Is Bitcoin a good asset for inflation hedging? - A comparison between Bitcoin returns and the inflation rates of the USA, the Euro-Zone, India, Kenya, and Venezuela

Author: Patrick Wissmann
University of Twente
P.O. Box 217, 7500AE Enschede
The Netherlands

ABSTRACT,
With rising inflation rates, cryptocurrencies are attracting more and more retail- and institutional investors. With Bitcoin being the first and largest cryptocurrency in terms of market capitalization many of these investors are asking themselves the same question: "Should I invest in Bitcoin?" The scarcity of Bitcoin, explained by its limited supply and its mining reward that is cut in half approximately every four years, makes many people believe that Bitcoin is an inflation hedge and Bitcoin is often stated as "digital gold". This research will show if this the assumption of Bitcoin being an inflation hedge is true. Therefore, we test whether Bitcoin has inflation hedging capabilities in the economies USA, Euro-Zone, India, Kenya and Venezuela in a monthly time frame with a sample period from October 2014 till May 2022. These economies have been chosen on the basis of "The Chainalysis 2021 Geography of Cryptocurrency Report" by Chainalysis and the calculations of the "Global crypto adoption" by the company TripleA. According to Chainalysis and TripleA these economies are showing a high adoption rate and a great number of cryptocurrency wallets, which makes it interesting to investigate Bitcoin on inflation hedging in these economies. We do so by using the Fisher Coefficient and the extension by Fama and Schwert (1977). We find no statistical evidence that Bitcoin can be an inflation hedge in any of our economies and we have to reject the hypothesis that Bitcoin has inflation hedging capabilities within our sample period. Concluding Bitcoin is not a good asset for inflation hedging and investors should be careful when investing in Bitcoin, when their only goal is to hedge against inflation.

Graduation Committee members:
Prof. dr. L. Spierdijk
Dr. X. Huang

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Bitcoin, Inflation hedging, Fisher Coefficient, Cryptocurrencies

1. INTRODUCTION

Every country has an inflation rate, which not only retail investors but also institutional investors try to outperform with assets they are including in their portfolio. With rising inflation rates and new asset classes like cryptocurrencies and especially Bitcoin, these investors ask themselves if they should invest in these new assets to hedge the inflation.

Bitcoin was introduced in 2008 and has been programmed to have a limited supply and a decreasing production rate, due to the mining rate that is cut in half approximately every four years (Nakamoto, 2008). This makes Bitcoin a scarce digital resource, which makes it interesting to investigate its inflation hedging capabilities.

Countries like the USA or countries in the Euro-Zone have a large number of institutional investors like pension funds or insurances and often well-diversified and risk-averse portfolios to hedge against inflation.

According to the report "Global Alternative Fund Survey" conducted by Ernst & Young (2021,) it is stated that already 7% of the firms of the participating hedge fund and private equity fund managers are invested in crypto-related assets. In total 210 managers were consulted with 138 from North America, 45 from Europe and 27 from Asia. Given that most of the managers that have been surveyed are coming from North America and Europe, it makes sense to investigate Bitcoin in these regions. Although most of them said that investing in cryptocurrencies does not align with their investment strategy the report states that still 10% of hedge funds are invested in cryptocurrencies and it also gives room for more research about the hedging capabilities of Bitcoin to support the decision of investors to include cryptocurrencies or Bitcoin in their portfolios or not (Ernst & Young, 2021).

Furthermore, the "Geography of Cryptocurrency" report by Chainalysis (2021) and the analysis of the global crypto adoption of the company TripleA (2021) showed that cryptocurrencies are also experiencing a great adoption rate in emerging countries like India, Kenya or Venezuela.

Chainalysis is a company that serves customers like governments, financial institutions, insurances and cybersecurity companies with data and software in over 70 countries. According to Chainalysis, 700 organisations rely on their services. Chainalysis is also stated as the "world's most comprehensive cryptocurrency investigation" (Chainalysis, 2021) and their reports have become standard to measure global crypto adoption.

The findings of the company TripleA that are conducted in this research were moreover also based on a report by Chainalysis. Here the 2020 Geography of Cryptocurrency report and another total of 16 reports and surveys including sources like the Bank of Canada, Deutsche Bank, Financial Conduct Authority of the United Kingdom and many more (TripleA, 2021).

In conclusion to that it also makes economic sense to investigate about the hedging capabilities of Bitcoin in emerging countries that are ranking high on the global currency adoption index in the "Geography of Cryptocurrency" report by Chainalysis (2021). But also at the countries with the highest estimated number of crypto owners and the highest percentage of the population owning cryptocurrencies delivered by the company TripleA (2021).

The 2021 Geography of Cryptocurrency report also showed that in cases of countries that are suffering from hyperinflation as seen in Venezuela the people are more driven by the necessity to receive Bitcoin payments as a form of remittance because of the depreciation of their currency. According to the report Venezuela has the highest peer-to-peer activity in Latin America with 629 million dollars of cryptocurrencies received (Chainalysis, 2021). This creates the question if Bitcoin can be an inflation hedge also in countries with hyperinflation so that the people have a safer way of storing money.

1.1 Research objectives

To investigate about if Bitcoin can be an inflation hedging asset in economically strong economies this research will firstly consider the inflation rates of the USA and the Euro-Zone. With having the highest inflation rates in the USA and the Euro-Zone since decades it will be shown whether Bitcoin can serve as an inflation hedge in these economies. This will be interesting for individual and institutional investors because the dollar and the euro are the two most used and traded currencies in the world (Investopedia, 2021) and as inflation rates are now also rising in these countries investors are searching for alternative ways to hedge against inflation.

In confluence with the 2021 Geography of Cryptocurrencies report by Chainalysis and the estimated number of crypto owners and the percentage of the population owning cryptocurrencies delivered by the company TripleA, also the countries India, Kenya and Venezuela have been chosen for this research.

In detail, India has been chosen because TripleA estimated that as of 2021 over 100 million people are owning cryptocurrencies in India, which makes it by far the country with the most crypto owners in the world. In conjunction with the whole population of India this equals 7.3% of the whole population owning cryptocurrencies (TripleA, 2021) and India ranks also second on the 2021 Geography of Cryptocurrencies report (Chainalysis, 2021).

Kenya and Nigeria are according to the 2021 Geography of Cryptocurrency report the leading countries in Africa in terms of crypto adoption (Chainalysis, 2021), but for this research Kenya has been chosen because the Central Bank of Nigeria directed all banks in Nigeria to ban cryptocurrency transactions and even close bank accounts of everyone transacting cryptocurrencies in the country on the 5th of February 2021 (Central Bank of Nigeria, 2021). In Kenya, it is estimated that about 4.5 million inhabitants own cryptocurrencies, which results in a total of 8.52% of the population. Kenya ranks fifth on the 2021 Geography of Cryptocurrencies report (TripleA, 2021).

Venezuela is on rank 7 in the 2021 Geography of Cryptocurrencies report but has the highest peer-to-peer activity in Latin America and also ranks 3rd in the report by TripleA when sorting for the highest percentage of the population owning cryptocurrencies. In the case of Venezuela, it is estimated that almost 3 million people owned cryptocurrencies in 2021, which equals approximately 10% of the population.

Moreover, the decision of countries for this research is also backed by a comparison of the Bitcoin trading volume in various countries that are using domestic currencies on online exchanges in 2020 by Statista. Here the USA is the leading country with approximately 1.5 billion dollars traded. One can also see that the Euro-Zone and countries in Africa are ranking high on the Bitcoin trading volume with the Euro-Zone having traded about 200 million dollars and Kenya about 91 million dollars (Statista, 2022).

Since the numbers of the trading volume appear a little bit too low, especially for India with only about 63 million US dollars traded in 2020, a report from the biggest Indian cryptocurrency exchange WazirX was also considered. WazirX reported a trading volume of 43 billion US dollars for all cryptocurrencies in 2021 and it was stated that Bitcoin was the most traded cryptocurrency on their platform (WazirX, 2021). One could argue that WazirX is also used by other countries so that the trading volume is split between other countries as well, but WazirX is only allowing deposits of the Indian Rupee (INR)

and it is assumed that mostly Indians are creating this trading volume.
The biggest crypto exchanges in the other countries USA, Euro-Zone, Kenya and Venezuela are available globally with deposit possibility of various currencies around the world, so that the trading volume could not be differentiated between the countries and therefore only the ranking of the Statista report for trading volume by country was taken into account.
To also give insight into the development of inflation rates a short report of the chosen countries is following: For the USA and the Euro-Zone the monthly inflation rate has been sitting between 0% and 2% for the last ten years, but since March 2021 it rises steadily with now sitting at 8,3% for the USA and 7,5% for the Euro-Zone in April 2022. For the other countries chosen we see a different dynamic in the inflation rate, which will be good for further research because we can see how Bitcoin behaves against different inflation dynamics. India had a monthly inflation rate of 12% at the end of 2013 which then slowly decreased until 2019 with a rate of 2%. Since then, India's inflation rate went up to 7,8% in April 2022. Kenya's inflation rate is constantly sitting at an inflation rate between 4% and 8% in the last ten years, with one outlier at the beginning of 2019 with a rate of 12%. As of April 2022, Kenya's inflation rate is sitting at 6,5% (TRADING ECONOMICS, 2022).
For the special case of hyperinflation in this research, the inflation rate of Venezuela has according to Trading Economics skyrocketed to a rate of 350.000% at the beginning of 2019 and has been decreasing since with seeing an inflation rate of 222% in April 2022, which is still extraordinary high (TRADING ECONOMICS, 2022).

2. LITERATURE REVIEW

In the recent literature Bitcoin has been tested several times on its inflation hedging capabilities. As discussed earlier this is mainly due to Bitcoin's limited supply and the decreasing production rate, which makes Bitcoin a scarce digital resource. Therefore, Bitcoin is often seen as the "digital gold" and often compared together with gold for its inflation hedging capabilities.
In a study by Choi & Shin (2022) the Bitcoin price and the Gold price are tested for their inflation hedging capabilities against the S&P 500, the VIX-Index (standard measure for economic uncertainty and near-term volatility based on the S&P 500), the five-year ahead inflation expectations and the one-year U.S. Treasury bill rate. The study uses the Vector Autoregression model (VAR Model), which allows to investigate multiple variables for a specific period. The findings of this research show that the Bitcoin price does not act like the gold price for the tested variables and the Bitcoin price does increase for example when there is a positive shock to the stock market. Bitcoin therefore had to be rejected as a safe haven or "digital gold". But more interesting for this research is that when Bitcoin was tested against expected inflation, the Bitcoin price increased when there was a positive shock in inflation.
Another study by Dhyrberg (2015) also investigated the hedging capabilities of Bitcoin against the FTSE Index (100 biggest companies listed on the London Stock Exchange by market capitalization) and the US Dollar. Dhyrberg (2015) used the GARCH model (Autoregressive conditional heteroskedasticity), which is used to estimate volatility for different kinds of financial data. The model showed that Bitcoin is a hedge against the FTSE-Index and also a hedge against the US Dollar, bearing in mind that the findings of a hedge against the US Dollar were more short-term and the resulting values rather small. Moreover, this study was conducted with a limited data set for Bitcoin because, although using daily data, Bitcoin was still in the early stages of development.
A more recent study done by Blau, Griffith and Whitby (2021) found significant evidence that the Bitcoin price is unexpectedly increasing when there is an increase in the forward inflation rate, which implicates that Bitcoin can be an inflation hedge. For this study, the 5-year Forward Inflation Expectation Rate and the Bitcoin price against the US dollar were used in a daily period from 1. January 2019 till 31. December 2020. Again, the VAR model was used to discover different periods and also a distinction between before and after the Covid-19 pandemic was added to the research. With this distinction Blau, Griffith and Whitby (2021) found out that their findings also hold true as well before and during the pandemic.
Until now the literature discussed above mostly conducts the inflation against the US dollar and does not take other countries into account. To also discuss if the Bitcoin hedging capabilities change when inflation rates of different countries are used Urbye (2021) included the monthly inflation rates of the US, Europe, Japan, South Korea and Norway in a GARCH model. The comparison of Bitcoin and the US 10-Year Breakeven Inflation Rate in this paper are suggesting that Bitcoin serves as an inflation hedge in the USA, just like Blau et. al. found out when testing Bitcoin against the 5-year Forward Inflation Expectation Rate. Moreover, Urbye (2021) found out that Bitcoin only acts as an inflation hedge for the PPI (Producer Price Index) in Japan and South Korea. However, the robustness check of the study showed that Bitcoin does not serve as an inflation hedge in the USA, Europe and Norway, so there is only evidence that Bitcoin is an inflation hedge for the US 10-Year Breakeven Inflation Rate and the PPI of Japan and South Korea.

2.1 Research Gap

Although Bitcoin has been tested several times on its inflation hedging capabilities the academic literature shows that current research has been mostly interested in the comparison of Bitcoin and Gold. Moreover, there has been little research on if Bitcoin is a good asset for inflation hedging in other economies than the USA.
Further research showed that when Bitcoin was investigated for inflation hedging in other countries than the USA, only the correlation of Bitcoin and the domestic stock markets were made. In the emerging countries of interest for this research, namely India, Kenya and Venezuela, this for example has been done for Venezuela by Kliber, Marszałek, Musiałkowska (2019), for India Stensås, Nygaard, Kyaw & Treepongkaruna (2019) and Kenya Kumah & Odei-Mensah (2021). This shows a general interest to research about Bitcoin in these countries, but the inflation hedging aspect is still to be investigated.
The fact that almost all of the proposed research used the GARCH model or the VAR model creates also a gap in the literature for the Fisher Coefficient and the extension made by Fama and Schwert in confluence with the hedging capabilities of Bitcoin.

2.2 Research Question

To conclude our findings and to build our economic hypothesis and research question, solely by considering the algorithm and the function of Bitcoin many Bitcoin researchers are thinking that Bitcoin is a good asset to hedge against inflation because of the limited supply and the supply not being controlled by a government (Dhyrberg, 2015). Because of the scarcity of Bitcoin many researchers are therefore also interested in the comparison with gold like already seen in chapter 2 in for example the study of Choi & Shin (2022).
In the academic literature we found evidence that Bitcoin acts as an inflation hedge against the US 5-year Forward Inflation

Expectation Rate like seen in the study of Blau, Griffith and Whitby (2021) and also acts as an inflation hedge against the US 10-Year Breakeven Inflation Rate in the study of Urbye (2021). However, these rates are calculated daily, so we only have evidence that Bitcoin is an inflation hedge against daily inflation rates in the USA.
When Urbye (2021) tested the inflation hedging capabilities against monthly inflation rates of the economies USA, Europe, Japan, South Korea and Norway he had to reject the hypothesis that Bitcoin can be an inflation hedge for the inflation rates of these countries and that Bitcoin only acts as inflation hedge for the Japanese and South Korean Producer Price Index. Although the study of Urbye also tests for Europe and he had to reject his hypothesis it will still be interesting for this study if Bitcoin can be an inflation hedge in the Euro-Zone because in the sample period of Urbye (Jan. 2010 - Jun. 2021) the CPI of Europe was still stable and just began to increase after June 2021 with a rate of 1.9% till May 2022 with a rate of 8,1% (TRADING ECONOMICS, 2022). Moreover, this study will use the Fisher Coefficient and it's extension of Fama and Schwert (1977) and not the GARCH model to find empirical results on the hedging capabilities on Bitcoin.

Consequently, this paper will answer the research question:

- Is Bitcoin a good asset to hedge against monthly inflation in the USA, Euro-Zone, India, Kenya and Venezuela?

3. METHODOLOGY

3.1 Fisher Coefficient

One of the most common methods to measure inflation capabilities of an asset is backed by the Fisher Coefficient, which this research will be based on. This method will be used because it describes the expected nominal return of an asset and the expected inflation rate (Fisher, 1930). Furthermore, the current literature shows that Bitcoin was mostly if not only tested on inflation hedging capabilities with the GARCH model or the VAR model, so that there is still a gap for the Fisher coefficient and the extension from Fama and Schwert (1977).

Fama and Schwert translated the Fisher Coefficient in an empirical test, which is a widely accepted inflation hedging measure in the literature. The Fama and Schwert (1977) equation is moreover including the expected and the unexpected inflation and can be expanded to following equation:

$$R_{it} = \alpha_i + \beta\big(E(\pi_t)\big) + \gamma\big(\pi_t - E(\pi_t)\big) + \varepsilon_{it}$$

Where:

R_{it}	is the return of asset i in period t
$E(\pi_t)$	is the expected inflation rate for period t
$\pi_t - E(\pi_t)$	is the unexpected inflation rate for period t
ε_{it}	is an error term for residual effects that cannot be explained by the data

We will conduct an Ordinary Least Squares regression (OLS regression in the following) that allows us to estimate the coefficients of the Fama and Schwert equation. The OLS regression describes the relationship between the Bitcoin returns per country R_{it} and our two independent variables expected inflation ($E(\pi_t)$) and unexpected inflation ($\pi_t - E(\pi_t)$).

In theory an asset is a complete hedge against expected inflation when our coefficient $\beta = 1$. The same principle applies for the unexpected inflation with coefficient $\gamma = 1$ being a complete hedge against unexpected inflation. If $\beta = \gamma_i = 1$ our asset is a complete hedge against inflation. To interpret this case, we say - that our asset has a one-to-one correspondence with inflation, which means that when our dependent variable, namely the inflation rate, increases by one percentage point, also our nominal return of asset i is expected to increase by one percentage point. In this case the asset return is expected to deliver a complete hedge and correspondence with the inflation rate (Fama and Schwert, 1977).

3.1.1 Regression with robust standard errors

Because not only the Bitcoin price is very volatile, but also the fact that we are using monthly data, so that the frequency of our data is very low, our dataset is resulting in huge jumps in the percentual change in the Bitcoin returns and sometimes also in the inflation rates. Moreover, Bitcoin is a relatively young asset class and our research is only containing 91 observations. Concluding we have to find a way on how to deal with sometimes extreme high minimum and maximum values. To counteract this our empirical test will use a regression with robust standard errors which is used when there is an unequal variance throughout the data.

3.1.2 Statistical Hypotheses

Because we are testing if Bitcoin has inflation hedging capabilities, we test if our results for the coefficients β_i and γ_i are statistically different from 0.

The statistical hypotheses are therefore written down as follows:

H_0: $\beta; \gamma = 0$ → The Beta coefficient of expected or unexpected inflation is equal to zero

H_A: $\beta; \gamma \neq 0$ → The Beta coefficient of expected or unexpected inflation is unequal to zero.

To test our hypotheses, we are using a t-test with a 95% confidence interval. The t-test shows us if there is a significant relationship between our dependent variables for Bitcoin return per country and our independent variables of inflation rate per country. If our t-test is giving us a sigma (p-value) of <0.05 for our regression coefficients of expected or unexpected inflation, we say that our results are significant. We then have enough evidence to reject our null hypotheses H_0 and our coefficients are statistically unequal to 0. This means that we can further interpret our coefficients β and γ.

If we do not reject our hypotheses the interpretations will be as follows: If Bitcoin is an inflation hedge against expected or unexpected inflation, our coefficients will be positive and therefore the return of Bitcoin is positively correlated with expected or unexpected inflation. If our coefficients are negative, it means that Bitcoin returns are negatively correlated to expected or unexpected inflation and Bitcoin being a "reverse hedge" against inflation. A reverse hedge means that one has to short sell the tested asset for it to deliver a hedge against inflation (Bodie, 1976).

If we are rejecting our null hypotheses H_0 we are interpreting that Bitcoin cannot be seen as inflation hedge in our sample period from October 2014 till May 2022 in our economies USA, Euro-Zone, India, Kenya or Venezuela.

3.1.2 Proxy expected Inflation

To distinguish between expected and unexpected inflation as proposed by Hamelink and Hoesli (1996), the monthly inflation rates have been conducted in a linear regression with a lagged inflation of t-1, which means that the actual inflation was the inflation rate of the previous month. Here the actual inflation rate

was the dependent variable and the lagged inflation rate the independent variable. The predicted value of the model then formed our expected inflation and the residual, which is the actual inflation rate subtracted by the expected inflation rate, formed our unexpected inflation.

We are doing this distinction because our asset Bitcoin could in theory be not correlated to the total inflation of a country, but it is just positively correlated to expected inflation and negatively to unexpected inflation or the other way around. In this case we would get the misleading result that Bitcoin has no correlation with inflation, but in reality there is a correlation for the expected and unexpected inflation.

The model is explained by following equation:

$$\pi_t = \alpha + \beta\,(\pi_{t-1}) + \varepsilon_t$$

Where:

π_t	is the expected inflation rate for period t
π_{t-1}	is the actual inflation rate for period t-1
ε_{it}	is an error term for residual effects that cannot be explained by the data

4. DATA

4.1 Bitcoin

The Bitcoin price will be only downloaded in US Dollars on the first of every month and we will use the open price for every price data we are using.
Bitcoin is a relatively new asset, so that this research will be limited on the availability of the Bitcoin price data and because the inflation rates of most of the chosen countries are only available per month.
The monthly Bitcoin price against the US dollar will be downloaded from Yahoo Finance and is available from 01. October 2014 till May 2022. This gives the research a total of 92 observations. Yahoo Finance uses the price data for Bitcoin from the company CoinMarketCap, which is according to CoinMarketCap the "world's most-referenced price-tracking website for cryptoassets" (*CoinMarketCap*, 2022).

4.2 Consumer Price Indices

The Consumer Price Indices (CPI in the following) of the USA and the Euro-Zone were downloaded from the Federal Reserve Bank of St. Louis on the 1st of every month. The Consumer Price Indices for India, Kenya and Venezuela have been downloaded from Refinitiv Eikon on the 15th of every month. This study used two different sources for the CPI's because the CPI's for India, Kenya and Venezuela are not available in a monthly format at the Federal Reserve Bank of St. Louis.
According to the U.S. Bureau of Labor Statistics the prices to calculate the CPI are collected during the entire month and the CPI is representing a whole month as a whole, so that we assume that the CPI of India, Kenya and Venezuela are valid for the whole current month (*U.S. Bureau of Labor Statistics*, 2022).

4.3 Exchange rates

Because the price of Bitcoin is downloaded in US Dollar, we need to calculate the Bitcoin returns for each country of interest separately to consider that Bitcoin prices can differ per country. To simulate the effect that people must convert the local currency of our countries in the Euro-Zone, India, Kenya and Venezuela to US Dollar first before they buy Bitcoins, we will download the exchange rates USD/EUR (Euro), USD/INR (Indian Rupee), USD/KES (Kenyan Shilling) and VES/USD (Venezuelan Bolivar). To maintain the same date of comparison (1st of every month) the several open prices of the exchange rates are also downloaded Yahoo Finance. Only the exchange rate for the Venezuelan Bolivar was not available for the whole sample period on Yahoo Finance, so that this one will be downloaded on Refinitiv Eikon on the 31st of every month. Concluding there is one day of delay for the calculation of the return for Bitcoin in Venezuela, but the exchange rate for the Venezuelan Bolivar and the US Dollar is fixed for a specific timespan because of the unstable situation in Venezuela and therefore it will not affect the results of this research.

4.4 Preparation of Data

4.4.1 Bitcoin returns

To further prepare the data first our Bitcoin returns had to be calculated by subtracting the current Bitcoin price per month from the previous month and then dividing it through the Bitcoin price of the previous month.
As explained in 4.3 we also must take into account the exchange rates of each country, except for the USA. We are therefore multiplying the before calculated Bitcoin returns with the exchange rates for each country to get the exact return for Bitcoin in each country.

4.4.2 Inflation Rates

Since the CPI's are indices and we need monthly rates of inflation to compare it with the returns of Bitcoin, another calculation had to be made to get the monthly rate of change for the several CPI's. Just like we calculated the Bitcoin return per month, the value of the CPI of the current month had to be subtracted from the previous month and then had to be divided by the CPI value of the previous month.

4.5 Descriptive Statistics

To give an overview of the data that this research will work with, one can find the descriptive statistics in table 1. It is showing us the number of observations (N) per variable and the values for the minimum, maximum, mean and the standard deviation in our dataset.

The variable for the Bitcoin returns in Venezuela has only 89 observations because this study will not consider the two events where Venezuela subtracted zeros from their currency. To explain this further the Venezuelan Bolivar was cut for five zeros in August 2018 (Pons, 2018) and another time for six zeros in October 2021 (The Economic Times, 2021). To give an example a million Venezuelan Bolivar became one Venezuelan Bolivar in October 2021 to reduce the amount of money the people had to spend on everyday goods. The process of this devaluation has an enormous effect on the exchange rate from one month to the following month, so that this would make our data for the Bitcoin returns of Venezuela unusable.

Table 1 shows us that the mean of the Bitcoin returns were more or less the same and positive. Only Venezuela has a negative mean and when having a look at Fig. 2, which shows the Bitcoin returns over our sample period, we can see that Venezuela had a lot of months where the Bitcoin returns were way lower than the Bitcoin returns in the USA, Euro-Zone, India and Kenya. This can be explained by the sometimes unstable exchange rate of the Venezuelan Bolivar against the US Dollar.

For the inflation rates we can observe in Fig. 3 that our inflation rates for the USA, Euro-Zone, India and Kenya are mostly ranging between -2% and 2% per month with only one clearly visible exemption where Kenyas inflation rate peaks at 4.7% in April 2019. More interesting is however that even though the inflation rates are mostly ranging between the same percentages, the behaviour of the four countries is not quite the same, i.e. Kenya has a positive inflation rate while the Euro-Zone has a negative inflation rate for the same month.

We also see how big the difference between the returns in Bitcoin and the inflation rates, at least for the countries USA, Euro-Zone, India and Kenya are in Fig. 2 and Fig. 3 when looking at the scales of the Y-A xis of both graphs.

The Bitcoin returns are ranging between a percentage of nearly +80% and -100%, while the inflation rates in Fig. 3 just from nearly +5% and -2%.

For Venezuela there is a separate visual representation in Fig. 1 because the inflation rate in Venezuela was too high to display it in the same graph with the other countries of research. The extreme values of Venezuelas inflation rates can also be seen in Table 1 when comparing the maximum and minimum values, the mean or the standard deviation with the other countries.

Table 1 Descriptive Statistics

	Variables	N	Min.	Max.	Mean	Std. Deviation
Bitcoin returns	**USA**	91	-36.303	69.719	7.502	22.797
	Euro-Zone	91	-.36.507	64.703	7.653	22.457
	India	91	-40.000	70.300	7.735	22.650
	Kenya	91	-36.404	70.188	7.786	22.672
	Venezuela	89	-99.971	69.719	-5.207	30.591
Inflation rates	**USA**	92	-.802	1.240	.223	.307
	Euro-Zone	92	-1.543	2.434	.162	.568
	India	92	-1.006	1.884	.390	.587
	Kenya	92	-1.200	4.679	.504	.795
	Venezuela	92	1.363	196.632	30.619	33.876

Notes: *Values rounded to 3 decimals*

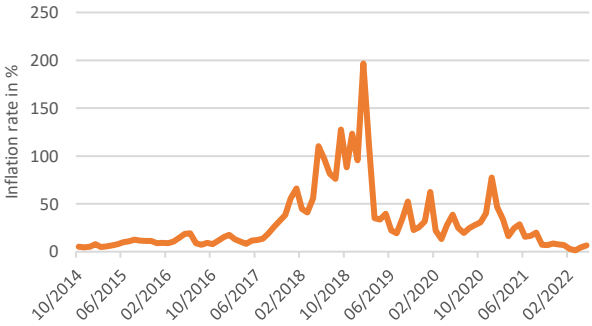

Fig. 1 Inflation rate of Venezuela (monthly, in %)

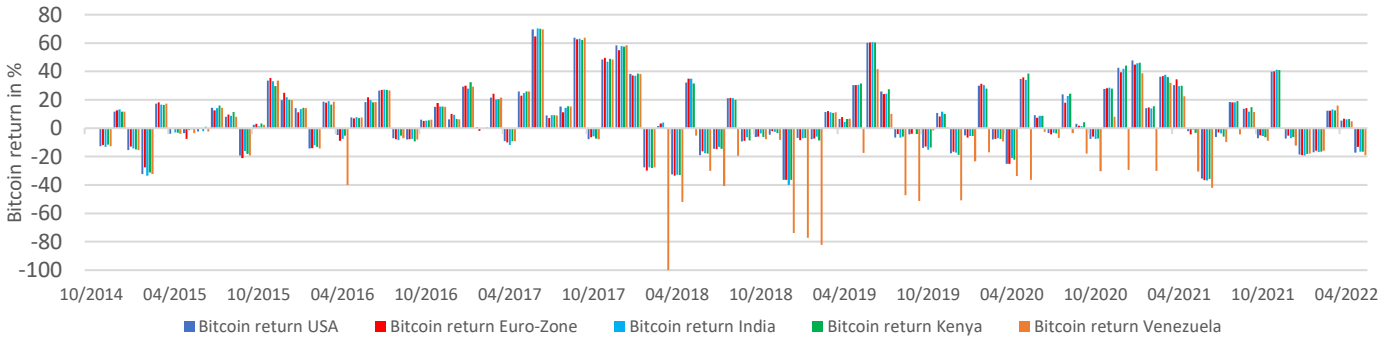

Fig. 2 Bitcoin returns in the USA, Euro-Zone, India, Kenya and Venezuela (monthly, in %)

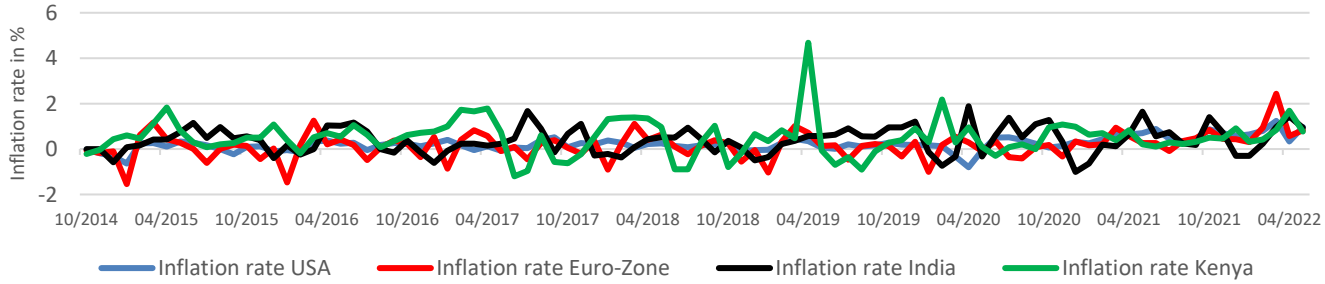

Fig. 3 Inflation rates of the USA, Euro-Zone, India, Kenya and Venezuela (monthly, in %)

5. RESULTS

5.1 Proxy Expected and Unexpected Inflation – Linear Regression

Table 2 Results for Expected and Unexpected Inflation

Country		Beta	Std. Error	Sigma	R^2
USA	Constant	.088	.031		
	Inflation rate t-1	.641	.086	<.001	.387
Euro - Zone	Constant	.136	.061		
	Inflation rate t-1	.188	.105	.076	.035
India	Constant	.258	.070		
	Inflation rate t-1	.358	.099	<.001	.127
Kenya	Constant	.369	.095		
	Inflation rate t-1	.286	.101	.006	.082
Venezuela	Constant	6.413	2.953		
	Inflation rate t-1	.793	.065	<.001	.629

Notes: Dependent variables: Total Inflation of the several countries, values rounded to 3 decimals

Table 2 shows the results of our linear regression to determine the expected inflation and the unexpected inflation. The total inflation rate of a country is the dependent variable and the total inflation with a lagged inflation rate of t-1 is our independent variable (also called predictor variable). In this model we are trying to predict the expected inflation with the predictor variable Inflation rate t-1 for each country and the dependent variable total inflation rate for each country. The outcome of this regression will give us an estimated value for each month (expected inflation) and a residual value, which is the total inflation rate minus the expected inflation. This residual value will build our unexpected inflation.

According to Table 2 our results for the USA, India, Kenya and Venezuela are all highly significant, with a p-value of <0.05. Only the Euro-Zone is a little bit less significant with the p-value being <0.1.

Furthermore, we can interpret the explained variance R2 that is used to show the discrepancy between our model and the actual data. For the USA and Venezuela our model shows the highest explained variance with 0.387 for the USA and 0.629 for Venezuela, which means that 38.7% of the variation of the expected inflation of the USA can be explained by the dependent variable (actual inflation). For Venezuela 62.9% of the variance can be explained by the data, so for this country the model documents an ever better fit. However, we find a poor fit of our model for the Euro-Zone with only 0.035 (3.5%), India with 0.082 (8.2%) and Kenya with 0.082 (8.2%).

Because all our Beta values are positive for the lagged version t-1 of the inflation rates of our countries we can furthermore interpret that the higher the value for our current inflation rate is, the higher is also the inflation expected for the next month.

5.2 Test for inflation hedge

5.2.1 OLS Regression with robust standard errors

After determining the expected and unexpected inflation rates we are now able to run our OLS regression with robust standard errors with the Bitcoin return being our dependent variable for each country and the expected and unexpected inflation rates per country being our independent variable. To fill out our equation for the Fisher Coefficient and the extension made by Fama and Schwert (1977) we are interested in the the two Beta coefficients for the expected and the unexpected inflation, where the Beta coefficient for the expected inflation is our β and the Beta coefficient for the unexpected inflation is our γ.

Table 3 is showing us the results of the OLS regression with robust standard errors for the test if Bitcoin can serve as an inflation hedge or not. As explained in 3.1.2 we can observe that all p-values are >0.05. Hence our coefficient β, as well as our coefficient γ, is equal to zero, so we do not have enough evidence to reject our statistical hypotheses H_0. Consequently, with neither βnor γbeing $\neq 0$, Bitcoin does not serve as a hedge against expected or unexpected inflation in any of our countries.

Table 3 Results of Regression with Robust Standard Errors

Country		B	Robust Std. Error*	Sigma (p-value)	R^2
USA	Constant	6.608	4.544		
	Expected Inflation	3.954	15.128	.794	0.005
	Unexpected Inflation	5.513	10.851	.613	
Euro-Zone	Constant	4.802			
	Expected Inflation	16.381	22.519	.469	0.01
	Unexpected Inflation	-2.501	3.507	.478	
India	Constant	2.343			
	Expected Inflation	13.642	12.399	.274	.053
	Unexpected Inflation	-7.899	4.022	.053	
Kenya	Constant	5.206			
	Expected Inflation	5.040	9.815	.609	.012
	Unexpected Inflation	-2.830	3.658	.441	
Venezuela	Constant	-5.401			
	Expected Inflation	-2.171	4.912	.660	.035
	Unexpected Inflation	-.280	.271	.305	

*Notes: Dependent variable: Bitcoin return for each country, * HC3 method, values rounded to 3 decimals*

There is one more result that is worth mentioning because for the unexpected inflation in India the p-value is showing a value of 0.053, which is nearly <0.05. Under a 90% confidence interval that would mean that we do have enough evidence to reject the null hypothesis H_0 for the unexpected inflation in India and γ is $\neq 0$. Due to our Beta coefficient being negative with a value of -7.899 it implicates a negative relationship between Bitcoin returns in India and the unexpected inflation in India, which would make Bitcoin a reverse hedge against unexpected inflation in India.

However, we chose a 95% confidence interval for this research, so that we will stick to the earlier assumption that Bitcoin does not serve as a hedge against expected or unexpected inflation in any of our countries.

To get to these results we used the HC3 method which is recommended to counteract the issues of having an unequal variance throughout the data as explained in 3.1.1 and when dealing with observations ≤ 250 (Long & Ervin, 2000).

Our model seems also not to be the best fit for testing Bitcoin on its inflation hedging capabilities since our R^2 values for the results of our coefficients in Table 3 are very low and is not even one time over 0.1 for any of our countries. That means that not even 10% of the variance in our data can be explained by the model. This matches also with the findings that Hofmann and Mathis (2016) found in their research who used the same method and a similar number of observations as explained in 6.1.

Moreover, we are reporting huge standard errors, which mean that our results for our Beta Coefficients (B) in Table 3 are not reliable and very biased. For example, the Euro-Zone with the highest standard error of 22.519 for the Beta Coefficient of expected inflation, the value for the Beta Coefficients could lay anywhere between -6.138 and 38.9.

6. DISCUSSION

6.1 Previous research

In the literature review in section 2. we already discussed some research about Bitcoin and inflation hedging. We have to be careful with comparing the already conducted research on this topic with this research because other research was mainly using other methods to test for the inflation hedging capabilities of Bitcoin. Due to that we cannot really say if the results of this research match or don't match other discussed research.

Urbye (2021) for example tested the Bitcoin returns against monthly inflation rates for different economies, such as the USA, Europe, Japan, South Korea and Norway in a GARCH model for the period of January 2010 till June 20201. He had to reject that Bitcoin acts as an inflation hedge in these economies and that Bitcoin only acts as a hedge against the Producer Price Index of Japan and South Korea.

Our research showed that, also by using the Fisher Coefficient and its extension by Fama and Schwert, Bitcoin has no hedging capabilities against monthly inflation rates in our countries USA, Euro-Zone, India, Kenya and Venezuela. Consequently, our results match with Urbye's research for the USA and the Euro-Zone, but as already mentioned, other models were used.

Urbye (2021) however also tested Bitcoin on its hedging capabilities against the US. 10-Year Breakeven Inflation Rate with another GARCH model. Here he finds strong statistical evidence that Bitcoin acts as a hedge against inflation in a weekly frequency and a sample period of 10 years from September 2011 until June 2021. But again, he is using another model than we do, so it is not said that we would have the same results when we would have used the US. 10-Year Breakeven Inflation Rate as well for our research.

Another study from Blau, Griffith and Whitby (2021) used the VAR model and conducted the 5 Year Forward Inflation Expectation Rate of the USA and the Bitcoin price in a sample period from January 1st 2019 until December 31st 2020 on a daily frequency. They also find that Bitcoin provides a hedge against inflation, but they are using another model, so we cannot say that we would also find these results if we would have used a daily frequency. Moreover, their findings are just defining a period of 2 years, so it does not prove long-term inflation hedging capabilities of Bitcoin. Though it is interesting that their findings apply for the phase before the Covid-19 pandemic and also after the pandemic.

Due to the fact that there has not been much research yet about Bitcoin and its inflation hedging capabilities against monthly inflation with the Fisher Coefficient and the extension by Fama and Schwert, we can also compare this research to a study done by Hofmann & Mathis (2016) where they test indirect real estate investments in Switzerland on its inflation hedging abilities. Here they use the same method as we did by Hamelink and Hoesli (1996) to proxy expected and unexpected inflation and the Fisher Coefficient and the extension by Fama & Schwert to carry out their results. With using quarterly data of a sample period of 20 years from 1995 until 2015 they are working with 82 observations, which is similar to our observation size of 91. Hofmann & Mathis (2016) stated that their small number of observations was leading to high standard errors in their regression. Moreover, they stated that all their found coefficients are not significant and their values for R-squared are extremely low, which leads to the assumption that the model they used is a poor fit for their research. The same issues occurred also in this research, which will lead us to some limitations and recommendations for further research in this topic.

6.2 Limitations and further research

The first and main limitation we were encountered within this research is the limited data for the Bitcoin price. With Bitcoin being a relatively new asset class, our dataset for Bitcoin just reached back until October 2014.

Due to the inflation rates of the chosen economies Euro-Zone, India, Kenya and Venezuela are not available in a daily/weekly timeframe we had to stick to the monthly timeframe. With a longer timeframe for the Bitcoin price or a shorter frequency of inflation data like daily or weekly, more observations would have been available.

Consequently, a longer timeframe of data or a higher frequency of data and therefore more observations could help in improving the fit of the model to the dataset.

Since Bitcoin and cryptocurrencies are still a young asset class it remains exciting what future research will find out in terms of the capabilities of this asset class.

7. CONCLUSION

To conclude we cannot say that Bitcoin is a hedge against whether expected or unexpected inflation in any of our economies USA, Euro-Zone, India, Kenya and Venezuela. Our coefficients β and γ have not been statistically different from 0 and therefore we had to reject our null hypothesis H0.

In a practical context this means, that even though the high average returns of Bitcoin of approximately 70% as showed in Table 1 (see Max. values) might seem attractive for investors,

they still have to be careful when considering to invest in Bitcoin when their only goal is to hedge against inflation.

Also, with Bitcoin being seen as a scarce digital resource and being called the “digital gold” it seems to be not the case that Bitcoin can be seen as a good asset to hedge against inflation, at least for our sample period, the economies we chose and the model that has been chosen in this research.

Furthermore, the still young asset class Bitcoin and the limited availability of daily/weekly inflation rates of other countries than the USA, led this study to contain very few observations, which resulted in a very high standard error in the regression. Therefore, it remains exciting what future studies about Bitcoin are contributing to the topic of inflation hedging, when there is more data available for the price of Bitcoin.

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