

DIGITAL ASSETS
JULY 2023

MarketVector™ Benchmark Rate Indexes

Transparency and Protection Against Manipulation

Martin Leinweber, CFA
Digital Asset Product Strategist

 MarketVector™

Contents

Executive Summary	2
Why Do Investors need an Index for a Single Token?	2
Understanding the Bitcoin Benchmark Rate: A Simplified Breakdown for Investors.....	3
Calculation Methodology.....	3
DeepDive: Understanding Medians and Volume-Weighted Medians.....	4
A Robust Data Set	5
Shielding Against Market Manipulation: Resilience to Various Attack Vectors.....	7
Case Studies.....	7
Case Study 1 - The Bitstamp Bitcoin “Flash Crash”	8
Case Study 2 - The Binance US Flash Crash.....	9
Case Study 3 - The Kraken ETH Flash Crash	10
DeepDive: Practical Use of MarketVector™ Benchmark Rates by ETFs and ETPs	11
Conclusion – The Vital Importance of Benchmark Rate Indexes for Digital Asset Investors	11
IMPORTANT DEFINITIONS AND DISCLOSURES.....	12

Executive Summary

This whitepaper presents an in-depth analysis of the critical role of benchmark reference prices in the rapidly evolving digital assets market. The proliferation of exchanges and the potential for price manipulation have led to a pressing need for reliable and universally accepted benchmark rates. We delve into the methodology behind the [MarketVector™ Bitcoin Benchmark Rate \(BBR\)](#) and [MarketVector™ Ethereum Benchmark Rate \(EBR\)](#), revealing how their innovative use of volume-weighted medians offers more accuracy and resilience against market manipulation compared to standard indices. Our detailed case studies demonstrate the robustness of these benchmarks against market shocks, enhancing investor confidence and facilitating strategic foresight. For anyone interested in the future of finance, this paper offers essential insights into navigating the complex cryptocurrency market with precision and assurance.

Why Do Investors Need an Index for a Single Token?

In contrast to traditional assets, whose trading in any particular asset tends to be limited to just a few exchanges, digital assets are fully fungible and can trade across hundreds of venues, all of which have markets that fluctuate independently based on order flows. While it is profitable for arbitrageurs to keep these differences in check across the ecosystem, temporary price differences can persist.

In fact, sometimes, large orders on any exchange can drive significant relative price differentials in the same asset when compared to other exchanges, a phenomenon that happens more frequently during periods of market stress. As a result, even the basic question “What is the price of bitcoin today” is not as easy to precisely answer as one might initially imagine. This is why using a benchmark index which aggregates price delivers a better answer than simply picking the last traded price on a specific exchange.

Various approaches to index construction exist to accommodate diverse client requirements. Although standard index prices deliver exceptional value, benchmark reference prices for digital assets like Bitcoin and Ethereum have been meticulously crafted for investors who express concerns over potential price manipulation and the potential for exchange failures. Benchmark reference prices are particularly favored for the pricing of financial derivatives and in the computation of the net asset value (NAV) of funds and exchange-traded products.

The significance of a Bitcoin and Ethereum price index extends beyond providing a mere reference price; it plays a pivotal role in derivatives trading. In the world of derivatives, the contract and the price are the bedrock of the entire trade. For those that do not regularly trade in instruments that reference the price of an underlying asset, the importance of an accurate index may not be immediately apparent. However, the price index is the most important component in a derivatives contract. It supplies the reference point that sets the pricing terms of the contract and ultimately governs the trade.

Providing a more reliable, regulated, and universally acknowledged reference point for these leading digital currencies can create a more secure and trustworthy environment for the continued growth and success of this new asset class.

However, the creation and maintenance of such reference rates are not without challenges. This paper will dissect the methodology behind the [MarketVector™ Bitcoin Benchmark Rate \(BBR\)](#) and [MarketVector™ Ethereum Benchmark Rate \(EBR\)](#), exploring how they compare to standard cryptocurrency indexes. We explore and explain the use of volume-weighted medians and the technical challenges we encounter as data providers.

Furthermore, through a series of case studies, this paper demonstrates the resilience of the BBR and the EBR in withstanding market shocks and anomalies. Using data from CCData, we will simulate intraday variations of these reference rates during significant events such as the Bitfinex Flash Crash and other market dislocations. These simulations will serve to underscore the robustness of the BBR and the EBR and their efficacy in mitigating manipulation.

By understanding the mechanisms behind these benchmark reference rates, we aim to equip readers with the knowledge to navigate the cryptocurrency market with confidence and strategic foresight. This knowledge is not only crucial for finance professionals, traders, and investors but also for anyone curious and interested in how the future of finance might look like. For the subsequent analyses, we will focus on the BBR. However, the methodology is equally applicable to the EBR.

Understanding the Bitcoin Benchmark Rate: A Simplified Breakdown for Investors

For an investor in the digital asset landscape, the BBR serves as an important tool for understanding the market value of Bitcoin. The BBR's design prioritizes accuracy, reliability, and resilience against market manipulation. To understand this tool better, let's break down its methodology into digestible components.

Calculation Methodology

Medians Over Averages

Imagine you're trying to find the middle value in a series of numbers. An average would consider all values equally, but what if there's a single extraordinarily high or low number? This could skew your average, creating a less accurate representation of the 'middle' value. Here's where medians come in handy. Medians help us pinpoint the middle value, minimizing the influence of these extreme values, or 'outliers'. In terms of the BBR, medians ensure that the price reflected is less affected by any extreme Bitcoin prices on a particular exchange.

Volume-Weighting of Medians

The utilization of volume-weighting in calculating medians serves to neutralize the effect of numerous smaller trades that might skew a median that does not account for volume. Unlike a traditional median, a volume-weighted median incorporates a weighting element - in this instance, the size of the trade - into its computation, thus providing a more comprehensive analysis.

DeepDive: Understanding Medians and Volume-Weighted Medians

Median: A median is the 'middle' number in a sorted list of numbers. To find the median, you arrange your numbers in order from smallest to largest. If you have an odd number of observations, the median is the middle number. If you have an even number of observations, the median is the average of the two middle numbers.

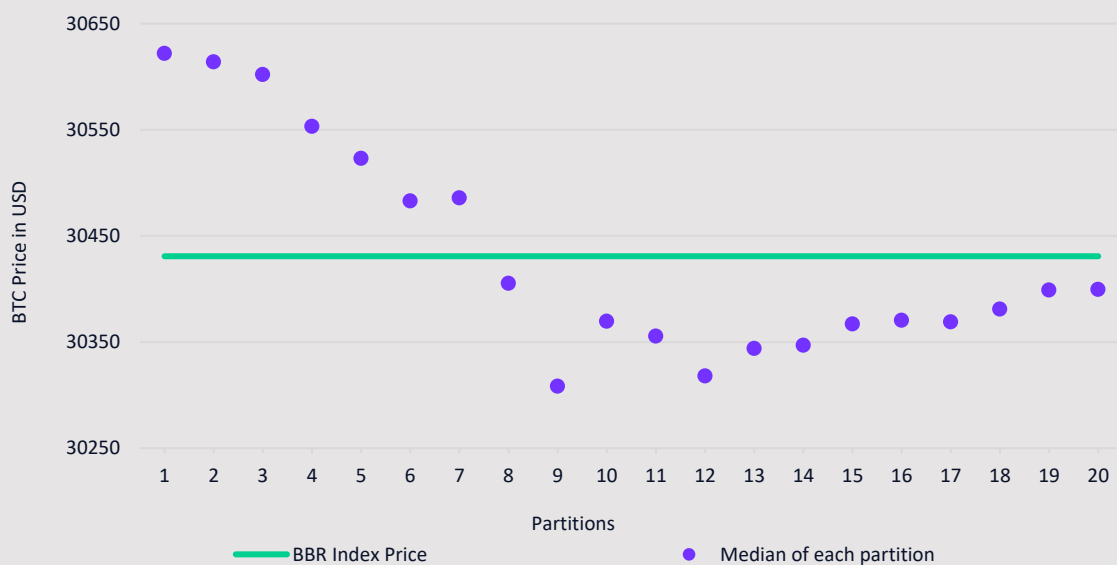
This contrasts with the mean (commonly referred to as the 'average'), which is determined by summing all numbers and then dividing by the total count of numbers. The median is less influenced by outliers (values that are extraordinarily high or low) and offers a more precise depiction of the 'central' point of your data.

Volume-Weighted Median: A volume-weighted median is a statistical measure used to find the midpoint value in a set of data that's been sorted in ascending order, where the weightings are determined by associated volumes. For a list of prices, each paired with a particular volume, the prices are first sorted from smallest to largest.

The volumes paired with these prices represent their respective weights. The volume-weighted median is identified as the first price at which the cumulative volume (from the smallest price to that point) constitutes 50% or more of the total volume. This ensures that half of the volume is concentrated at or below this price, providing a median measure that's influenced by the volume associated with each price, rather than just the prices themselves.

20 Equal Partitions: Imagine trying to understand the weather in your city. If you only look at the temperature at noon, you'd miss out on the cooler morning and evening temperatures. The same principle applies to understanding Bitcoin's price. The BBR divides one hour into 20 equal parts or 'partitions'. It then calculates the median price in each of these partitions (Exhibit 1).

Exhibit 1: Bitcoin Benchmark Rate: Example with 4 pm fixing on BTC-USD



Source: MarketVector Indexes™ ("MarketVector"), CCData.

This method ensures that the final rate isn't overly influenced by the price at a particular time and provides a more comprehensive view of the market conditions throughout the day. Large-scale individual trades typically have a marginal impact on the Index level, as they merely alter the volume-weighted median for that particular partition. Similarly, a series of trades happening within a brief time frame would only affect the volume-weighted median of the partitions in which they took place. This process is repeatedly done in real-time every 15 seconds, on a rolling 1-hour period.

The BBR's methodology is carefully designed to capture a true and reliable picture of Bitcoin's price. By incorporating medians, volume-weighting, and partitioning, the BBR ensures a fair representation of Bitcoin's price. Manipulating such a rate would require significant resources and effort, making it a robust tool against market manipulation.

As an investor, understanding an index like the BBR can equip you with valuable insights and confidence when navigating the Bitcoin market.

A Robust Data Set

The quality of data inputs for benchmark reference rates in the cryptocurrency domain is of paramount importance. Due to their nascent state and the frequently volatile nature of this market, choosing the appropriate sources of data can greatly influence the integrity and reliability of the indexes.

A rigorous selection of exchanges whose prices should be included in the index calculation is a vital first step. The amount of trading volumes an exchange has is another important factor. Finally, limiting the markets to USD pairs is also important.

Exchange Selection

Bitcoin trading is a broad, dynamic field, featuring numerous markets and exchanges worldwide. However, with variations in trading volumes and practices, not all exchanges are created equal and they vary significantly in terms of regulatory compliance, security measures, and liquidity.

This disparity emphasizes the importance of selecting the right exchanges when trading or developing a pricing index. Furthermore, the chosen exchanges must effectively address market manipulation, liquidity, pricing, and arbitrage concerns. Therefore, it is vital that traded volume is not the sole criterion for exchange inclusion given the rapidly evolving landscape. The adoption of a listing framework can significantly curtail instances requiring operator intervention. Both the EBR and the BBR are dependent on the top five exchanges, as rated based on the Exchange Benchmark Report authored by CCData¹.

¹ See <https://ccdata.io/research/exchange-benchmark-rankings>

USD Pairing

The BBR is specifically designed to minimize vulnerability to temporary price swings and outlier prices. As such, the BBR only includes trades executed between BTC and USD. It does not use alternate currency pairs or crypto-to-crypto pairs or trading and does not include transactions involving USDT or other stablecoins in the BTC-USD order book.

This approach ensures the stability of the reference rate, as the US Dollar, a government-issued currency, offers a level of stability and confidence that cryptocurrencies or stablecoins may not provide. Moreover, most people are familiar with USD pairing, possibly making the index more accessible to a broader audience.

Real-time indexing

A real-time index, as opposed to one updated once a day, may offer several advantages to various market participants, including ETF market makers and derivative issuers. Here's why:

Accurate Pricing and Arbitrage Opportunities: For ETF market makers, having real-time information is crucial for accurate ETF pricing. ETFs are designed to track the performance of their underlying assets – in this case, Bitcoin. The ETF's price may deviate from the index's value if the index does not accurately represent the current value of Bitcoin. Real-time information can allow sophisticated traders and institutional investors to spot and exploit arbitrage opportunities, which can arise from temporary price discrepancies between different markets or between an ETF and its underlying asset.

Risk Management: For derivative issuers, having real-time updates can be important for managing risk. Derivatives like futures and options are highly sensitive to the underlying asset's price. Real-time updates allow issuers to better monitor changes in the asset's value and adjust their positions accordingly.”

Shielding Against Market Manipulation: Resilience to Various Methods of Attack

The BBR appears to be resistant to the following types of attacks:

Large Trades Attacks: By using partitions and a volume-weighted median, the index minimizes the effect of individual trades of large size. This means that a sudden, substantial trade won't unduly influence the overall index.

Short-term Volume Spikes Attacks: Similarly, the index is designed to limit the effect of a sudden cluster of trades in a short period of time by using volume-weighted medians within each partition.

Price Manipulation Attacks: By using volume-weighted medians instead of volume-weighted means, the index prevents transactions conducted at outlier prices from having an undue effect on the value of a specific partition. This feature helps resist attempts to manipulate the index through extreme pricing.

Exchange Targeting Attacks: With equal weighting of constituent exchanges, the index ensures that potential manipulators can't overly influence the index by targeting a specific platform for manipulative trades.

The rigorous design of the BBR provides a robust defense against potential manipulative or disruptive trading practices.

Case Studies

As everyone from investors to regulators is starting to focus on the fast-paced digital asset world, a sturdy pricing mechanism is essential, so we need benchmark rates that are as reliable as a Swiss watch. Think of it as the foundation of a skyscraper: without it, everything else is at risk. Robust reference rates keep pricing glitches in check, which is very important in the somewhat chaotic crypto market.

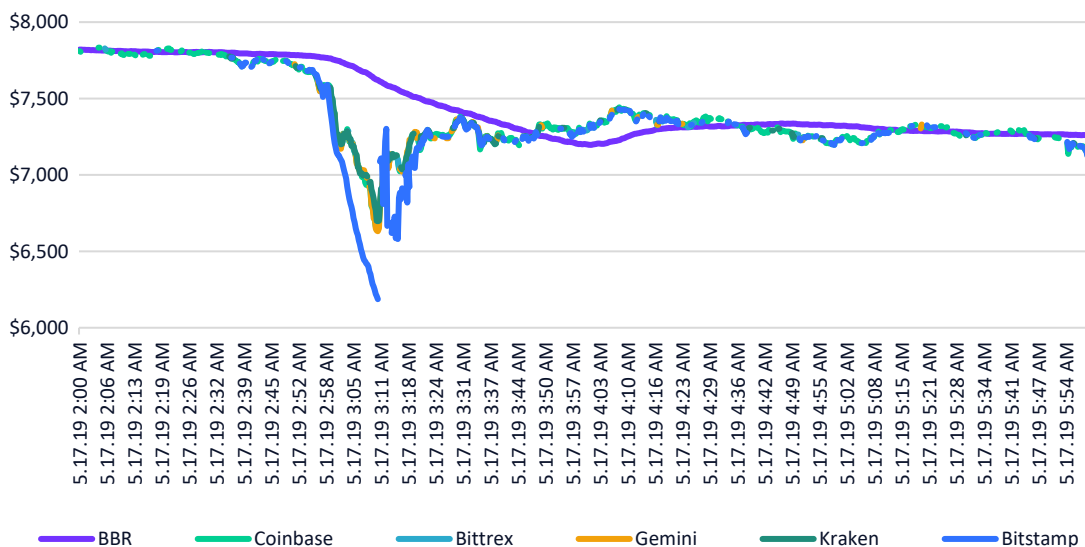
Below, we discuss case studies that demonstrate how the Bitcoin Reference Rate can tackle some of the challenges that the crypto markets can face at times. Users leveraging these rates get a clearer picture of the true market price, reducing the risks linked to price discrepancies. Through these case studies, we aim to showcase the true value these reference rates bring to the crypto landscape.

Case Study 1 - The Bitstamp Bitcoin “Flash Crash”

One of the prevailing mistakes in the trading world is the so-called "fat-finger" error, where a trader accidentally enters an incorrect trade (usually when entering the desired trade quantity for a transaction) due to a typing error. These human blunders can trigger flash crashes, which are sharp, sudden market downturns that retrace back to previous price levels very quickly once the market realizes that the move was due to a trading error rather than an exogenous event. These flash crashes have occurred in cash equities, equity index futures, ETFs, cash bonds/fixed income, and bond derivatives, as well as a range of commodity futures markets.

An excellent example of the crypto markets was the Bitcoin “flash crash” that transpired on May 17, 2019. This crash was induced by a hefty sell order that may have been submitted erroneously. The repercussions were particularly severe on Bitstamp, the exchange from which the order originated, and the bitcoin price on Bitstamp fell precipitously compared to other exchanges.

Exhibit 2: BBR vs. Exchange Prices During Bitstamp Flash Crash (May 17, 2019)



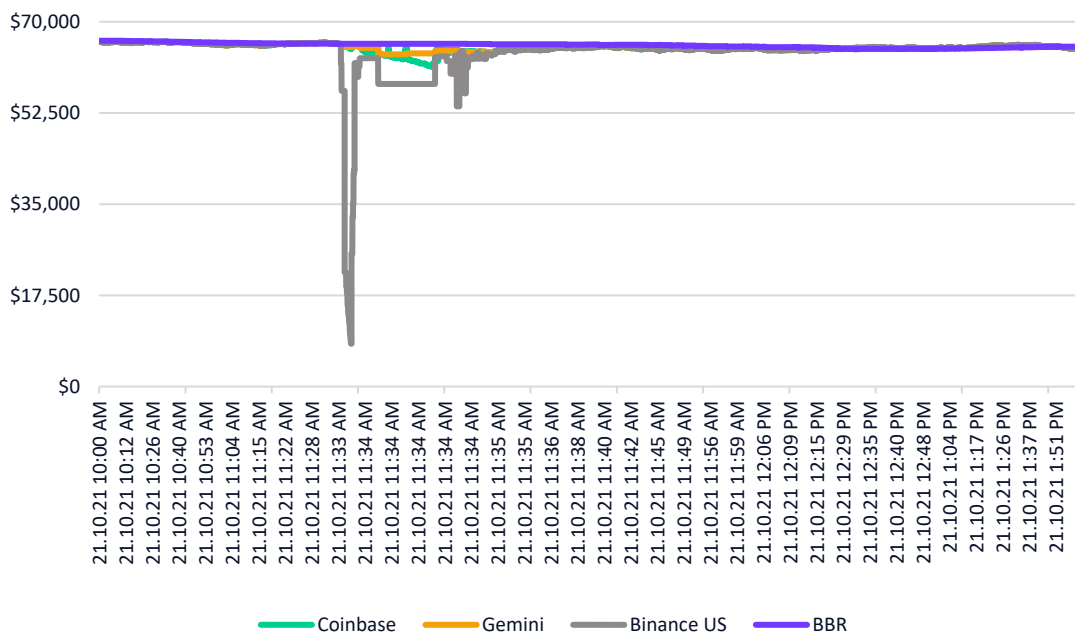
Source: MarketVector, CCDData, Data as of May 17, 2019.

As can be seen in Exhibit 2, over the one day period on May 17, 2019, the BBR remained stable due to its extensive computation window, accurately tracked the market price, and excluded the extraneous downward movement on Bitstamp.

Case Study 2 - The Binance US Flash Crash

On October 21, 2021, a sudden flash crash on the Binance.US Exchange led to a drastic plunge in Bitcoin's price, where it tumbled from \$66,000 to \$8,000 and then swiftly rebounded back to \$65,000 within a matter of seconds (Exhibit 4). This event was reportedly triggered by a glitch in the trading algorithm of a significant institutional investor. The tremors from the flash crash on Binance US were felt across other Bitcoin markets, clearly showing that an anomaly in a specific exchange does not exist in a vacuum, due to the interconnectedness of markets and the presence of arbitrageurs and market makers that operate across multiple venues. Yet, during this time of heightened volatility, the BBR remained entirely unaffected. Within a short period span of time, all exchanges resumed trading in congruence with the BBR.

Exhibit 3: BBR vs Exchange Prices During Binance US Flash Crash (October 21, 2021)

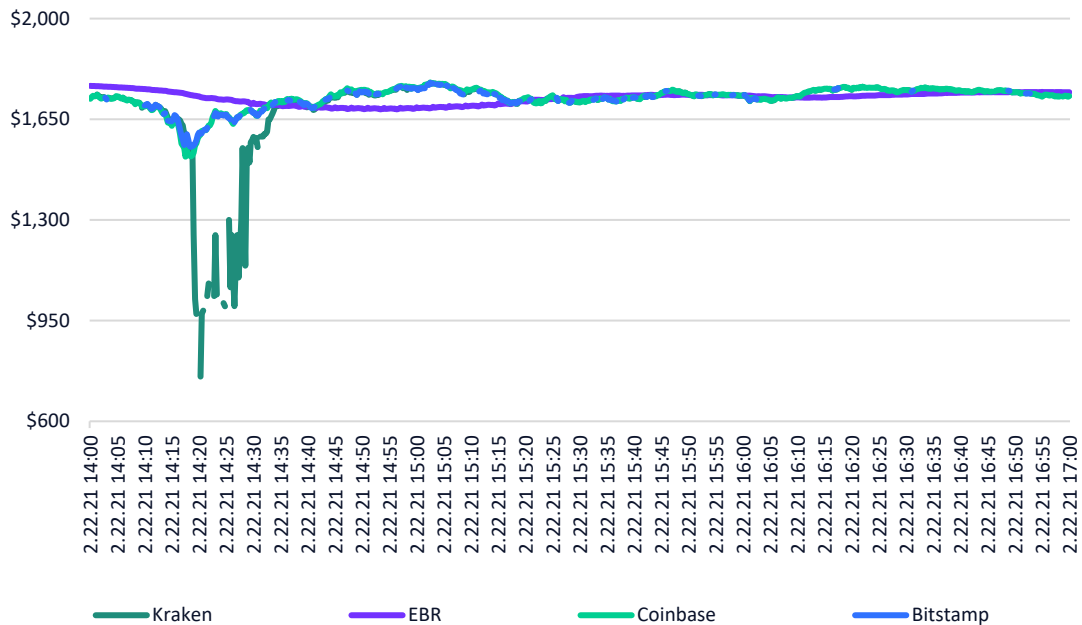


Source: MarketVector, CCData, Data as of October 21, 2021.

Case Study 3 - The Kraken ETH Flash Crash

The Ether price graph (Exhibit 4) depicts three exchanges operating in harmony until Kraken experiences a sudden crash at 14:18 GMT. This rapid downturn in Kraken's ETH wasn't due to a system malfunction, and even though its trading volumes were substantial, they weren't at the peak compared to Bitstamp and Coinbase. However, just prior to the crash, Kraken did record the largest individual ETH-USD transaction of 481.4 ETH. Moreover, there was an influx of sizable trades (50 ETH or more) during the crash, with Kraken managing 13 such trades at 14:18 GMT, a figure considerably higher than other exchanges at the same time. Notably, the EBR remained completely unaffected by this event.

Exhibit 4: EBR vs Exchange Prices During Kraken Flash Crash (February 22, 2021)



Source: MarketVector, CCData, Data as of February 22, 2021.

DeepDive: Practical Use of MarketVector™ Benchmark Rates by ETFs and ETPs

The MarketVector™ Benchmark Rates have seen active application by several number of prominent entities in the realm of Exchange Traded Funds (ETFs) and Exchange Traded Products (ETPs).

One notable example is a Canada-based investment fund manager, renowned for its institutional quality and innovative investment strategies. This entity has employed the BBR and the EBR for its Ether ETF and Bitcoin ETF. The application of the BBR allows the ETFs to benefit from a representative reference rate that is robust against market distortions and manipulations. The index's design, based on an average of volume-weighted median prices, gives the ETFs access to a reliable source of Bitcoin and Ethereum data to better measure their performance and market exposure.

The MarketVector has also been licensed by Coinbase for their crypto futures offerings, underlining the utility of these indices beyond traditional ETFs. The new Nano Bitcoin futures contract and future Ethereum product line offered by Coinbase's Derivatives Exchange rely on the [MarketVector™ Coinbase Bitcoin Benchmark Rate \(CBBR\)](#) and the [MarketVector™ Coinbase Ethereum Benchmark Rate \(CETBR\)](#). These licenses underscore the importance of a robust, hard-to-manipulate price benchmark in driving innovation and broadening utility in the crypto futures space.

These examples clearly demonstrate the utility and broad applicability of MarketVector™'s Benchmark Rates in the financial market. By providing a robust, transparent price benchmark, it helps to support new product developments and gives investors better access to cryptocurrency data, thereby promoting greater acceptance and engagement in the digital assets market.

Conclusion - The Vital Importance of Benchmark Rate Indexes for Digital Asset Investors

Inconsistencies in pricing are a notable feature of cryptocurrency markets, rendering the use of price feeds from a single exchange precarious for calculating portfolio value and settling contracts. The inconsistencies come from a multitude of sources, including market manipulation, errors by traders, exchange downtime, and inherent market inefficiencies.

In light of this, index providers maintaining benchmark rates should construct their methodologies to robustly withstand market dislocations and failures. One successful strategy to achieve this involves using median prices across exchanges as opposed to mean prices, as medians are more resilient to outliers. Even if such disruptions affect exchanges contributing to the index price, their impact remains minimal.

Using a reliable, regulated, and universally acknowledged reference point for leading digital currencies, can create a more secure and trustworthy environment for the continued growth and success of this new asset class. Understanding the mechanisms behind these benchmark reference rates equips investors with the knowledge to navigate the cryptocurrency market with confidence and strategic prudence.

IMPORTANT DEFINITIONS AND DISCLOSURES

Copyright © 2023 by MarketVector Indexes GmbH ("MarketVector"). All rights reserved. MarketVector™ is a registered trademark of VanEck Associates Corporation that has been licensed to MarketVector. MarketVector™ and MarketVector Indexes™ are pending trademarks of VanEck Associates Corporation. BlueStar® and BlueStar® Indexes are registered trademarks of MarketVector. Redistribution, reproduction, and/or photocopying in whole or in part are prohibited without written permission. All information provided by MarketVector is impersonal and not tailored to the needs of any person, entity, or group of persons. MarketVector receives compensation in connection with licensing its indexes to third parties. You require a license from MarketVector to launch any product that is linked to a MarketVector index to use the index data for any business purpose and all use of the MarketVector™ name or name of the MarketVector index. The past performance of an index is not a guarantee of future results.

It is not possible to invest directly in an index. Exposure to an asset class represented by an index is available through investable instruments based on that index. MarketVector does not sponsor, endorse, sell, promote, or manage any investment fund or other investment vehicle that is offered by third parties and that seeks to provide an investment return based on the performance of any index. MarketVector makes no assurance that investment products based on the index will accurately track index performance or provide positive investment returns. MarketVector is not an investment advisor, and it makes no representation regarding the advisability of investing in any such investment fund or other investment vehicle. A decision to invest in any such investment fund or other investment vehicle should not be made in reliance on any of the statements set forth in this document.

Investments into cryptocurrencies and/or digital assets are subject to material and high risk including the risk of total loss. The calculated prices may not be achieved by investors as the calculated price is based on prices from different trading platforms. Furthermore, an investment into cryptocurrencies and/or digital assets may become illiquid depending on the trading platform or investment product used for the specific investment. Investors should carefully review all risk factors disclosed by the relevant trading platform or in the product documents of relevant investment products.

Prospective investors are advised to make an investment in any such fund or other vehicle only after carefully considering the risks associated with investing in such funds, as detailed in an offering memorandum or similar document that is prepared by or on behalf of the issuer of the investment fund or other vehicle. The inclusion of a security within an index is not a recommendation by MarketVector to buy, sell, or hold such security, nor is it considered to be investment advice.

All information shown prior to the index launch date is simulated performance data created from backtesting ("Simulated past performance"). Simulated past performance is not actual but hypothetical performance based on the same or fundamentally the same methodology that was in effect when the index was launched. Simulated past performance may materially differ from the actual performance. Actual or simulated past performance is no guarantee for future results.

These materials have been prepared solely for informational purposes based upon information generally available to the public from sources believed to be reliable. No content contained in these materials (including index data, ratings, credit-related analyses and data, model, software, or other application or output therefrom) or any part thereof (Content) may be modified, reverse-engineered, reproduced or distributed in any form by any means, or stored in a database or retrieval system, without the prior written permission of MarketVector. The Content shall not be used for any unlawful or unauthorized purposes. MarketVector and its third-party data providers and licensors (collectively "MarketVector Parties") do not guarantee the accuracy, completeness, timeliness, or availability of the Content. MarketVector Parties are not responsible for any errors or omissions, regardless of the cause, for the results obtained from the use of the Content. THE CONTENT IS PROVIDED ON AN "AS IS" BASIS. MarketVector PARTIES DISCLAIM ANY AND ALL EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, FREEDOM FROM BUGS, SOFTWARE ERRORS, OR DEFECTS, THAT THE CONTENT'S FUNCTIONING WILL BE UNINTERRUPTED OR THAT THE CONTENT WILL OPERATE WITH ANY SOFTWARE OR HARDWARE CONFIGURATION. In no event shall MarketVector Parties be liable to any party for any direct, indirect, incidental, exemplary, compensatory, punitive, special, or consequential damages, costs, expenses, legal fees, or losses (including, without limitation, lost income or lost profits and opportunity costs) in connection with any use of the Content even if advised of the possibility of such damages.