Rijish Ganguly

rg239

Professor Brian Weller

ECON 571

**Inclusion of Bitcoin into an investor’s portfolio**

Abstract

This paper seeks to estimate the Beta of Bitcoin with respect to four different portfolios and answer the question whether we should include bitcoin as part of our investment portfolio using Markowitz Portfolio Optimization. The paper begins with a brief introduction to Bitcoin and challenges of investing in Bitcoin followed by a concise description of Beta calculation using the CAPM theory, results from calculation of Betas with respect to four portfolios and lastly, the Sharpe ratio obtained from including Bitcoin to an existing portfolio of twenty-two randomly selected stocks.

Bitcoin and Volatility

Although the initial excitement about cryptocurrencies and Bitcoin among investors has dwindled over the past year, optimists still believe that Bitcoin would fundamentally alter payments, economics and politics in the near future. Bitcoin is a decentralized digital currency without a central bank or single administrator that can be sent from user to user on the peer-to-peer bitcoin network without the need of intermediaries. Since the value of Bitcoin can be denominated in dollar value and it fluctuates with market conditions, we can consider bitcoin not only as a form of currency but also as an investment vehicle. One of the objectives of this paper is to discuss whether it is optimal to include Bitcoin to a well-diversified portfolio in spite of the several challenges posed by the volatility of cryptocurrencies. One major reason why the price of Bitcoin fluctuates severely over the course of a time period is because of the relatively small market of cryptocurrency. The total market capitalization of digital crypto-currencies exceeded US $800 billion in early 2018, with Bitcoin comprising of 40% of the total market capitalization. For comparison’s sake, the global equity market crossed a total value of US $76.3 trillion. The reason why market capitalization plays a significant factor in increased volatility is because small markets are susceptible to manipulation compared to large markets. According to Kerim Derhalli, CEO and founder of Invstr Ltd., small changes to the key variables of supply and demand can have a significant influence on Bitcoin prices. A major investor or a small group of investors working collaboratively can create a sharp gain or loss in the value of Bitcoin. The phenomenon when the value of a cryptocurrency falls sharply in a short period of time is known as “flat-crash” and can be attributed to the small market-cap effect. Another significant factor that contributes to the volatility of Bitcoin is the low liquidity of Bitcoin. Low liquidity exacerbates the price fluctuations resulting in high volatility. Regulation is another contributing factor to the volatility of Bitcoin. Since the inception of Bitcoin in 2009, several governments have tried to regulate Bitcoin along with other digital crypto-currencies. The U.S. Commodity Futures Trading Commission (CFTC) announced in 2015 that bitcoin and other digital currencies were commodities, and as a result the government agency could regulate them. In India, the Reserve Bank implemented a ban on dealings with crypto-businesses in 2018. The Chinese Government has banned initial coin offerings (ICO) and has cracked down on domestic exchanges of cryptocurrencies. As a result of regulations and anti-cryptocurrency laws imposed by the governments around the world, the price of Bitcoin has become increasingly volatile over the years. The price of a Bitcoin as an asset is not immune to news events and speculation. Coinbase added 100,000 users in a single day after exchange operator CME Group Inc. announced in November 2017 that it planned to add bitcoin futures that year. Positive news can increase investor interest and increase demand resulting in higher prices, while negative news might cause the prices to plummet. In August 2016, nearly 120,000 units of bitcoin went missing from Bitfinex. Soon after the news broke, the price of Bitcoin fell by more than 20%. Lastly, another major factor behind Bitcoin’s volatility is the uneven distribution of Bitcoin among investors. Aaron Brown from AQR Capital Management, estimated that 1,000 individuals owned approximately 40% of all bitcoin. If a single individual possesses a significant amount of Bitcoin, the individual can cause substantial price fluctuations by selling a fraction.

A screenshot of a cell phone

Description automatically generated

Fig I. Picture depicting standard deviation of daily returns for Bitcoin

As we can observe from Figure I, the Bitcoin volatility hit a 17-month low in the early October of 2018. While some pundits believed that this might be a sign of the cryptocurrency maturing and becoming more stable, some believed otherwise. This period of low volatility came to an abrupt end in mid-November as Bitcoin prices crashed. The volatility of gold averages around 1.2%, while other major currencies average between 0.5% and 1.0%. In contrast, the volatility of Bitcoin averages around 3.36%.

Beta (ß)

A beta coefficient is a measure of the volatility, or systematic risk, of an individual asset in comparison to the unsystematic risk of the entire market. Beta is used in the capital asset pricing model (CAPM), which calculates the expected return of an asset using beta and expected market returns. In statistical terms, beta represents the slope of the line through a regression of data points from an individual asset's returns against those of the market. Beta measures the tendency of an asset to respond to changes in the price of a benchmark, like the S&P 500. The S&P 500 is a commonly used benchmark because it usually reflects the performance of the overall U.S. stock market. A positive beta indicates that an asset is correlated with a benchmark. If the benchmark increases in value, then the asset also tends to increase in value. A negative beta indicates the reverse.

The formula for Beta is:

Beta =

Where Re is the return of an individual asset, Rm is return on overall market and Variance (Rm) is the variance of the entire market.

When viewed in the light of the CAPM, beta is a regression of asset returns against portfolio returns. We collect historical returns on the asset i, the market proxy m, and the risk free rate; that is, *ri*,*t*, *rm*,*t*, *rf*,*t* for t= 1 to T. The most common way to estimate the betas is to use the single index model, or characteristic line regression:

*ri*,*t* −*rf*,*t* = α*i* + β*i*(*rm*,*t* −*rf*,*t*) + ε*i*,*t*

Where εi is the idiosyncratic risk of asset i

α*i* is the alpha or excess return of asset i,

βi is the beta of the asset i

In estimating betas, we typically rely on a relatively short rolling window of 5 year of historical data because Betas vary significantly over time which might be attributed to changes in a firm’s leverage and operations, acquisitions or expansion of the firm into other industries or changes in the composition of the aggregate market. GARCH and related statistical procedures explicitly allow for time-variation of the Betas. In the process of estimating betas, we typically use monthly data. We can potentially get better estimates using higher frequency data. However, some significant drawbacks of higher frequency data are non-synchronous prices and bid-ask bounce effects. For CAPM, the benchmark portfolio is the market portfolio. However, we can calculate beta against other portfolios. The beta value calculated with respect to a particular portfolio would describe the activity of the asset’s return with changes in the benchmark portfolio.

1. <https://www.fincen.gov/sites/default/files/2016-08/20131118.pdf>
2. <https://cryptoslate.com/data-indicates-bitcoin-price-uncorrelated-stock-market/>
3. <https://www.fxcm.com/uk/insights/what-causes-volatility-in-bitcoin/>
4. <https://www.buybitcoinworldwide.com/volatility-index/>
5. <https://www.investopedia.com/terms/b/beta.asp>