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Developing central bank digital currencies: A reality check during cryptocurrency euphoria

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Abstract

The creation and testing of central bank digital currency (CBDC) have been observed as a potential pathway to the strengthening of cryptocurrency regulatory conditions. However, for some, such central bank intervention is observed as nothing more than an unnecessary hindrance and a threat to both confidentiality and potential profitability. Using estimated sentiment indices based on CBDC-related social media posts, and testing for the effects of regulatory-related announcements upon blockchain and cryptocurrency-related funds, this research presents two key findings: first, the continued evolution of the pricing structures of digital finance products to respond to such perceived threats constitutes a further evolutionary point in the product's life-cycle. However, secondly, the very fact that returns fall while volatility increases indicate a largely negative market response to the threat of potential external regulation of cryptocurrencies in the future. The nature of this negative response validates concerns that anonymity continues to be an attractive central feature for cryptocurrency stakeholders, further verifying the necessity for third-party oversight.

Keywords: cryptocurrency, CBDC, sentiment, central bank, exchange traded funds

JEL Classification Codes: G10, G15, G18

1. Introduction

Anonymity, through the process of financial transactions, and the ability to invest assets without verification, has been observed as a key feature that continues to attract cryptocurrency enthusiasts [Foley et al., 2019]. The ability of 'investors' to open cryptocurrency investment accounts in jurisdictions with weak, and in some cases, non-existent KYC (Know-Your-Customer) regulations have been a source of concern for regulatory authorities, many of whom have been attempting to shore up regulatory conditions [Fletcher et al., 2021].

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The intention and realised development of Central Bank Digital Currencies (CBDC hereafter), has been observed as one of the key disrupting forces, against largely unchallenged cryptocurrency growth and development, which has resulted in a host of altcoins that have been exposed to the forces of social media-driven price manipulation, while being largely compromised by broad illegality through a number of both simplistic and complicated channels alike [Griffin and Shams, 2020, Corbet et al., 2020, Cioroianu et al., 2021a]. Over the past four years, multilateral agencies such as the World Bank, IMF and Bank for International Settlements have worked with several central banks to develop a steadily more sophisticated understanding of the design, implementation, operation, and regulation of a CBDC in the context of Decentralised Finance (DeFi) and cryptocurrencies [Mancini-Griffoli et al., 2018, Adrian and Mancini-Griffoli, 2019, Alvarez and Argente, 2020]. As recently as January 2022 the Bank for International Settlements has placed CBDCs, next-generation payments systems and DeFi, and the development of new technological public goods for central banks at the core of their Innovation Hub work programme, coordinating the efforts of several national central banks¹. Importantly, the U.S. Federal Reserve has begun the process of consultation on a CBDC as of January 2022, with a significant Board of Governors consultation paper². CBDCs, representing a digital version of central bank-supported digital assets, present an avenue through which many channels of illicit behaviour can be removed, while further issues relating to moral hazard and asymmetric information can be largely mitigated, significantly reducing the presence of non-transparent transactions [Corbet and Cumming, 2020, Agur et al., 2022].

Using a number of blockchain and cryptocurrency-related fund products, this research attempts to investigate the specific effects of social media coverage relating to CBDC, as measured by the polarity and subjectivity of discussion over time, along with the release dates of CBDC-based research, as circulated by six of the largest international central banks to specifically investigate as to whether such markets have responded over time to the development of CBDCs. Specifically, we test both the scale and direction of market response in terms of both returns and volatility, observed not only to be representative of the intensity of market reaction but also the disruption and disorientation generated therein.

2. Data

We collected cryptocurrency funds data from Thomson Reuters Eikon for the period 1 January 2017 through 30 September 2021. In total, 210 funds were identified to have been based on either blockchain or cryptocurrency investment³. The funds are further separated into six types of funds, and respective geographic regions, where returns by product type are presented in Figure 1, and respective summary statistics are presented in Table 1. As per Corbet et al. [2018] and Cioroianu et al. [2021b], we define returns as the daily log changes and volatility as the five-day standard deviation.

We next obtained data relating to sentiment from Twitter. All tweets mentioning the terms "CBDC," "CBDC", and "central AND bank AND digital AND currency" were computationally collected through the Twitter v2 API (the academic access track) using the R package 'academictwitterR' Barrie and C.T.Ho [2021]. A total number of 761,704 unique tweets were collected⁴. The data were then aggregated by date as presented in Figure 2, with further summary statistics presented in Table 2, taking sums of the quantitative variables and aggregating the text.

¹ Further information is available at the following [link](#).

² Money and Payments: The U.S. Dollar in the Age of Digital Transformation, Board of Governors of the Federal Reserve System, 2022. Available [here](#).

³ For the purpose of this analysis, 189 additional funds were removed from the analysis as they did not possess data in excess of one year of duration or did not present daily transactions throughout the entire period of analysis.

⁴ For brevity, additional summary statistics based on these tweets are available from the authors upon request.

Table 1. Summary statistics relating to selected cryptocurrency-related funds.

Fund Type	Mean	Variance	Skewness	Kurtosis	Minimum	Maximum
Equity ETF	0.0040	0.0011	1.7306	25.1412	-0.2227	0.3178
Exchange-Traded Fund	0.0005	0.0016	-1.7714	8.1630	-0.2608	0.1173
Exchange-Traded Note	0.0045	0.0024	0.0120	13.8792	-0.3572	0.3983
Other Exchange-Traded Product	0.0039	0.0016	-0.6596	7.5798	-0.2675	0.2026
Open-End Fund	0.0037	0.0027	-0.0715	12.3390	-0.3262	0.3573
Geographic Region	Mean	Variance	Skewness	Kurtosis	Minimum	Maximum
Australia	0.0023	0.0037	-1.3619	9.9994	-0.3679	0.2786
Brazil	0.0033	0.0028	3.2498	27.7896	-0.1369	0.4344
Canada	0.0007	0.0023	1.1965	10.3929	-0.1401	0.3098
Germany	0.0036	0.0020	-0.8217	6.7561	-0.2942	0.2348
Netherlands	0.0024	0.0020	0.0131	1.7053	-0.1416	0.1561
Switzerland	0.0035	0.0018	-0.4419	14.8155	-0.3362	0.2877
United Kingdom	0.0103	0.0044	3.9241	24.1095	-0.1154	0.4815
United States	0.0039	0.0011	2.8285	37.3573	-0.2225	0.3488

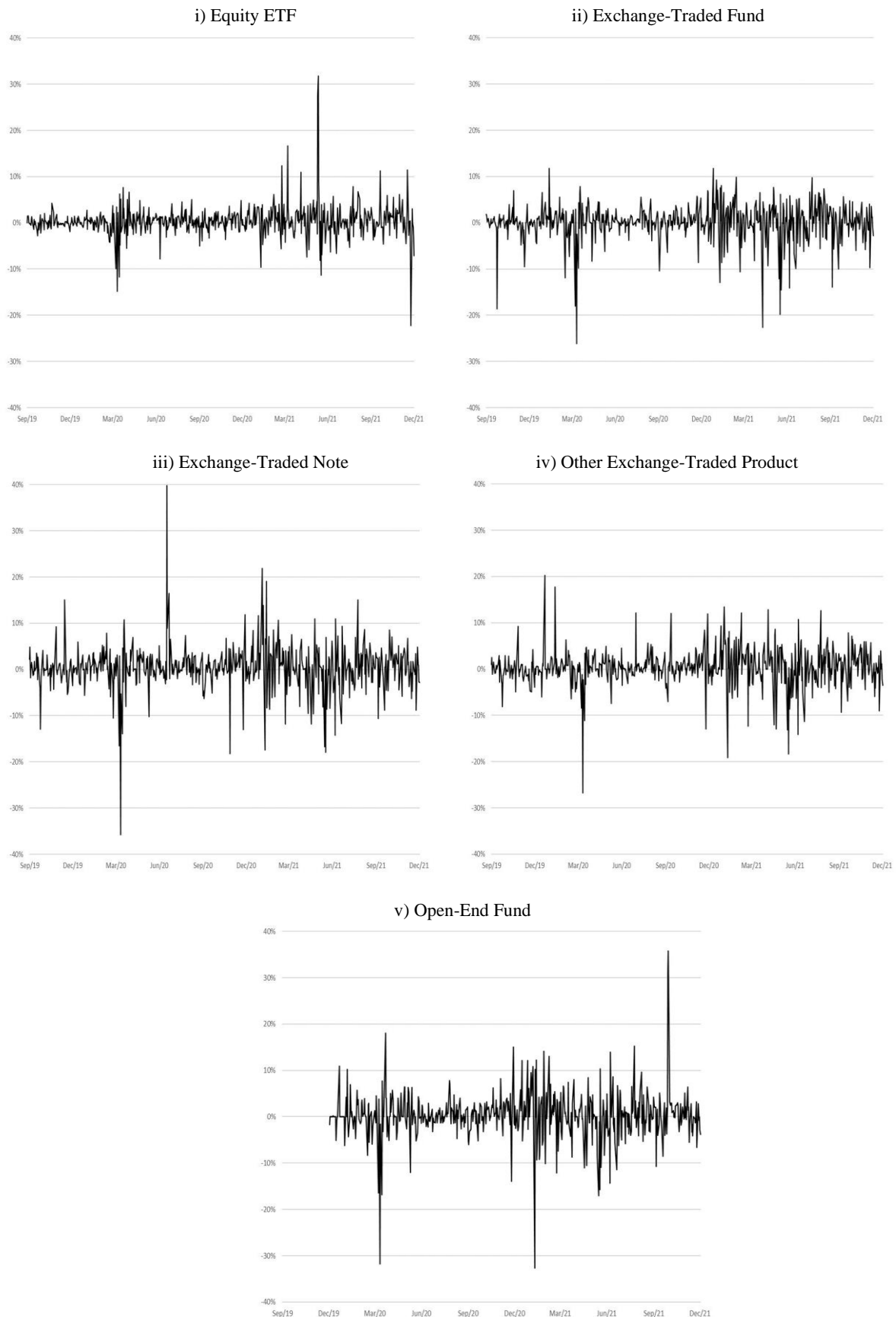
Note: The above data is based on the period 1 January 2017 through 30 September 2021. In total, 210 funds were identified to have been based on either blockchain or cryptocurrency investment.

Table 2. Summary statistics relating to collected social media data.

Time Period	Tweets	Likes	Retweets
2017 Q1	3,320	29,673	1,498
2017 Q2	5,482	293,231	3,871
2017 Q3	3,370	104,234	2,818
2017 Q4	4,695	25,472	2,199
2017 Total	16,867	452,610	10,386
2018 Q1	4,535	275,587	5,209
2018 Q2	11,013	315,686	8,722
2018 Q3	6,838	230,185	5,343
2018 Q4	7,810	622,312	10,525
2018 Total	30,196	1,443,770	29,799
2019 Q1	5,486	67,361	6,682
2019 Q2	6,567	206,414	9,780
2019 Q3	17,142	4,133,913	29,133
2019 Q4	32,317	4,375,106	62,365
2019 Total	61,512	8,782,794	107,960
2020 Q1	37,220	1,563,719	70,784
2020 Q2	38,317	927,914	63,948
2020 Q3	54,713	1,959,856	104,673
2020 Q4	76,679	1,838,124	160,964
2020 Total	206,929	6,289,613	400,369
2021 Q1	95,912	6,464,895	259,307
2021 Q2	162,536	31,404,284	451,578
2021 Q3	187,752	40,402,754	503,500
2021 Total	446,200	78,271,933	1,214,385
Total Period	761,704	95,240,720	1,762,899

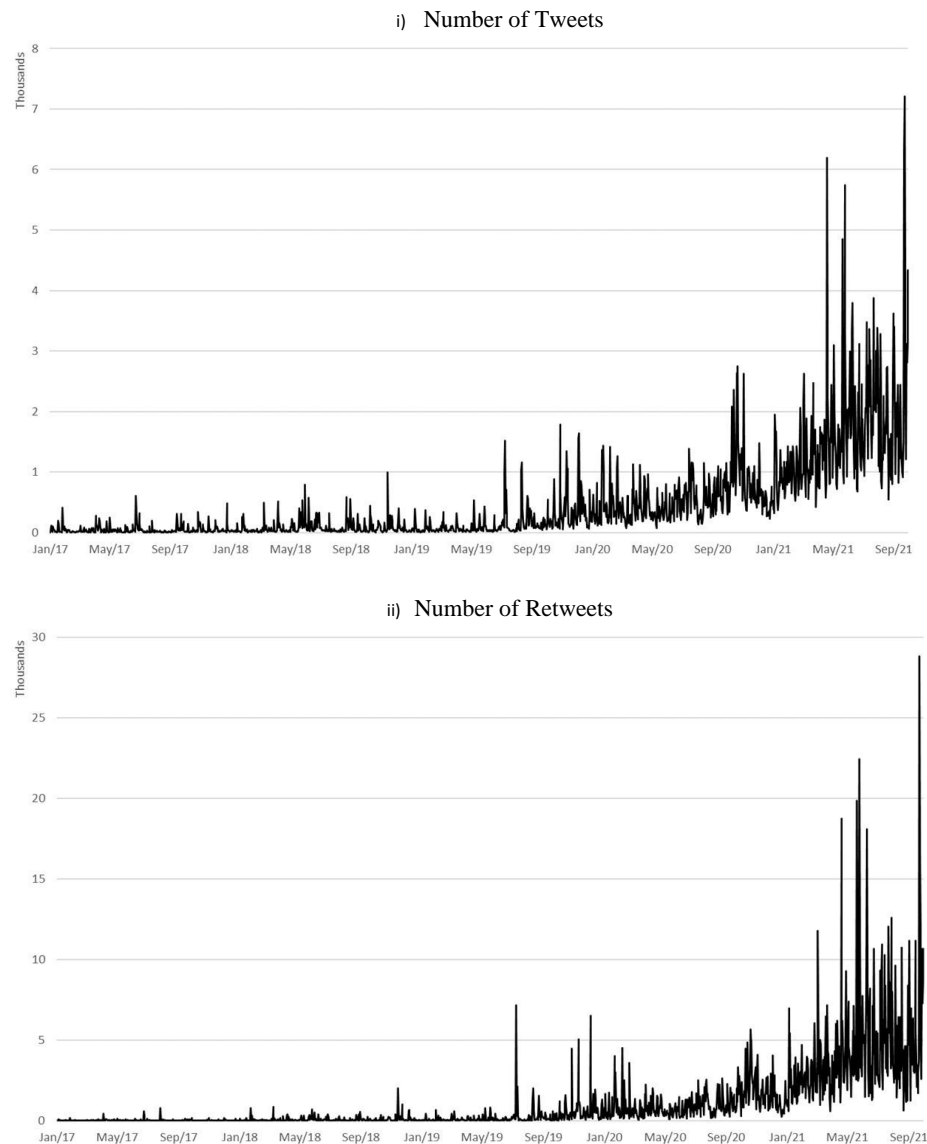
Note: All tweets mentioning the terms “CBDC”, “CBDC” and “central AND bank AND digital AND currency” were computationally collected. A total number of 761,704 unique tweets were collected between Q1 2017 and Q3 2021.

Figure 1. Asset performance as separated by fund type



Note: The above data is based on the period 1 January 2017 through 30 September 2021. In total, 210 funds were identified to have been based on either blockchain or cryptocurrency investment.

Figure 2. Social media data relating to CBDC.



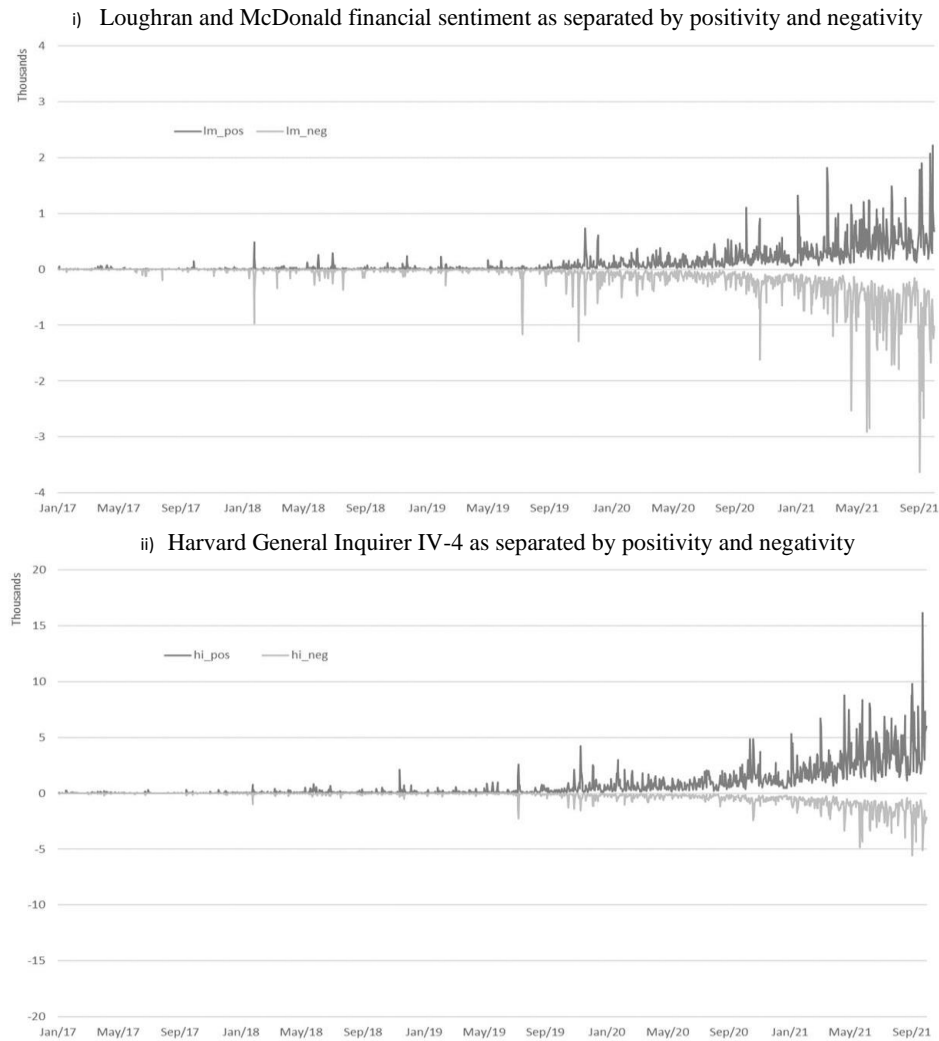
Note: All tweets mentioning the terms “CBDC”, “CBDC” and “central AND bank AND digital AND currency” were computationally collected. A total number of 761,704 unique tweets were collected between Q1 2017 and Q3 2021.

We next determine the sentiment of a tweet through polarity analysis, developing the emotional attitude of the text to ascertain whether such social media posts express a positive or negative opinion. In Figure 4, we present a series relating to all announcements made on the respective websites of the U.S. Federal Reserve, the European Central Bank, the Bank of England, the Bank of Japan, the Swiss National Bank, and the Bank of Canada relating explicitly to either CBDC or central bank-denoted cryptocurrencies.

In the next stage of the analysis, we computationally code the collected tweets based on the Harvard General Inquirer IV-4 dictionary and the Loughran and McDonald Financial Sentiment dictionary. This research focuses specifically on the subjectivity and polarity of these social media posts⁵, which are considered to be representative of market opinion at the point in the time surrounding central bank intervention in cryptocurrency markets as presented in Figure 3.

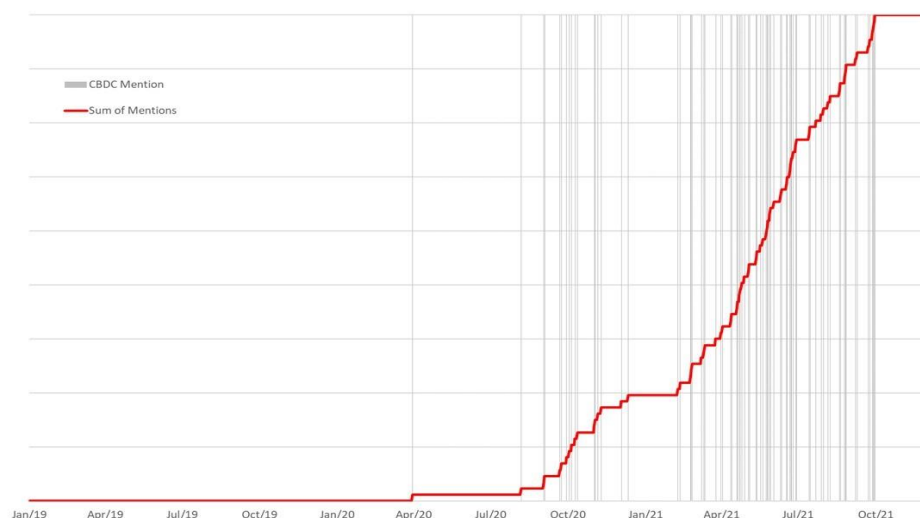
⁵ Subjectivity analysis of the text is a part of sentiment analysis, where using Natural Language Processing (NLP) researchers classify a text as opinionated or not opinionated.

Figure 3. Sentiment based on social media driven perceptions of CBDC.



Note: The sentiment variables are based on the Loughran and McDonald Financial Sentiment dictionary and the Harvard General Inquirer IV-4 dictionary.

Figure 4. Major central bank mentions with regards to CBDC (2019-2021).



Note: In the above figure, we present a series relating to all announcements made on the respective websites of the U.S. Federal Reserve, the European Central Bank, the Bank of England, the Bank of Japan, the Swiss National Bank, and the Bank of Canada relating explicitly to either CBDC or central bank-denoted cryptocurrencies.

3. Empirical approach and results

We specifically investigate the potential effects stemming from the growing focus of major international central banks on CBDC and broad cryptocurrency regulation upon funds with a focus on digital technology. To complete such as task, we focus on two distinct avenues of investigation: The first avenue observes CBDC as a direct competitor to cryptocurrencies, where we hypothesise that widespread CBDC adoption could negatively impact cryptocurrency valuations both directly (by reducing the user base) and indirectly (potentially dampened cryptocurrency regulatory environment); while the second avenue focuses on the potential for CBDC to act as a complement to cryptocurrencies. Any identified behavioural responses would be considered to be connected with either positive, or negative future expectations with regard to third-party regulatory involvement in these developing financial assets. To specifically analyse such effects, we employ a GARCH (1,1) methodology as developed by Bollerslev [1986] and previously used in a similar manner by Corbet et al. [2020, 2021], of the following form:

$$R_t = a_0 + Xb_j R_{t-j}^5 + b_2 DJ_t + b_3 S_t + D_{reg} + \varepsilon_t \quad (1)$$

$$\varepsilon_t | \Omega_t \sim i.i.d. N(0, h_t) \quad (2)$$

$$h_t = \omega + \alpha_1 h_{t-1} + \beta_1 u_{t-1}^2 \quad (3)$$

R_{t-j} represents the lagged value of the selected cryptocurrency-based fund returns, j number of periods before R_t is observed. $b_2 DJ_t$ represents the effects of the Dow Jones Industrial Average as a measure of international effects. $b_3 S_t$ represents the effects of sentiment, as separated by the Loughran and McDonald Financial Sentiment dictionary-based (L.M.) and the Harvard General Inquirer IV-4 dictionary-based (H.I.) sentiment. The effects of both the polarity and subjectivity of these models are analysed in isolation. D_{reg} focuses on the effects of all announcements made by major central banks explicitly to either CBDC or central bank-denoted cryptocurrencies. Volatility estimates are obtained through the use of the same sentiment and regulatory variables. As per Corbet et al. [2020], we present Bonferroni-adjusted results in this analysis⁶. The selection of this methodological structure enables robust analysis with regard to the influence of both sentiment and central banking announcements relating to CBDC.

The influence of CBDC and regulatory announcements are separated based on return and volatility influence by fund type and geographical region, with resulting estimates presented based on the polarity and the subjectivity of analysed sentiment in Table 3. Focusing initially on key differentials as identified by the type of fund, and then by geographic region, a number of interesting observations can be identified. In over half of all analysed funds, as separated by type, there exists a significant response to both returns and volatility at the 1% level in the aftermath of central bank announcements relating to CBDC. The largest influential pathways from sentiment are identified for returns relating to other types of exchange-traded products. However, substantial volatility interactions are identified throughout. From a geographic perspective, it is quickly apparent that there exist significant regional differentials of response, particularly in the United States, where very low levels of interaction with both sentiment and regulatory mentions are observed for both the returns and volatility of the analysed ETF (Exchange Traded Fund) products. Such a result is most likely a side-effect of the perceived weakness of any potential regulatory intervention due to a lack of concise signalling, but also possibly due to issues such as that caused by recent messaging board stock attacks and a broad inability to robustly clampdown on much of the fraud that has been inherent within cryptocurrencies and their associated by-products for the best part of a decade. When focusing

⁶ To cater for the multiple hypothesis problem, we adjust the significance level using the Bonferroni correction, which leads to a significance level of 0.1%.

on the level of significant interactions at the 1% level in Figure 5, we observe that while estimated sentiment interaction presents negative average returns of -0.19%, when further consideration is given to the direct central bank announcements relating explicitly to CBDCs, cryptocurrency-related ETF products are found to present average returns of -0.71%. The majority of estimates are found to be below zero. Both sentiment and regulatory announcements relating to CBDC are found to significantly increase the volatility of analysed ETF products, accounting for elevations of 6.95% and 6.26%, respectively.

4. Conclusions

This research presents significant evidence of a further layer of fragility that has been influencing cryptocurrency markets, specifically the threat of third-party, central bank-driven market entry and intervention. Results indicate that sentiment effects relating to discussions surrounding CBDC significantly reduce cryptocurrency-related ETF returns, while simultaneously increasing respective short-term price volatility. The influence of central bank announcements relating to CBDC is found to be even more pronounced. Our results further verify the view that CBDC can become a direct competitor to cryptocurrencies, where widespread CBDC adoption has the potential to significantly, and negatively impact cryptocurrency valuations by reducing the number of users and through further international regulatory ambiguity. Such evidence supports the view that regulatory announcements do

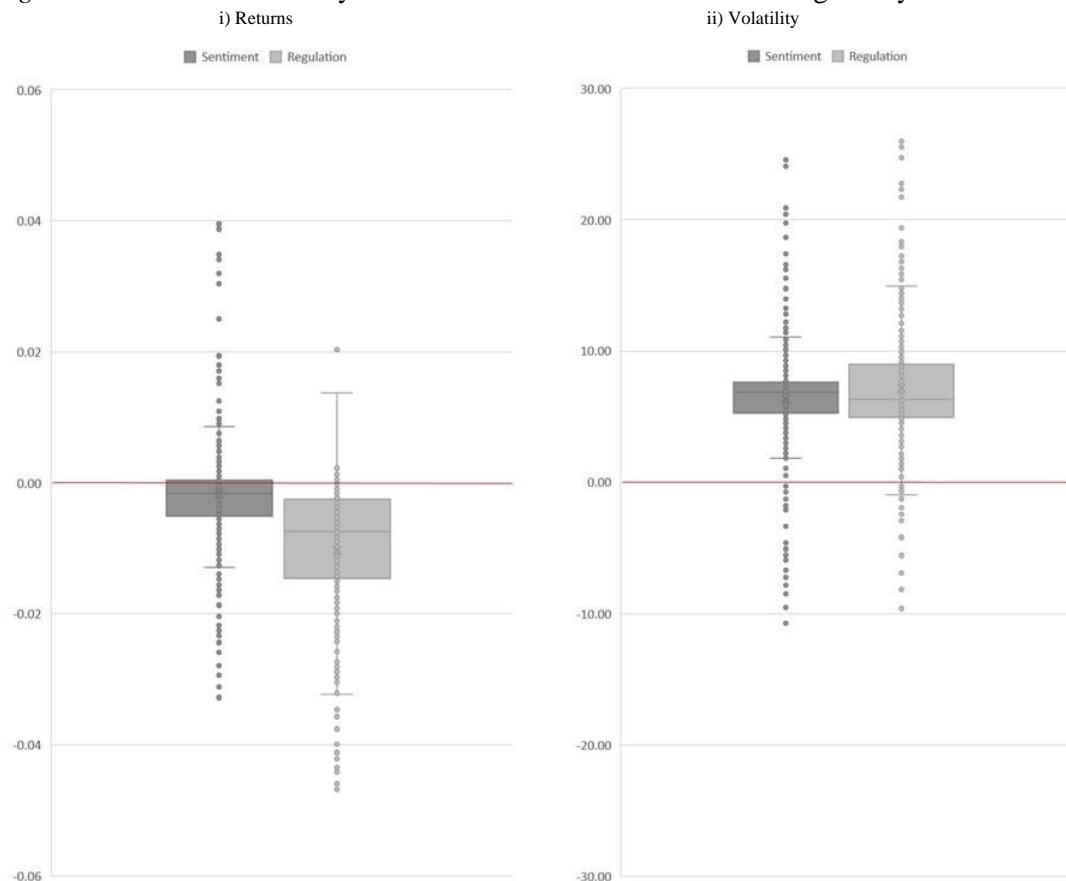
Table 3. Return and volatility differentials based estimated sentiment variables.

<i>Fund Type</i>	<i>Returns</i>					
	LM Pol.	HI Pol.	Reg.	LM Subj.	HI Subj.	Reg.
Equity ETF	40.4%	41.2%	46.7%	48.1%	44.6%	56.9%
Exchange-Traded Fund	16.7%	33.3%	33.3%	66.7%	16.7%	66.7%
Exchange-Traded Note	34.3%	41.1%	46.0%	34.9%	47.6%	60.3%
Other Exch-Traded Products	61.9%	76.2%	61.9%	78.6%	59.5%	85.7%
<i>Geographic Region</i>	<i>LM Pol.</i>	<i>HI Pol.</i>	<i>Reg.</i>	<i>LM Subj.</i>	<i>HI Subj.</i>	<i>Reg.</i>
Germany	42.6%	50.0%	63.2%	51.5%	58.8%	77.9%
Switzerland	81.0%	71.4%	95.2%	95.2%	71.4%	71.4%
United States	5.6%	7.2%	7.8%	7.8%	7.2%	13.9%
Other	56.5%	53.2%	65.8%	66.5%	64.5%	77.4%

<i>Fund Type</i>	<i>Volatility</i>					
	LM Pol.	HI Pol.	Reg.	LM Subj.	HI Subj.	Reg.
Equity ETF	49.0%	53.1%	54.2%	55.2%	57.3%	52.1%
Exchange-Traded Fund	33.3%	16.7%	50.0%	50.0%	50.0%	83.3%
Exchange-Traded Note	34.9%	47.6%	60.3%	31.7%	68.3%	54.0%
Other Exch-Traded Products	78.6%	59.5%	85.7%	59.5%	73.8%	66.7%
<i>Geographic Region</i>	<i>LM Pol.</i>	<i>HI Pol.</i>	<i>Reg.</i>	<i>LM Subj.</i>	<i>HI Subj.</i>	<i>Reg.</i>
Germany	51.5%	58.8%	77.9%	70.6%	83.8%	72.1%
Switzerland	95.2%	71.4%	71.4%	61.9%	81.0%	76.2%
United States	7.8%	7.2%	13.9%	15.6%	14.4%	17.8%
Other	65.0%	64.5%	59.0%	54.8%	58.2%	87.1%

Note: The above results present the proportion of results that were found to be significant at the 1% level for each GARCH(1,1) analysis. For brevity, individual methodological results, and those results focusing on variants of the presented dummy variables as a robustness testing mechanism have been omitted, but are available from the authors upon request.

Figure 5. Return and volatility differentials based on sentiment and regulatory effects.



Note: The above estimates represent the individual GARCH(1,1) estimates, where represent coefficients are obtained from the mean and variance equations respectively.

significantly affect cryptocurrency investors. However, the threat of future regulation, or third-party oversight, appears to be a condition that generates significant concern. This latter observation further supports what is considered to be one of the large attractions with regard to some digital assets, namely anonymity and the freedom to move outside of the scope of regulatory observation. Central bank coordination and announcements in this space mean that the use of cryptocurrencies for non-transparent transactions will become more difficult as new CBDCs seek to supplant stablecoins and traditional cryptocurrencies and regulators seek to replicate much of the traditional transaction tracking from the existing national and transnational banking system. The removal of, or third-party intervention to, this freedom and programmed anonymity, is found to present a threat to the future viability of existing cryptocurrencies. The use of cryptocurrency for purposes necessitating and valuing anonymity in such a strong manner should be strongly considered to be representative of characteristics of which illegality cannot be immediately omitted. CBDCs, in the eyes of cryptocurrency investors, appear to act like streetlights and sunlight, a most effective authority and disinfectant.

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