Stablecoins and Central Bank Digital Currencies: Friends or Foes?

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Abstract

We examine how cryptocurrency investors behave in response to the disclosure of the potential adoption of a new Central Bank Digital Currency (CBDC). To this end, as a natural environment for our analysis, we employ the setting process of the new CBDC in the Eurozone – the digital Euro (DE). Building a new hand-collected dataset with 142 cryptocurrencies and their functioning characteristics, we investigate how the cryptocurrency market perceives the potential entrance of a new CDBC. Considering 32 DE disclosure events, we document that cryptos negatively discounts the potential entrance of DE in the payment system of Eurozone countries, and we support the view that CDBCs divert crypto investors attention from unregulated cryptos. In line with our expectations, we find that these events affect worst stablecoin, which display closer intrinsic characteristics to central banks digital currencies. Lastly, using textual analysis, we find that the disclosure tone of the central bank governors matters in explaining investors' reaction to this disclosure.

Keywords: Cryptocurrencies; Digital Euro Disclosure; Event Study; Market Performance
JEL: G12; G14

"Our work aims to ensure that in the digital age, citizens and firms continue to have access to the safest form of money, central bank money."

Christine Lagarde, ECB President

1. Introduction

The advent of cryptos has undoubtedly grabbed the attention of policymakers due to their uncontrolled market growth[1] and unpredictable volatility. These issues have raised regulatory concerns and challenges (Baur and Dimpfl, 2018; Foley et al., 2019) and positioned cryptos at the forefront of a vibrant discussion for several reasons. First, being unregulated and potentially borderless, cryptocurrencies undermine and challenge the central bank's sovereignty (Auer and Claessens, 2021; Arner et al., 2020), harboring confusion among investors about their roles as a store of value and means of payment (ECB, 2021). Generally, users consider cryptocurrencies as a flexible means of payment to transfer money, impairing the fiat money sovereignty. However, for any instrument to be qualified as a viable means of payment, it should ideally exhibit three essential economic properties: *i)* serving as a medium of exchange, *ii)* functioning as store of value, and *iii)* acting as a unit of account (Tobin, 2008). In addition to the elevated transaction costs associated with cryptocurrencies (Yermack, 2015), their extreme volatility, speculative nature, and the related risk of market manipulation impair their effectiveness as means of payment.

Second, cryptocurrency users' adoption may systemically affect financial stability and investor wealth. Cryptocurrencies expose users to extreme and unpredictable price swings, panic selling, and market disruptions, resulting in extensive losses for investors and accepting institutions and ultimately leading to spillover effects and a higher systemic risk. This is particularly true when large investors or financial institutions hold sizeable cryptocurrency trading positions. When cryptocurrency prices surge rapidly, in fact, more investors are incentivized to enter the market, thus pushing up their prices. In the event of a cryptocurrency market shock, fears can lead investors to adjust their positions, and cause cascading prices. This situation increases both the agents'

[1] Bitcoin and multiple other cryptocurrencies' market value rose from a few cents to more than $4,000 per unit (S&P, 2022), moving from an unclear curiosity to a widely established household construct (Auer et al., 2021).

contribution to system risk and their vulnerability to liquidity shocks. Lastly, market manipulation and cybersecurity threats (such as fraud and scams), along with insufficient customer protection can further distort prices. Additionally, there have been some concerns about using cryptocurrencies for illicit activities such as tax evasion and money laundering.

In the current landscape, central banks worldwide are considering the introduction of digital asset policies and currencies (Copestake et al., 2023) to discourage the use of cryptocurrencies for payments. This initiative aims to maintain their sovereignty over the monetary system by offering a digital instrument capable to mitigating potential risks associated with unregulated crypto assets. The underlying idea of these initiatives is to modernize the payment system to achieve four important goals and simultaneously mitigating the challenges posed by cryptocurrencies. The primary goal is to provide a more efficient and convenient transaction tool, especially for cross-border transactions. The second objective is to promote the financial inclusion of individuals unserved by the traditional banking sector. The third and fourth goals are interconnected and closely tied to the need for a better-developed regulatory framework. Specifically, central banks will seek to maintain direct control over monetary policy transmission (sovereignty) and ensure the security of market transactions, including aspects such as privacy, fraud avoidance, and reduced transaction costs (Auer and Claessens, 2021).

Among various initiatives, the European Central Bank (hereafter, ECB) announced the launch of the Digital Euro (DE) project on July 14, 2021 presenting it as: "an electronic means of payment" accessible to everyone within the euro area.[2] The project aims to expand the availability of digital central bank money beyond its current use.[3] Remarkably, the DE refers to the digital version of the Euro currency of the ECB, where its significance gains importance nowadays in the context of a

[2] For the complete definition see: https://www.ecb.europa.eu/paym/digital_euro/html/index.en.html
[3] https://www.ft.com/content/e59e5d61-043a-4293-8692-f8267e5984c2

continuing digital transformation into the financial markets. Unlike prior studies, we examine the consequences of the DE disclosure rather than any other CBDC announcements[4] for three reasons.

First, the Euro plays a crucial role in international trade since it represents the official currency of 19 out of 27 European Union member states, and the Eurozone countries have a combined gross domestic product (GDP) approaching that of other major economies. Second, being a "relatively stable currency" compared to other digital asset policies already implemented, such as the Sand Dollar (Bahamas), E-Naira (Nigeria), and Digital Yuan (China), international Eurozone partners and investors are more likely to use the Euro as a major reserve of currency in the foreign exchange markets and unit of account for the global bond markets. Third, the digital asset policy is not yet implemented as the central bank governors are still in the embryonic stage of its design, and its setting process and related evolution represent an interesting laboratory to deliver policy recommendations for other international currencies, such as the US dollar and the British pound.

Hence, we aim to answer the following questions: Does the potential introduction of a new CBDC – the Digital Euro (DE) – affect the valuation of the cryptocurrency market? Are these effects more severe for some specific segments of the cryptocurrency market? To seek to answer these questions, we build a new comprehensive dataset encompassing 142 cryptocurrencies, merging hand-collected information about their inner features[5] (gathered from cryptocurrencies' white papers) with the information on crypto market performance (prices, trading volume, and market capitalization) publicly available from CoinMarketCap. Finally, to exploit the investors' reaction to ECB disclosure on the launch of the Digital Euro, we collect the DE releases and merge this set of events with that of Copestake et al. (2023) and Auer et al. (2020).

In line with previous papers that suggest that investors adjust their expectations regardless the effective policies' implementation (Bruno et al., 2018; Onali et al., 2021), we investigate whether and

[4] For instance, China has been one of the most prominent countries in developing a CBDC with its Digital Yuan (e-CNY). The Central Bank of the Bahamas issued the "Sand Dollar" in 2020, while in 2021, the Nigerian government launched the e-Naira.

[5] Such as if cryptos are stablecoins or benefits from either DAO technology or interoperability.

how the DE disclosure incorporates into crypto market prices around the release of announcements, speeches and interviews from ECB Governors. In doing so, we cover all the announcements and other DE disclosure events before its preparation phase, namely all the operations aimed at finalizing the Eurozone CBDC rulebook and selecting providers that could develop its platform and technological infrastructure. This also allows us to deal with the anticipatory effects problem, typical of the event study approach.

Different from other existing studies that investigated other digital asset policies and banks regulations showing their impact on the trading volume (Copestake et al., 2023; Liu et al., 2022), we are pioneers in measuring the market consequences of the Digital Euro disclosure on cryptocurrency prices (Auer et al., 2021; Copestake et al., 2023). First, we estimate the price reaction to the DE official statements released on the ECB website, then we examine the investor behavior around interviews and speeches of Eurozone central bankers to explore the abnormal investor attention spikes. Covering different type of disclosure allow us to control for further informational spillovers that might affect investors' expectations. Second, we dissect the price reaction considering the cryptocurrency heterogeneity, their distinctive technological features and infrastructures related to the operating blockchain and white paper design. We dig deeper into the crypto market reaction and emphasize both the existence of a nexus between stablecoins and CBDCs and the potential substitution effect between the two instruments. Due to technological similarities, stablecoins could compete with CBDCs in the payment system as they are less exposed to unexpected price swings and serve as means of payment. Third, we explore how the ECB disclosure tone affects market participants in the crypto market using text analysis to examine the linguistic style of the policy announcements. Again, we benchmark our paper with that of Copestake et al. (2023). Yet, rather than simply classifying policy events of the central bank governors as positive, neutral, and negative, [6] we compute linguistic style proxies to capture deeper characteristics of tone (such as authenticity,

[6] Assigning either a value of +1 if the speech is positive or a value of -1 if the speech is negative, and zero otherwise.

complexity, and emotional tone) and understand whether they affect cryptocurrency prices. The primary advantage of this technique consists of its ability to extrapolate social, cognitive, and affective emotions used by ECB Governors in their disclosure strategy.

Our main findings are as follows. We provide evidence of an adverse reaction of the cryptocurrency market to the DE. For our DE events[7] (both official announcements, interviews, and speeches), we document a negative three-day Cumulative Abnormal Return (hereafter, CAR) which ranges between -5.6% and -4.1%. This result is robust across several specifications and identification strategies. Given that investors perceived the potential entrance of DE as value-destroying for the crypto market, our results are coherent with the idea that CBDCs enhance the competition in the payment system, reducing the demand of cryptos (Copestake et al., 2023).

In our main findings, we rely on the typical market model to estimate the price reaction, then we implement and propose a multi-factor event study which accounts for daily global economy factors to partially exclude that they drive the estimated price reaction. We include other factors related to the VIX volatility, the gold, oil, and S&P 500 index returns and control for potential confounding events. For this reason, we first bridge our dataset with that of Copestake et al. (2023) to avoid that other digital asset policies and crypto bans could lead our results and we allow for the inclusion of ECB and FOMC monetary policy announcements.

In addition, we demonstrate that the linguistic style of DE disclosure affects cryptocurrency prices and that a high confident tone of Governors and negative emotions drive a negative price change. While we find that cryptos price reaction to DE disclosure is statistically significant at the 5% level, the magnitude of this result is not homogenous across all cryptocurrencies. In line with our expectations, the negative price reaction is stronger for stablecoins after controlling for forward-looking crypto-specific measures. We interpret this result as evidence that the launch of CBDC might be an effective (and "defensive") tool against the *cryptoization* and *stablecoin dollarization* (IMF,

[7] Originally, the set of events is about 38 events. In the section related to event dates, we explain our selection criteria.

2021) of the financial markets. Further, our results demonstrate that both the announcements, speeches, and interviews attract an adverse price reaction, especially for the most traded and liquid cryptocurrencies. This finding remains stable either when we exclude Bitcoin observations - to avoid that its price swings over the sample period could drive our estimates - and when we control for disclosure tone. Lastly, our results indicate that the potential introduction of a DE does not affect crypto tokens.

Our paper is organized as follows. Section 2 provides a review of the literature and presents our hypotheses development. Section 3 describes the data, the sample selection criteria and discusses the methodology employed. Section 4 presents our main results and discussion. Section 5 proposes additional results. Section 6 draws our conclusion.

2. Relation to the prior literature and hypotheses development

2.1 Related literature

Our paper applies to multiple strands of the literature. Firstly, our paper aligns with numerous studies exploring the determinants of the market performance of cryptocurrencies. Secondly, it is connected to the strand of research on the valuation effects of regulatory news on cryptocurrencies. Thirdly, from a theoretical point of view, our paper relates to literature that investigates the consequences of the potential entrance of a new regulated competitor into the market; where the regulated competitor is the Central Bank Digital Currency (CBDC), and the market encompasses the universe of available cryptocurrencies. Consequently, our study relates to the literature exploring the implications of the CBDCs on the real economy and financial markets.

As mentioned, our paper aligns with the literature focusing on the determinants of cryptocurrency pricing and market performance. Previous research suggests that the cryptocurrency market performance is a function of cryptocurrency- and market-specific factors, which include supply and demand-side dynamics (Wang and Vergne, 2017), production factors (Abadi and Brunnermeier, 2018) cryptocurrency technology (Corbet et al., 2019), unexpected downturns in other asset classes

leading portfolio recalibration (Corbet et al., 2019), network factors (Biais et al., 2019; Pagnotta and Buraschi, 2018; Cong, Li, and Wang, 2023; Sockin and Xiong, 2023), hacking and cyber-security events (Corbet et al., 2020), market volatility (Zhang et al. 2021; Liu et al., 2021, Naeem et al., 2022), and investor attention (Lin, 2021; Liu and Tsyvinski, 2021).

The second stream of the literature linked to our paper delves into the emerging set of studies examining the impact of regulatory news on cryptocurrency prices. This body of research explores bans and restrictions on trading (Auer and Classens, 2018, Copestake et al., 2023); tax treatment of cryptocurrencies (Auer and Claessens, 2018), and other regulatory news on combating money laundering and preventing unintended financing of terrorism.[8]

The last strand of literature explores the consequences of introducing and potentially adopting the central bank digital currencies, which have garnered substantial attention due to their potential impact on commercial banks, financial stability, and the overall cryptocurrency market. Regarding to the first two issues, Carapella and Flemming (2020) highlight in their literature review that CBDCs can have a dual effects on monetary policy and financial stability (Tobin, 1969; Carapella and Flemming, 2020), as well as on commercial banks (Andolfatto, 2021; Bech and Garratt, 2017). Moreover, the introduction (or potential adoption) of CBDCs might also serve as a tool for counterbalancing the uncontrolled and unregulated expansion of borderless cryptocurrencies among investors and citizens.

This view seems to be supported by Rogoff (2017), who suggests that: *"Bitcoin's price bubble will burst under government pressure"*. Consequently, central banks, public supranational authorities, and governments may view the potential introduction and proposals of a Central Bank Digital Currency (CBDC) as an optimal regulated alternative for payment (Copestake et al., 2023). As CBDC is an electronic method of payment, that would offer a public regulated instrument to spend and save money and reduce the risk that cryptos undermine the sovereignty of policymakers and governments (Arner et al., 2020; Auer and Claessens, 2021), it is reasonable assertion that

[8] https://www.europarl.europa.eu/RegData/etudes/STUD/2018/604970/IPOL_STU(2018)604970_EN.pdf

cryptocurrencies have notoriously "failed to be a method of payments".[9] However, despite the concerns around their volatility, they have been largely employed as investment vehicles. In this context, CBDCs can act as a regulated competitor. Its introduction, in fact, could resolve the issues of data protection, transparency, and financial market stability revolving around cryptos (Allen et al., 2022). In relation to the latter issue, Wang et al. (2022) built an uncertainty index on CBDCs and find that they are positively correlated with the volatility of cryptos and negatively associated with the volatility of the equity market. This last finding suggests that the financial markets positively discount the introduction of CBDCs while crypto investors negatively welcome them.

Our study fills the gap in the existing research by bringing together these three streams of the literature. Our primary contributions are twofold. Firstly, we measure the valuation effects of the DE on cryptocurrency prices. Secondly, by exploiting technological heterogeneity across cryptocurrencies, we uncover the nexus between stablecoins and CBDCs and find that the price reaction is driven by these specific cryptocurrencies rather than tokens and other coins.

In doing so, we make good use of the official declarations of the European Central Bank on the Digital Euro, as our setting for the analysis. The key advantage of employing this specific setting lies in the fact that the DE has not been implemented yet and, therefore, it is less likely to be subject to endogenous market effects. We include all the official statements considered in the central banking announcement literature, along with any other relevant disclosure (such as speeches or interviews) on DE, and ensure that we gauge any information that hits the market within our sample period.

2.2 Conceptual framework and hypotheses development

2.2.1 Aggregate price reaction to the Digital Euro disclosure

We develop our hypotheses and build our framework on the recent seminal literature on central banks announcements regarding the economic outlook and monetary policy (Aït Sahalia et al., 2012;

[9] A method of payment, by definition, has to be able to store value, have a defined unit value and be a medium of exchange.

Lucca and Moench, 2015). We postulate, in fact, that DE disclosure is closely comparable to the aforementioned announcements. This last argument is also supported by the recent results from Copestake et al. (2023), who states that crypto markets pay attention to government policies on digital assets.

These policy makers disclosure has undoubtedly effects on capital markets. Based on the premise that cryptocurrency markets are efficient (Vidal-Tomaz and Ibanez, 2018), DE disclosure should analogously be immediately incorporated into crypto market prices. Even though cryptocurrencies are mainly successful as speculative assets (Auer et al. 2022), they compete with more traditional forms of money in the payment system (Carstens, 2019), which might induce policy makers to discourage their use with CBDC promoting initiatives, ultimately affecting crypto prices. In line with this reasoning, Copestake et al. (2023) find, in fact, that CBDC speeches are associated with declines in cryptocurrency trading volumes.

Therefore, regulators might launch and announce the CBDC initiatives to reduce the access and demand for cryptocurrencies. Based on these arguments, the disclosure of the imminent adoption of CBDCs should be perceived as negative news from crypto market participants because of the potential threat of a newly regulated incumbent backed by the ECB into the payment system market. Given the interplay between the supply and demand of cryptocurrencies, all else equal, this should entail a negative price reaction of cryptocurrency to the DE disclosure.

More formally, we postulate the following hypothesis:

H1: *The disclosure of DE potential features leads to a negative cryptocurrency price reaction.*

2.2.2 Stablecoins reaction to Digital Euro disclosure

Since the launch of the Bitcoin white paper by Satoshi Nakamoto (2008), few scholars have questioned whether cryptocurrencies could be a money substitute. As well as physical desirable properties – such as durability and portability (Lehdonvirta and Castronova (2014) – cryptocurrencies lack features that can overall classify it as a medium of exchange, unit of account, and store value

(Tobin, 2008). This is mainly due to the high fluctuations in their price and value, and their technology constraints.

On the one hand, Kubàt (2015) suggests that cryptos' volatility makes the determination of their purchasing power too uncertain over time, preventing their use as a medium of exchange. On the other hand, Williamson (2018) points out that the decentralized technology on which cryptocurrencies rely on is unsuitable for offline transactions, determining a limited acceptance among users, and obstructing the support of a large-scale payment system. Nevertheless, we conjecture that the price reaction to the policy events may be heterogenous based on the different cryptocurrency types and intrinsic characteristics (Corbet et al., 2020; Lucey et al., 2022; Luo et al., 2020; Akyildirim et al., 2021).

Within their universe (decentralized coins and tokens), there is one type of cryptocurrency that is designed to maintain a stable value through their backing of assets (for instance, Tether) (Auer et al., 2022), which reduces their price volatility and could facilitate users' transactions requiring a denomination in a fiat currency: the *stablecoins*. Additionally, being non-mineable, the stablecoins are similar to CBDCs but with the critical difference that there is a third and centralized party within the exchange, such as a central bank. Furthermore, stablecoins could challenge the central bank sovereignty by playing a role in real-time and cross-border transactions. Thus, the potential entrance of an regulated instrument in the market would significantly increase the competition for stablecoins (Allen and Jagtiani, 2022).

Due to their similarities with a CBDC, we expect that the introduction of the DE, may generate competition effects especially for stablecoins in the payment system (Halaburda et al., 2022) rather than other cryptocurrencies (i.e. token), resulting in a negative price reaction. This perspective is supported by Morgan (2022) who critiques the Bank of England's framing for the design of the digital pound, mainly regarding the lack of sufficient emphasis on the "defensive" aspect of CBDC. The launch of CBDCs, in fact, should generate a competitive effect, which stand as a real alternative to

stablecoins. Consequently, the underlying asset of the stablecoins can vary in liquidity and quality, which poses a systemic threat in the case of extensive adoption. Based on these arguments, we hypothesize that DE disclosure would attract negative price reactions for stablecoins. More formally:

H2: *The stablecoins lead the negative price reaction of cryptocurrencies to DE disclosure.*

3. Data, event dates, and methodology

The following sections describe our data and methodology employed in the event study on cryptocurrency prices. Following Hedge and McDermott (2003), we additionally propose falsification tests to exclude that any anticipation effects affect our estimates.

3.1 Data

To investigate crypto investors behavior around DE disclosure events, we collect data from several sources. We begin collecting both prices and volume for the entire universe of cryptocurrencies included in CoinMarketCap[10] and retain only those with available market capitalization data, thus resulting in a final sample of 142 cryptocurrencies. After gathering gold and oil prices, VIX volatility index, and S&P 500 market index data from Refinitiv, we proceed to hand-collect information on intrinsic characteristics specific to each cryptocurrency, extracted from their white papers. Additionally, we acquire information on event dates associated to the Digital Euro released from January 2020 to February 2022. [11] This leads to a sample of 38 events. Subsequently, we drop six events because of they were consecutive during the same calendar week. For example, if there were two events in the same week, we consider only the first one since investors have already updated their expectations. In addition, we bridge this set of events with those reported by Copestake et al. (2023) and Auer et al. (2020).[12] This step is also auxiliary to allow us to check for confounding

[10] We downloaded this information from https://coinmarketcap.com (February 23, 2022)
[11] This info has been acquired from the official ECB press releases and allow us to check for the presence of an abnormal investor attention around Digital Euro announcements.
[12] We use this dataset to check for confounding events in our sample period.

events in our sample period. Lastly, we also collect data on the daily investor attention around the keywords "Digital Euro" from Google Trends.

3.2 Event dates

As mentioned, our final sample consists of 32 events[13] that include both DE announcements and other related disclosures officially released by ECB over the period considered. In line with Onali et al. (2021) before the preparation phase,[14] we consider as official DE disclosure all ECB declarations made through announcements, press releases, and speeches available on ECB website. These events are connected to the rollout of the Digital Euro in the Eurozone countries, where the absence of a public digital currency to anchor digital innovation and the rise of cryptocurrencies expose the financial sector to the risk of instability.

Following Fiordelisi and Ricci (2016), we include speeches and interviews as both informal and formal disclosure from central banks result in an effective policy tool that: affect market participants' expectations, restore market confidence and, sometimes, signal market conditions.

To ascertain whether the investors were genuinely focused on the DE during the specified dates, we examined their attention using the widely recognized Google Search Volume Index (SVI) as suggested by Da et al. (2011). We evaluate the extent to which the SVI, for the keyword "Digital Euro", is higher around the 32 event dates compared to the non-event trading days. We apply a strict criterion to the SVI to ensure that the proxy is capturing the investor attention around the DE disclosure (for instance, "Central+Bank+Digital+Currency", "Central+Bank Digital+Currencies", "CBDC", "CBDCs", and "digital+money") rather than using similar, but broader search strategies used in other studies. We employ a two-sample unequal variance *t*-test on the SVI over our sample period (January 2020 – February 2022). In line with our expectations, the SVI associated to the Digital

[13] In case in which two events that are consecutive in days, we consider only the first one. In fact, our sample of announcements is about 38 events.
[14] The preparation phase consists of the set of operations aimed at finalizing the DE rulebook and selecting providers that could develop its platform and technological infrastructure.

Euro is significantly larger during the trading days around the DE events, with an average SVI equal to 37 for the event-window days and 34 for the non-event window ones (p-value is 0.056).

To corroborate this finding, we run a second test and purged the raw SVI from seasonality effects by regressing it against monthly and days of the week effect.[15] The residuals from this regression are used to proxy the "Digital Euro" attention index. We employ this index and replicate the two-sample unequal variance *t-test* over our sample period. The results remain qualitatively unchanged, showing the investors' attention patterns around the DE events.

3.3 Market reaction to the Digital Euro disclosure

To assess the impact of the DE disclosure, we employ an event study methodology, enabling an exploration of market expectations around market-specific events. In contrast to Yue et al. (2021), who compared the pre- and post-ratios of the crypto-market performance, we drawn upon existing literature on stock price reactions within the area of banking regulation and monetary policy (Armstrong et al., 2010; Aït-Sahalia et al., 2012; Bruno et al., 2018) and investigate the consequences of DE disclosure on cryptocurrencies' prices. Nevertheless, this body of literature underscores the absence of a widely accepted consensus on the optimal length of the event window. On one hand, opting for a shorter event window in the event study serves to mitigate the impact of confounding events. On the other hand, short event windows do not necessarily lead to more accurate estimates of abnormal returns (Brown and Warner, 1980). Following previous studies (Bruno et al., 2018), we estimate the abnormal returns (ARs) within a three-day (-1,1) event window by using an estimation window of 120 trading days to mitigate the impact of the crypto market crash.

Particularly, we estimate the ARs using a simple market model based on the daily logarithm returns of each cryptocurrency in our sample as follows:

$$AR_{i,t} = R_{i,t} - (\alpha_i + \beta_i R_{m,t}) \qquad (1)$$

[15] We follow a similar approach to Fisher et al. (2022) and Monaco & Murgia (2023) that construct their macroeconomic attention indexes, based on both news coverage and the SVI.

Then, we cumulate them to estimate the corresponding CARs for our event window (-1,+1):

$$CAR_{i,t} = \sum_{t=-1}^{t=+1} AR_{i,t}$$

We employ a synthetic index of all cryptocurrency market based on all cryptos traded on CoinMarketCap. Further, to investigate our hypothesis that the market reaction of cryptocurrencies is significantly different from zero, we first aggregate the effect of the DE disclosure by considering the sample-average CARs over all 32 DE events, and then we compute the *p*-values and *t*-statistics. As alternative specifications, we propose an augmented model including gold and oil price logarithm returns, S&P 500 index returns, and related volatility (VIX) to exclude that shocks in the global economy influence our estimates.

Furthermore, we questioned whether crypto investors display different levels of sensitivity to specific types of announcements (Ait-Sahalia et al., 2012; Fiordelisi et al., 2014; Fiordelisi and Ricci, 2016). For this reason, we first split the DE events into three distinct groups: press releases, speeches, and interviews. Subsequently, we analyze the price reaction of cryptocurrencies separately for each type of disclosure released to market participants.

Moreover, we account for the potential impact of confounding events. Specifically, we control for the release of information on the digital asset policies worldwide, cryptocurrency ban dates (Copestake et al., 2023; Auer et al., 2020), and other monetary policies by the ECB and US Federal Reserve during the specified event window.

To ensure that the price reaction is driven by the DE disclosure and rule out any anticipatory effect from the announcements, we first examine the potential changes in trading volume around the specified event window. Following prior studies, in fact, changes in trading activity influence either positively or negatively stock returns depending on the information released (Verrecchia, 1981; Easley and O'Hara, 1992; Harris and Raviv, 1993; Monaco et al., 2022).

We extend the model proposed by Hegde and McDermott (2003) to include another term that considers autocorrelation dynamics (Chordia and Swaminathan, 2002; Alborg et al., 2019), given the significant influence of investor attention on cryptocurrency volume variation.

Based on these arguments, we run an AR (1) regression on the logarithm of volumes using the following formula:

$$Log\ (\mathrm{Vol}_{t,i}) = \alpha + \beta Log\ (\mathrm{Vol}_{t-1,i}) + z_{t,i} \qquad (3)$$

After estimating the residuals from Equation 3 ($z_{t,i}$), we include them in the following equation (Hedge and McDermott, 2003):

$$Log\ Volume = \mathbf{i}\alpha_j + t\gamma + \sum_{i=-4}^{+4} D_i \beta_i + z_{t,i} + \varepsilon_j \quad \text{for } j = 1, 135 \text{ and } t = -4, 4 \qquad (4)$$

where $\boldsymbol{i}$ is a 142 × 142 identity matrix, D_i are dummy variables for each trading day in the event window (-4, +4), ε_j is a zero mean heteroscedastic disturbance term, and α_j, γ and β_i are the parameters of our interest. We also estimate the model by adjusting the White (1980) covariance matrix to control for the potential heteroscedasticity.

In the absence of anticipatory effects, the pre-treatment dummy variables (dummies related to the pre-announcement period, namely, $\beta_{t-4}, \beta_{t-3}, \beta_{t-2}, \beta_{t-1}$) are expected to be statistically and economically insignificant.

3.4 Cross-sectional variation in cryptocurrency prices

In this section, we describe the econometric methodology also employed by prior studies and measure the price sensitivity of the cryptocurrencies (Liu and Tsyvinski, 2021) around DE events considering both their inherent characteristics and market-based controls. More specifically, we employ the following cross-sectional regression analysis:

$$CAR\ (-1, 1) = \beta_0 + \beta_1\ Stablecoin_i + \beta_2\ Amihud\ Ratio_i + \beta_3 Market\ Capitalization\ (ln)_i + \beta_4 Token_i + \beta_5\ Scalability_i + \beta_6\ Interoperability + \beta_7 Algorithm_i + \beta_8\ Lending\ \&\ Borrowing_i + \beta_9\ AMM + \beta_{10}\ DAO_i + e_i \qquad (5)$$

CAR (-1,1) is the cumulative abnormal returns observed over a three-day event window, including the day of the event, the day before, and the day following the DE disclosure. $Stablecoin_i$ is the variable of our interest, which equals one if the cryptocurrency is backed by an asset (or a pool of assets) held by the cryptocurrency's issuer and zero otherwise.

Moreover, among the market-based controls, we include the average Amihud Ratio (Amihud, 2002) in the pre-announcement period ($Amihud\ Ratio_i$) and the logarithm of the market capitalization of cryptocurrencies. We expect that the DE events negatively affect the most liquid cryptocurrencies and those with a larger market capitalization. According to Copestake et al. (2023), the policy statements on central bank digital currencies are associated with a drop in cryptocurrency trading volumes. Therefore, we would expect that the potential introduction of DE increases the competition in the cryptocurrency market particularly impacting the most prominent and traded cryptocurrencies, leading to negative abnormal returns.

Then, we include a set of variables associated with the functioning of the cryptocurrency. We first distinguish between tokens and coins using the variable *Token* which takes a value of one if the cryptocurrency is a token and zero otherwise. Since the DE is conceived to be a payment means, it would essentially affect coins rather than tokens. Consequently, we expect the coefficient to be non-statistically significant or positively correlated with the abnormal returns related to the DE events.

During the last few years, developers have proposed a number of cryptocurrencies with distinct features and technological architectures to broaden the potential participants in the market. Thus, these aspects affect the overall market performance (exposure to the market risk and operational risk) as well as their price sensitivity. Indeed, cryptocurrencies are generally not considered to be "stable assets" that can reliably keep their market value over time (Allen and Jagtiani, 2022; Halaburda et al., 2022; Allen et al., 2021). For this reason, we include a series of dummy variables capturing the technological infrastructure of cryptocurrencies: *Scalability*[16] which equals one if the cryptocurrency

[16] Technological infrastructure speed of the cryptocurrency to process a higher number of transactions per second.

has a fast-scaling blockchain in processing transactions, and zero otherwise;[17] *Interoperability* takes the value of one if the cryptocurrency blockchain can exchange data with another blockchain, and zero otherwise; *Algorithm* equals one if the cryptocurrency ensures the confidentiality of the original data, consumer protection, and privacy, and zero otherwise; *AMM*, equals one if the trading platform benefits from Auto-Market maker service (AMM),[18] and 0 otherwise; and *Lending & Borrowing* is assigned the value of one if the cryptocurrency can also be used for lending and borrowing money, and zero otherwise. Lastly, cryptocurrencies are commonly decentralized. Unlike flat currencies, this feature entails that any central and public authority does not supervise the transactions ensuring a higher level of privacy and security. Usually, their functioning is governed and distributed among several anonymous nodes within the blockchain. However, there are some cryptocurrencies that are based on a decentralized autonomous organization (*DAO*). In DAO-based cryptocurrencies, a collective group of nodes and participants in the network acts as a governing entity of the transactions to promote its oversight and management. To account for this technological feature, we include an additional dummy that takes the value of one if the cryptocurrency benefits from this characteristic, and zero otherwise. Table 1 reports our predictions about cryptocurrency sensitivity to the DE events.

[INSERT TABLE 1]

Table 2 reports descriptive statistics.

[INSERT TABLE 2]

4. Empirical results

This section reports our findings. Firstly, we provide evidence of the market impact of DE events on cryptocurrency prices. Secondly, we examine whether any significant increase in the pre-/post-

[17] For instance, the Bitcoin scale to a large set of market participant, while it may not scale to many transactions per second, while Solana, Stellar, Avalanche, and IOTA are considered among the quickest-scaling cryptocurrencies. Thus, for cryptocurrencies like the Bitcoin, the dummy assumes a value of zero, while for the five aforementioned cryptocurrencies, the dummy takes the value of one.

[18] AMM refers to the possibilities that sellers and buyers do not need to wait for counterparts to either buy or sell cryptos on any decentralized exchange system.

period can be attributed to trading rebalancing and anticipation effects. Thirdly, we conduct a cross-sectional variation analysis of CARs based on the cryptocurrencies' inner characteristics.

4.1 Cryptocurrency market reaction to the disclosure of Digital Euro

In this section, we present our results about the aggregate market reaction of cryptocurrencies to the DE disclosure. Table 3, Panel A reports our first set of findings. The average CARs are negative and statistically significant at a 1% level for all our events. The same result holds when we implement the augmented model, confirming the negative effect of DE on cryptocurrency prices, supporting our **H1**. These results are coherent with Carstens (2019), suggesting that cryptos compete with the traditional form of money. The DE disclosure increases the competition in the cryptocurrency market, pushing investors to negatively discount crypto values in favor of *digital* central bank money.

[INSERT TABLE 3]

Further, we examine the price reaction by classifying the events into three groups: speeches, interviews, and press release announcements. This analysis unfolds interesting evidence. On the one hand, the reaction is adverse and statistically significant across each type of event, however, the arrival of new information hits crypto prices with different magnitudes depending on the types of disclosure released. According to our estimates, investors pay more attention to ECB Governors' interviews and speeches rather than press releases.

Furthermore, we investigate whether our results are robust after controlling for confounding events. We first replicate the analysis excluding event dates related to cryptocurrency trading bans and monetary announcements from the European Central Bank and the Federal Reserve. Panels B and C of Table 3 report the estimates and confirm our main findings (Panel A).

Finally, we check for the presence of anticipatory effects in our analysis, following Yue et al. (2021) and Hedge and McDermott (2003). Table 4 shows the insignificance of the pre-event dummy coefficients, suggesting there is no evidence of anticipatory effects.

[INSERT TABLE 4]

4.2 Cross-sectional variation of cumulative abnormal returns

Table 5 presents CAR cross-sectional variations of cryptocurrencies around the DE events. Our results indicate that two specific inner cryptocurrency characteristics largely explain the crypto price reaction during the event windows.

First, the launch of the DE has a detrimental impact on stablecoins, in fact, our findings indicate that stablecoins experience a strong adverse price reaction following the DE events, as displayed in the negative coefficient of *Stablecoins* which is statistically significant at the 5% level. We interpret this result as evidence that the launch of CBDC could function as "*cryptoization"* and "*stablecoin dollarization"* (IMF, 2021) of the financial markets. This result is also coherent with Arner et al. (2020) perspective suggesting that stablecoins may be more vulnerable to economic shocks than to other cryptos. In this specific case, the arrival of new informational releases by central banks is intended to be an "informative shock". This result support of **H2**, according to which stablecoins are more likely to react to the CBDC announcements.

Second, we find that cryptocurrencies with higher liquidity in the pre-announcement period react negatively to the potential introduction of the DE. The variable *Amihud Ratio* shows a positive coefficient, which is statistically significant at the 1% level. All the other variables included are not statistically significant. A plausible interpretation of this finding is that the introduction of DE significantly affects cryptocurrencies that could be considered as "substitute products" due to their similar characteristics to the Euro.

Moreover, we repeat our analysis solely on Bitcoin observations. The rationale of this analysis is to avoid that our results are biased because of fluctuations in Bitcoin prices. Bitcoin, in fact, is the largest cryptocurrency by market capitalization (with more than $500 billion) and represents the most systemically important cryptocurrency in the crypto market (Koutmos, 2018; Fry, 2018). However, our results remain consistent after removing Bitcoin from our sample.

[INSERT TABLE 5]

4.2.1 ECB Governors' disclosure tone and other robustness checks

Next, we explore the relationship between Digital Euro disclosure tone and CARs cross-sectional variation of cryptocurrencies to determine whether ECB Governors' use of optimistic/pessimistic language and specific linguistic styles influence crypto market performance. Specifically, we investigate whether and how quantitative and qualitative information released by the ECB affects cryptocurrency prices. This set of analysis is supported by several studies on central banks communication strategy (Woodford, 2005; Ehrmann and Fratzscher, 2007; Eusepi and Preston, 2010; Cieslak and Schrimpf, 2019; Ehrmann and Talmi, 2020; Hubert and Labondance, 2021), where few of them highlight the relevance of trust in broadcasting information (Blinder et al., 2022).

A strand of literature documents the consequences of disclosure tone (DT) on investors' decision-making (Henry, 2008; Tetlock, 2014; Loughran and McDonald, 2016) suggesting that investors rely on official announcements to revise their expectations and determine whether to buy, sell, or hold assets, while another one explores the role of emotions, psychological factors, and linguistic-style (Pennebaker et al., 2007; Parhankangas and Renko, 2017) in determining investors behavior (Tetlock, 2007).

Based on this assumption, we believe that the DT employed by Governors may impact crypto prices through at least two channels. Firstly, DT plays a crucial role in shaping how investors interpret newly disclosed information. For instance, a positive or optimistic DT can lead investors to perceive the news favorably. Conversely, a hostile or pessimistic DT should display a more cautious or negative interpretation of the information disclosed. Therefore, we expect that DT has the potential to affect market sentiment. Secondly, the DT may influence trading patterns since it can evoke either panic or confidence regarding the future states of the economy, leading to sharp price movements (market volatility) and herding behavior, thus potentially amplifying market movements.

Hence, in this section, we explore how the central bank regulators' tone affects cryptocurrency prices depending on different linguistic attributes of DE disclosure, relying on psychometric measures, as suggested by Pennebaker et al. (2015). In this respect, we are the first to relate CBDC announcements, disclosure tone of regulators, and crypto prices. We analyze the tone using several measures from the general psychosocial dictionary included in LIWC 2022 software (Boyd et al., 2022), and capture the announcement's length, analytical thinking, clout, authenticity, and emotional tone disclosed in the transcripts of press releases, speeches, and interviews. Hence, we extrapolate five tone measures and relate them with CARs for each DE event.

First, we consider the length of the announcement - *Disclosure Length* – which is defined as the logarithm of the number of words used in the public announcement. We assume that the quantity of disclosure plays an important role in affecting investors' decisions. When ECB Governors provide more information and details about the introduction of the Digital Euro – thus, a larger amount of information is disclosed – the cryptocurrencies should strongly and negatively discount the release of new information.

Second, we include the analytic thinking proxy (*Analytic*), which captures the frequency of using words that display formal, logical, and hierarchical thinking patterns. A lower value of this variable implies that the language used in the disclosure is simple and intuitive. Conversely, a higher formality level of the disclosure is associated with negative cryptocurrency returns because investors may perceive it as a "less friendly" and rigid announcement.

Third, we include in our regression the variable *Clout,* which reflects both the confidence and leadership that central bank officials show while speaking. We postulate that cryptocurrency investors should react negatively to DE events when ECB Governors are using a high level of *Clout*. Our interpretation is that the higher the level of confidence displayed by the speaker regarding the strengths of the DE, the more harmful the disclosure is for the cryptocurrencies due to the potential "substitution effect" of the Eurozone CBDC.

Moreover, we assess the level of authenticity in the DE disclosure (*Authentic*) and measure the extent to which the speaker broadcasts honesty, personal involvement, and transparency. A low value of this variable suggests a more guarded and distant form of disclosure. In line with the literature on monetary policy announcements, declarations reporting higher values of *Authentic* may signal that the ECB Governors are using the announcement to communicate more trustworthily with investors, potentially discouraging the use of cryptocurrencies in favor of a safer form of money, that is the DE. Lastly, we include the emotional tone variable (*Tone*), which captures whether Governors tend to use emotional tone. Higher scores of *Tone* are associated with more positive emotions, instead scores below 50 indicate a more negative emotional tone. However, we unpack the aforementioned variable by introducing positive and negative emotions dummies (*Positive Tone* and *Negative Tone*).

We report our findings in Table 6.

[INSERT TABLE 6]

The results confirm our conjectures that cryptocurrency investors care about the DT of central bank Governors. Among the five attributes of tone, *Clout* matters more than others. The coefficient of *Clout* is statistically significant at a 5% level in five out of six columns of Table 6, suggesting that the speakers' high confidence about the potential introduction of DE attracts a negative price reaction.

We also find that *Tone* has a positive coefficient, in line with the idea that when ECB Governors use positive words, the cryptocurrency market reacts more positively. However, when we unpack the tone in two sub-indicators - *Positive Tone* and *Negative Tone* - to better distinguish separate positive and negative emotions, their negative tone triggers a negative price reaction.

After confirming the significance of tone attributes in influencing crypto asset prices, we check whether our main findings are robust while controlling for the disclosure tone. To run this analysis, we estimate the Equation 5 by adding the five disclosure tone proxies mentioned above. These results, reported in Table 7, confirm previous findings, even when we drop Bitcoin observations. As an additional robustness test, we control for speakers' identity. For this reason, we first introduce a

dummy variable *Christine Lagarde* that takes the value of one if Cristine Lagarde is the speaker and zero otherwise. Then, we include a dummy *Ettore Panetta*, which assigns a value of one when Ettore Panetta is the speaker and zero otherwise. Interestingly, our findings reveal that the identity of the speaker disclosing information about Digital Euro is significant. Specifically, our results indicate that whenever Christine Lagarde delivers a speech on the Digital Euro, cryptocurrencies experience a negative price reaction.

[INSERT TABLE 7]

5.1 A closer look at Bitcoin, Ethereum, and Tether using Local Linear Projections

In this section, we further investigate the reaction of cryptocurrency prices by examining the role of investor attention on the DE.[19] Investors' Attention measures have been widely employed both in the cryptocurrencies literature (Dastgir et al., 2019; Alborg et al., 2019; Lin, 2021) and in the monetary policy announcement research (Boguth et al., 2019; Fisher et al., 2022; Monaco and Murgia, 2023). These streams of the literature provide us with a dual support in employing a measure of Investors Attention to further investigate the reaction of cryptocurrencies to overall DE disclosure.

We follow a similar empirical approach to Dastgir et al. (2019)[20], however, we don't focus on the attention related to the Bitcoin, we directly explore the investor attention shock related to DE, proxied as the difference between the daily attention in the "DIGITAL+EURO" keyword and average attention over the whole sample period. To run this analysis, we focus only on the Bitcoin (coin), Ethereum (token), and Tether (stablecoin) as the biggest cryptos by market cap within their own kinds (Corbet et al., 2018).

We employ local linear projection *á la* Jordà (2005) to estimate the response of prices and volumes of the three cryptos to the abnormal DE attention measures. This methodology, which has been

[19] The investor attention shock is computed for the daily relevant sample period, purged from autocorrelation as in Monaco and Murgia (2023), and finally calculated as in Da et al. (2011).
[20] Dastgir et al. (2019) use a Granger causality test to understand the relationship between Bitcoin investors' attention and Bitcoin returns.

largely used in macroeconomic studies, was preferred to vector autoregressive methodologies, because of its flexibility, precision in point estimation and suitability for smaller samples.

The analysis is formalized in the following equation (Equation 6):

$$x_{(t+h)} - x_t = c + \Psi_h (L)\, z_{(t-1)} + \beta_h\, shock_t + \varepsilon_{(t+h)} \quad \text{for } h = 0,1,2\ldots, \qquad (6)$$

where x is the variable of interest, z_{t-1} is a vector of control variables, Ψ_h (L) is a polynomial lag operator, and $shock_t$ refers to our measure of abnormal investor attention on the DE. The frequency of all the variables is daily, and, in line with prior analyses, the sample period spans from January 2020 to February 2022.

We account for several control variables by exploiting the volatility indexes publicly available from the Chicago Board Options Exchange (CBOE). Specifically, we include the Crude Oil Volatility Index (OVX), the Gold Volatility Index (GVX), and the S&P 500 9-Day Volatility Index (VIX9). We set the maximum number of lags at 30, according to the BIC criteria, and treat the abnormal investor attention as an exogenous shock. We enter all the variables using *log-level* transformations to interpret the results in percentage points. Lastly, we include the Bitcoin, Ethereum, and Tether prices and volumes in pairs one at a time.

Figure 1 presents the impulse responses for Bitcoin (Panel A), for Ethereum (Panel B), and for Tether (also denominated "stablecoin" in Panel C). In line with our expectations, the Bitcoin price is negatively associated with a positive investor attention shock on the DE, with a statistically significant (10%) 2%[21] drop within ten days. Then, we also observe a decline in its trade volume, which occurs after ten days. Conversely, when examining Ethereum, our results are not statistically significant not displaying effects on its prices, with a marginal increase in volume. This result could be attributed to tokens (as discussed earlier) which are the less "threatened" by the CBDC due to their

[21] We plot the impulse responses along with 90% confidence interval as common in the literature, however, our results are also robust at 95% confidence interval.

underlying characteristics. The overall attention may contribute to enhancing public awareness of the underlying attributes of cryptos and CBDC, influencing the results as mentioned above.

Being a stablecoin, the Tether is particularly relevant to the purpose of this analysis. The impulse response does not show any statistically significant effect on prices, yet we find a significant drop in volumes after seven days. In line with the expectations and the literature, CBDCs play the role of the main competitor of stablecoins. However, as the stablecoin price is tied to an underlying asset (in this case, the US dollar), we do not expect a loss in value and a substantial price discovery effect, but a reduction in trading interests from investors. These last results corroborate our previous findings.

[INSERT FIGURE 1]

6. Concluding Remarks

In this study, we are the first to assess the market reaction of cryptocurrency prices to the disclosure of the introduction of the Digital Euro. The disclosure of these information is particularly relevant for the participants of the cryptocurrency market, since a newly regulated form of digital money will be made publicly available by the ECB in the Eurozone.

We firstly document that cryptocurrency prices drop by 4% on average when DE information is disclosed. Furthermore, this result remains robust when controlling for confounding events such as worldwide cryptocurrency bans, other CBDCs disclosure, and monetary policy announcements. Secondly, this effect is mainly driven by stablecoins and highly liquid cryptocurrencies (shown as a higher Amihud Ratio within the pre-announcements period). Finally, when focusing on the Bitcoin, Ethereum, and Tether reaction to the abnormal investors attention to the DE, we find mixed results. The price and volumes of the Bitcoins drop consistently in the days subsequent to the attention shock. Showing movements in the trading position as well as in the value of the Bitcoin, resulting in a price discovery effect. In line with our expectations, we find an unaffected Ethereum, due to its intrinsic token characteristics. Ultimately, corroborating our past results, we find a drop in the volumes of the Tether, finding a potential migration of interest from the stablecoin. Our interpretation relies within

the cryptos characteristics. Coins and Stablecoins are more sensitive to the DE disclosure since they show similar characteristics to fiat currencies, and the potential introduction of the DE is perceived as negative news for cryptocurrency investors given that a more regulated and safer form of means of payments is going to be introduced. The price of the Tether is unaffected in line with the fact that its value is linked to an underlying asset (the US dollar in this case) and therefore price discovery should be primarily led by its fluctuations. Overall, our results contribute to previous studies on competition effects, providing evidence that the potential entrance of alternative products (CBDCs) influences market dynamics.

Our results have important policy implications. Central bank digital currencies serve as a positive response to avoid the "cryptoization" of financial markets and protect monetary sovereignty by diverting investor attention away from unregulated cryptocurrencies (coins) toward safer forms of money, such as central bank money. Yet, this is especially true for stablecoins. In addition, our findings support the view that the CBDC policy is ineffective in dealing with the uncontrolled rise of token usage in the cryptocurrency market. Interestingly, our results suggest that not only the information spread by the central banker matters and attracts investor attention, but also central bank disclosure tone affects the cryptocurrency market performance. This effect is particularly evident when central bankers communicate with leadership and confidence when they disclose critical information about the launch of a CBDC policy. Thus, a potential strategy to discourage the use of unregulated cryptocurrencies should consider the implementation of a well-defined confident and assertive communication strategy to defend the sovereignty and role of central banks.

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Table 1. Predictions of cryptocurrency reactions to the Digital Euro Disclosure.

Variable	The rationale for variable inclusion
Amihud Ratio	Most traded cryptos will react negatively to the introduction of the digital Euro.
Market Capitalization	Largely capitalized cryptos will react negatively to the introduction of the digital Euro.
Token	Providing further services rather than simple means of payment may not react negatively to the DE announcements.
Scalability	Less scalable cryptos would attract negative abnormal returns since the introduction of a safer form of money makes them less attractive.
Collateral	Collateralized cryptocurrencies, being less exposed to the market volatility, may react positively to the launch of the DE.
Algorithm	Being the central bank's digital currency, the safest form of money, the cryptocurrencies having an algorithm should react negatively to the DE disclosure.
Lending & Borrowing	The Digital Euro has no feature related to the possibility of lending and borrowing money; thus, these crypto-assets might not react to the Digital Euro announcements.
AMM	Cryptocurrencies benefitting from Auto-Market Marker could be unaffected by the introduction of DE.
DAO	Because of the cyber risks to which cryptocurrencies are exposed, cryptocurrencies based on decentralized blockchains may react negatively to introducing the DE.

Table 2. Descriptive statistics

Panel A: Event Study Analysis					
Variable	Obs	Mean	Std. dev.	Min	Max
Returns	63,196	-0.003	0.093	-1.581	1.200
Market Index Returns	63,197	-0.003	0.049	-0.475	0.353
VIX Returns	63,030	-0.001	0.069	-0.220	0.480
Gold Returns	63,037	0.000	0.008	-0.051	0.026
Oil Returns	63,037	0.001	0.018	-0.114	0.082
S&P market index Returns	63,320	0.001	0.009	-0.035	0.024
Panel B: Cryptocurrencies price reaction					
Variable	Obs	Mean	Std. dev.	Min	Max
Dependent variable					
CAR	3,092	-0.003	0.274	-10.531	2.630
Variable of interest					
Stablecoin	3,092	0.056	0.229	0.000	1.000
Crypto forward-looking variables					
Amihud Ratio	3,092	0.004	0.004	0.000	0.108
Market Capitalization (ln)	3,092	19.562	2.295	13.036	27.551
Crypto-specific characteristics (time-invariant)					
Token	3,092	0.792	0.406	0.000	1.000
Scalability	3,085	0.127	0.333	0.000	1.000
DAO	3,092	0.142	0.349	0.000	1.000
Interoperability	3,092	0.041	0.198	0.000	1.000
Algorithm	3,092	0.159	0.366	0.000	1.000
Lending & Borrowing	3,092	0.025	0.157	0.000	1.000
AMM	3,066	0.053	0.224	0.000	1.000
Tone Analysis					
Disclosure Length	2,443	7.715	0.350	6.366	8.541
Analytic	2,443	0.850	0.124	0.538	0.990
Clout	2,443	0.666	0.070	0.542	0.805
Authentic	2,443	0.215	0.130	0.057	0.546
Interview	3,092	0.451	0.498	0.000	1.000
Tone	2,443	0.526	0.146	0.236	0.815
Positive Tone	2,443	0.027	0.006	0.016	0.038
Negative Tone	2,443	0.013	0.004	0.003	0.022
Christine Lagarde	3,092	0.178	0.382	0.000	1.000
Fabio Panetta	3,092	0.475	0.499	0.000	1.000

Table 3. Price reaction of cryptocurrencies to the Digital Euro Disclosure events.
This table shows the results of the event study using prices related to 142 cryptocurrencies.
*, **, *** denote the statistical significance at the 10%, 5% and 1% levels, respectively.

PANEL A: Main findings				
Type of Event Study		*Reaction*	*p-value*	*T-statistic*
All Events				
MM-STYLE	CAR (-1,1)	-0.041***	0.000	-65.370
APT-STYLE	CAR (-1,1)	-0.054***	0.000	-48.795
Only speeches				
MM-STYLE	CAR (-1,1)	-0.040***	0.000	-35.957
APT-STYLE	CAR (-1,1)	-0.049***	0.000	-24.325
Only interviews				
MM-STYLE	CAR (-1,1)	-0.048***	0.000	-50.568
APT-STYLE	CAR (-1,1)	-0.056***	0.000	-42.650
Only press release				
MM-STYLE	CAR (-1,1)	-0.049***	0.000	-14.998
APT-STYLE	CAR (-1,1)	-0.047***	0.000	-15.232
PANEL B: Excluding confounding events (bans and other CBDC announcements)				
Type of Event Study		*Reaction*	*p-value*	*T-statistic*
All Events				
MM-STYLE	CAR (-1,1)	-0.046***	0.000	-60.540
APT-STYLE	CAR (-1,1)	-0.057***	0.000	-26.741
Only speeches				
MM-STYLE	CAR (-1,1)	-0.041***	0.000	-35.293
APT-STYLE	CAR (-1,1)	-0.054***	0.000	-11.446
Only interviews				
MM-STYLE	CAR (-1,1)	-0.049***	0.000	-44.854
APT-STYLE	CAR (-1,1)	-0.057***	0.000	-40.363
Only press release				
MM-STYLE	CAR (-1,1)	-0.048***	0.000	-15.104
APT-STYLE	CAR (-1,1)	-0.048***	0.000	-16.428
Panel C: Excluding confounding events related to monetary policies				
Type of Event Study		*Reaction*	*p-value*	*T-statistic*
All Events				
MM-STYLE	CAR (-1,1)	-0.046***	0.000	-25.544
APT-STYLE	CAR (-1,1)	-0.053***	0.000	-47.732
Only speeches				
MM-STYLE	CAR (-1,1)	-0.040***	0.000	-35.549
APT-STYLE	CAR (-1,1)	-0.049***	0.000	-24.760
Only interviews				
MM-STYLE	CAR (-1,1)	-0.050***	0.000	-14.619
APT-STYLE	CAR (-1,1)	-0.056***	0.000	-40.509
Only press release				
MM-STYLE	CAR (-1,1)	-0.048***	0.000	-15.155
APT-STYLE	CAR (-1,1)	-0.046***	0.000	-15.756

Table 4. Trading volume activity of cryptocurrencies around the Digital Euro Disclosure events.

This table shows a pooled time-series cross-sectional analysis with the White (1980) covariance matrix, following Hegde and McDermott (2002) to investigate the volume patterns around DE events. Panel A reports the results of the regression analysis, where *Abnormal volume* is log of the trading volume in the cryptocurrency j at time t; B_{ti} are dummy variables for each trading day in the event window (-4, +4); *Drift* is a correction of the linear drift in volume over time; *Innovation* is the residual from an AR(1) regression of the volume to ensure an additional control for confounding effects in the volumes; outside Standard errors are reported in parentheses. *, **, *** denote the statistical significance at the 10%, 5% and 1% levels, respectively.

Panel A: Anticipatory effects analysis	
	Abnormal Volume
β_{t-4}	0.0919
	(0.056)
β_{t-3}	0.0272
	(0.061)
β_{t-2}	0.0819
	(0.061)
β_{t-1}	0.0426
	(0.062)
β_{t0}	-0.0972
	(0.063)
β_{t+1}	0.0831
	(0.063)
β_{t+2}	0.1500**
	(0.060)
β_{t+3}	0.1014*
	(0.055)
β_{t+4}	-0.0206
	(0.056)
Market Capitalization (ln)	1.0338***
	(0.007)
Drift	-0.0043***
	(0.000)
Innovation	0.9632***
	(0.029)
Observations	15,145
Number of cryptos	142
R-squared	0.774
Panel B: Parallel trend test	
Time	Coefficient
t-4	$\beta_{t-4}=0$
t-3	$\beta_{t-3}=0$
t-2	$\beta_{t-2}=0$
t-1	$\beta_{t-1}=0$
F(4, 12,211)	1.10
Prob>F	0.3529

Table 5. Cryptocurrency sensitivity to Digital Euro Disclosure events.
This table reports multivariate regressions estimated according to Eq. 5, where the CAR (-1, +1) is the dependent variable estimated following Equations 1 and 2 represents the cumulative abnormal returns over a three-day event window, including the day of the policy event, the day before, and the day after. *Stablecoin* is a dummy variable that equals one if the cryptocurrency is backed by an asset or a pool of assets held by the cryptocurrency's issuer and zero otherwise. *Amihud Ratio* is the average Amihud Ratio in the pre-announcement period for each event. Market Capitalization is the log of the cryptocurrency's market capitalization. *Token* takes the value of one if the cryptocurrency is a token and zero otherwise. *Scalability* equals one if the cryptocurrency has a fast-scaling blockchain in processing transactions and zero otherwise. *Interoperability* is a dummy variable taking the value of one if the cryptocurrency blockchain can exchange data with another blockchain and zero otherwise. *Algorithm* is a dummy variable that equals one if the cryptocurrency ensures original data secrets, consumer protection, and privacy and zero otherwise. *AMM* equals one if the trading platform benefits from Auto-Market maker service and 0 otherwise. *Lending & Borrowing* takes the value of one if the cryptocurrency can also be used for lending and borrowing money and zero otherwise. DAO is a dummy that takes the value of one if the cryptocurrency benefits from DAO-based technological features and zero otherwise. Standard errors are reported in parentheses. ***, **, * indicate significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)
Variables	CAR (-1, +1)	CAR (-1, +1)
Stablecoin	-0.0255***	-0.0260***
	(0.008)	(0.008)
Amihud Ratio	-7.5839***	-7.7187***
	(0.435)	(0.440)
Market Capitalization (ln)	-0.0014	-0.0012
	(0.001)	(0.001)
Token	0.0035	0.0039
	(0.006)	(0.006)
Scaling	0.0043	0.0041
	(0.006)	(0.006)
DAO	0.0041	0.0039
	(0.005)	(0.005)
Interoperability	-0.0081	-0.0080
	(0.009)	(0.009)
Algorithm	-0.0027	-0.0021
	(0.006)	(0.007)
Lending & borrowing	0.0014	0.0015
	(0.011)	(0.011)
AMM	0.0054	0.0055
	(0.008)	(0.008)
Intercept	Yes	Yes
Event FEs	Yes	Yes
Observations	3,059	3,033
Number of cryptos	142	141
R-squared	0.115	0.117

Table 6. Disclosure Tone and Cryptocurrency price reaction.
This table reports the results of ECB central bankers' announcement tone and market reaction. CAR (-1, +1) is the dependent variable estimated following Eqs. 1 and 2 and represents the cumulative abnormal returns over a three-day event window, including the day of the policy event, the day before, and the day after. *Disclosure Length* is defined as the log of the number of words used in the public announcement. *Analytic* is a proxy capturing the degree to which people use words that suggest formal, logical, and hierarchical thinking patterns. *Clout* is a proxy capturing the relative social status, confidence, and leadership of the Eurozone central bankers through their speaking. *Authentic* measures the extent to which the ECB central banker speaks more spontaneously and does not self-regulate or filter what she/he is saying. The tone variable is a proxy measuring the emotional tone of the ECB central banker. We also introduce two variables obtained splitting Tone in Positive Tone and Negative Tone. Standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)
	CAR	*CAR*	*CAR*	*CAR*
Variables	*(-1;+1)*	*(-1;+1)*	*(-1;+1)*	*(-1;+1)*
Disclosure Length	-0.0042	-0.0039	-0.0071	-0.0066
	(0.006)	(0.006)	(0.006)	(0.006)
Analytic	-0.0251	-0.0240	-0.0128	-0.0123
	(0.023)	(0.024)	(0.024)	(0.025)
Clout	-0.0961***	-0.0957***	-0.1087***	-0.1076***
	(0.035)	(0.035)	(0.035)	(0.036)
Authentic	0.0139	0.0144	0.0248	0.0248
	(0.018)	(0.018)	(0.019)	(0.019)
Tone	0.0257*	0.0248*		
	(0.014)	(0.014)		
Positive Tone			-0.0256	-0.0161
			(0.333)	(0.337)
Negative Tone			-1.3824***	-1.3183***
			(0.492)	(0.497)
Intercept	Yes	Yes	Yes	Yes
Observations	2,443	2,422	2,443	2,422
R-squared	0.006	0.006	0.008	0.007

Table 7. Cryptocurrency sensitivity to DE announcements and text analysis.
This table reports robustness tests for our main findings controlling for ECB central bankers' tone. CAR (-1, +1) is the dependent variable estimated following Eqs. 1 and 2 and represent the cumulative abnormal returns over a three-day event window, including the day of the policy event, the day before, and the day after. *Stablecoin* is a dummy variable that equals one if the cryptocurrency is backed by an asset or a pool of assets held by the cryptocurrency's issuer and zero otherwise. We introduce controls in line with Tables 5 and 6. Standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	CAR	*CAR*	*CAR*	*CAR*	*CAR*	*CAR*
Variables	*(-1;+1)*	*(-1;+1)*	*(-1;+1)*	*(-1;+1)*	*(-1;+1)*	*(-1;+1)*
Stablecoin	-0.0185**	-0.0191**	-0.0183**	-0.0188**	-0.0189**	-0.0194**
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Amihud Ratio	-6.7040***	-6.8423***	-6.7378***	-6.8725***	-6.8940***	-7.0234***
	(0.474)	(0.478)	(0.474)	(0.479)	(0.475)	(0.478)
Market Capitalization (ln)	-0.0010	-0.0009	-0.0011	-0.0010	-0.0009	-0.0008
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Token	0.0042	0.0045	0.0040	0.0043	0.0044	0.0047
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Scaling	0.0085	0.0084	0.0087	0.0085	0.0085	0.0084
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
DAO	0.0072	0.0069	0.0071	0.0068	0.0071	0.0068
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Interoperability	-0.0029	-0.0029	-0.0029	-0.0028	-0.0031	-0.0031
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Algorithm	-0.0044	-0.0038	-0.0041	-0.0035	-0.0045	-0.0039
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Lending & Borrowing	0.0107	0.0109	0.0112	0.0113	0.0109	0.0110
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
AMM	0.0104	0.0106	0.0106	0.0108	0.0106	0.0108
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Disclosure Length	-0.0001	0.0004	0.0002	0.0006	-0.0063	-0.0051
	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)
Analytic	-0.0310	-0.0294	-0.0007	-0.0006	-0.0410	-0.0387
	(0.035)	(0.036)	(0.038)	(0.038)	(0.032)	(0.033)
Clout	-0.0808**	-0.0788*	-0.0840**	-0.0820**	-0.0879**	-0.0841**
	(0.040)	(0.040)	(0.040)	(0.040)	(0.039)	(0.040)
Authentic	0.0056	0.0057	0.0196	0.0190	0.0128	0.0112
	(0.018)	(0.019)	(0.020)	(0.020)	(0.023)	(0.023)
Interview	0.0008	0.0010	0.0049	0.0049	-0.0057	-0.0053
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Tone	0.0152	0.0140				
	(0.016)	(0.016)				
Positive Tone			-0.1566	-0.1633		
			(0.355)	(0.360)		
Negative Tone			-1.3637**	-1.2916**		
			(0.573)	(0.581)		
Christine Lagarde					-0.0131**	-0.0126**
					(0.006)	(0.006)
Fabio Panetta					-0.0075	-0.0080
					(0.007)	(0.007)
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,417	2,396	2,417	2,396	2,417	2,396
Number of cryptocurrencies	142	141	142	141	142	141
R-squared	0.091	0.093	0.092	0.094	0.095	0.097
Event FEs	Yes	Yes	Yes	Yes	Yes	Yes

Figure 1. Local Projections Estimates: Focus on Bitcoin (coin), Ethereum (token), and Tether(stablecoin).

The figure presents the impulse response function estimated in Equation 6, where a measure of abnormal investor attention on the Digital Euro represents the exogenous shock. The controls are represented by the Crude Oil Volatility Index (OVX), the Gold Volatility Index (GVX), and the S&P 500 9-Day Volatility Index (VIX9). The variables of interests are the prices and volumes of different cryptocurrencies (Bitcoin, Ethereum, and Tether) and are added in pairs one at the time (three separate models are estimated for each crypto). The figure plots the impulse response functions along with 90% bootstrapped confidence intervals. According to the BIC test, the lags are set to a maximum of 30.