FACULTY OF ECONOMICS AND BUSINESS ADMINISTRATION DOCTORAL SCHOOL
MARKETING STUDY FIELD

EXPLORING CITIZEN SENTIMENT TOWARDS CENTRAL BANK DIGITAL CURRENCIES. AN X (EX-TWITTER) ANALYSIS.

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Thesis summary in English

The early twentieth century saw the rise of mass media and mass communication, with popular democracy and industrialism as key foundations. The term "mass" originates from Old English and Latin, with the Catholic Mass being one of the oldest forms. The term has also been used to

describe festivals, celebrations, and commemoration days. Following the information communications revolutions, with the third one being largely driven by the advent of computers and the Internet, people were able to not only receive media but also generate and publish content online. As a result, technologies like Twitter, Facebook, Instagram, and Google+ have emerged, allowing consumers to access information faster and easier. This has influenced people's lives in various ways, and central banks are using these new channels to communicate with financial markets and citizens.

At the same time, central banks and financial institutions are implementing policies to provide and issue physical and digital currencies for payments. Digital currencies are part of the shift to a cashless society, with authorities like the People's Bank of China, the Central Bank of Uruguay, and the Sveriges Riksbank working on issuing them. To ensure successful implementation and high digital currency usage, central banks must rely on communication, marketing, and targeted language and discourse techniques with political and financial authorities and citizens. Central bank communication has historically not been linked to language, rhetoric, or storytelling, but relies heavily on narration. This narrative format, introduced by the Bank of England after 2004, captures the audience and makes the language audible and understandable to target communities, including those without a background in finance.

Central banks have become more transparent and rely on external communication and marketing communication to implement monetary policy, especially following the financial crisis. The European Central Bank (ECB) has started publishing minutes of policy meetings, working papers, statistics papers, legal working papers, discussion papers, occasional papers, economic bulletins, annual reports, convergence reports, and macroeconomic projections. However, more communications by the ECB do not necessarily increase accessibility to the general public. Central bank publications are difficult to read and understand due to their technical nature. Readers need to be skilled in economics and finance to understand them without too much effort. A YouGov poll in 2015 found that 12% of respondents found media and politicians' discussions about economics accessible. The Eurobarometer (2018) revealed an understanding deficit and trust deficit at the European Union level, with only 42% of Europeans trusting the EU, while 48% tend not to trust it. The economic situation also shows significant disparities between member states, with 93% of Luxembourg's population viewing the national economic situation as good compared to 27% of Romanian and 2% of Greek populations.

Research has shown that satisfaction with central banks' policies increases if their empirical basis is better understood. Draghi addressed the communication challenge faced by the ECB, which communicates in 19 countries using different languages, to people with different expectations. This plurality is dealt with through the Eurosystem, comprising 19 national central banks, each having their own communications department to propagate ECB messages locally.

The majority of academic economics is written in formal terms, but criticisms of the prevailing formal language approach have crept into economic conferences, especially those pertaining to monetary policy and central bank theory. Coherence requires a shared understanding, and understanding in economics does not develop incrementally. Language is more than just a tool for transforming information; it also serves as a catalyst for the speaker and listener to become more oriented to one another, creating a context for the encounter. The neutrality of money or language is not nearly as relevant to the modern view of central banking as central banking practice. The world of mainstream economics has chosen to ignore the opinions of John M. Keynes, who argued that money cannot be viewed as neutral. The future of the monetary market is at stake in uncertain, volatile contexts, and central banks must focus on everyday language for effective communication and marketing. Central banking is an interactive process where central banks and financial markets play crucial roles. Monetary policy success depends on the bank's sensitivity to changing contexts and interactions with agents. Language and banks' decision-making have proven to be more effective in guiding market expectations than fixed numerical rules.

Central banks should prefer to communicate in everyday language, as interactions are based on shared understanding. The notion that coded language replicates certainty is deceptive and will backfire. The effectiveness of central banks depends on their ability to act and society's acceptance of their actions. Financial literature can be made more widely available by utilizing studies on the relationship between language and central bank communication. The research hypothesis and objectives of the thesis are based on the emergence of digital currencies and the rising power of social media in influencing citizens' buying decisions.

The study explores the impact of financial communication and marketing communication on citizens' opinions on digital currencies like the digital euro. It focuses on the emerging social media networks used for communicating and marketing financial information, as well as the opinions expressed by citizens regarding digital currencies. The research aims to understand citizens' views, opinions, and worries over Central Bank Digital Currencies (CBDCs) and their effects on the euro

and the European financial system.

The main research questions include what types of sentiments are expressed and the main topics addressed on social media regarding CBDCs. The study hypothesizes that public discourse is dominated by a neutral attitude due to the novelty of the topic, with most keywords used expressing positive, neutral, and negative sentiment. Concerns about privacy, security, and technical aspects of the digital euro are also central bank concerns.

A sentiment and text analysis was conducted using X data, including terms "CBDC" and "euro". Sentiment analysis was used to examine the opinions and concerns expressed in 4,462 tweets made between September 14, 2018, and June 19, 2023. The K-Means algorithm was used to find similar clusters of tweets, and each cluster was subjected to sentiment analysis, which identified the pertinent main themes and public opinion by assigning a positive, neutral, or negative rating. The study uses a qualitative methodology, identifying sentiment analysis and grouping participants based on their perceptions of CBDC. The research's focus on the digital euro, a unique type of CBDC, is a novel insight, as millions of people's lives and financial choices could be impacted by its implementation.

The following research questions and hypotheses are tackled in this thesis:

Question 1: What types of sentiments (positive, neutral, negative) are expressed via X regarding the digital euro and CBDCs?

Question 2: What are the main topics citizens address on X with regards to the digital euro and CBDCs?

In addition to the research questions, several research hypotheses have been outlined:

Hypothesis 1: Due to the novelty of the topic regarding the implications of Central Bank Digital Currencies (CBDCs), the public discourse is dominated by a neutral attitude.

Hypothesis 2: The majority of the keywords used in public discourse on CBDCs are nouns that express positive, neutral and negative sentiment.

Hypothesis 3: Concerns about privacy, security, and the technical aspects of the digital euro are the main topics of public discussion regarding CBDCs. Other topics include how central banks will handle digital currencies.

The thesis explores the evolution of central bank marketing communication strategies within the financial system, focusing on the BoE, ECB, FED, FOMC, People's Bank of China, and Bank of Russia. It distinguishes between classical and modern communication, highlighting the need for open and citizen-friendly communication on social media platforms like Twitter. The study also examines citizens' perceptions of the digital euro, revealing a complex interplay between communication and linguistic factors. The BERT model was used for sentiment analysis, cluster analysis, and emotion analysis. The findings suggest that people are both involved and cautious, emphasizing the need for financial institutions to take decisive action to address these concerns. Encouraging candid dialogue and open communication strategies can help central banks align their actions with public sentiment and facilitate a smoother transition to the digital euro.

The general framework of the literature review is set by introducing how the public sector is influenced by marketing, communication and language. The public sector is a crucial part of society, responsible for producing, providing, and financing public goods and services through government spending. It plays a significant role in establishing laws and delivering essential services like healthcare and education, which are not provided by NGOs or the private sector. The public sector accounts for between 40 and 44% of GDP in the United States, with a range of 49.7 - 53.4% in the European Union, 40.3 - 38.7% in Japan, and 28.1 - 36.3% in China. Marketing aims to create value by establishing and preserving positive relationships with customers. Over the past 30 years, the public sector has adopted private sector tools and approaches, such as strategic marketing, to address the challenge of using reduced resources to meet goals and mandates.

To effectively use marketing, the public sector must understand and adapt four main forms: product and service marketing, social marketing, policy marketing, and demarketing. The first type involves using the marketing mix to adapt communication strategies, while the second type involves social marketing to change audience behavior and social ideas. Policy marketing aims to persuade the public to accept certain policies, while demarketing advises against using past programs. The public sector is a crucial part of society, responsible for producing, providing, and financing public goods and services through government spending. It plays a significant role in establishing laws and delivering essential services like healthcare and education, which are not provided by NGOs or the private sector. The public sector accounts for between 40 and 44% of GDP in the United States alone, with its range varying across the European Union, Japan, and China.

Marketing aims to create value through positive relationships with customers and involves activities and processes used to create, communicate, and deliver products and services that satisfy them. Over the past 30 years, the public sector has adopted private sector tools and approaches, such as strategic marketing, to address the challenge of using reduced resources to meet goals and mandates. To effectively use marketing, the public sector needs to understand and adapt four main forms: product and service marketing, social marketing, policy marketing, and demarketing. Product and service marketing follows private, profit-oriented organization marketing, while social marketing encourages certain public behavior and social ideas. Policy marketing aims to increase public awareness regarding public legislation, while demarketing discourages citizens from using obsolete services. Public sector marketing has evolved beyond public health, public law, and social welfare, focusing on education quality and political stability. By understanding and adapting to the needs of citizens and businesses, the public sector can better serve their stakeholders and contribute to the greater good.

Financial inclusion can reduce poverty by fostering shared wealth, economic welfare, and successful financial individual development. The degree of financial inclusion varies among nations, and it is related to the availability of financial services and the transparency and trustworthiness of the financial industry. By boosting financial institutions' resilience to economic and systemic shocks and expanding access to financial goods and services, a fairer distribution of income can be achieved. Financial institutions can profit by raising profits, lowering operating costs, and gaining market share through various strategies, including marketing. Public financial institutions, such as government-owned banks, development banks, and state-owned institutions, use marketing communication strategies to promote their products and services to the public. Public marketing focuses on benefiting society, while private sector marketing aims to maximize profit by meeting client requirements and winning their allegiance. The consumer of public services is a crucial component of public marketing, as consumerism led to changes in public services and new public management.

In the financial services sector, businesses must undergo a digital transition, as integrating digital advancements can significantly affect a company's success. Modern financial organizations face challenges to adapt to the new landscape, but they tend to adopt innovative solutions early on due to their clear understanding and ability to evaluate return on investment. Understanding how innovation and modern communication occur requires understanding how financial institutions

interact with different parties and the influence of social media on decision-making. Financial institutions play a crucial role in the financial system, providing services that are essential for market development. The communication between these roles is influenced by various genre sets, such as the genre system of finance. Central banks and financial organizations are seen as the engine of growth in every economy, and their marketing efforts are essential for differentiation. However, not all actors within the financial sector have connected their services to their marketing strategy, leading to a lack of pertinence and creativity.

The financial services sector has incorporated new technologies and expanded trade channels, but there is still room for improvement in terms of service culture, service standard, and service level. Language plays a significant role in central bank communication, as it can be a strong indicator of future intentions and actual situation. Political scientists have recently begun examining the language of central banks, finding that the language shifted during Mario Draghi's presidency, with a discourse emphasis placed on stability. Language can be examined using various methodologies, including interpretive study of conversation and automated and/or quantitative content analysis, to look into long-term development trends and specific ECB-related decisions.

In 1993, the UK adopted inflation targeting, leading to the Bank of England (BoE) releasing the Inflation Report as a tool to control citizen and company expectations. The BoE communicates with the public from a democratic perspective, granting the central bank authority, legitimacy, and independence in exchange for continued accountability. The BoE communicates through various channels, including quarterly bulletins, inflation reports, Mansion House addresses, and other channels, which make up economic policy. Language's performativity is crucial for the BoE to achieve its macroeconomic goals, and the use of terms like "public currency" and "fiat money" is used interchangeably. Narrative has been a key component of the BoE communication strategy since 2004, using macro-narratives to announce the incoming governor's mandate and micro narratives to express ideas on difficulties that must be overcome.

Speech plays a significant role in the BoE communication strategy, with archives of newspapers like The Times and The Evening Standard containing articles containing speeches pertaining to the BoE. The official name of the event that includes the speech has been mostly unaltered over the years, indicating that speeches are viewed as belonging to a specific genre for the BoE.

Research by Holat et al. (2018) explored whether an improved marketing communication strategy affected perceived and actual public trust and knowledge regarding the bank's actions. The study

found that simplified versions of the reports enhanced public understanding of the texts, offering specific recommendations for the BoE to enhance their public relations efforts.

The way and amount of information shared with businesses and citizens has a substantial impact on the economy, and direct communication from central banks to the general public has been lagging behind. The policy dilemma is how to write communication so that it gets the media attention the central bank wants while conveying key themes that can have significant effects on agents and the real economy. Munday and Brookes (2021) studied data surrounding written communication about the BoE, such as newspaper articles, to measure news coverage and find a communication model that can be used by the BoE for receiving more news coverage. The model used computational linguistic approaches to test various qualities that would determine whether a communication is reported on or not. In 1993, the UK adopted inflation targeting, leading to the Bank of England (BoE) releasing the Inflation Report as a tool to control citizen and company expectations. The BoE communicates with the public from a democratic perspective, granting the central bank authority, legitimacy, and independence in exchange for continued accountability.

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central bank wants while conveying key themes that can have significant effects on agents and the real economy.

The Federal Reserve (FED) communicates on various topics via various channels, aiming to inform and influence policy objectives and decisions. These interactions are typically printed and saved in text form. After the 2007-2008 financial crisis, a new normal was formed regarding central bank communication, with unconventional monetary policy tools dominating the Fed's messaging. The COVID-19 crisis marked a point when the Fed started using less uncertainty related terminology in their monetary policy statements and contributed to creating a new trend to decrease market uncertainty and convey a positive sentiment. According to a 2020 survey by the Hutchins Center on Fiscal and Monetary Policy, the press conference organized by the Fed as a result of FOMC meetings is the most useful communication tool. Over 80% of those surveyed gave them an "extremely useful" or "useful" rating. The same goes for communications around the Survey of Economic Projects and the annual conference regarding monetary policy. The FOMC dot plot, which displays each committee member's predictions for the federal funds rate's future course, was considered of the least value.

The FOMC started publishing an annual report on long-term objectives and a monetary policy strategy report in 2012, which presented an exact and well-defined inflation target—2%—which was updated by the FOMC in August 2020. The revised version states that the institution will pursue steps towards an inflation rate higher than 2% following several years during which inflation had been consistently lower than its target of 2%. However, 80 percent of Fed watchers predicted that public inflation expectations would not move much. Using the Flesch-Kincaid index, Jansen (2011b), Hernández-Murillo, and Shell (2014) analyze FOMC statements made by the US Federal Reserve. They demonstrate that FOMC comments become less understandable as they become more elaborate, possibly reflecting increased transparency in decision-making.

Central bank communication is increasingly crucial for achieving monetary policy goals, especially through social media. Communication strategies are essential for managing public opinion and achieving targeted policy objectives. Simple language increases public impression and fosters public trust. Digital transformation within public organizations requires new institutional frameworks and employee acceptance of the evolving nature of work. Digital marketing is a marketing strategy that employs digital means to address customer or citizen requirements, including social media marketing and the gathering and maintenance of customer datasets.

The role of X (ex-Twitter) users' sentiment in describing how financial markets react to monetary policy announcements has been investigated for central bankers and markets. Analytical models and comparative methods can be used by AI to decipher consumer behavior and behavioral intents in marketing, helping organizations make better decisions and increase efficiency. The abundance of digital data allows for the collection and processing of data on customer and citizen needs, as well as about marketing and communication efforts, and analysis of citizen and consumer behavior. Digital technologies are viewed as efficiency incentives within public governance, redefining marketing strategies and enhancing effectiveness and cross-entity communication. To understand customer requirements, satisfy them, and even create new ones, a significant amount of data must be collected and processed, and AI-based solutions must be used. This leads businesses to become more customer-centric and meet their requirements thanks to digital transformation.

In a constantly changing setting, citizens need access to qualitative and engaging public services. Digitalizing public organization information systems allows digital communication and marketing
to become focus points for better communication with citizens. Social media marketing (SMM) via social media platforms is essential for businesses to achieve organizational objectives. Consumers are more likely to choose brands that provide enjoyable experiences, leading marketers to view social networks as a crucial channel aimed at reaching their actual and potential customers. Banks use social networks to get closer to customers and provide them with communication and interaction. Innovations at the digital and societal level empower banks to create unique and memorable brand experiences for current and potential customers. Social networks offer a more affordable and effective way for users to communicate with one another, increasing client loyalty and retention.

Businesses can facilitate user-generated content at any moment and engage with customers, enhancing the brand-customer relationship. By allowing users to share their brand exposures and experiences and spreading brand knowledge on social media, it promotes communication with other users and raises consciousness. The evolution of central bank communication strategies was explored, emphasizing the importance of language and rhetoric in explaining complex monetary policy to non-experts, particularly during economic crises, before a deep dive into the case study.

The case study examines the evolving nature of social media communication and the need for transparent and user-friendly communication on social media platforms like Twitter. It highlights

the complex interaction between linguistic and communication factors, as well as the need for financial institutions to act swiftly to ease concerns about the digital euro. Central banks can better align their actions with public sentiment and facilitate a more seamless transition to the digital euro by promoting open communication and honest discourse.

Technological advancements have led to the development of central bank digital currencies (CBDCs), which will change the functions of central banks from serving as financial intermediaries' settlement institutions to organizations running a payment system accessible to everyone. Central banks have traditionally used monetary policy to achieve price stability, but digital currencies could add an additional tool to the toolbox of central banks, especially in times of crisis or to adapt to the ever-changing technological landscape. Monetary policy and its tools have evolved, and banknotes and payment systems need to evolve as well. The science of currency changes in tandem with society's advances in technology and social necessities pertaining to the insurance of promises among actors. The emergence of cryptocurrencies, such as Bitcoin, has challenged fiat money by offering a way to avoid money backed by central banks and guarantee complete anonymity. Compared to credit cards, CBDCs offer faster, safer, and more resilient payment options. Central banks should continue to research and utilize blockchain-based technology and infrastructure as the foundation for CBDCs, as they can be used to address various social and economic challenges.

Quantitative research is appropriate for How-type research questions and for gaining insight into subjects that have not been extensively studied. It encompasses five main types: case studies and grounded theory, phenomenology (mainly used by counselor researchers), narrative research, and PAR (participatory action research). The author chose to use X (ex-Twitter) as a source for empirical evidence and performed sentiment analysis on tweets containing the words "cbdc" and "euro". Sentiment analysis represents the polarity detection of text data, identifying whether a tweet speaks positively, negatively, or neutrally about something. By analyzing how people talk about a brand on X (ex-Twitter), one can understand if they like a new feature that has just been launched. It identifies which aspects of the offer are most liked and disliked to make business decisions with the help of sentiment analysis, word clouds, and more.

X (ex-Twitter) offers an enormous amount of real-time data capable of collecting public thoughts, attitudes, and sentiments concerning CBDCs. This can help central banks better understand how the public views CBDCs and spot potential problems. A high level of positive sentiment could

indicate enthusiasm for the potential advantages of CBDCs, such as faster and less expensive transactions, while a significant amount of negative sentiment could indicate concerns about privacy, security, or the potential impact on traditional financial systems. The research aims to identify how people's attitudes regarding CBDCs have changed over the previous five years and evaluates X (ex-Twitter) users' primary worries and sentiments, allowing the identification of the main problems and elements influencing users' attitudes toward CBDCs on social media.

The goal of this study was to pinpoint the tweets that had the greatest impact on public opinion on CBDCs in the EU, as well as to outline their content and the sentiments conveyed in them. The dataset consisted of 4462 tweets containing the CBDC and euro tag published between September 14, 2018 and June 19, 2023. The tweets were cleaned from irrelevant elements and translated into English using deepl.com to ensure language uniformity. Sentiment analysis was performed using TextBlob, a text analysis tool that allows for numerical representation of textual data. The KMeans clustering algorithm was used to identify similar patterns and clusters of tweets, while the Roberta base model was used to analyze sentiment associated with the discussions in each cluster. Two different emotion recognition models were applied to the entire dataset of tweets (the translated version, so those tweets were completely written in English), one being a BERT-based recognition model and the second being a Roberta-based model.

Statistical analyses were performed for the TF-IDF values of the keywords, providing information about the relative distribution of words within clusters. The evolving landscape of CBDCs was also analyzed by conducting a keyword co-occurrence analysis using VOSviewer, a software that creates bibliometric networks and co-occurrence maps. The thesaurus compiled and inserted into VOSviewer contains labels that VOSviewer replaces with another because they define the same term or concept. This ensures the generation of a more accurate co-occurrence map. By identifying the most frequently used words and phrases in tweets related to CBDCs, central banks can better communicate their concerns and influence on the public debate on the topic.

A study using VOSviewer was conducted to analyze public perceptions and concerns about Central Bank Digital Currencies (CBDCs) and their impact on the European financial system. The research aimed to understand the opinions and attitudes of citizens regarding the digital euro and the traditional euro, particularly in relation to the euro and the European financial system. The study analyzed 167 text items, 1316 links, and 1316 tweets, identifying trends, patterns, and findings. The findings provide insights for the development and implementation of CBDCs and managing

their impact on the European economy and financial system. The research question is: What are citizens' perceptions and concerns about CBDCs and their impact on the traditional euro and the European financial system?

Central banks aim to ensure low inflation and maximize wealth for society, with the main goal being to combat it through standard monetary policy. They supply and create digital currencies for payment transactions, such as the People's Bank of China, the Central Bank of Uruguay (e-peso), and the Sveriges Riksbank (e-krona). Research on these currencies is growing, covering topics such as privacy concerns, cybersecurity risks, and the applicability of digital currencies. Central bank digital currencies (CBDCs) have been the subject of intense discussion as central banks and governments worldwide weigh the advantages and disadvantages of issuing digital versions of their currencies. CBDCs can enhance financial inclusion by providing access to digital money forms, increasing efficiency and lowering costs of cash transactions, enabling digital payments by customers, and potentially giving central banks new tools to implement monetary policy. However, privacy concerns and potential financial instability may arise if CBDCs are implemented widely all at once.

There are several reasons for issuing CBDCs, including improved efficiency and security, improved monetary policy transmissions, and reduced costs. However, there are also potential risks such as impeding the mechanism for transmitting monetary policy, data leakage, reputational risks, issues with cyber resilience, and privacy concerns. To properly deploy CBDCs, challenges such as financial literacy, internet infrastructure, access to technology, data protection concerns, and cross-border cooperation must be solved. X (ex-Twitter) has become the default way for companies to monitor user mentions of their brands to detect any problems early on. By analyzing sentiment analysis, companies can determine which features of an offer users like and hate to aid with corporate decision-making.

X (ex-Twitter) can be considered a useful tool for analyzing consumer sentiment, providing real time and historical data on citizen thoughts, positions, and sentiments regarding CBDCs. Central banks can modify their CBDC approach, encourage widespread adoption, and sway public opinion by monitoring citizen sentiment. Based on insights from X (ex-Twitter), focused marketing campaigns and other CBDC-related measures can be taken to address citizen concerns. The majority of tweets on X (ex-Twitter) are written in English, with bilingual tweets in both German and English coming in second. Other European languages, such as Dutch, Spanish, French, Polish,

Italian, Czech, Finnish, and Swedish, also contribute to the platform's appeal to users worldwide. This language distribution highlights the international debates surrounding the digital euro.

The dataset includes 608 tweets from users with business profiles, 457 tweets from content creators, and 3397 tweets from personal accounts. Most tweets were written by users with a personal account. Business accounts are recommended for organizations, brands, service providers, and retail shops, while creator accounts are recommended for public figures, influencers, and artists. Both categories overlap, meaning that everyone can choose their type of account and switch the type later, if desired. The top professional categories of professional accounts include media and news companies, financial services providers, science and technology professionals, entrepreneurs, educational accounts, and computer companies. These three types of accounts take the most interest in the development of the digital euro at the moment.

When analyzing the X (ex-Twitter) client applications used to access and post on X (ex-Twitter), most tweets were posted using the X web app (1392 tweets), followed by the iPhone X (ex-Twitter) application (645 tweets) and the Android X (ex-Twitter) application (578 tweets). The X web app, iPhone X (ex-Twitter) for iPhone, and Android X (ex-Twitter) for Android are the most widely used platforms for posting, suggesting that most discussions about digital currency take place on mobile devices and through Twitter's official web interface. Posting is done on a variety of platforms, such as automated services, developer plugins, and mobile apps. The most popular app is the X (ex-Twitter) web app, with almost 31.18% of the overall use. The next most popular platforms are X (ex-Twitter) for iPhone and X (ex-Twitter) for Android, with 14.45% and 12.95% of the distribution, respectively. In contrast to other values, which are varied and occur less frequently, the value "Twitter Web App" is frequently found and has a high frequency in the dataset.

The data analysis reveals a balanced exchange of views on topics such as digitization, CBDCs, the digital euro, and cryptocurrencies. However, some key elements have polarized the dialogue more. Descriptive analysis of tweet data by tweet type (tweet, retweet, reply) highlights relevant information about the frequency and period of posts on the X (ex-Twitter) platform. This data provides a deeper understanding of how the X (ex-Twitter) community interacts with the topic of the digital euro, highlighting key moments and notable posting frequencies. The evolution of user behavior over the years is consistent across all years studied. The Kruskal-Wallis test (22.388) indicates a significant difference in the distribution of the number of tweets between 2018, 2019,

2020, 2021, 2022, and 2023. The intensity of the tweet activity is variable, as suggested by the u type statistics. There is a surge in tweets and CBDC-related X (ex-Twitter) activity whenever there are press conferences around it and when the ECB publishes progress reports regarding the digital euro.

In 2019, interest in digitization and cryptocurrencies slightly increased to around 8 tweets per month, indicating an increase in discussion or interest in digitization and cryptocurrencies. In 2020, the number of tweets increased significantly, reaching around 68 per month due to major events or the increase in global interest in CBDCs. In 2021, the upward trend continued, with an average of around 76 tweets per month, indicating sustained interest in the field. In 2022, the number of tweets increased to around 108 per month, suggesting a continued increase in interest and adoption of these technologies. In 2023, the average number of tweets saw a dramatic increase to around 342 per month, indicating an explosion of interest or major events in the field of CBDCs and cryptocurrencies.

The qualitative analysis of citizen sentiments and views regarding the implementation of Central Bank Digital Currencies (CBDCs) is conducted using tools such as VOSviewer co-occurrence analysis, cluster analysis using the K-means algorithm, and keyword and sentiment analysis of tweets from a CMC perspective. The analysis aims to find a strategy for effective CBDC implementation and adoption by citizens, based on previous research and extending it. Consumers frequently voice privacy concerns, which are indicative of a general fear of governmental monitoring and manipulation of the digital currency market. A crucial aspect of the discussion is whether or not CBDCs will lead to a loss of financial autonomy and personal freedom, as highlighted by tweets casting doubt on the role of governments and central banks in overseeing financial transactions. This is in line with more general worries about data privacy, control, and the loss of anonymity in financial transactions in digital communication spaces.

On the other hand, many users are enthusiastic about the possibilities for innovation, seeing CBDCs as a logical development in an increasingly digital economy. This qualitative analysis also shows how users' trust in central institutions shapes their sentiments. People who express mistrust of governments or central banks frequently do so in relation to perceived overreach or previous financial crises, illustrating how historical and contextual factors shape public perceptions of new financial instruments. The author performed a term co-occurrence analysis via VOSviewer, revealing five big clusters containing terms used by citizens to voice their opinions on CBDC

related topics. The hottest cluster contains the words France, CBDC, euro, yen, cash, banknote, payment, and CBDC pilot, hinting at a comparison between the digital euro and the digital yen, to the role of France, a country running CBDC experiments at the moment, and concerns related to the fact that CBDCs could eventually replace cash.

The third cluster draws comparisons between CBDCs and Coinbase and discusses blockchain technologies and networks, such as TomoChain, a decentralized public blockchain network that prides itself on enhanced security features and zero-gas transactions. The fourth cluster contains words such as current state, digital euro, ECB executive board member, and Cointelegraph, a news platform providing cryptocurrency and blockchain news.

The density visualization displays the main words and ideas that citizens have brought up in connection with CBDCs, with their sentiment ranging to positive to neutral and negative. The interests and concerns identified within the cluster and presented here are consistent with research by Ozili (2022), who finds that privacy and surveillance are central concerns in how the public views CBDCs. Research has shown that Central Bank Digital Currencies (CMCs) can have a polarizing effect on social media users, as they can construct semi-public or public profiles within a restricted system. However, CMCs have drawbacks such as difficulty in revealing personal identity and low social awareness among users. Personality physiognomies play a role in persuading some people to choose CMC over traditional face-to-face interactions.

The study analyzes the connections between various topics, including privacy, payment methods, and central banking regulations, in public discourse on X (ex-Twitter). The European Central Bank (ECB) and terms like payment, bond, wholesale CBDC, and privacy have the strongest link strength, followed by smaller clusters related to other digital currencies (like Ethereum and Coinbase) to topics like identity, mass monitoring, and the CBDC race. To ensure the successful implementation and widespread adoption of CBDCs, central banks should address these subjects of great concern to the public, especially given the interest of researchers. While there are risks associated with implementing CBDCs, such as hindering the mechanism for transmitting monetary policy and privacy and identity issues, there are also benefits that can be related to these issues. Studies contrast the capabilities of CBDCs with those of conventional money and other cryptocurrencies, weighing the benefits, drawbacks, and unique features of each. Citizens are also interested in comparing cryptocurrencies to digital currencies in general and the digital euro in particular. A noteworthy connection is seen between the terms CBDCs, ETH (Ethereum), and

Coinbase. People who are knowledgeable about finance and Coinbase and other cryptocurrencies occasionally compare CBDCs to other cryptocurrencies in their tweets. Central banks could take advantage of this by using phrases and cryptocurrencies that the public is already aware of to explain how the digital euro operates.

Key topics of interest for citizens surrounding CBDCs revolve around privacy and data security, technological control and transparency, equitable access to technology, digital inequities, and the role of the European Central Bank (ECB) in the euro and CBDC context. Investing in education and digital literacy is crucial to address digitization's problems and potential, helping people better understand and manage developing technology. The keyword analysis indicates several difficulties about the European Central Bank's (ECB) engagement in the euro and CBDC context, such as the future of the euro in the context of digital currencies, the function of traditional banks, and the geographical influence of digital currencies. The inclusion of the ECB demonstrates how closely talks are related to the eurozone's monetary policy organization, aligning with citizens' concerns. The author conducted a VOSviewer co-occurrence analysis of scientific articles to determine the pros and cons of Central Bank Digital Currencies (CBDCs) as presented in literature. The study found that there is a significant overlap between scientific literature and X, suggesting that the tweets were likely written by researchers, financial professionals, or well-informed citizens. However, the reliability of the data cannot be guaranteed due to the possibility of users inserting any socio-professional category without verification.

The study also identified the terms with the highest number of occurrences and connection strength of keywords within the analyzed tweets. Nouns and adjectives play a significant role, with adjectives providing descriptive value and altering the meaning conveyed by nouns. The term "euro" was the most frequent, at over 5% (5.76%), suggesting a strong interest and link between the common European currency and discussions about digital currencies. The impact of digitization on society prompts us to consider whether the technological future can unfold in multiple directions and whether the way society navigates this transformation hinges on decisions made today. Key issues to ponder include data privacy and security, technological control and transparency, equitable access to technology, legislation and regulation, and education and digital literacy. The research hypothesis that keywords such as "euro", "CBDC", and "digital" dominate online discussions suggests significant public interest and exploring citizens' perceptions and concerns about CBDCs and their implications for the euro and the European financial system. A

visual representation of the most used keywords is visible within the entire tweet dataset consisting of 4462 tweets.

The study of emotion on social networks aims to understand the attitudes and sentiments of users on Central Bank Digital Currencies (CBDC) implementation. The tweet analysis focused on CMC aimed to better comprehend the polarization that results from emotional discourse. The study found that citizens are mostly interested in subjects outlined in literature as being the pros and cons of CBDC implementation. Cons include privacy concerns, mass control of citizens, disappearance of cash payments, and too much central bank influence.

The pros of CBDCs relate to faster payment options, technological advancements, more privacy, and less money laundering. A sentiment study on CBDCs is pertinent given people's expectations and habits are changing from relying on cash payments to using digital ones. The analysis was conducted on a dataset of 4462 tweets, which were divided into three main categories: tweets (3228, corresponding to 72%), reply-type tweets (964, meaning 22%), and retweets (270, corresponding to 6%). Sentiment analysis for original tweets provides insight into how users directly share their thoughts, interact, and react to topics related to Central Bank Digital Currencies (CBDC), the euro, and their impact on the European financial system. The slightly positive sentiment suggests a level of interest or support for CBDC and euro currency discussions among X (ex-Twitter) users. However, the relatively large standard deviation of around 0.096 indicates significant variation in sentiment polarity, suggesting that there are also varying opinions or controversies in online discussions.

Sentiment analysis on the highest occurring keywords showed that words like "euro", "currency", and "cash" have a positive average sentiment, while words like "time", "future", "see", and "like" have a neutral average sentiment. This information is valuable in understanding the discussions and opinions expressed on X (ex-Twitter) about the introduction of digital currency by the European Central Bank and its impact on the European economy and financial system. The findings can provide important insights for decision making and policy development in this area, helping to address citizen concerns and ensure successful CBDC implementation. The sentiment distribution of original tweets is more consistent and less favorable than retweets and reply-type tweets. Retweets show a greater average sentiment and variability, suggesting people usually view retweeted information more favorably. Reply-type tweets exhibit the broadest variety of sentiment expression, indicating that replies encompass a wider diversity of responses and viewpoints.

The author created separate word clouds for tweets showcasing positive (violet), neutral (orange), and negative tweets (blue). All word clouds have the highest occurring words: cbdc, euro, digital, monitoring, payment, massive, without, and protest as additional very occurring keywords. The first three words are neutral in meaning, but depending on the context, their meaning can change. The importance of the context in which the words are used must be highlighted, as it is paramount to turn a tweet from a positive one into a negative one with just a twist of words. Sentiment analysis was carried out using a Roberta-base model calibrated for sentiment analysis using the TweetEval benchmark and trained on approximately 124 million tweets between January 2018 and December 2021. The full dataset of tweets (the translated version, meaning all of the tweets were written in English) was subjected to two distinct emotion identification models: a Roberta-based model and a BERT-based model. The Roberta-based emotion analysis identified 3852 tweets (out of 4462) as being neutral, followed by the sentiment expressing curiosity (217 tweets), approval (52 tweets), and confusion (50 tweets). The median emotion score was 0 for the lowest value and 1 for the highest value concerning the emotion identified in the tweet.

Upon comparison of the emotions identified using Roberta and BERT, it was found that Roberta identified 26 emotions in the dataset, while BERT identified 22 emotions. The number of tweets to which an emotion has been assigned greatly differs, with Roberta identifying a higher number of emotion types and less tweets as being neutral than BERT. The sentiment analysis of the data reveals that all three major types of sentiments (positive, negative, and neutral) are present in the dataset, with topics addressed by citizens similar to recent literature around CBDC implementation. The public discourse on X is dominated by a neutral attitude, with over 50% of tweets having a neutral sentiment. The discussion on central bank implication and control of CBDCs, as well as privacy and security concerns, expressing both positive and negative sentiment, is closely linked to the second research question.

The digital dialogue surrounding the digital euro and digital currencies is worth investigating and considering, as it can provide valuable insights and be integrated into the implementation and adoption action plan by central banks, policymakers, and parties involved in the digital euro project. The discussion mainly focuses on changes to traditional banking and financial frameworks, suggesting that digitization has the ability to disrupt old paradigms and represent a challenge to incumbent institutions. The ECB's prominent role and mentions suggest that the public understands the need of central banks in supervising financial sector reforms. Central banks should

foster understanding and ensure an inclusive transition in which citizens trust the process and support the changes to the financial and banking systems. It is crucial for citizens, policymakers, and industry to maintain an open dialogue about the opportunities and uncertainties surrounding digital currencies. Examining sentiment and emotions on social media sites like Twitter might reveal important information about how the general public views financial advances. Central banks could modify their communication tactics and foster increased trust in the digital financial future by thoroughly comprehending these viewpoints and worries, and by implementing novel marketing techniques, such as celebrity endorsement.

It is critical to understand how much of a payment option digital currencies serve for customers rather than becoming an investment. Bitcoin, initially intended as a decentralized currency, has experienced a significant price increase, leading to increased public interest and regulatory and financial industry scrutiny. The conversation around Bitcoin focused on users' usage of it as a means of investment and speculation, rather than replacing current financial institutions and payment methods. Central banks can use Bitcoin technology and learn from its history to successfully implement their digital currencies. Central banks often use marketing and communication strategies to manage macroeconomic monetary policy challenges. One of the main challenges in creating a modern central banking system is determining how central bank communication should effectively support the transmission mechanism for transmitting monetary policy, positively impacting commercial banks and increasing monetary policy efficacy. Unconventional monetary policy measures, such as central bank communication, are crucial and widely used.

This study contributes significantly to understanding the impact of digital currencies issued by central banks (CBDCs) on individuals' perceptions and behavior. The results of assessing attitudes and emotions stated on Twitter provide a nuanced picture of public opinion of these new digital money. It is suggested that public policymakers direct their attention from the primary benefits and drawbacks of CBDCs to the possible societal ramifications, emphasizing customers, their needs, and best interests while igniting a democratic discussion about the digital euro. The study highlights the significance of timely, precise, and succinct communication of the digital euro's features from a managerial standpoint. Digital currencies will be adopted more widely and implemented more quickly if central banks respond to public concerns.

Central Bank Digital Currencies (CBDCs) have been the subject of much discussion in recent

years, with one of their key advantages being the promotion of financial inclusion by offering CBDCs to citizens who would not otherwise have access to traditional banking services. However, tracking people's financial actions might also present privacy concerns, and many people, particularly the elderly and those who have historically used cash, may suffer as a result of adoption. Sentiment analysis can help central banks and policymakers spread the word about digital currencies and increase public awareness. Social media sentiment research can be a useful technique in the case of digital currencies issued by central banks and the digital euro, projects whose success hinges on citizens' adoption.

In the context of digitalization and the rapidly evolving landscape, this analysis aimed to offer a comprehensive overview of the various issues and concerns surrounding digital currencies and the European Central Bank's role in potentially issuing a digital euro. It is imperative to remain vigilant and informed regarding the ongoing discussions and emerging keywords that may shape the discourse on this critical subject matter. The study explores the perception and response of people towards the introduction of Digital Currencies (CBDCs), revealing generally positive approval but occasional divisive views. It emphasizes the importance of analyzing social media outlets and information to gather feedback and integrate results into strategic objectives. Central banks could focus on Bitcoin owners as forerunners of CBDC adoption, as they may start using digital payment methods if they become more widely accepted. The sentiment and co-occurrence analysis contribute to the research by highlighting that citizens express interest and distrust on the same topics as researchers, but use different language. This highlights the importance of language in sentiment expression, with nouns having the highest weight and can be leveraged by central banks in their communication strategies.

Policymakers and central banks can use this study as a basis for research on how to turn negative sentiment around and leverage positive sentiment to enhance its reach. They should also leverage social media tools, such as Twitter, which is one of the most popular social networks for sharing information and opinions. Twitter has grown in importance as a platform for sharing intimate information and providing a voice to celebrities.

From a managerial perspective, the study is relevant as it focuses on the digital euro as a type of digital currency, encompassing both sentiment analysis and keyword analysis, making the research comprehensive and offering guidance to central banks. Central banks can use the same language and communication channels as citizens to cater to their needs and create effective communication

strategies tailored to their concerns.

This study explores the public's perception of the digital euro through Twitter, focusing on end users' perspectives. However, limitations and prospects for future research include a lack of language-related comparison, a small data sample size, inability to perform location-based analysis and fine-tuning of results, identifying sentiments such as irony, and validating results by repeating the experiment with different sentiment analysis software.

The study found that Twitter extraction could not accurately identify each user's location due to users using VPNs, which could lead to inaccurate results. This limitation prevents comparisons by country of origin, as users do not always register their location. The data sample constraint is significant, suggesting that the results could be repeated with a larger data set and multiple languages spoken in Europe. Emotion analysis software like BERT and Roberta is only partially correct, resulting in differing emotions recognized by different software. Further investigation and analysis of these disparities could constitute the basis for further research. Alternative sentiment analysis software could have been used to compare results by program.

Future research could focus on extending the current analysis and contrasting public perceptions before and after the adoption of digital currency. The study also suggests that universities should engage with social media influencers, possibly from the crypto sector, to promote or glorify CBDCs. Further studies could also focus on comparing sentiments across different social media platforms, such as Facebook or LinkedIn. Topics citizens are interested in can also be considered for future research, focusing on CBDCs and the digital euro in the context of the green economy and the transition towards sustainability. Central banks need to adapt and use all channels they have at their disposal, making use of both traditional and modern techniques while innovating not only in terms of currencies but also in channels, language, and marketing techniques to meet the needs of today's and tomorrow's generations. Future research could also analyze the socio professional category of individuals posting on Twitter and correlating trust in central banks to the messages expressed.