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Suitability Analysis of the CME CF Ether-Dollar Reference Rate - New York Variant as a Basis for Regulated Financial Products

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Benchmarking the Price of Ether

In traditional markets, price benchmarks are used extensively for a variety of purposes, from settling derivatives transactions, to determining Net Asset Value (NAV) for investment funds amongst a host of use cases in institutional finance. One could almost go as far as saying that the preponderance of the use of a benchmark is a hallmark of the degree to which any market is institutional in nature. Certainly, as asset classes like commodities saw greater participation from financial institutions, benchmarks such as the S&P GSCI became more ubiquitous in that market. The market for Ether trading has, since its inception in 2015, been largely driven by individual investors with a small but increasing stream of institutional participation since 2021, when the first regulated Ether futures contracts were launched by CME Group in 2021.

Today, there are various Ether regulated derivatives contracts from CME Group, and regulated exchange traded products and funds in Canada, Brazil and Europe. A market at this juncture typically begins to exhibit increased benchmark usage that accelerates participation in the markets for these products by institutions; this process is also likely to be accelerated if spot Ether ETFs in the US are to be approved. Whilst Ether is just like Bitcoin a novel asset, the requirements of a benchmark price for Ether are no different from those required of a benchmark price for any asset. Whether it be Brent/WTI for crude oil, Term SOFR for money markets, or EuroStoxx 50 for the European equity markets – all benchmarks need to be ***representative of the underlying market, resistant to manipulation***, and ***replicable by market participants,*** to be able to foster further institutional participation in the underlying market that is being measured.

When examining any benchmark the first thing to understand is why we benchmark the price of any asset or an asset class. In the case of ETFs the primary purpose of a benchmark is to determine the cash value of the investments held by the ETF so a Net Asset Value (NAV) can be calculated. This facilitates a number of processes that are crucial to the operation of an ETF and serve its investors

1. ***Shares to be created and redeemed at NAV;*** a consistent and reliable NAV strike across time allows Authorised Participants (APs) to provide reliable secondary market liquidity, resulting in tight spreads for investors that buy or sell the shares
2. ***Measuring the efficacy of the ETF structure and operational skill of the ETF manager***; where the chosen benchmark is suitable for the purpose of striking NAV for an ETF then the ETF should track this closely - where tracking error becomes evident then it is symptomatic of either poor structure (ie. poor choice of benchmark) or a deficiency of skills on behalf of the manager

To be able to fulfil the above two objectives a benchmark must fulfil the three Rs; be ***representative*** of the underlying market, be ***resistant to manipulation*** and be ***replicable*** by market participants - especially APs given the role they play in providing liquidity and their ability to create/redeem ETF shares.

The CME CF Ether-Dollar Reference Rate – New York Variant

This paper seeks to understand whether those qualities are being achieved by the regulated **CME CF Ether-Dollar Reference Rate – New York Variant (ETHUSD_NY).**

The purpose of the CME CF Ether-Dollar Reference Rate – New York Variant is to provide a replicable, manipulation-resistant and representative Ether benchmark that synchronizes with the traditional U.S. market close. ETHUSD_NY is a once-a-day benchmark index price for Ether denominated in U.S. dollars. Input data are obtained from major cryptocurrency exchanges that conform to the CME CF Constituent Exchange Criteria.

The ETHUSD_NY index has been calculated every day since its launch on February 28th, 2022. It is methodologically identical to the regulated **CME CF Ether-Dollar Reference Rate** (**ETHUSD_RR**) that has been calculated daily since its launch on 14th May 2018; except that ETHUSD_RR references the daily price of Ether at 16:00 London Time, whilst ETHUSD_NY references the price of Ether at 16:00 New York Time.

Both ETHUSD_RR and ETHUSD_NY are regulated Benchmarks under the UK Benchmarks Regulation (BMR) regime. ETHUSD_NY and ETHUSD_RR are the Ethereum counterpart reference rates to the CF Benchmarks-administered Bitcoin indices, the regulated **CME CF Bitcoin Reference Rate (BRR)** and its variants **BRRNY** and **BRRAP**, the most widely used benchmark prices for Bitcoin.

Just as the BRR settles the Bitcoin-USD derivatives complex listed by CME Group, ETHUSD_RR settles the CME Group's Ether-USD derivatives complex. It also serves as the NAV for exchange listed investment products from WisdomTree, in the EU; Evolve ETFs, in Canada; and QR Asset Management and Hashdex in Brazil.

Calculation Methodology

The ETHUSD_NY calculation methodology aggregates transactions of Ether in U.S. dollars that are only conducted on the most liquid markets for which data is publicly available and operated by exchanges that meet the CME CF Constituent Exchange Criteria.

The list of Constituent Exchanges and information about changes to its composition are available at the following URL:

https://docs.cfbenchmarks.com/CME%20CF%20Constituent%20Exchanges.pdf

The full methodology is also available here:

https://docs.cfbenchmarks.com/CME%20CF%20Reference%20Rates%20Methodology.pdf

The methodology can be summarised thus:

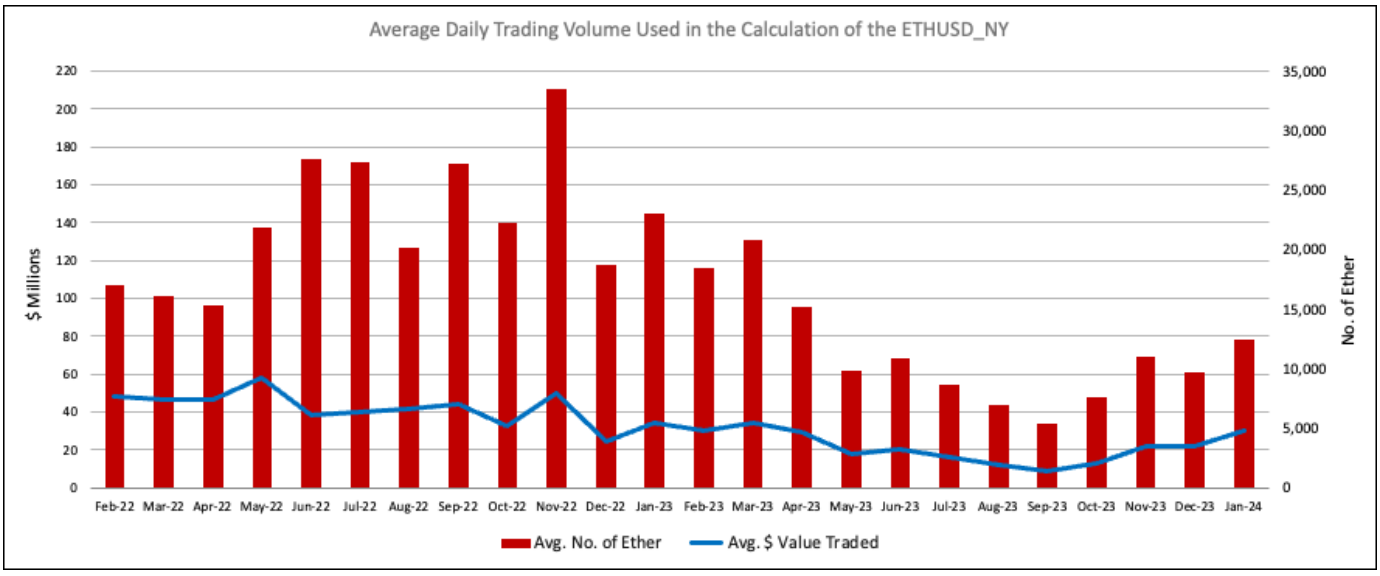
- Transactions conducted on Constituent Exchanges are observed during a one-hour window from 15:00 to 16:00 New York Time
- The one-hour window is divided into 12 partitions of equal length (five minutes each)
- For each partition, a volume-weighted median (VWM) is calculated

- The index value is expressed as the arithmetic mean of the 12 VWMs calculated in the previous step

Benchmark validity and volume sufficiency

A valid and robust benchmark needs to be calculated from input data of ***sufficient volume*** so that it is representative of the market it seeks to measure. From a practical perspective, volume sufficiency is also key in order for the benchmark to be replicated by institutional market participants and product providers that need to warehouse price risk. To understand how the ETHUSD_NY measures up, data summarising a total number of transactions and an average number of transactions per day observed each month during the observation window (data represent both trade count and ether volume) are presented in Figure 1.

Figure 1



Note: The ETHUSD_NY was launched on February 28th, 2022. LMAX Digital was added as a Constituent Exchange from May 2022

Between February 28th, 2022, and January 31st, 2024 (weekdays only), on average 16,965.88 Ether, or $31 million were traded during each daily observation window between 15:00 and 16:00 New York Time. Whilst trading activity exhibits volatility, this volatility is not substantially different from that shown in traditional asset markets. In conclusion, the volume observed and the reliability of that volume are clearly evident to be sufficient for the calculation of a ***robust and reliable benchmark***.

Resistance to Manipulation – Benchmark Integrity

This section will address the question of whether the ETHUSD_NY is possessed of integrity in the specific sense applied by securities regulations. The practical imperative is that a benchmark requires integrity because it will be used for a wide range of activities such as asset valuation, settlement of financial risk, risk management, NAV calculation, unit creation and unit redemption. Specifically, the benchmark must both be shown to be free of manipulation and furthermore, it must be administered and calculated in a manner that deters and impedes manipulation.

Deterring and Impeding Manipulation

The methodological design underlying the ETHUSD_NY and its system of administration incorporate measures that promote integrity as outlined in the sub-sections below.

Impeding Manipulation by Input Data selection

CF Benchmarks exclusively sources input data from Constituent Exchanges that meet published criteria as set out in its Constituent Exchanges Criteria. The criteria are available at this link: https://docs.cfbenchmarks.com/CME%20CF%20Constituent%20Exchanges%20Criteria.pdf.

Particular attention is drawn to the following statement from the Constituent Exchanges Criteria document (part 2 of Section 3, page 5: 'Eligibility Criteria'):

"The venue has policies to ensure fair and transparent market conditions at all times and has processes in place to identify and impede illegal, unfair or manipulative trading practices."

CF Benchmarks ascertains the presence of fair and transparent market conditions and processes to identify and impede illegal, unfair or manipulative practices by conducting a thorough review of any exchange under consideration for inclusion as a Constituent Exchange. The arrangements of all Constituent Exchanges are reviewed annually to ensure that they continue to meet all criteria specified within "Constituent Exchange Criteria". This due diligence is documented, and the information is distributed to CF Benchmarks' oversight organs to consider. The deliberations of oversight organs are conducted during regular meetings, minutes of such meetings are publicly available, being published by the Administrator on its website.

Manipulation resistance by design

Resistance to manipulation is a priority aim of the design methodology underlying the CME CF Ether-Dollar Reference Rate – New York Variant. The methodology takes an observation period and divides it into equal partitions of time. The volume-weighted median of all transactions within each partition is then calculated. The benchmark index value is determined from the

arithmetic mean of the volume-weighted medians, equally weighted. The benefits of this process with respect to achieving manipulation resistance are outlined below.

- **Use of partitions**

Individual trades of large size have limited effect on the Index level as they only influence the level of the volume-weighted median for that specific partition.

A cluster of trades in a short period of time will also only influence the volume-weighted median of the partition or partitions they were conducted in.

- **Use of volume-weighted medians**

Use of volume-weighted medians as opposed to volume-weighted means ensures that transactions conducted at outlying prices do not have an undue effect on the value of a specific partition.

- **Equal weighting of partitions**

By not volume weighting partitions, trades of large size or clusters of trades over a short period of time will not have an undue influence on the index level.

- **Equal weighting of constituent exchanges**

CF Benchmarks applies equal weight to transactions observed from CME CF Constituent Exchanges. With no pre-set weights, potential manipulators cannot target one platform for the conduct of manipulative trades.

- **Use of arithmetic mean of partitions**

Using the arithmetic mean of partitions of equal weight further denudes the effect of trades of large size at prices that deviate from the prevailing price having undue influence on the benchmark level.

Manipulation resistance by exclusion of input data

A specific procedure for dealing with potentially erroneous data is incorporated into the methodology of the ETHUSD_NY. Although volume-weighted medians of transaction prices from individual data sources are not part of the benchmark determination process, they are calculated as a means of quality control and manipulation resistance.

In the event of an instance of index calculation in which a Constituent Exchange's volume-weighted median transaction price exhibits an absolute percentage deviation from the volume-weighted median price of other Constituent Exchange transactions greater than the Potentially Erroneous Data Parameter (10%), then transactions from that Constituent Exchange are deemed potentially erroneous and excluded from the index calculation. All instances of data excluded from a calculation trigger a Benchmark Surveillance Alert that is investigated.

Between February 28th, 2022, and January 31st, 2024, the Potentially Erroneous Data Parameter of the methodology for the CME CF Ether-Dollar Reference Rate – New York Variant

has never been triggered. Analysis of the max volume-weighted median per exchange during the observation period produced the results in Table 1. The results illustrate that during the observation period, no Constituent Exchange's input data needed to be excluded due to exhibiting potential manipulation and indeed no individual cryptocurrency exchange exhibits a deviation percentage above 1.85% during this period.

Table 1

Max in Month	Max volume weighted median deviation per exchange (%)					
	Bitstamp	Coinbase	Gemini	itBit	Kraken	LMAX Digital
Feb-2022	0.00%	0.02%	0.27%	0.04%	0.12%	N/A
Mar-2022	0.43%	0.12%	0.16%	0.41%	0.59%	N/A
Apr-2022	0.52%	0.38%	0.40%	0.42%	0.43%	N/A
May-2022	0.51%	0.21%	1.17%	1.16%	0.37%	0.31%
Jun-2022	0.71%	0.43%	0.43%	0.52%	0.94%	0.60%
Jul-2022	0.53%	0.37%	**1.85%**	0.49%	0.41%	0.37%
Aug-2022	0.55%	0.11%	0.50%	0.35%	0.34%	0.35%
Sep-2022	0.62%	0.38%	0.49%	0.60%	0.43%	0.26%
Oct-2022	0.17%	0.17%	0.41%	0.23%	0.36%	0.16%
Nov-2022	0.99%	0.85%	0.54%	1.19%	0.62%	1.75%
Dec-2022	0.35%	0.14%	0.11%	0.28%	0.56%	0.50%
Jan-2023	0.21%	0.27%	0.47%	0.26%	0.45%	0.37%
Feb-2023	0.20%	0.15%	0.71%	0.27%	0.26%	0.15%
Mar-2023	0.98%	0.32%	0.40%	0.85%	0.33%	0.23%
Apr-2023	0.42%	0.13%	0.40%	0.53%	0.26%	0.31%
May-2023	0.31%	0.12%	0.20%	0.36%	0.26%	0.20%
Jun-2023	0.37%	0.17%	0.36%	0.62%	0.22%	0.48%
Jul-2023	0.24%	0.12%	0.22%	0.20%	0.32%	0.15%
Aug-2023	0.21%	0.11%	0.45%	0.42%	0.11%	0.14%
Sep-2023	0.17%	0.08%	0.30%	0.11%	0.13%	0.14%
Oct-2023	0.35%	0.11%	0.21%	0.17%	0.25%	0.13%
Nov-2023	0.26%	0.15%	0.29%	0.50%	0.19%	0.20%
Dec-2023	0.26%	0.07%	0.20%	0.19%	0.57%	0.08%
Jan-2024	0.60%	0.20%	0.25%	0.50%	0.48%	0.33%

Note: The ETHUSD_NY was launched on February 28th, 2022. LMAX Digital was added as a Constituent Exchange from May 2022

Benchmark Surveillance

Although a series of measures have been undertaken to mitigate the risk of benchmark manipulation, CF Benchmarks remains vigilant against attempted benchmark manipulation and monitors input data continuously. To that end, CF Benchmarks has implemented a benchmark surveillance programme for the investigation of alerts. Instances of suspected benchmark manipulation are escalated through appropriate regulatory channels in accordance with CF Benchmarks' obligations under the UK Benchmarks Regulation (UK BMR). Regarding benchmark manipulation, Article 14 of the UK BMR, Reporting of Infringements, states:

1. An administrator shall establish adequate systems and effective controls to ensure the integrity of input data in order to be able to identify and report to the FCA any conduct that may involve manipulation or attempted manipulation of a benchmark, under Regulation (EU) No 596/2014.

2. An administrator shall monitor input data and contributors in order to be able to notify the FCA and provide all relevant information where the administrator suspects that, in relation to a benchmark, any conduct has taken place that may involve manipulation or attempted manipulation of the benchmark, under Regulation (EU) No 596/2014, including collusion to do so."

As a regulated Benchmark Administrator, CF Benchmarks is subject to supervision by the UK FCA. Furthermore, CF Benchmarks' Control Procedures with respect to compliance with the UK BMR have been audited by 'Big Four' accountancy firm Deloitte. The Independent Assurance Report on Control Procedures Noted by CF Benchmarks Regarding Compliance with the UK Benchmarks Regulation as of 12 September 2022 is available at the following link:

https://docs.cfbenchmarks.com/Deloitte_CF%20Benchmarks%20SOC1%20Audit%20Report.pdf

This further verification of CF Benchmarks' compliance with the UK BMR places the CME CF Ether-Dollar Reference Rate – New York Variant on the same level of scrutiny applied to widely used traditional financial benchmarks like ICE SWAP, SONIA and RONIA.

Assessing ETHUSD_NY values and input data for signs of manipulation

Whilst the ETHUSD_NY was designed and is administered to the highest standards, including efforts to uphold provisions of the UK BMR, the proof of the pudding is in the eating and further analysis of the data is required to evaluate its efficacy against the three Rs.

Were there to be a lack of integrity in the input data that could in turn affect the integrity of the benchmark, one would expect to see one of a number of phenomena reflected in the input data provided by Constituent Exchanges. One potential example would be significant price dislocations between Constituent Exchanges.

How well correlated are Constituent Exchange prices?

An analysis was undertaken of the pair-wise correlation of prices from Constituent Exchanges on a per-minute basis (the price difference between transactions for each minute at each exchange) during the observation period. The results of this analysis are shown in Table 2.

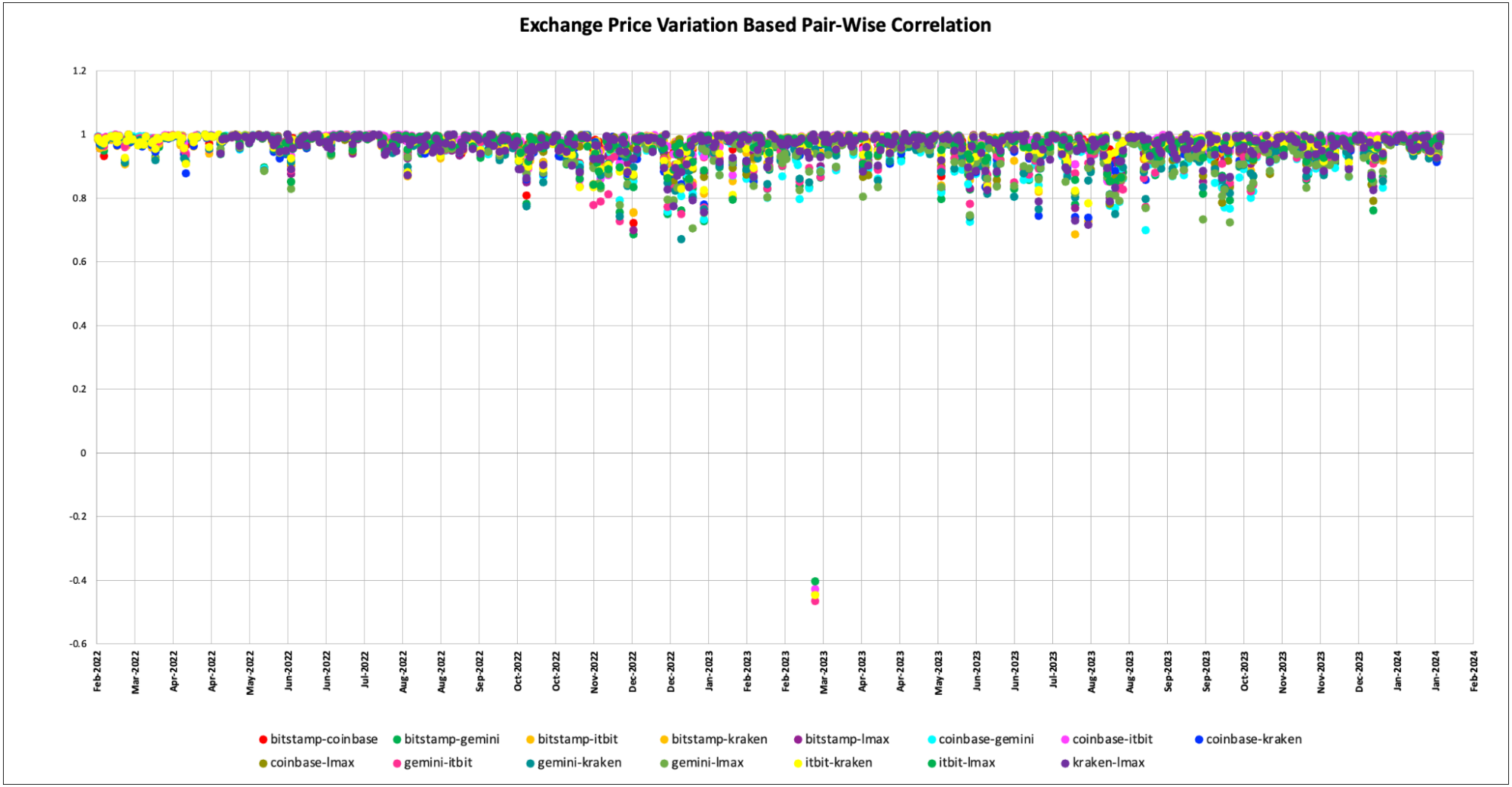
Table 2

Pairwise Correlation of Constituent Exchanges to ETHUSD_NY			
Constituent Pair Platform	**Mean Correlation %**	**Median Correlation %**	**Standard Deviation**
Bitstamp-Coinbase	98.41%	98.98%	1.72%
Bitstamp-Gemini	96.38%	98.23%	5.78%
Bitstamp-itBit	97.62%	98.66%	2.97%
Bitstamp-Kraken	96.72%	98.20%	4.29%
Bitstamp-LMAX Digital*	96.70%	98.03%	4.36%
Coinbase-Gemini	96.25%	98.19%	5.97%
Coinbase-itBit	97.33%	98.55%	3.55%
Coinbase-Kraken	96.43%	98.13%	4.78%
Coinbase-LMAX Digital*	96.65%	98.07%	4.63%
Gemini-itBit	96.44%	98.30%	5.97%
Gemini-Kraken	95.67%	97.83%	6.13%
Gemini-LMAX Digital*	95.16%	97.49%	6.55%
itBit-Kraken	97.51%	98.65%	3.48%
itBit-LMAX Digital*	96.70%	98.17%	4.53%
Kraken-LMAX Digital*	95.85%	97.66%	5.45%

LMAX Digital was added as a Constituent Exchange from May 2022.

To illustrate the data analysed in Table 2 in graphical form, Figure 2 (below) displays the full data set. The clustering towards correlation coefficients of 1.00 and the fact that on less than 0.45% of days any exchange had a correlation with another exchange below 0.5 demonstrate strong price correlation between the Constituent Exchanges and points towards fair and orderly markets. The pattern is understandably broken around the time of the FTX bankruptcy (November-December 2022) given the extreme volatility this event precipitated.

Figure 2



Replicability and Implementation

The final characteristic of the ETHUSD_NY that this paper will examine with respect to its merits as a benchmark price is its replicability. In other words, that the ETHUSD_NY benchmark price can be transacted in practice on any given day without undue risks.

Buying and selling large amounts of Ether at ETHUSD_NY

To begin demonstrating the replicability—or to use another term, the achievability—of the strategy presented in this paper for purchasing Ether 'at scale', observations taken whilst modelling the purchase or sale of a notional large amount of Ether are presented below. It was decided that the purchase or sale of 894.18 Ether (c. $2.8M at the time of writing) was at an adequate scale to represent a large Ether trade of the kind that institutional traders might need to undertake for a client, or that an issuer of a financial product (such as an ETF, or a derivative) would be required to execute on any given day, in order to facilitate trading of that product. A simple replication simulation was thereby conducted to demonstrate the extent of slippage that implementation of the ETHUSD_NY would probably encounter. Given that the purpose is to demonstrate institutionally sized liquidity, the simulation was conducted for weekdays only.

Simulation Methodology

- Trades are executed on *n* (6) Constituent Exchanges, during a 3,600-second window
- One trade is executed every second and the price achieved is assumed to be the last execution price observed in that second. Its associated volume is assumed to be the volume executed during that second
- If no trade is completed in any single-second period, then the price achieved is assumed to be the price achieved in the previous second, but the associated volume from the previous second is not added to the volume executed in the latest second

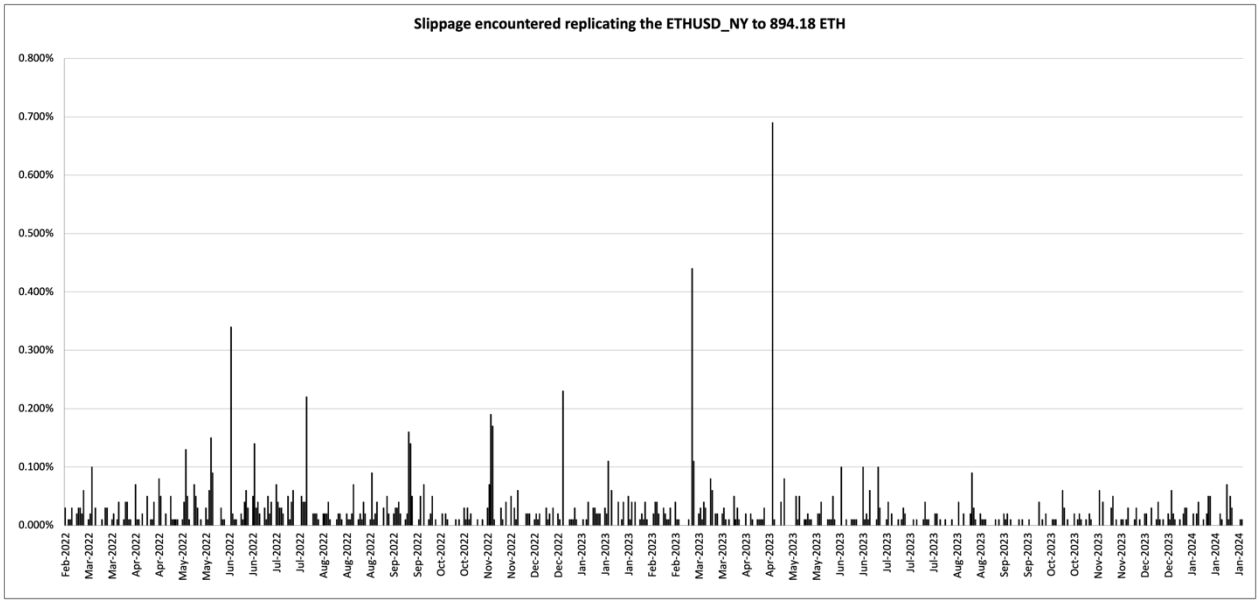
It is worth noting that in the 'real world', institutions deploy algorithmic systems to execute large-scale asset purchases. It is highly probable that conducting the exercise presented here by means of algorithmic systems would have produced outcomes that are even more favourable. For research purposes, a simplified simulation methodology was favoured to demonstrate the replicability of the ETHUSD_NY.

The results of this exercise are displayed in Figure 3 and summary data provided in Table 3. As can be seen, the ETHUSD_NY can be replicated with a high degree of confidence and usually with slippage of no more than 1 basis point. On only 8.35% of days would slippage have been greater than 5 bps. Indeed, even on the most volatile day, slippage was only 69 basis points. Furthermore, in the 24-month period under observation slippage would have been in double-digit basis points only 18 times.

Table 3

Slippage %	
MAX	0.690%
MIN	0.000%
MEDIAN	0.010%
MEAN	0.025%
STD. DEV.	0.048%

Figure 3



Conclusion

From the analysis conducted it is quite clear that the CME CF Ether-Dollar Reference Rate – New York Variant exhibits all the key properties required of a benchmark.

Representative: Ether-USD markets that are operated by the CME CF Constituent Exchanges during 15:00 to 16:00 New York Time are liquid, with sufficient volume of trading to represent the market in a robust manner.

Resistant to Manipulation: The ETHUSD_NY Constituent Exchange Criteria ensure that it takes input data only from cryptocurrency exchanges that exhibit fair and orderly behaviour, where trading shows strong price correlations between each other. On top of this, the methodology the ETHUSD_NY employs nullifies the effects of any manipulation, and the Administrator's policies and processes regarding surveillance ensure that any manipulation is detected.

Replicable: The ETHUSD_NY methodology promotes replicability, allowing users (especially APs to ETFs) to replicate the benchmark simply and without undue risks, in turn giving them the confidence to provide secondary market liquidity to the ETF shares.

For suitability analysis articles that analyse Bitcoin-Dollar products please click the links below:

CME CF Bitcoin Reference Rate (BRR)

https://blog.cfbenchmarks.com/suitability-analysis-of-the-cme-cf-brr-as-a-basis-for-regulated-financial-products-may-2023/

CME CF Bitcoin Reference Rate New York Variant (BRRNY)

https://www.cfbenchmarks.com/blog/suitability-analysis-of-the-cme-cf-bitcoin-reference-rate-new-york-variant-as-a-basis-for-regulated-financial-products-february-2024-update

CME CF Bitcoin Reference Rate Asia Pacific Variant (BRRAP)

https://www.cfbenchmarks.com/blog/suitability-analysis-of-the-cme-cf-bitcoin-reference-rate-asia-pacific-variant-as-a-basis-for-regulated-financial-products-2

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