a certain level of return and risk. This is the main advantage of portfolio investing as opposed to investing in individual securities. The following tasks are set in the work: definition of basic concepts, economic essence of cryptocurrencies, history of origin and ways of interaction with them; research and justification of typical risk measures for assessing the attractiveness of a cryptocurrency asset, their calculation and analysis; analysis of investment portfolio optimization models; construction and research of economic and mathematical models of optimization of the cryptocurrency investment portfolio, while minimizing the risk using G. Markowitz model, Quasi-Sharp model and Huang-Litzenberger approach [1].

The purpose of this work is analysis of existing approaches to evaluate the ratio of return and risk of portfolio investment, comparison of economic and mathematical models to find the optimal portfolio and prove the economic effect of the combination of portfolio investment in traditional assets and cryptocurrencies.

Literature overview

Modern Portfolio Theory (MPT) states how an investor with a high risk aversion value can develop an investment portfolio to maximize return based on existing market risk. Markowitz (Portfolio Selection, 1952) revealed that by establishing Efficient Frontier, can know the level of return from each level of risk. Measurement of selected asset allocation based on sharpe ratio value of each allocation. Sharpe ratio proposed by William Sharpe (1994) which describes the level of return earned from each measure of risk in the investment. The higher the sharpe ratio the better the return, but not necessarily the optimal portfolio diversification. From the various allocations that describe the return and sharpe ratio, then formed Efficient Frontier diagram illustrating the X axis as a risk and Y axis as a return. The point in this hyperbola diagram is then described as the best option for investors to invest according to their own utility level. This method will ultimately minimize the risk of deviation than if only selecting a particular asset. Investors should remain cautious because of the risks that exist in Bitcoin and only allocate small portions into it (Wu and Pandey, 2014).

One of Bitcoin's criteria as a new investment asset is Correlation of returns: Price Independence. In terms of optimal portfolio formation, correlation becomes an important thing. Burniske and White (2016) calculated the correlation between Bitcoin with S & P 500, Gold, US Bonds, US Real Estate, Oil, and Emerging Market Currencies. Bitcoin will grow and become a differentiator among other assets and can potentially transform the financial world. Baur, Hong and Lee (2016) analyzed the return and correlation of Bitcoin compared to 16 other assets including stocks, bonds, energy, currency, and precious metals. The result is that Bitcoin has the highest return and standard deviation compared to other assets of 7.6%. Associated with the correlation, similar to many previous studies, they found no significant correlation between Bitcoin and other assets. Eisl, Gasser and Weinmayer (2015) analyzed the effect of Bitcoin in the portfolio.

Assets used include stocks, fixed income, money market, property, and commodities. From the historical data determined, the highest asset allocation of Bitcoin is 7.69% is in the portfolio where the load of each asset is the same. This portfolio generates a monthly average return of 1.93%. The result concludes that the allocation of Bitcoin in the portfolio brings good influence in the investment portfolio.

Results

The price of the 10 largest cryptocurrencies by the level of capitalization at the beginning of 2019 from the best online source of up-to-date CoinMarketCap [2] information was used for calculations and analysis. Daily statistics were used during the period from October 2017 to December 2018 inclusive. For further calculations, the daily yield of cryptocurrencies was calculated in this paper, which was calculated on the basis of the USD price using the logarithmic yield formula. At the beginning of 2019, the 10 largest cryptocurrencies by market capitalization were selected, namely: Bitcoin (BTC), Ripple (XRP), Ethereum (ETH), EOS (EOS), Bitcoin Cash (BCH), Tether (USDT), Stellar (XLM), Litecoin (LTC), TRON (TRX), Cardano (ADA). The task of building effective portfolios is set as follows: from the selected set of cryptocurrencies, it is necessary to form optimal investment portfolios with appropriate values of return and risk, provided that risk is minimized at a given level of profitability [5].

Assume that the daily return on the portfolio is 0.10% (this rate of return will be applied to all models for a fair and clear comparison). We optimize the portfolio diversification task for cryptocurrencies under consideration. The risk of an optimal investment portfolio formed by the Markowitz model is 1.28%. Only 4 of them (Tether (USDT) 78%, Stellar (XLM) 13%, TRON (TRX) 6%, EOS (EOS) 3%) are in the portfolio of 10 different cryptocurrencies and Tether (USDT) holds the largest share as a cryptocurrency with minimal initial risk. This is logical because risk minimization is the basis.

After the implementation of the Huang-Litzenberger approach, we can see that portfolios have scales with negative values, because the conditions of this method declare the absence of restrictions on positions in the portfolio and permission to open both long (buy) and short (sell) positions in cryptocurrencies [4]. These are the main differences between this method and the classic Markowitz model. The risk of the optimal investment portfolio formed is 0.71%, which is significantly less than the result of the Markowitz model with the same level of return.

By implementing the Quasi-Sharp model, we get the risk of an optimal portfolio formed at 0.49% and a greater variety of cryptocurrencies in the portfolio.

To plot the efficient frontier, a number of iterations were made to obtain a plurality of risk-return ratios. The graph of efficient frontier for built portfolios using models is shown in Fig. 1.
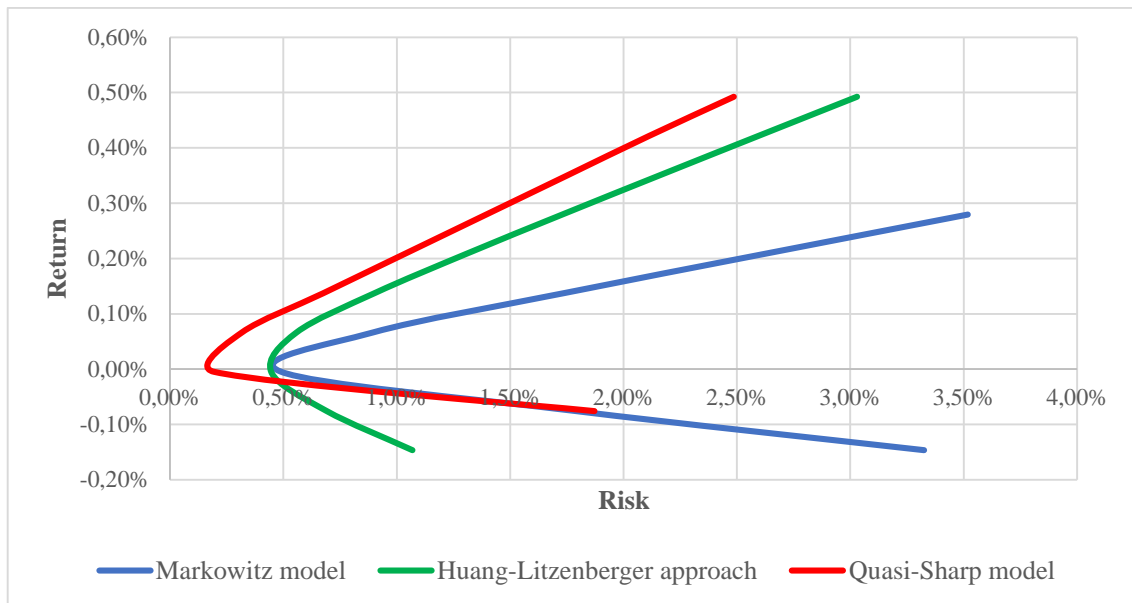

Figure 1. Efficient frontiers on cryptocurrency portfolios obtained in various ways

Source: compiled by the author based on his own calculations

In Fig. 2 shows a graph of the efficient frontiers of two cryptocurrency portfolios and two mixed portfolios (formed by the addition of traditional assets — ETFs (SPY, MDY, IJR, IEF, LQD, SPX)).
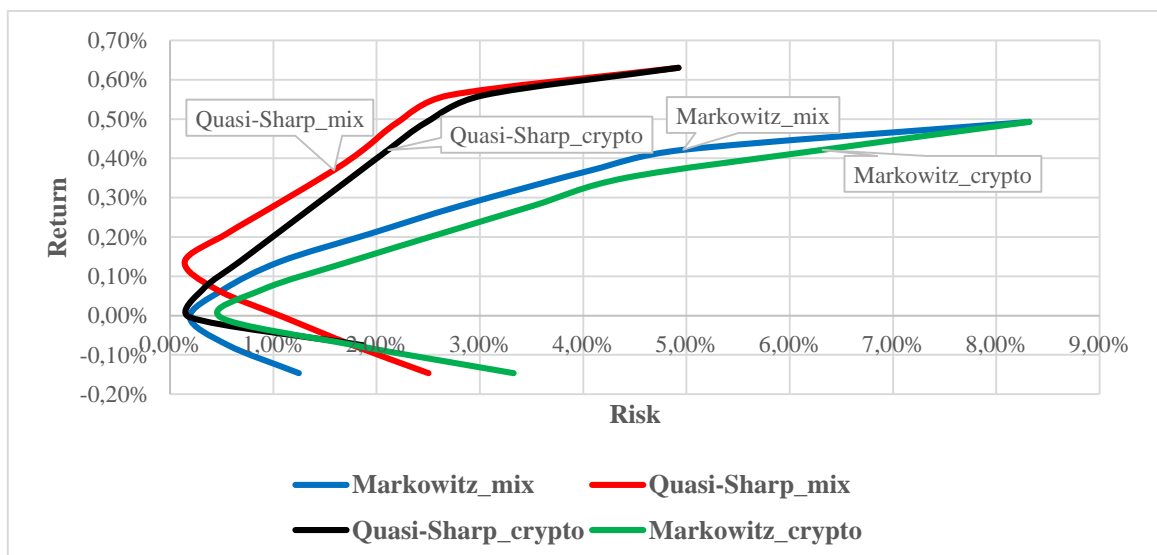

Figure 2. Efficient frontiers on cryptocurrency and mix portfolios obtained in various ways

Source: compiled by the author based on his own calculations

Conclusions

From Fig. 2 it can be concluded that, overall, the lines of efficient mixed portfolio frontiers are higher than the same cryptocurrency-based models. This traces the economic effect of adding traditional assets to cryptocurrency portfolios, where an investor may receive greater returns per unit of risk. This is especially evident in the graph on very low yield and risk areas near the beginning of the coordinate axis, where mixed portfolios are higher than cryptocurrency, and in high risk areas where there is a significant difference in portfolio returns. It is still more advantageous for an investor to choose a mixed portfolio because environmental factors do not so clearly affect traditional types of assets and are more stable than cryptocurrency behaviors, making this type of investment the most optimal and diversified [3].

Portfolio investment involves regular evaluation and effective management of portfolios. Nowadays portfolio investment is developing dynamically, constantly improving both theoretical provisions and practical methods and approaches.

References

1. Christodoulakis, G. A. "Bayesian Optimal Portfolio Selection: the Black-Litterman Approach" (November, 2002).
2. Coin Market Cap. Crypto-currency market capitalization. Retrieved from http://coinmarketcap.com/
3. Eisl, Alexander and Gasser, Stephan and Weinmayer, Karl, Caveat Emptor: Does Bitcoin Improve Portfolio Diversification? (June 3, 2015).
4. Gangwal Shashwat. Analyzing the Effects of Adding Bitcoin to Portfolio. International Journal of Economics and Management Engineering 10: 3519–32 (2016).
5. Mary Jackson and Mike Staunton. Advanced modelling in finance using Excel and VBA, published by Wiley (2001).