

Vlasta
Roška
Marko
Otročak

**PRINOSI NA INVESTICIJSKA
ULAGANJA:
KRIPTOVALUTE ILI ETF**

**RETURNS ON INVESTMENT:
CRYPTOCURRENCIES OR ETF**

SAŽETAK: Velika volatilnost tržišta kapitala i tržišta kriptovaluta, uz sveprisutnu inflaciju, stavlja pred investitore svakodnevnu neizvjesnost u povrat na svoju investiciju. Cilj ovog rada je bio istražiti prinos na investiranje u kriptovalute, kao visokorizičnu investiciju u usporedbi s investiranjem u S&P 500 indeksni fond, odnosno europsku inačicu Vanguard 500 indeksnog fonda, kao investiciju relativno nižeg rizika. Istraživanje je pokazalo da je, bez obzira na visoku volatilnost tržišta, na uloženih 10.000,00 USD portfelj kriptovaluta pokazao veći ostvareni prinos u odnosu na Vanguard 500 za 2.368,66% za razdoblje od 2017. do 2021. godine, odnosno za 1.150,75% za razdoblje od 2017. do 2022. godine. Investitori trebaju dobro poznavati karakteristike svoje investicije, rizike te moguće prinose. Uz dobru diverzifikaciju svog investicijskog portfelja, investitori mogu ostvariti zadovoljavajuće prinose uz smanjenu izloženost riziku.

KLJUČNE RIJEČI: investicije, ROI, kriptovalute, S&P 500, ETF Vanaguard 500

ABSTRACT: The high volatility of the capital market and the cryptocurrency market, along with the omnipresent inflation, creates an everyday uncertainty for investors regarding returns on their investments. The purpose of this paper was to research returns on investing in cryptocurrencies as a high-risk investment, compared to investing in the S&P 500 index fund, or the European equivalent, the Vanguard 500 index fund, as a relatively low-risk investment. The research showed that, regardless of the high market volatility, the cryptocurrency portfolio showed a higher return on invested USD 10,000.00 in relation to the Vanguard 500 by 2,368.66% from 2017 to 2021, i.e., by 1,150.75% from 2017 to 2022. Investors should have a good knowledge of the characteristics of their investments, the risks, and potential returns. With a good diversification of their investment portfolio, investors can generate satisfying returns with decreased risk exposure.

KEY WORDS: investment, ROI, cryptocurrencies, S&P 500, ETF, Vanguard 500



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Vlasta Roška, *izvanredni profesor, Libertas International University* address: Trg J. F. Kennedyja 6, 10000 Zagreb, Croatia e-mail: vroska@libertas.hr

Marko Otročak, *Libertas International University* address: Trg J. F. Kennedyja 6, 10000 Zagreb, Croatia e-mail: motrocak@student.libertas.hr

UVOD

U doba sveprisutne inflacije, pada životnog standarda, investitori traže nove mogućnosti ulaganja da bi ne samo očuvali vrijednost svoga ulaganja nego i povećali svoje bogatstvo. Ako investitori žele veći prinos na svoja ulaganja, moraju prihvatiti i veći rizik.

Investitori danas sve više ulažu u investicijske fondove i kriptovalute uz klasične oblike ulaganja u dionice, obveznice, plemenite metale. Velika volatilitnost tržišta kapitala i kriptovaluta investorima predstavlja problem u odabiru visokoprotabilnih ulaganja.

Prema Arneriću i Mateljanu (2019, str. 452), “temeljne se funkcije tržišta kriptovaluta mogu klasificirati analogno tržištu kapitala: mobilizacija štednje, pružanje likvidnosti, određivanje cijena, alokacija resursa, omogućavanje dugoročnih investicija i kontinuirana dostupnost sredstava”. O značaju tržišta kriptovaluta za globalnu ekonomiju govori i procjena Svjetskog ekonomskog foruma, prema kojoj će do 2027. godine 10% globalnog bruto društvenog proizvoda biti pohranjeno na *blockchain* mreži, odnosno biti sačinjeno od kriptovaluta (World Economic Forum, 2015).

Iako na tržištu kapitala vlada velika volatilitnost, početkom ožujka 2023. godine na Wall Streetu (Hrportfolio, 2023) Dow Jones je ojačao 1,05 posto, dok je S&P 500 porastao za 0,76 posto, a Nasdaq indeks za 0,73 posto. Londonski FTSE indeks ojačao je 0,37 posto, dok je frankfurtski DAX porastao za 0,15 posto, a pariški CAC za 0,69 posto.

Burzovni indeksi uključuju kompanije s najvećom tržišnom kapitalizacijom u nekoj zemlji. Svaka burza na svijetu, samim time i svaka država, ima po nekoliko burzovnih indeksa. Burzovni indeksi omogućuju praćenje, ali i mjerenje uspješnosti određene burze ili države. Ulaganjem u određeni indeksni fond investitori tako mogu uložiti u dionice raznih kompanija koje su u određenom burzovnom indeksu. Ulaganje u

INTRODUCTION

In times of omnipresent inflation, lowering living standards, investors are seeking new investment opportunities, not only to preserve the value of their investment but also to increase their wealth. If investors want to increase their returns on investment, they need to accept higher risks.

Besides the traditional investments in stocks, bonds, precious metals, investors today are investing in investment funds and cryptocurrencies. The high volatility of the capital market and the cryptocurrency market represents an issue for investors when choosing high-profit investments.

According to Arnerić and Mateljan (2019, p. 452), the fundamental functions of the cryptocurrency market can be classified analogously to the capital market: savings mobilisation, provision of liquidity, price setting, allocation of resources, enabling long-term investments and continued availability of funds. The World Economic Forum estimations also highlights the significance of cryptocurrencies for global economy by saying that 10% of the global gross domestic product will be stored on the blockchain network, i.e., in the form of cryptocurrencies by 2027 (World Economic Forum, 2015).

Although there is high volatility on the capital market, in the beginning of March 2023, the Wall Street (Hrportfolio, 2023) showed that the Dow Jones grew stronger by 1.05%, while the S&P 500 increased by 0.76%, and the Nasdaq index by 0.73%. The London's FTSE index grew stronger by 0.37%, while the Frankfurt's DAX increased by 0.15%, and the Parisian CAC by 0.69%.

Stock market indexes comprise companies with the highest market capitalisation in a country. Each stock market in the world, and each country in the world, holds several stock market indexes. Stock market indexes enable the monitoring, as well as measuring the success of a specific stock market or country. By investing in a specific index fund investors can invest in shares of various companies that make up a specific stock index. Investing in

indeksne fondove nosi i manji rizik od ulaganja u pojedinačne dionice. Budući da se ne može ulagati direktno u burzovne indekse, investitori ulažu u indeksne fondove ili ETF-ove (engl. *Exchange-Traded Funds*) koji prate određene indekse. Investitori imaju mogućnosti investirati u više od nekoliko tisuća ETF-ova, koji omogućuju širokodiverzificirano ulaganje u dionice određenog tržišnog indeksa.

Kriptovalute, od svoje pojave 2009. godine u obliku bitcoina, kao prve u potpunosti decentralizirane digitalne valute, unijele su promjenu na financijskom tržištu. Rast vrijednosti bitcoina, a zatim i ostalih, alternativnih kriptovaluta, kao i cjelokupnog tržišta, privukao je mnoge i znatno proširio mogućnosti ulaganja za investitore. Visoka volatilnost sa sobom donosi i relativno visok rizik ulaganja u kriptovalute te tako donosi potencijal visokog povrata na ulaganje, ali i rizik potpunog gubitka uloženi sredstava za one koji su spremni preuzeti takav rizik. U usporedbi s tržištem kriptovaluta, tržište dionica smatra se manje riskantnim ulaganjem te investitori neskloni preuzimanju količine rizika prisutne na tržištu kriptovaluta preferiraju ulaganje na tradicionalnim financijskim tržištima, iako je i ono, kao i svako ulaganje, izloženo riziku. Iako volatilno, tržište kriptovaluta kod nekih je ulagača prepoznato i kao određena vrsta osiguranja od globalnih političkih i ekonomskih nesigurnosti te njihovog utjecaja na tradicionalna financijska tržišta.

Cilj ovog rada je istražiti prinos na investiranje u kriptovalute, kao visokorizičnu investiciju zbog visoke volatilnosti tržišta kriptovaluta u usporedbi s investiranjem u S&P 500 indeksni fond, odnosno europsku inačicu Vanguard 500 indeksni fond, kao investiciju relativno nižeg rizika.

Jedan od najpoznatijih svjetskih indeksa je S&P 500. Danas investitori mogu kupiti sve dionice S&P 500 i ostvariti dividendu od svih sastavnica odjednom putem ETF-ova. S obzirom na to da izravno ulaganje u indeks nije moguće, za to je izabran indeksni fond Vanguard S&P 500

index funds also brings lower risk than investing in individual shares. Since it is impossible to invest directly in stock indexes, investors invest in index funds or ETFs (Exchange-Traded Funds) that follow specific indexes. Investors have the possibility of investing in several thousand ETFs, which enable a widely diversified investment in shares of a specific market index.

Since their emergence in the form of Bitcoin in 2009 as the first completely decentralised digital currency, cryptocurrencies have brought a change in the financial market. The rise in value of Bitcoin and then other, alternative cryptocurrencies, as well as the entire market, appealed to many and significantly expanded investment opportunities for investors. The high volatility is accompanied with a relatively high cryptocurrency investment risk, thus having the potential of high return on investment, but also the risk of complete loss of invested funds for those who are willing to take the risk. Compared to the cryptocurrency market, the stock exchange market is considered as lower risk investment, and investors who are unwilling to take the risks related to the cryptocurrency market prefer investing in traditional financial markets, although these too, as well as any investments, create risk exposures. Despite being volatile, for some investors, the cryptocurrency market represents a kind of an insurance from the global political and economic uncertainties and their effect on traditional financial markets.

The purpose of this paper is to research return on investment in cryptocurrencies as high-risk investment, due to the high volatility of the cryptocurrency market as opposed to investing in the S&P 500 index fund, or the European equivalent, the Vanguard 500 index fund as a relatively low-risk investment.

One of the most famous world indexes is the S&P 500. Today, investors can buy all S&P 500 shares and generate a dividend from all constituents via ETF at the same time. Considering that a direct investment in the index is not possible, the

ETF, koji nastoji vjerno zrcaliti sastav S&P 500 indeksa. S&P 500 indeks, odnosno indeksni fond uzeti su za usporedbu jer se S&P 500 indeks smatra jednim od najvažnijih dioničkih indeksa globalno, a njegove performanse imaju značajan učinak na kretanje cjelokupne ekonomije SAD-a i posljedično ostatka svijeta. Koliko je reprezentativan za trendove u ekonomiji SAD-a i globalno govori i činjenica da ukupna tržišna kapitalizacija kompanija S&P 500 indeksa čini nešto više od 80% ukupne tržišne kapitalizacije svih dionica na tržištu SAD-a (S&P Global, 2022). Isto tako, u usporedbi s ulaganjem na tržištu kriptovaluta, ulaganje u S&P 500 indeksni fond svakako je investicija nižeg rizika te se smatra pogodnom dugoročnom investicijom. Kao i kod svake druge investicije niskog rizika, očekivani prinosi ovakvih fondova nisu visoki. Vanguard S&P 500 prati indeks S&P 500 i jedan je od najvećih fondova na tržištu u koji mogu ulagati i europski investitori.

Uz mlado tržište kriptovaluta veže se i visoka volatilnost. Nedostatak osiguranja je posebno riskantan za ulagače koji ulažu znatna sredstva na tržištu kriptovaluta, što može rezultirati vrlo visokim gubitcima. Primjer takvih gubitaka je potpuni kolaps stabilne kriptovalute TerraUSD. Kolaps te kriptovalute izbrisao je nešto više od 275 milijardi američkih dolara u samo 24 sata (Nikkei Asia, 2022).

Zbog velike volatilnosti tržišta svaki investitor pri odabiru strategije investiranja treba voditi računa o ključnim faktorima kao što su količina dostupnih sredstava za ulaganje, ročnost investicije, količina rizika koju su spremni preuzeti te cilj ulaganja. Nobelovac Markowitz u svojoj teoriji modernog portfelja pokazuje da je razumno očekivati veći povrat na investiciju preuzimanjem većeg rizika te je za svakog ulagača ključno da ozbiljno uzme u obzir rizik koji prihvaća (Burniske i Tatar, 2017). Iz toga je proizašla i hipoteza koja glasi: *Postoji statistički značajna razlika između prinosa od ulaganja u kriptovalute kao rizičnije investicije u odnosu na*

Vanguard S&P 500 ETF was selected for this purpose, which tends to model the composition of the S&P 500 index. The S&P 500 index, i.e., index fund, was selected for comparison because it is considered as one of the most significant stock exchange indexes globally, and its performances have a significant effect on the entire economy of the USA and consequently the rest of the world. The vast extent of its representation of trends in the US economy and globally is evident in the fact that the total market capitalisation of companies in the S&P 500 index comprises over 80% of the total market capitalisation of all shares in the US market (S&P Global, 2022). Also, compared to investing in the cryptocurrency market, investing in the S&P 500 index fund is certainly a lower-risk investment and is considered a favourable long-term investment. As with any other low-risk investment, the expected returns for these funds are not high. The Vanguard S&P 500 accompanies the S&P 500 index and is one of the largest funds on the market available to European investors.

The young cryptocurrency market is also accompanied by high volatility. The lack of insurance is especially risky for investors who invest considerable resources in the cryptocurrency market, which can result in substantial losses. An example of such loss is the collapse of the TerraUSD cryptocurrency. This collapse wiped out over 275 billion US dollars in only 24 hours (Nikkei Asia, 2022).

Due to the high market volatility, when choosing investment strategy, each investor needs to consider key factors such as the amount of available investment resources, maturity, the amount of risk they are willing to take and the purpose of investment. In his theory on modern portfolio, the Nobel prize winner Markowitz shows that it is reasonable to expect a higher return on investment by taking a higher risk, and that is essential for any investor to seriously consider the risk they are willing to take (Burniske and Tatar, 2017). Springing from this is the hypothesis that states that: *There is a statistically*

ulaganje u indeks S&P 500 odnosno ETF Vanguard 500 kao manje rizične investicije.

Rad se sastoji od pet poglavlja, uključujući uvod i zaključak. Nakon uvoda, drugo poglavlje donosi teorijski okvir ovog istraživanja. Treće poglavlje prezentira korištenu metodologiju i izvore podataka, dok se u četvrtom poglavlju analiziraju dobiveni rezultati.

TEORIJSKI OKVIR

Tržište kapitala, kao i tržište kriptovaluta, pod stalnim je utjecajem sustavnih i nesustavnih rizika, odnosno čimbenika. Sustavni i nesustavni čimbenici (Van Horne i Wachowicz, 2008) predstavljaju stalan rizik investitorima, koji ih pokušavaju premostiti. Učinkovitom diverzifikacijom portfolija nesustavni rizici, odnosno čimbenici mogu se smanjiti ili čak eliminirati, za većinu dionica, jer čine oko 50 posto ukupnog rizika (Van Horne i Wachowicz, 2008, str. 105).

Nepredvidivo i slučajno kretanje cijena nije dokaz tržišne iracionalnosti, već posljedica djelovanja inteligentnih investitora koji se natječu u otkrivanju značajnih informacija prije nego što ih ostatak tržišta postane svjestan (Bodie et al., 2008, str. 558). Na volatilnost tržišta kapitala i kriptovaluta utječu i anomalije kao što su učinak veličine, učinak malog poduzeća, učinak siječnja, pretjerana reakcija tržišta, pretjerana kolebljivost, povratak prema prosječnoj vrijednosti. Anomalija pretjerana reakcija tržišta govori da (Mishkin i Eakins, 2003, str. 283) istraživanja pokazuju da cijene dionica mogu pretjerano reagirati na objave u vijestima te da se pogreške u određivanju cijena mogu ispraviti jedino polako. Objave li korporacije veliku promjenu u zaradi, recimo veliki pad, cijene dionica mogu pretjerano reagirati te, nakon prvotnog znatnog opadanja, mogu porasti natrag na normalnu razinu kroz razdoblje od nekoliko tjedana. Na postojanje pozitivne veze između nesustavnih rizika upućuje i istraživanje Merkaša i Roške (2021). Istraživanje je dalje potvrdilo snažan

significant difference between returns on investment in cryptocurrencies as a higher-risk investment in relation to investing in the S&P 500 index, i.e., the ETF Vanguard 500 as a lower-risk investment.

The paper comprises five sections, including the introduction and the conclusion. After the introduction, the second section contains the theoretical framework of the research. The third section presents the methodology and source of data, while the fourth analyses the obtained results.

THEORETICAL FRAMEWORK

The capital market, as well as cryptocurrency market, is under constant impact of systematic and unsystematic risks, i.e., factors. Systematic and unsystematic factors (Van Horne and Wachowicz, 2008) represent a continuous risk for investors who try to overcome them. By effective portfolio diversification unsystematic risks, i.e., factors, can be reduced or even eliminated for the majority of stocks, because they make up 50% of total risk (Van Horne and Wachowicz, 2008, p. 105).

Unpredictable and random price movements are not proof of market irrationality, but a consequence of intelligent investor activity upon competing for the discovery of significant information before it is picked up by the rest of the market (Bodie et al., 2008, p. 558). The volatility of the capital and the cryptocurrency markets is also affected by anomalies such as size effect, small enterprise effect, January effect, market overreaction, excess volatility, reversion to the mean. Research into market overreaction anomaly (Mishkin and Eakins, 2003, p. 283) states that share prices may overreact to media publications and that errors in price setting can only be corrected slowly. If corporations publish a substantial change in profit, a plunge for example, the share prices may overreact and, after the first considerable drop, they can increase back to normal over a period of several weeks. The existence of a positive relationship between unsystematic risks is also indicated in research by Merkaš and Roška

utjecaj informacija koje nisu tehničke prirode, a u direktnoj su vezi s vrijednošću bitcoina.

U vrijeme inflacije investitori traže ulaganja koja bi poslužila kao sigurna utočišta za očuvanje njihova bogatstva. Mogu li kriptovalute biti sredstvo ograničavanja rizika ulaganja, odnosno sigurno utočište, bilo je predmet mnogih istraživanja. Urquhart i Zhang (2019) zaključuju u svom istraživanju da je bitcoin sigurno utočište u nesigurnim vremenima, ali samo za određene valute kao što su CAD, CHF i GBP. Wang et al. (2019) u svom istraživanju došli su do zaključka da je bitcoin sigurno utočište u odnosu na međunarodne burzovne indekse, a Bouri et al. (2017) u odnosu na dionice izlistane na azijskom tržište u vrijeme pada njihove vrijednosti. Bitcoin i litecoin mogu biti korisni kao zaštita zbog negativne ili nulte korelacije s drugim klasama imovine, dok ripple pokazuje osobine za diverzificiranje ulaganja. Zbog svoje velike intrinzične volatilnosti, kriptovalute će uvijek dodati varijancu univarijantnom portfelju, čime se povećava rizik portfelja. Bitcoin poboljšava Sharpeov omjer portfelja koji se sastoji samo od zlata za 60,1%. U svim slučajevima kriptovalute (Wong et al., 2018) ne poboljšavaju Sharpeov omjer S&P 500. Porast Sharpeovog omjera za obveznice i zlato, ali ne i za dionice, objašnjavaju činjenicom da portfelji dionica teoretski već imaju visoke povrate, stoga kriptovalute neće poboljšati Sharpeov omjer. Arnerić i Mateljan (2019) u svom istraživanju analiziraju dva vodeća reprezentanta tržišta kapitala i tržišta kriptovalutama, odnosno burzovni indeks S&P 500 i bitcoin. Rezultati istraživanja pokazuju da je korelacija između dvaju tržišta vremenski promjenjiva te svoje najveće negativne vrijednosti poprima krajem 2015., sredinom 2016. i početkom 2017. godine, upravo kada je volatilnost S&P 500 indeksa bila najveća. Time se potvrđuje da je tržište kriptovaluta sigurno utočište u razdobljima visoke volatilnosti na američkom tržištu kapitala te može pridonijeti diverzifikaciji rizika i to samo kratkoročno, jer se u dugome

(2021). The research also confirmed a strong impact of non-technical information, which are in direct relation to Bitcoin value.

At times of inflation, investors seek investments that would serve as safe havens for the preservation of their wealth. Whether cryptocurrencies could be means of limiting investment risk, i.e., a safe haven, was subject of a lot of research studies. Urquhart and Zhang (2019) form a research conclusion that Bitcoin is a safe haven in uncertain times, but only for specific currencies such as CAD, CHF, and GBP. In their research, Wang et al. (2019) reached a conclusion that Bitcoin was a safe haven in relation to international stock indexes, and Bouri et al. (2017) in relation to shares listed on the Asian market at the time of their value decrease. Bitcoin and Litecoin can be useful as protection due to the negative or zero correlation with other asset types, while Ripple displays characteristics for diversification of investment. Due to their high intrinsic volatility, cryptocurrencies will always add a variance to a univariate portfolio, thus increasing the portfolio risk. Bitcoin improves the portfolio Sharpe ratio that consists of only gold by 60.1%. In all cases, cryptocurrencies (Wong et al., 2018) do not improve the S&P 500 Sharpe ratio. The increase of Sharpe ratio for bonds and gold, but not for shares, is explained by the fact that theoretically stock portfolios bring high returns, therefore, cryptocurrencies will not improve the Sharpe ratio. In their research, Arnerić and Mateljan (2019) analyse two leading representatives of the capital market and cryptocurrency market, i.e., the stock index S&P 500 and Bitcoin. The research results indicate that the correlation between the two markets is changeable with time and that it featured the strongest negative values in the end of 2015, the middle of 2016, and the beginning of 2017, exactly when the volatility of S&P 500 index was the highest. This confirms that the cryptocurrency market is a safe haven in periods of high volatility on the US capital market and can contribute to risk diversification and only in the short term, because in the long term the correlation

roku očekuje korelacija približno jednaka nuli. U dostupnoj, uglavnom novijoj literaturi nema jasnoga konsenzusa jesu li i koliko tržišta kapitala i tržišta kriptovaluta korelirana. Analizirajući stupanj negativne koreliranosti ili nekoreliranosti između navedenih tržišta u kratkom i dugom roku, može se utvrditi jesu li tržišta kriptovaluta sigurno utočište u turbulentnim vremenima (engl. *safe haven*), dobar diverzifikator ili mogu poslužiti i zaštiti (engl. *hedging*). Zaključci postojećih istraživanja (Bouri et al., 2017; Urquhart i Zhang, 2019; Wang et al., 2019) nisu jedinstveni. Wang et al. (2019) su spoznali da kriptovalute nemaju svojstvo ograničavanja rizika, ali su sigurno utočište u odnosu na međunarodne burzovne indekse koje karakterizira visoka likvidnost i visoka tržišna kapitalizacija DJI30 i Nasdaq. S druge strane, Cheah i Fry (2015) pokazuju da je bitcoin kriptovaluta suštinski sklona spekulativnim mjehurićima (engl. *speculative bubbles*).

Na koja tržišta je bolje ulagati da bi se ostvario veći prinos, sljedeće je pitanje koje se razmatra kroz brojna istraživanja. Analiza na tržištima temeljena na nepravilnostima (Hadhri i Ftiti, 2019) naglašava potencijalne prilike za diverzifikaciju portfelja i investicijske strategije. Rezultati pokazuju da se čini da su ulaganja u tržišta u razvoju bolja od ulaganja u razvijena tržišta tijekom vremena i za različite vremenske horizonte, posebno u kriznim razdobljima.

Rezultati istraživanja (Thomas et al., 2022) pokazuju da, iako granična tržišta nude veće mogućnosti diverzifikacije od tržišta u nastajanju, ulaganja u granična tržišta preporučuju se ulagačima s velikom sklonošću riziku. Azijsko-pacifička tržišta u razvoju postižu bolje rezultate od graničnih tržišta u poboljšanju performansi portfelja. Na performanse europskih graničnih tržišta negativno je utjecala pandemija COVID-19. Općenito, azijsko-pacifička tržišta dionica pružaju veći potencijal za diverzifikaciju od svojih europskih pandana. Novija istraživanja Liewa i Hewletta (2017) pokazuje da bitcoin osigurava diverzifikaciju bolje od portfelja koji se sastoji od tradicionalne imovine.

is expected to be approximately equal to zero. In the available, mostly recent literature there is not a clear consensus on whether and to what extent the capital markets and the cryptocurrency markets are correlated. By analysing the level of negative correlation or non-correlation between the mentioned markets in the short term and the long term, we can determine whether cryptocurrency markets are safe havens in turbulent times, a good diversifier or whether they can also serve as hedging. The conclusions in existing research (Bouri et al., 2017; Urquhart and Zhang, 2019; Wang et al., 2019) are not unique. Wang et al. (2019) found out that cryptocurrencies do not have a feature of limiting risks but are a safe haven in relation to international stock indexes characterised by high liquidity and high market capitalisation DJI30 and Nasdaq. On the other hand, Cheah and Fry (2015) showed that Bitcoin is a cryptocurrency essentially prone to speculative bubbles.

The next question considered in numerous research studies is which markets are the best for higher returns. Irregularity-based market research (Hadhri and Ftiti, 2019) highlights potential opportunities for portfolio diversification and investment strategies. The results show that it seems that investing in emerging markets is better than investing in developed markets over time and for different time horizons, especially during crises.

Research results (Thomas et al., 2022) show that, although frontier markets offer more opportunities for diversification than emerging markets, investing in frontier markets is recommended to investors with higher proneness to risk. The Asian-Pacific emerging markets achieve better results than frontier markets in enhancing portfolio performances. The COVID-19 pandemic adversely affected the performances of the European frontier markets. In general, the Asian-Pacific stock markets offer a higher potential for diversification than their European counterparts. More recent research by Liewa and Hewletta (2017) shows that Bitcoin ensures diversification better than a portfolio consisting of traditional assets.

U svom istraživanju, Chincarini et al. (2023) simulirali su izvedbu S&P EWI u odnosu na S&P 500 tijekom proteklih 13 godina i nisu pronašli uvjerljive dokaze o tome da je jedan indeks bolji od drugoga. Međutim, pokazalo se da se usporedni prinosi i volatilnosti dvaju indeksa mogu razlikovati tijekom tržišnih ciklusa. Godišnji promet tržišne kapitalizacije S&P EWI bio je 29%, naspram 5% u S&P 500, od siječnja 1990. do listopada 2002. To pruža priliku za osmišljavanje strategija širenja ili zaštite. Analiza atribucije i korelacije pokazala je da S&P EWI ima veću izloženost premiji vrijednosti od S&P 500.

Sve investicije nose određeni stupanj rizika. Kao opće pravilo, ulaganja s višim rizikom imaju veći potencijalni povrat, ali veći rizik znači i povećanu vjerojatnost da investicija neće ostvariti taj povrat, osobito kratkoročno. Kada su tržišni povrati niski, odnosno β in the tails (Bandi et al., 2020), obično se izvješćuje o visokim betama na tržištima. Rizik ulaganja potaknut je višim sustavnim rizikom povezanim s povratom diskontinuiteta.

Svi investitori trebaju biti svjesni svih značajnih rizika ulaganja (mcfairbanks.com, 2023). Prvi je rizik diverzifikacije. Ako investitor svu svoju imovinu stavi u jednu vrstu ulaganja (jednu "košaricu"), njegov portfelj je u opasnosti ako tom ulaganju padne vrijednost. Svaka vrsta imovine ima svoje loše godine i zato je potrebno diverzificirati portfelj imovine na različite vrste imovine, jer se tada gubitak na jednoj vrsti imovine može nadoknaditi na drugoj vrsti imovine. Drugi rizik je rizik inflacije. Rizik inflacije je mogućnost da povrat na ulaganja ne prati inflaciju te da vrijednost uložene imovine s vremenom opada i gubi na vrijednosti.

Tečajni rizik je prisutan kod međunarodnih investicija, gdje fluktuacija tečajeva može donijeti gubitke, ali i profit. Zbog neutralizacije tečajnog rizika potrebno je ulagati na viševalutna tržišta ili imati investicije u valuti svoje zemlje. Rizik likvidnosti je rizik da investitor neće moći

In their research, Chincarini et al. (2023) simulated the performance of S&P EWI in relation to S&P 500 in the period of the last 13 years and did not find convincing evidence that one index is better than the other. However, it was shown that the comparable returns and volatility of the two indexes may differ during market cycles. The annual turnover of market capitalisation of S&P EWI was 29%, as opposed to 5% in the S&P 500, from January 1990 to October 2002. This offers an opportunity to conceptualise strategies for expansion or hedging. The attribution and correlation analysis showed that the S&P EWI has a higher exposure to premium value than the S&P 500.

All investment is exposed to a certain level of risk. As a general rule, investments with higher risk exposure bring a higher potential return, but higher risk also means an increased probability that the investment will not generate a return, especially in the short term. When market returns are low, i.e., β in the tails (Bandi et al., 2020), larger market betas are reported. The risk of investment is initiated by higher systematic risk related to return of discontinuity.

All investors need to be aware of all significant investment risks (mcfairbanks.com, 2023). The first is the diversification risk. If an investor places all their assets into one form of investment (one "basket"), their portfolio is in danger should the value of the investment drop. Each type of asset suffers a bad period, and this is why it is necessary to diversify the asset portfolio to various types of assets because the loss on one type of asset can be compensated with another type of asset. Another risk is the inflation risk. Inflation risk is the possibility that a return on investment does not follow inflation and that the value of invested assets decreases in time and loses value.

Exchange rate risk is related to international investments, where exchange rate fluctuation can lead to loss, but also profit. Due to the neutralisation of exchange rate risk, it is necessary to invest in multi-currency markets or hold investments in

pristupiti svojim sredstvima onda kada su mu potrebna. Zbog toga se ulaže samo ono što investitorima neko određeno vrijeme neće trebati, odnosno investitori trebaju stvoriti novčane rezerve za hitne slučajeve. Međutim, ako se sredstva povlače u nepovoljno vrijeme, investitor može pretrpjeti kapitalni gubitak. Regulatorni rizik je rizik promjene zakonskih propisa u budućnosti koja može utjecati na profit investicije. Ovaj rizik je još jedan od razloga zbog kojeg portfelj ulaganja treba biti fleksibilan. Tržišni rizik je rizik da ulagač doživi gubitak zbog čimbenika koji utječu na cjelokupno poslovanje financijskih tržišta, što uključuje negativan sentiment ulagača, prirodne katastrofe, recesije, ekonomske utjecaje i političke promjene. Tržišni rizik općenito se ne može eliminirati diverzifikacijom, jer se javlja u svim vrstama imovine. Kamatni rizik je mogućnost da će na ulaganje negativno utjecati pad ili porast kamatnih stopa.

Povrat na ulaganja i volatilnosti tržišta predmet su istraživanja mnogih studija (Jordà et al., 2019; Bryan et al., 2022). U svom istraživanju, Jordà et al. (2019) su zaključili da povrat na nekretnine i dionice u prosjeku iznosi 7% godišnje te da je siguran povrat dosta niskih 1-3% godišnje u mnogim zemljama. Investitori su uvijek zainteresirani za očekivani povrat i procjenu čimbenika koji na njega mogu utjecati (Greenwood i Shleifer, 2013; van Binsbergen i Koijen, 2015; Martin i Wagner, 2019). Tržišta kriptovaluta novonastala su tržišta koja se razvijaju sukladno s razvojem informacijskih tehnologija te se pojavljuje mogućnost odljeva kapitala s tradicionalnih tržišta kapitala na tržišta kriptovaluta. Keller i Sholz (2019) kao kategorije koje utječu na ponašanje i odluke ulagača o investiranju u kriptovalute navode makrofinancijske indikatore poput prinosa državnih obveznica SAD-a i cijene nafte na svjetskom tržištu, indikatore tržišta kriptovaluta koji uključuju tehničke indikatore i indikatore trgovanja te općenit pozitivan ili negativan odnos prema tržištu i broj objava, odnosno aktivnost

one's own domestic currency. Liquidity risk is a risk meaning that an investor will not be able to access their funds when they need it. This is why investors invest the funds that they will not need for a specific period of time, i.e., the investors need to make emergency monetary reserves. However, if the funds are withdrawn at an unfavourable time, the investor might suffer a capital loss. Regulatory risk is a risk of future changes in legislation that may affect investment profit. This risk is one more reason why an investment portfolio needs to be flexible. Market risk is a risk of investor suffering a loss due to factors impacting the entire activity of financial markets, which includes negative investor sentiment, natural disasters, recessions, economic impacts, and political changes. Market risk cannot in general be eliminated by diversifying because it can appear in all types of assets. Interest rate risk is the possibility that an investment will be adversely affected by a decrease or an increase of interest rates.

Return on investments and market volatility are subject of research studies (Jordà et al., 2019; Bryan et al., 2022). In their research, Jordà et al. (2019) concluded that return on real estate and shares is 7% per year on average, and that a secure return is considerably low 1-3% per year in a lot of countries. Investors are always interested in expected return and estimation of factors that may impact it (Greenwood and Shleifer, 2013; van Binsbergen and Koijen, 2015; Martin and Wagner, 2019). Cryptocurrency markets are new markets developing in accordance with information technology development and there is a possibility of capital outflows from traditional capital markets into cryptocurrency markets. Keller and Sholz (2019) mention macro-financial indicators as categories affecting investor behaviour and decisions related to cryptocurrency investments, such as US government bond yields and oil prices on the global market, cryptocurrency market indicators including technical indicators and trading indicators and the general positive or negative attitude towards the market and the

na društvenim mrežama povezanu s određenom kriptovalutom. Mlado i volatilno tržište kriptovaluta primamljivo je onima koji su u potrazi za visokim profitom i u toj potrazi su se spremni izložiti većem riziku. Potencijalni ulagači osobito trebaju obratiti pozornost na volatilnost tržišta, s obzirom na to da volatilnost tržišta kriptovaluta uglavnom proizlazi iz emocionalnih poteza ulagača, a ne promjene u osnovnim postavkama pojedine kriptovalute (Lee et al., 2018).

Value at Risk kao mjera tržišnog rizika indicira da je rizičnost kriptovaluta u odnosu na dionice (Sajter i Binder, 2021, str. 202-203), mjerena odabranim indeksima, indeksom S&P 500 i indeksom kriptovaluta CRIX, oko tri do četiri puta veća od rizičnosti dionica, no prinosi su bili preko pet puta veći. Sharpeov omjer kod dionica je oko 1,5 puta manji, odnosno prinos po jedinici rizika je oko 150% veći pri ulaganju u kriptovalute.

Rezultati studije Bakry et al. (2021) sugeriraju da, iako bitcoin može biti potencijalan diverzifikator za investitore željne rizika, investitori neskloni riziku trebaju ograničiti izloženost bitcoinu u svojim portfeljima. Ulaganje u izvedenice kriptovaluta je u znatnom porastu u proteklih nekoliko godina te je u srpnju 2022. godine činilo 69% ukupnog prometa na tržištu kriptovaluta (Howcroft, 2022). Iako bi dodatak mogućnosti trgovanja izvedenicama mogao pridonijeti volatilnosti tržišta, sigurno je da će tržište kriptovaluta dugoročno biti prisutno (Wong et al., 2018).

S pojavom i rastom tržišta kriptovaluta te sve većim brojem investitora koji su svoj novac odlučili uložiti u kriptovalute, bitno je znati što su neke od prednosti, a što neki od nedostataka kriptovaluta, što je prikazano u Tablici 1. Neke od najčešće spominjanih prednosti kriptovaluta u odnosu na fiat novac su svakako decentralizirana priroda kriptovaluta, transparentnost, brzina transakcija, globalna dostupnost, kao i potencijal za visok povrat na ulaganje. Ograničenja pri raspolaganju vlastitim novcem na računu banke

number of publications, i.e., social media activity related to a specific cryptocurrency. The young and volatile cryptocurrency market appeals to those seeking high profits and willing to take on higher risk. Potential investors need to pay special attention to market volatility, considering that cryptocurrency market volatility is caused mostly by emotional moves by investors, and not by changes in the basic settings of an individual cryptocurrency (Lee et al., 2018).

Value at Risk as a market risk measurement indicates that the risk of cryptocurrencies in relation to shares (Sajter and Binder, 2021, p. 202-203), measured by selected indexes, the S&P 500 index and the CRIX cryptocurrency index, is three to four times higher than the risk related to shares; however, the yields were over five times higher. The Sharpe ratio is about 1.5 times lower with shares, i.e., the yield to unit of risk is about 150% higher when investing in cryptocurrencies.

The results of research by Bakry et al. (2021) suggest that, although Bitcoin can be a potential diversifier for risk-prone investors, the risk-averse investors should limit exposure to Bitcoin in their portfolios. Investing in cryptocurrency derivatives has been rising in the last several years and in July 2022 it comprised 69% of total traffic in the cryptocurrency market (Howcroft, 2022). Although the addition of possibility of trading in derivatives could contribute to market volatility, it is certain that the cryptocurrency market will be present in the long run (Wong et al., 2018).

Along with the emergence and growth of cryptocurrency markets and an increasing number of investors deciding to invest in cryptocurrencies, it is noteworthy to state some of the advantages and some of the disadvantages of cryptocurrencies, as shown in Table 1. Some of the most frequently mentioned advantages of cryptocurrencies in relation to fiat money definitely include the decentralised nature of cryptocurrencies, transparency, speed of transactions, global availability as well as the potential for high returns of investment. Limitations

u slučaju rata, financijske krize ili neke druge izvanredne situacije navele su mnoge pobornike kriptovaluta da dostupnost kriptovaluta smatraju jednom od bitnih prednosti kriptovaluta nad fiat novcem. Kao nedostaci kriptovaluta često se navode visoka volatilnost tržišta, tehnička kompleksnost za one koji prvi put pristupaju kriptovalutama, nedostatak pravne sigurnosti i regulacije, ali i opasnost od *cyber* napada i utjecaj rudarenja na okoliš. Relativno visoka volatilnost tržišta kriptovaluta atraktivna je ulagačima i špekulantima u potrazi za brzim i visokim profitom koji su spremni preuzeti veći rizik, no ona isto tako predstavlja opasnost od velikih gubitaka uloženi sredstava. Mnoge postojeće i potencijalne ulagače zabrinjava i mogućnost *cyber* napada te djelomičnog ili potpunog gubitka kriptovaluta. Jedan od najpoznatijih slučajeva *cyber* napada, napad na burzu kriptovaluta Mt.Gox, za posljedicu je imao gubitak 850 tisuća bitcoina (Ryan, 2021).

Wong et al. (2018) smatraju da je zbog znatno negativne korelacije bitcoina sa S&P 500 indeksom

related to disposing one's own money in bank accounts in case of war, financial crisis or another emergency situation have made the availability of cryptocurrency one of the most favoured advantages over fiat money among cryptocurrency advocates. The disadvantages frequently include the high market volatility, technical complexity for those approaching cryptocurrencies for the first time, lack of legal security and regulations as well as risk from cyber-attacks and impact of mining on the environment. A relatively high volatility of the cryptocurrency markets is attractive to investors and speculators seeking fast and high profits for which they are willing to take higher risks; however, it also represents risk of high losses of invested funds. Numerous existing and potential investors are also worried by the potential of cyber-attacks and partial or complete loss of cryptocurrencies. One of the most famous cyber-attack cases, the attack on the Mt.Gox cryptocurrency exchange, caused the loss of 850 Bitcoin (Ryan, 2021).

Wong et al. (2018) consider Bitcoin a favourable investment in the sense of insuring against

TABLICA 1. PREDNOSTI I NEDOSTATCI KRIPTOVALUTA
TABLE 1. ADVANTAGES AND DISADVANTAGES OF CRYPTOCURRENCIES

PREDNOSTI / ADVANTAGES	NEDOSTATCI / DISADVANTAGES
Decentralizacija / Decentralisation	Visoka volatilnost / High volatility
Transparentnost / Transparency	Tehnička kompleksnost / Technical complexity
Brzina transakcija / Speed of transaction	Nedostatak pravne sigurnosti i regulacije Lack of legal security and regulation
Globalna dostupnost / Global availability	Transakcije nisu reverzibilne / Irreversible transactions
Anonimnost / Anonymity	Utjecaj rudarenja na okoliš Mining effect on the environment
Potencijal za visok povrat na investiciju High return on investment potential	Cyber napadi / Cyber attacks

Izvor: Otročak, M. (2022), *Usporedba primosa kriptovaluta i S&P 500 indeksnog fonda*, Libertas međunarodno sveučilište, str. 17
 Source: Otročak, M. (2022), *Usporedba primosa kriptovaluta i S&P 500 indeksnog fonda*, Libertas International University, p. 17

bitcoin povoljna investicija u smislu osiguranja od kretanja klasičnih financijskih tržišta.

Odnos država prema kriptovalutama je različit od države do države, što ulagačima može djelovati zbunjujuće. El Salvador je postao prva država koja je prihvatila neku kriptovalutu kao službeno prihvaćeno sredstvo plaćanja, no dugoročne rezultate takvog eksperimenta tek treba vidjeti. S druge strane, Kina je u potpunosti zabranila trgovanje kriptovalutama. Roška (2016) navodi da svaka država koja želi privući strane investicije to može postići nižom poreznom stopom ili nekom vrstom porezne olakšice. Investicijska strategija i financijska politika povezani su kroz poreze. Investitori, kada se odlučuju za neku investiciju, trebaju poznavati i porezne propise, posebice za oporezivanje kapitalne dobiti. U svijetu, pa i u Europi, je raznolika politika oporezivanja kapitalne dobiti (Enache, 2022). Danska ima najveći porez na kapitalnu dobit, po stopi od 42 posto, zatim slijede Norveška s 35,2 posto te Finska i Francuska s 34 posto. Zemlje koje nemaju porez na kapitalnu dobit su Belgija, Češka, Luksemburg, Slovačka, Slovenija, Švicarska i Turska. Među zemljama s niskim stopama poreza na kapitalnu dobit su Grčka i Mađarska, sa stopom od 15 posto, te Hrvatska sa stopom od 10 posto.

Uz rast tržišta kriptovaluta i sve veći broj *start up* kompanija koje ulaze na tržište te multinacionalne kompanije koje su uvele kriptovalute u svoje poslovanje, mnoge države prepoznale su to kao priliku da povoljnom poreznom politikom privuku investitore. Zemlje poput Malte, Singapura i Švicarske odlučile su poreznim politikama vezanim uz kriptovalute privući privatne i institucionalne investitore kao i kompanije kojima kriptovalute čine bitan dio poslovanja.

METODE ISTRAŽIVANJA

Za potrebe ovog rada korišteni su javno dostupni podatci s internetske stranice CoinMarketCap

movements on traditional financial markets, due to the negative correlation between Bitcoin and the S&P 500 index.

Countries' attitudes toward cryptocurrency differ from country to country, which can be confusing for investors. El Salvador was the first country to accept a cryptocurrency as an official method of payment; however, the long-term effects of such an experiment are yet to be seen. On the other hand, China completely banned cryptocurrency trading. Roška (2016) states that each country seeking to attract foreign investment can do so by lowering tax rates or introducing some type of tax advantages. Investment strategies and financial policies are related through taxes. When deciding on investments, the investors also need to be familiar with tax regulations, especially taxation of capital gains. Both worldwide and in Europe, the policies of capital gains taxation vary (Enache, 2022). Denmark has the highest tax on capital gains at the rate of 42%, followed by Norway with the rate of 35.2%, Finland and France both with 34%. Countries that do not tax capital gains are Belgium, the Czech Republic, Luxemburg, Slovakia, Slovenia, Switzerland, and Turkey. Among countries with low tax rates on capital gains are Greece and Macedonia with a 15% rate and Croatia with a 10% rate.

With the rise of the cryptocurrency markets and an increasing number of start-ups entering the market, as well as multinational companies introducing cryptocurrencies into their business, a lot of countries recognised the opportunity to attract investors with a more favourable tax policy. Countries such as Malta, Singapore and Switzerland introduced tax policies related to cryptocurrencies to attract private and institutional investors as well as companies whose significant business activity relies on cryptocurrencies.

RESEARCH METHODOLOGY

For the purpose of this paper, we used the publicly available data from the internet pages

za cijene kriptovaluta te internetske stranice Vanguard fonda za performanse Vanguard 500 indeksnog fonda i S&P 500 indeksa za razdoblje od 2017. do 2022. godine. Za analizu prinosa kriptovaluta sastavljen je portfelj koji se sastoji od prvih 10 kriptovaluta prema tržišnoj kapitalizaciji.

Ulažacka strategija promatranog hipotetskog portfelja kriptovaluta podrazumijeva ravnomjerno ulaganje u najjačih 10 kriptovaluta prema tržišnoj kapitalizaciji jednom godišnje, na početku svake godine promatranog razdoblja. S obzirom na to da je riječ o *ex-post* analizi kretanja cijena kriptovaluta, ovakvim pristupom sastavljanja portfelja izbjegava se biranje samo uspješnih ili kriptovaluta s iznimno visokim rastom u promatranom razdoblju, jer u tom slučaju rezultati ne bi bili reprezentativni. Kako se tržište kriptovaluta vrlo brzo razvija, tako se iz godine u godinu mijenja i lista vodećih kriptovaluta prema tržišnoj kapitalizaciji. Tako su samo 3 kriptovalute prisutne u portfelju tijekom cijelog trajanja promatranog razdoblja, dok ih je čak 11 prisutno samo jednom.

Performanse S&P 500 indeksa promatrane su putem Vanguard 500 indeksnog fonda (VOO 500), jednog od najsnažnijih fondova koji zrcali kretanje S&P 500 indeksa.

Za svaki portfelj i za svaku godinu izračunavao se prinos na ulaganje po formuli:

$$\text{ROI \%} = \frac{[(\text{Prodajna tržišna cijena ulaganja} - \text{početna tržišna cijena ulaganja}) / \text{početna tržišna cijena ulaganja}] \times 100}{}$$

Godina 2017. ujedno je i godina koja je najsnažnije utjecala na ukupne rezultate, zbog iznimno visokog porasta vrijednosti niza promatranih kriptovaluta, koji najbolje ilustrira činjenica da je najmanji postotni porast cijene promatranih kriptovaluta iznosio 871%, u slučaju MaidSafeCoina. Najveći doprinos rastu cjelokupnog portfelja donijela je kriptovaluta XRP, s porastom cijene od 36000%. U 2018. godini došlo je do sada već poznatog pada tržišta kriptovaluta i tzv. kriptozime. Cjelokupno tržište kriptovaluta doživjelo je pad za nešto više od

of CoinMarketCap for the cryptocurrency prices and the internet pages of the Vanguard fund for the performances of the Vanguard 500 index fund and the S&P 500 index for the period from 2017 to 2022. For the analysis of cryptocurrency yields a portfolio was composed consisting of the first 10 cryptocurrencies according to market capitalisation.

The investment strategy for the observed hypothetical cryptocurrency portfolio entails an even investment into the 10 strongest cryptocurrencies according to market capitalisation once a year, at the beginning of each year of the observed period. Considering that it is an *ex-post* analysis of cryptocurrency price movements, this process of composing a portfolio avoids the selection of only successful cryptocurrencies or those with a considerably high increase in the observed period, because in such a case the results would not be representative. As the cryptocurrency market is fast developing, so the list of leading cryptocurrencies according to market capitalisation changes from one year to another. This is why only three cryptocurrencies are present in the portfolio during the entire observed period, while 11 are present only once.

The S&P 500 index performances were observed via Vanguard 500 index fund (VOO 500), one of the most significant funds that reflects the S&P 500 index movements.

The return on investment was calculated for each portfolio and for each year according to the formula below:

$$\text{ROI \%} = \frac{[(\text{Market selling price of investment} - \text{initial market price of investment}) / \text{initial selling price of investment}] \times 100}{}$$

2017 is also a year that most significantly affected total results, due to the dramatic rise in value of numerous observed cryptocurrencies, best illustrated by the fact that the smallest percentage rise in the price of observed cryptocurrencies was 871%, in the case of MaidSafeCoin. The biggest contribution to the rise of the entire portfolio was the XRP cryptocurrency, the price of which

80% ukupne vrijednosti. Polovina kriptovaluta u portfelju 2018. godine je zabilježila pad cijene između 90% i 96%. Tržišni lider bitcoin, koji je 2018. godinu započeo s cijenom nešto višom od 16.000 američkih dolara, godinu je završio s cijenom od 3.865 američkih dolara. Godine 2019. tržište kriptovaluta bilježi blag oporavak, no portfelj sastavljen prema principu najsnažnijih 10 kriptovaluta prema tržišnoj kapitalizaciji početkom godine godinu je završio s minusom. Najveći rast ponovno je ostvario bitcoin, čije su performanse najzaslužnije za relativno nizak minus portfelja u 2019. godini. Najveći pad vrijednosti zabilježen je u slučaju kriptovalute stellar, koja je u 2019. godini izgubila gotovo 60% tržišne kapitalizacije. U 2020. i 2021. godini zabilježen je snažan oporavak i rast tržišta kriptovaluta. Pandemija COVID-19, zatvaranja cijelih država i gospodarstava mnoge nove investitore su naveli da razmotre investiranje u kriptovalute. Najsnažniji rast cijene u 2020. godini zabilježio je Ethereum. U 2021. godini 10 promatranih kriptovaluta u portfelju ostvaruje dobar rezultat te odražava rast tržišta kriptovaluta u toj godini. Najveći rast, od 1.229%, ostvarila je kriptovaluta Binance Coin. U 2022. godini ponovno je došlo do pada tržišta kriptovaluta. Cjelokupno tržište kriptovaluta doživjelo je pad za nešto više od 80% ukupne vrijednosti. Tržišni lider bitcoin, koji je 2022. godinu započeo s cijenom nešto višom od 47.345 američkih dolara, godinu je završio s cijenom od 16.842 američka dolara. Cjelokupno tržište kriptovaluta doživjelo je drastičan pad vrijednosti. Takva kriza uplašila je mnoge postojeće i potencijalne ulagače u kriptovaluta te je dovela do preispitivanja budućnosti kriptovaluta.

Podatci o rezultatima Vanguard 500 indeksnog fonda javno su dostupni te su preuzeti s internetskih stranica Vanguard fonda. U 2018. i 2022. godini fond VOO 500 ostvario je negativne prinose: -5,20 i -18,02%. Najprofitabilnija godina za investitore bila je 2019., s prinosom od 31,26%, te 2021. godina, s prinosom od 30,93%.

grew by 36000%. 2018 saw the already familiar fall of the cryptocurrency market and the so-called crypto winter. The entire cryptocurrency market experienced a drop in price by over 80% of the total value. Half of the cryptocurrencies in the portfolio recorded a fall in prices by 90 to 96 %. The market leader, Bitcoin, whose initial price was USD 16,000, ended the year with the price of USD 3,865. In 2019 the cryptocurrency market saw a mild recovery, but the portfolio composed in accordance with the principle of strongest 10 cryptocurrencies according to market capitalisation at the start of the year, ended the year in the negative. The biggest growth was again achieved by Bitcoin, whose performances contribute the most to the relatively low portfolio minus in 2019. The largest drop in value was recorded for the Stellar cryptocurrency, which lost almost 60% of its market capitalisation. 2020 and 2021 recorded a considerable recovery and rise in cryptocurrency market. The COVID-19 pandemic, the closing of entire countries and economies led a lot of new investors to consider investing in cryptocurrencies. The most significant rise in price in 2020 was recorded by Ethereum. In 2021, the 10 observed cryptocurrencies achieved good results and maintained the growth of the cryptocurrency market. The highest increase, by 1,229% was achieved by the Binance Coin cryptocurrency. In 2022, there was a drop in the cryptocurrency market. The entire market saw a decrease by over 80% of total value. Bitcoin as the market leader, which started the year with a price of over USD 47,345, ended the year with a price of USD 16,842. The entire cryptocurrency market plummeted in value. The crisis scared a lot of existing and potential investors in cryptocurrencies and led to questioning the future of cryptocurrencies.

The data on the Vanguard 500 index fund results are publicly available and retrieved from the Vanguard fund internet pages. In 2018 and 2022 the VOO 500 fund achieved negative yields: -5.20% and -18.02%. The most profitable year for investors was 2019, with a return of 31.26%, as well as 2021, with a return of 30.93%.

Statistička obrada podataka napravljena je u statističkom programu SPSS. Prikazana je deskriptivna statistika istraživanih elemenata kao i Wilcoxon Signed Ranks Test.

REZULTATI ISTRAŽIVANJA I DISKUSIJA

Rad analizira investiranje u hipotetski portfelj kriptovaluta te njegove performanse u usporedbi s konzervativnijim pristupom i ulaganjem u S&P 500 indeksni fond. U testiranju hipoteze pretpostavimo da je početkom 2017. godine investitor uložio 10.000,00 američkih dolara u hipotetski portfelj kriptovaluta i 10.000 američkih dolara u hipotetski portfelj VOO 500. Krajem svake godine prodao je svoje portfelje te reinvestirao potencijalni prihod početkom svake sljedeće istraživane godine.

Testiranje hipoteze napravljeno je temeljem investiranja u svaki od istraživanih portfelja kriptovaluta i Vanguard 500 fonda u promatranom razdoblju, od 2017. do 2022. godine. Investitor je koristio strategiju ulaganja 10.000 američkih dolara na početku 2017. godine u svaki od portfelja te je svake godine portfelj prodat i početkom sljedeće se cjelokupni iznos dobiven prethodne godine reinvestirao.

U Tablici 2 prikazan je ostvareni prinos ulaganjem početnih 10.000,00 USD te reinvestiranjem dobivenih prihoda u dva portfelja, portfelja kriptovaluta i portfelja VOO 500 za razdoblje od 2017. do 2021. godine i za razdoblje od 2017. do 2022. godine. Portfelj kriptovaluta sastojao se od 10 kriptovaluta s najvećom tržišnom kapitalizacijom. Najveći prinos ostvario je 2021. godine, a najmanji 2018. godine. Povrat na investirano u portfelj kriptovaluta u odnosu na uložene 10.000,00 USD za razdoblje od 2017. do 2021. godine iznosi 3.105,01%, a za razdoblje od 2017. do 2022. godine iznosi 1.029,18%. Drugi je portfelj Vanguard 500 ETF (VOO 500). I ovdje je najveći prinos ostvaren 2021. godine, a najmanji 2018. godine, ali u daleko manjim iznosima. Povrat na investirano u portfelj Vanguard 500

The statistical data analysis was done in the SPSS statistical programme. The descriptive statistics of researched elements is shown as well as the Wilcoxon Signed Ranks Test.

RESEARCH RESULTS AND DISCUSSION

The paper analyses investing in a hypothetical cryptocurrency portfolio and its performances in comparison with the more conservative approach and investing in the S&P 500 index fund. For hypothesis testing, we assumed that at the start of 2017 an investor invested USD 10,000.00 in the hypothetical cryptocurrency portfolio and USD 10,000 in the hypothetical VOO 500 portfolio. At the end of the year, they sold their portfolios and reinvested the potential profit at the beginning of each year in the observed period.

The hypothesis testing was conducted based on investing in each of the observed portfolios, cryptocurrencies and Vanguard 500 fund, in the observed period, from 2017 to 2022. The investor used the investment strategy whereby they invested USD 10,000 at the beginning of 2017 in each of the portfolios, then sold the portfolio at the end of each year and reinvested the entire profit at the beginning of the following year.

Table 2 shows the generated returns of investing the initial USD 10,000 and reinvesting the generated profits in the two portfolios, the cryptocurrency portfolio and the VOO 500 portfolio for the period from 2017 to 2021 and for the period from 2017 to 2022. The cryptocurrency portfolio consisted of 10 cryptocurrencies with the highest market capitalisation. The highest return was achieved in 2021, and the lowest in 2018. The return on investment in the cryptocurrency portfolio, in relation to the invested USD 10,000 for the period from 2017 to 2021 was 3,105.01%, and from the period from 2017 to 2022 it was 1,029.18%. The other portfolio is the Vanguard 500 ETF (VOO 500). The highest return for this portfolio was also achieved in 2021, and the lowest in 2018, but

fonda u odnosu na uloženi 10.000,00 USD za razdoblje od 2017. do 2021. godine iznosi 131,09%, a za razdoblje od 2017. do 2022. godine iznosi 89,44%.

Iz rezultata prikazanih u Tablici 2 je vidljivo da je povrat na investiciju, uz strategiju ulaganja istog i ravnomjerno raspoređenog iznosa u slučaju kriptovaluta, znatno veći kod hipotetskog portfelja kriptovaluta nego u slučaju investiranja u indeksni fond Vanguard 500. Iako je povrat na investiciju veći u slučaju portfelja kriptovaluta, znatno je veći i rizik koji investitor preuzima. Povrat na investiciju indeksnog fonda Vanguard 500, iako znatno niži od povrata na investiciju portfelja kriptovaluta, prihvatljiviji je konzervativnijim investitorima nesklonima preuzimanju visokog rizika. Investitor je ostvario za 2.368,66% veći profit portfelja kriptovaluta od profita ostvarenog u Vanguard 500 u razdoblju od 2017. do 2021. godine, odnosno za 1.150,75% veći u razdoblju od 2017. do 2022. godine.

U Tablici 3 prikazana je deskriptivna statistika istraživanih portfelja.

U Tablici 4 prikazan je Wilcoxon Signed Ranks Test za testiranje hipoteze.

Iz Tablice 4 je vidljivo da postoji statistički značajna razlika ($Z = -2,023$, $p = 0,043$) između ulaganja u kriptovalute i Vanguard 500 (VOO 500) u razdoblju od 2017. do 2021., kao i u razdoblju od 2017. do 2022. godine ($Z = -2,201$, $p = 0,028$).

in considerably smaller amounts. The return on investment in the Vanguard 500 fund portfolio, in relation to the invested USD 10,000, for the period from 2017 to 2021 was 131.09%, and for the period from 2017 to 2022, it was 89.44%.

The results shown in Table 2 illustrate that the return on investment, with the investment strategy of equal and evenly distributed amount in case of cryptocurrencies, is considerably higher in the hypothetical cryptocurrency portfolio than in the case of investing in the Vanguard 500 index fund. Even though the return on investment is higher in the case of the cryptocurrency portfolio, the risk is also considerably higher for the investor. The return on investment in the Vanguard 500 index fund, despite being considerably lower than the return on investment in the cryptocurrency portfolio, is more acceptable to more conservative investors, who are not prone to high risks. The investors generated profit from the cryptocurrency portfolio, which was 2,368.66% higher than the profit generated from the Vanguard 500 portfolio in the period from 2017 to 2021, and 1,150.75% higher in the period from 2017 to 2022.

Table 3 shows the descriptive statistics of the researched portfolios.

Table 4 shows the Wilcoxon Signed Ranks Test for testing the hypothesis.

Table 4 shows a statistically significant difference ($Z = -2.023$, $p = 0.043$) between investing in

TABLICA 2. OSTVARENI PROFIT U PORTFELJIMA
TABLE 2. GENERATED PROFIT IN THE PORTFOLIOS

GODINE PERIOD	KRIPTO PROFIT CRYPTO PROFIT	ROI %	VOO 500 PROFIT	ROI %	% KRIPTO/VOO500 % CRYPTO/VOO500
2017-2021	310.500,62	3.105,01	13.108,69	131,09	2,368.66
2017-2022	102.917,83	1.029,18	8.943,53	89,44	1,150.75

Izvor: obrada autora / Source: Authors

TABLICA 3. STATISTIČKA OBRADA PODATAKA
TABLE 3. STATISTICAL DATA ANALYSIS

DESCRIPTIVE STATISTICS	N	MEAN	STD. DEVIATION	MINIMUM	MAXIMUM	PERCENTILES		
						25th	50th (Median)	75th
PROFIT KRIPTO 17-21 PROFIT CRYPTO 17-21	5	153.183,57	116.014,03	32.416,64	320.500,62	44.507,21	159.806,12	258.548,65
PROFIT KRIPTO 17-22 PROFIT CRYPTO 17-22	6	146.472,61	105.060,10	32.416,64	320.500,62	50.552,50	136.361,98	227.572,66
PROFIT KRIPTO UKUPNO 17-21 PROFIT CRYPTO TOTAL 17-21	1	310.500,62		310.500,62	310.500,62			
PROFIT KRIPTO UKUPNO 17-22 PROFIT CRYPTO TOTAL 17-22	1	102.917,84		102.917,84	102.917,84			
PROFIT VOO 17-21	5	15.873,17	4.741,04	11.464,96	23.108,69	11.779,11	15.048,83	20.379,42
PROFIT VOO 17-22	6	16.384,90	4.421,90	11.464,96	23.108,69	11.936,18	16.349,49	19.984,82
PROFIT VOO UKUPNO 17-21 PROFIT VOO TOTAL 17-21	1	13.108,69		13.108,69	13.108,69			
PROFIT VOO UKUPNO 17-22 PROFIT VOO TOTAL 17-22	1	8.942,53		8.942,53	8.942,53			

Izvor: obrada autora / Source: Authors

Time je potvrđena postavljena hipoteza, koja glasi: Postoji statistički značajna razlika između prinosa od ulaganja u kriptovalute kao rizičnije investicije u odnosu na ulaganje u indeks S&P 500, odnosno ETF Vanguard 500 kao manje rizične investicije.

Dobiveni rezultati u skladu su s rezultatima sličnih istraživanja. Fond S&P 500 (Maverick, 2023) ostvario je prosječan godišnji povrat od 1957. do 31. prosinca 2022. od 10,15%, a za razdoblje od 1957. do kraja 2021. godine 11,88%. Stopa povrata za prvu kriptovalutu bitcoin od 18% (Dasman,

cryptocurrencies and the Vanguard 500 (VOO 500) in the period from 2017 to 2021, as well as the period from 2017 to 2022 ($Z = -2.201$, $p = 0.028$). This confirms the hypothesis that there is a statistically significant difference between returns on investment in cryptocurrencies as a riskier investment in relation to investing in the S&P 500 index, i.e., ETF Vanguard 500 as a less risky investment.

The obtained results are in accordance with results of similar research studies. The S&P 500 fund

TABLICA 4. WILCOXON SIGNED RANKS TEST / TABLE 4. WILCOXON SIGNED RANKS TEST

RANKS		N	MEAN RANK	SUM OF RANKS
VAR00024 – VAR00022 Profit VOO 500 17 – 21 – profit CRYPTO 17 – 21	Negative Ranks	5 ^a	3,00	15,00
	Positive Ranks	0 ^b	0,00	0,00
	Ties	0 ^c		
	Total	5		
VAR00011 – VAR00005 Profit VOO 500 17 – 22 – profit CRYPTO 17 – 22	Negative Ranks	6 ^d	3,50	21,00
	Positive Ranks	0 ^e	0,00	0,00
	Ties	0 ^f		
	Total	6		
VAR00016 – VAR00014 Total profit VOO 500 17 – 21 – total profit CRYPTO 17 – 21	Negative Ranks	1 ^g	1,00	1,00
	Positive Ranks	0 ^h	0,00	0,00
	Ties	0 ⁱ		
	Total	1		
VAR00020 – VAR00018 Total profit VOO 500 17 – 22 – total profit CRYPTO 17 – 22	Negative Ranks	1 ^j	1,00	1,00
	Positive Ranks	0 ^k	0,00	0,00
	Ties	0 ^l		
	Total	1		

- a. VAR00024 < VAR00022
- b. VAR00024 > VAR00022
- c. VAR00024 = VAR00022
- d. VAR00011 < VAR00005
- e. VAR00011 > VAR00005
- f. VAR00011 = VAR00005
- g. VAR00016 < VAR00014
- h. VAR00016 > VAR00014
- i. VAR00016 = VAR00014
- j. VAR00020 < VAR00018
- k. VAR00020 > VAR00018
- l. VAR00020 = VAR00018

TEST STATISTICS¹

	PROFIT VOO 500 17 TO 21 -PROFIT CRYPTO 17 TO 21	V PROFIT VOO 500 17 TO 21 -PROFIT CRYPTO 17 TO 21
Z	-2,023 ²	-2,201 ²
Asymp. Sig. (2-tailed)	,043	,028

¹ Wilcoxon Signed Ranks Test

² Based on positive ranks

2021) pokazala je da postoji značajna razlika u usporedbi sa stopom povrata tečaja, zlata i dionica za razdoblje od 2011. do 2020. godine. U svom istraživanju, Sajter i Binder (2021) utvrdili su da je rizičnost kriptovaluta mjerena indeksom CRIX oko tri do četiri puta veća od rizičnosti dionica mjenom indeksom S&P500, no prinosi su bili više od pet puta veći. U njihovom istraživanju, investitori koji su po strategiji *kupi i drži* kupili portfelj kriptovaluta sredinom kolovoza 2018. i držali ga dvije godine (do sredine kolovoza 2020.) te ga potom prodali ostvarili su prinos od 94%, za razliku od investiranja u portfelj indeksa S&P 500, koji je ostvario prinos od 18%. Iz rezultata dobivenih ovim istraživanjem je vidljivo da je portfelj 10 kriptovaluta s najvećom tržišnom kapitalizacijom daleko većih prinosa u odnosu na Vanguard 500 fond.

ZAKLJUČAK

Pojava kriptovaluta te kasnije i tržišta kriptovaluta dovela je do promjena ekonomske, tehnološke, ali i društvene prirode. Kriptovalute su utjecale na financijska tržišta, ali i na način na koji mnogi pristupaju ulaganju u svoju budućnost te kako uopće percipiraju svoje financijske mogućnosti. Takva promjena utjecala je i na pojavu sve većeg broja malih ulagača s relativno skromnim sredstvima raspoloživim za ulaganje. Potencijal za ostvarenje visokog povrata na uložena sredstva u slučaju kriptovaluta vrlo je jasan, a tome u prilog govore i rezultati ovog istraživanja i potvrda postavljene hipoteze. Iako je tržište kriptovaluta mlado i volatilno, njegov potencijal sve više prepoznaju institucionalni i veliki ulagači.

Iz rezultata je vidljivo da je povrat na investiciju znatno veći kod hipotetskog portfelja kriptovaluta nego u slučaju investiranja u indeksni fond Vanguard 500. Iako je povrat na investiciju veći u slučaju portfelja kriptovaluta, znatno je veći i rizik koji investitor preuzima. Povrat na investiciju indeksnog fonda Vanguard 500, iako znatno niži od povrata

(Maverick, 2023) generated an average annual return from 1957 to 31 December 2022 of 10.15%, and from 1957 to the end of 2021 of 11.88%. The 18% return rate for the first cryptocurrency, Bitcoin, (Dasman, 2021) showed that there is a significant difference in comparison to exchange rate, gold, and stock return rates in the period from 2011 to 2020. In their research, Sajter and Binder (2021) determined that the risk factor for cryptocurrencies, measured by the CRIX index, was three to four times higher than the risk factor for stocks measured by the S&P 500; however, the returns were over five times higher. In their research, the investors who implemented the *buy and hold* investment strategy bought a cryptocurrency portfolio in mid-August of 2018 and held it for two years (mid-August 2020), sold it and achieved a return of 94%, as opposed to investing in the S&P 500 index portfolio, which achieved a return of 18%. The results of this research study show that the portfolio made up of 10 cryptocurrencies with the highest market capitalisation generates considerably higher returns in relation to the Vanguard 500 fund.

CONCLUSION

The emergence of cryptocurrencies followed by the cryptocurrency markets led to economic, technological, but also social changes. Cryptocurrencies affected financial markets, but also the way in which a lot of investors approach investing in their future and how they perceive their financial possibilities. This change impacted the emergence of an increasing number of small investors with a relatively modest means for investment. The potential of generating high returns on investment in the case of cryptocurrencies is highly evident, and also supported by results of this research and the confirmation of the hypothesis. Even though the cryptocurrency market is young and volatile, its potential is increasingly being recognised by institutional and large investors.

na investiciju portfelja kriptovaluta, prihvatljiviji je konzervativnijim investitorima nesklonima preuzimanju visokog rizika.

Ovaj rad pridonosi investitorima koji žele ulagati u kriptovalute ili ETF da bolje razumiju karakteristike, moguće stope povrata, ali i rizike svojih investicija te je ujedno i potvrda općepoznatog pravila da visoki rizik nosi i visoke prinose za ulagače u svim dijelovima svijeta.

Nedostatak ovog rada je mali obuhvat kriptovaluta u portfelju, kao i drugih indeksnih fondova. Za daljnja istraživanja ostaje proširenje broja kriptovaluta u portfelju kriptovaluta, kao i obuhvat većeg broja indeksnih fondova.

Prikazana velika volatilnost tržišta kapitala i tržišta kriptovaluta ukazuje na potrebu diverzificiranja ulaganja, kojim se može smanjiti rizik ulaganja. Međutim, portfelj kriptovaluta je pokazao ROI od 3.105% za razdoblje od 2017. do 2021. godine te nešto manji ROI od 1.029% za razdoblje od 2017. do 2022. godine. Taj potencijal prepoznaje sve veći broj ulagača na tržištu kriptovaluta. Preostaje vidjeti hoće li trend visoke volatilnosti tržišta kriptovaluta ostati prisutan i kako tržište s vremenom bude sazrijevalo te kako će to utjecati na budućnost kriptovaluta kao ulaganja koje predstavlja potencijal za visok povrat uložених sredstava.

The results show that returns on investments are significantly higher for the hypothetical cryptocurrency portfolio than is the case for investing in the Vanguard 500 index fund. Despite the return on investment for the cryptocurrency portfolio being higher, the risk that the investor is exposed to is also significantly higher. The return on investment in the Vanguard 500 index fund, although significantly lower than the return on investment in the cryptocurrency portfolio, is more acceptable to more conservative investors who are not prone to take high risks.

This paper contributes to investors who want to invest in either cryptocurrencies or ETF, by providing a better understanding of their characteristics, possible return rates, but also differences in their investments, at the same time confirming the generally accepted rule that high risk brings higher yields for investors in all parts of the world.

The limitation of this paper is the small number of cryptocurrencies in the portfolio, as well as other index funds. Further research might benefit from expanding the number of cryptocurrencies in the cryptocurrency portfolio, as well as the number of index funds.

The shown high volatility of the capital markets and cryptocurrency markets indicates the necessity of diversifying investment, which can decrease the investment risks. Nevertheless, the cryptocurrency portfolio showed a ROI of 3,105% from the period from 2017 to 2021, and a somewhat lower ROI of 1,029% for the period from 2017 to 2022. This potential is being recognised by an increasing number of investors in the cryptocurrency market. Whether the trend of high volatility of the cryptocurrency market will continue and how the market will mature over time remains to be seen, as well as how this will affect the future of cryptocurrencies as potential investments yielding high returns.

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