

## THE EVOLUTION OF THE CENTRAL BANK'S POLICY ON CRYPTOCURRENCIES

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**Abstract.** In this article, we discuss the central banks' attitude to cryptocurrencies and focus more on European Central Bank. First, based on the analysis of scientific literature, we show that cryptocurrency is money and performs all of the functions of money, such as the exchange medium, value storage, and accounts unit. We found a positive correlation between the level of economic development of a country and the level of regulation and the integration of crypto cryptocurrencies into the economic system. We discuss not only the approach of the ECB to cryptocurrencies, but also how it developed. According to the study data, the ECB only began to respond to cryptocurrency as an equivalent monetary instrument in 2021, established regulatory mechanisms, and developed the digital euro project.

**Keywords:** Central banks, cryptocurrency, monetary policy, bitcoin, European central bank, ECB.

**JEL Classification:** E58, E00, E50.

### Introduction

Cryptocurrencies are becoming more widespread throughout the world (Laboure et al., 2021). They currently have a total market capitalization in US dollars of just over 1 trillion (CoinMarketCap, n.d.). Meanwhile, the number of US dollars in circulation in 2021 was just over 2 trillion (U.S. Currency Education Program, n.d.). So, we can see that this financial instrument is becoming an equal player in the financial markets in terms of the size of its issue and a genuine alternative to fiat money. For these reasons, central banks cannot stay on the sidelines and ignore cryptocurrencies, as this crypto-asset is directly linked to currency markets and influences the money supply, which can affect price stability and reduce the effectiveness of monetary policy (Claeys et al., 2018; Tomić et al., 2020). For these reasons, the stance of major central banks towards cryptocurrencies has evolved dramatically from complete non-intervention (ECB, 2015) to the emergence and eventual implementation of the idea of central bank digital currency (Burlon et al., 2022). We are currently witnessing a convergence of views among the major central banks (ECB, Fed, BIS) on what monetary policy and what controls should be in place for cryptocurrencies (Krivoruchko et al., 2018). The

position of the European central banks and other smaller central banks was assessed using the method of scientific literature analysis and by analyzing the working papers of these institutions as well as the statements of their representatives. The study established a link between a country's level of development in terms of its real GDP per capita and the level of acceptance and regulation of cryptocurrencies. Countries with lower levels of living are more likely to ban and eliminate cryptocurrencies from their economies, while countries with higher GDP per capita seek to integrate cryptocurrencies and create a regulatory environment. The creation of a regulatory environment increases the reliability of cryptocurrencies, which, in turn, increases their popularity and demand (Sauer, 2015).

The novelty of this paper lies in its comprehensive analysis of the monetary properties of cryptocurrencies, the evolution of policy on crypto-assets of European central banks, and the link between a country's level of development and the acceptance and regulation of cryptocurrencies. This paper also presents up-to-date information on the rapidly changing landscape of cryptocurrencies and their impact on the global financial system.

The aim of this paper is to analyze the monetary properties of cryptocurrencies and the evolving stance

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of major central banks toward them, with a focus on the European Central Bank. The goal is to provide insights into the potential impact of cryptocurrencies on monetary policy and the global financial system.

The limitations of this paper are as follows: first, only one central bank is studied, i.e., the ECB, while extending the scope of the study to include additional important monetary institutions such as the Bank of international settlements or the Federal Reserve. The paper also examines the relationship between the level of real GDP per capita of a country and the level of integration of cryptocurrencies into the country's economy. More economic factors could be included to establish a more detailed relationship.

This paper is further organized as follows: Section 2 analyzes the monetary properties of cryptocurrencies; Section 3 provides information on the central banks' approach and the level of regulation of cryptocurrencies; Section 4 devoted to investigate about the evolution of the ECB's monetary policy towards cryptocurrencies; Section 5 describes the evolution of the FED's monetary policy towards cryptocurrencies; and Section 6 presents the BIS's stance and how it has changed.

## 1. Monetary aspects of cryptocurrencies

### 1.1. Differences between Cryptocurrencies and fiat currencies

Cryptocurrencies have been studied in the academic world from various angles. They have also been studied to answer the question: are cryptocurrencies and other crypto-assets money (Mattke et al., 2020; Levulytė & Šapkauskienė, 2021; Shibano & Mogi, 2022)? Cryptocurrencies have a couple of distinguishing characteristics: the first is the decentralized governance of cryptocurrencies (Gervais et al., 2014; Lee, 2019; Gencer et al., 2018), the second is the lack of regulation and control (De Filippi, 2014; Shanaev et al., 2020; Li et al., 2019). The regulation aims to protect consumers to ensure safer transactions and to ensure that personal data are used by regulation, and regulation is particularly effective in combating money laundering and disabling economic and criminal activities. Regulation is thus beneficial to cryptocurrency users, society, and the overall economy (Sauer, 2015).

Cryptocurrencies differ from fiat currencies in that their value is defined by the fact that all market participants value them equally, i.e., it is assumed that all entities will use and value them. On the contrary, the value of fiat currencies is based on monetary policy and their legal status, and they must be accepted as means of payment (Umar et al., 2021; Jin et al., 2021). The fact that the value of cryptocurrencies is determined solely by the valuation of entities, which is not determined by the legal status of the currency, or that they are not pegged to real assets, provides a good explanation for the high volatility of cryptocurrency prices. Although some cryptocurrencies, including bitcoin, do not face a high risk of

inflation due to limited supply, the possibility of deflation remains high. There is also the question of whether crypto-assets fulfill the three essential monetary functions that most stable monetary systems would fulfill to protect against the risk of structural deflation, due to the ability of monetary policy to adjust to temporary shocks to the demand for money and to act as a lender-of-last-resort (Chenguel, 2023). In light of the above, the key question is: Is cryptocurrency money or not? Money must fulfil three characteristics: being a medium of exchange, a store of value, and a unit of account. The fulfilment of each of these characteristics by cryptocurrencies is described in more detail in the following subsections. In the following subsections, we will highlight the shortcomings of individual cryptocurrencies but show that the cryptocurrency market as a whole fit the definition of money perfectly. This in turn shows that cryptocurrencies have become an element of monetary policy and thus a headache and control element for central banks.

### 1.2. Cryptocurrencies as an exchange instrument

Baur et al. (2018) analyzed the properties of bitcoin using statistical methods and found that this cryptocurrency is not correlated with other asset classes such as bonds, stocks, or commodities. This lack of correlation is typical both in financially stable times and in volatile periods. The analysis of bitcoin account transaction data has shown that this cryptocurrency is mainly used as a speculative instrument rather than as a medium of exchange and an alternative to fiat currencies. Baur & Dimpfl, (2021) also investigated bitcoin price fluctuations. The study revealed that price fluctuations are almost 10 times stronger than those of the major currencies (US dollar to Euro and US dollar to yen). The results of this study suggest that bitcoins are not a suitable alternative to classic currencies and are not able to function as an exchange instrument. The results also showed that, on the theoretical basis and the deflationary design of bitcoin, in the long term this cryptocurrency performs as a store of value. Mattke et al. (2018) showed that the majority of individuals refuse to use bitcoins as a method of payment.

Therefore, from the above, it could be concluded that bitcoin does not meet the concept of a medium of exchange. However, the cryptocurrency ecosystem is much broader as there are thousands of other cryptocurrencies that have solved the shortcomings of bitcoin. These include stablecoins, whose price fluctuations are linked to one of the major currencies, usually the US dollar. Mattke et al. (2020) concluded that existing knowledge from research on Bitcoin cannot be directly transferred to the context of other cryptocurrencies, based on the abundance of cryptocurrency characteristics and the growing circulation of cryptocurrencies, it can be concluded that bitcoin lacks properties of a medium of exchange, but other cryptocurrencies I the shortcomings of it (Chenguel, 2023).

### 1.3. Cryptocurrencies as a store of value

In the cryptocurrency ecosystem, thousands of cryptocurrencies perform different functions, but a store of value is best performed by the main cryptocurrency bitcoin, which is not suitable as a medium of exchange but is well suited for this function due to its deflationary properties (Baur & Dimpfl, 2021). Cryptocurrencies are only a suitable store of value if their value increases over time. However, traditional value reserves, such as savings funds and life insurance, are also vulnerable to inflation risk and administration fees. The price of cryptocurrencies fluctuates dramatically regularly, so they are quite volatile as a reserve of value, but in the long term, they are a real reserve of value based on statistical data.

### 1.4. Cryptocurrencies as a unit of account

Bitcoin is currently not a suitable unit of account due to its high price volatility, but as market capitalization and the efficiency of the cryptocurrency markets increase, the price could become much more stable and bitcoin could become a suitable unit of account as these circumstances change. However, given the broad ecosystem of cryptocurrencies, it is possible to find cryptocurrencies that perform adequately as units of account. Currently, stablecoins, which are pegged to other units of value such as gold or other fiat currencies, are best suited for this function. Thus, despite all the imperfections inherent in individual cryptocurrencies, the cryptocurrency market as a whole has properties of a unit of account (Chenguel, 2023).

## 2. Central banks and cryptocurrencies

In the previous section, we argued that cryptocurrencies perform all the functions of money, i.e., cryptocurrencies are a private money alternative to the classical financial system. This private money entering the financial market can imbalance existing monetary and financial systems. As a result, central banks have begun to pay more attention to cryptocurrencies and their regulation. In this section, we will discuss in more detail the current attitudes and postures of monetary policymakers toward cryptocurrencies.

Annex 1 provides a table summarizing the cryptocurrency governance of the countries studied and the size of the real GDP per capita of the country concerned. The real GDP per capita of all countries (except Taiwan) was obtained from the World Bank database (World Bank, n.d.). Taiwan's GDP per capita data are from the Statista database (Statista, n.d.). Data on the level of regulation of countries were obtained by analyzing the scientific literature of (Krivoruchko et al., 2018) and (Chenguel, 2023).

In this table: *outlawed* – means that all transfers of cryptocurrencies are prohibited; *Partially outlawed* – means that the use of cryptocurrencies as a medium of exchange is prohibited, but the mining of cryptocurrencies as well as their use for speculative purposes are not

regulated in any way; *No regulation* – Cryptocurrencies do not have a legal environment and do not have a legal status of their own; *Partially regulated* – Cryptocurrencies are legal, including in the context of Initial coin offerings (ICOs), decentralized applications (Dapps), and smart contracts. Cryptocurrencies can be mined and traded and capital gains can be made. *Permitted (regulated)* – All cryptocurrency activities are strictly regulated exchanges must be registered in a dedicated registry, keep records for a set period, and take security measures to protect customers' data. According to Sauer (2015), regulation of cryptocurrencies and integration of them to the economic system increases stability and reduces the risk of cryptoassets, and makes them more attractive for the user, so the biggest increase in popularity and user count should be in the countries with a higher rate of regulation of the crypto market. There are five main ways central banks could regulate cryptocurrencies and integrate them into a country's economics: i) raise interest rates on crypto assets, central banks need to buy and sell many crypto assets; ii) central banks should seek to improve the default currency and make it a more stable account unit; iii) the Government Authority should regulate the use of crypto assets in order to prevent regulatory arbitration, and any unfair competitive advantage of crypto assets could be derived from simpler regulations; iv) , central banks should continue to attract funds as settlement mechanisms. For example, by issuing digital tokens to supplement physical cash and bank reserves, central bank money can be used in the digital world. The digital currency of such central banks can be exchanged in a decentralized manner, as well as crypto assets; v) the central bank's digital currency could help counteract the monopoly power of strong external networks to private payment networks. It could help individuals and small businesses with low or expensive access to banking services to reduce transaction costs and facilitate long-distance transactions.

Understanding the relationship between the level of GDP per capita and the regulation of cryptocurrencies can provide valuable insights for policymakers, investors, and the general public. For instance, it can shed light on the potential risks and benefits associated with cryptocurrencies, as well as the optimal level of regulatory oversight required to ensure their safe and effective use.

Additionally, the relationship between GDP per capita and cryptocurrency regulation is important from a global perspective. Countries with different levels of economic development may have different approaches to regulating cryptocurrencies, and understanding the factors that influence these approaches can help identify best practices and inform policy decisions.

From the data above, we can see that there is a correlation between a country's level of development and the level of acceptance and regulation of cryptocurrencies, i.e., countries with higher real GDP per capita tend to integrate cryptocurrencies into their economies by creating a regulatory environment that is suitable for them. In

contrast, countries with lower real GDP per capita tend to prohibit the use of cryptocurrencies altogether and eliminate them from their economic system. The data presented in Figure 1 are aggregate real GDP per capita data disaggregated by level of regulatory prohibition. This graph further illustrates the fact that richer countries are more likely to integrate cryptocurrencies into their economies.

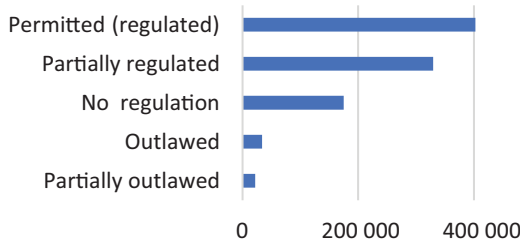


Figure 1. Sum of GDP per capita (2021) by Type of regulations (source: created by authors)

The classical Pearson correlation coefficient could not be used for the formal correlation estimation, as it has to be calculated using continuous data that would be normally distributed. In this case, the data are not continuous, but ranked, so the Spearman rank correlation was used to obtain the correlation coefficient, which was calculated using MS excel software according to the Eq. (1):

$$\rho_{Spearman} = 1 - 6 \frac{\sum_{i=1}^n d_i^2}{n(n^2 - 1)}, \quad (1)$$

where:  $\rho_{Spearman}$  – Spearman correlation coefficient;  $n$  – number of observations,  $d_i^2$  – squared differences of the rank of  $i$ -th observation.

To find out whether this correlation coefficient is statistically significant, the  $t$ -value of the correlation coefficient was calculated using the MS Excel software using the Eq. (2):

$$t = \rho \sqrt{\frac{n-2}{1-\rho^2}} \sim T(n-2), \quad (2)$$

where:  $t$  –  $t$ -statistics;  $n$  – number of observations,  $\rho$  – Spearman correlation coefficient;  $T$  –  $t$  distribution.

Table 1 shows the results of the calculations. We can see that the Spearman rank correlation coefficient is 0.609. This is quite a high value, more than twice the critical value of 0.25, which is considered in econometrics as the threshold value for the correlation coefficient.

Table 1.  $t$ -stat,  $p$ -value, and correlation coefficient (source: created by authors)

Name	Coefficient
Spearman rank correlation	0.609849906
Spearman $t$ -stat	4,743579773
Spearman $p$ -value	2,94787E-05

We can also see that the  $t$ -statistic is high, which results in a very low  $p$ -value (close to zero). These values indicate that the resulting correlation coefficient is statistically significant. It shows that there is correlation between the level of development of the country and the level of acceptance and regulation of cryptocurrency, i.e., countries with higher real GDP per capita tend to integrate crypto in their economies by creating a suitable regulatory environment. On the contrary, countries with low per capita real GDP tend to completely ban the use of cryptocurrencies and remove them from their economic system.

A multinomial logit regression method was used to establish a more detailed relationship between a country's real GDP per capita and the level of cryptocurrency control. This method was chosen because in this case the dependent variable is not continuous, but nominal, and therefore a conventional least squares regression would not be appropriate. Nor would the binomial logit regression method be appropriate, since in this case there are five outcomes rather than two.

Multinomial Logit Regression (MLR) is a statistical method for analyzing the relationship between multiple-level categorical variables and multiple independent variables. In this method, dependent variables are modelled as independent variable functions using odds ratio logarithms, and then converted to probabilities.

The model can be expressed using the following formula:

$$\ln [P(Y = 1)/P(Y = K)] = \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p;$$

$$\ln [P(Y = 2)/P(Y = K)] = \gamma_1 X_1 + \gamma_2 X_2 + \dots + \gamma_p X_p;$$

where  $Y$  is the categorical dependent variable with  $K$  categories,  $X_1, X_2, \dots, X_p$  are the independent variables,  $\beta_1, \beta_2, \dots, \beta_p$  and  $\gamma_1, \gamma_2, \dots, \gamma_p$  are the coefficients associated with the independent variables for each level of the dependent variable.

The Maximum Likelihood Estimation Method were used to estimate the coefficient of the model and provides direction and strength information about the relationship between independent variables and dependent variables. The model's good fit can we evaluated by probability ratio test and McFadden R2.

All calculations were carried out using the R software environment, the mlogit library package.

Annex 2 is a table showing the results of the polynomial logit regression. We can see that one type of control is missing, i.e., "No regulation". This is because this category was chosen as the reference category. The reason for this choice is that this category indicates the absence of regulation, so it is very convenient to assess whether the integration of cryptocurrencies increases with the increase in the level of GDP, and vice versa whether the stricter attitude towards cryptocurrencies increases with the decrease in the level of GDP. The second reason for choosing "No regulation" as the reference category is that it is one of the most populated categories.

The regression results confirm the results of the correlation analysis. We can see that the probability that a country will comply with the “Partially regulated” type of regulation is higher as the level of GDP per capita increases than the reference category, i.e., “No regulation”, and the probability that a country will comply with the “Permitted” category is even higher than the probability that it will comply with the “Partially regulated” category. We also find that the probability that a country will comply with the “Partially outlawed” type as the level of GDP per capita increases is lower than the reference category, while the probability that it will comply with the “Outlawed” category is even lower than the probability that it will comply with the “Partially outlawed” category. It is also worth noting that many of the coefficients are insignificant, but the likelihood ratio test shows that the overall significance of the regression is very high, that is, the  $p$ -value is less than 1%.

#### 4. The evolution of policy on crypto-assets of the European Central Bank

The ECB's changing attitude towards cryptocurrencies is another important aspect of this study. To enable us to correctly assess changes in the ECB's policy towards cryptocurrencies. We have chosen to analyze ECB annual reports and documents that are related to cryptocurrencies, virtual currencies, or digital currencies and to which these reports refer. The study period is from 2009 to 2021, and a total of 13 ECB annual reports and five related documents are analyzed. This time frame has been chosen to cover the period from the emergence of cryptocurrencies to the last annual report issued. This research design was chosen to maintain the integrity of the study, that is, to ensure that all institutions surveyed are treated similarly.

The first mention appears even in a 2012 report, which states that a virtual currency scheme has been formed (ECB, 2012). This document provides for the first time a definition of virtual currencies “a virtual currency is a type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community” (ECB, 2012a). This paper does not refer to the relationship between cryptocurrencies and monetary policy. Virtual currencies are referred to as a phenomenon of interest only to members of a small closed community, but not as a real alternative to money. Only one cryptocurrency is mentioned, bitcoin, and it is compared to virtual video game money. At this stage, the ECB not only does not express any concern about this new phenomenon, but is not even looking at it as a real financial instrument, but rather as an interesting technological novelty.

Virtual currencies are mentioned for the second time three years later in the 2015 Annual Report. It mentions the establishment of an expanded virtual currency scheme (ECB, 2015). This paper analyses three main

aspects: i) payment-related aspects of virtual currency schemes; ii) a closer look at virtual currency schemes from a central bank perspective; iii) legislative and regulatory measures related to virtual currency schemes. The report states that the ECB does not consider cryptocurrencies to be full-fledged forms of money, as defined in the economic literature. The ECB also does not consider them to be money or currency from a legal point of view and recognizes that cryptocurrencies can be used as an alternative to money in certain circumstances (ECB, 2015b). At that time, the virtual currency system was not as developed as it is now. At present, the ECB does not yet see any risks associated with virtual currencies, apart from the fact that frustration with cryptocurrencies could spill over into other areas of the digital economy, to their detriment. The ECB has no plans to regulate virtual currencies in any way.

In 2017, the possibility of creating an ECB virtual currency is starting to be discussed. The impact of distributed ledger technology (DLT) on Europe's financial market infrastructure has been investigated. The ECB's in-house fintech group is monitoring analytical work on a possible digital representation of cash. At the Eurosystem level, work is also being carried out to understand the potential impact of fintech on payments, supervisory activities, implementation of monetary policies, and financial risk. Environmental concerns are also raised about the high electricity consumption compared to other means of money transfer. The ECB views cryptocurrencies as value transfer instruments with high speculative risk (ECB, 2017).

In 2018, the ECB presented the paper “Virtual currencies and central banks' monetary policy: challenges ahead”(ECB, 2018), which explored the impact of cryptocurrencies on the financial system in depth and for the first time suggested that virtual currencies could abolish the central bank's monopoly as a money issuer. This work also recognizes that virtual currencies are private money. However, it is still argued that their transactional role will remain limited and that they will mainly fulfill a third monetary function, that of value storage, i.e., they will serve as one of many investment functions. It is also argued that central banks are unlikely to recognize them as official legal tender, but the question of market acceptance remains open and the rapid development of bitcoins and other major cryptocurrencies around the world suggests that this could happen. It is recommended that regulators treat cryptocurrency settlements as any other financial transaction or instrument, that is, in proportion to their market importance, complexity, and associated risks. Given their global and cross-border nature, it is recommended that the rules relating to venture capital firms be harmonized across jurisdictions. Investments in venture capital firms should be taxed similarly to investments in other financial assets (Dabrowski & Janikowski, 2018). Therefore, we see that in 2018 the ECB finally recognizes cryptocurrencies as money.

In early 2019, the ECB's Directorate General for Statistics developed an internal cryptocurrency data set and defined a set of indicators based primarily on publicly available aggregated data. This data set and the indicator set became the ECB's entry point for monitoring the cryptocurrency phenomenon, following quality checks, and supplemented by other data from commercial sources (Boumghar et al., 2019; ECB Crypto-Assets Task Force, 2019). Using big data technologies, the ECB was able to develop an automated set of procedures for collecting, managing, and integrating multiple cryptocurrency datasets. An important component of this work is the investigation of the statistical classification of crypto assets. As in previous annual reports, this one also warns of the volatility of cryptocurrency prices and the risks associated with them. It discusses central banks' virtual currencies and the potential for integrating them into financial systems (ECB, 2019). The 2019 Annual Report focuses on cryptocurrencies to a much greater extent than in previous years' reports.

In 2020, the ECB also continued its analysis of cryptocurrencies, focusing on the impact of stablecoins issued by the private sector on monetary policy, financial stability, market infrastructure and payments, and banking supervision. In light of this analysis, the ECB aims to develop and implement a comprehensive policy response to mitigate the potential negative impact of stablecoins on payments and the financial environment in the EU, while allowing credible initiatives to benefit European consumers and businesses. A public consultation on the digital euro was launched in October 2020 to gather views from the general public and practitioners and to ensure that any new form of money and payments that the Eurosystem may propose remains firmly anchored in public trust. At the same time, the Eurosystem is continuing its exploratory work, including the experimentation of technical solutions (ECB, 2020).

Finally, in 2021, the ECB decided on the need to regulate cryptocurrency-related activities and decided to develop regulations on cryptocurrencies and stablecoins. In response to the European Commission's proposed regulation on markets for cryptocurrencies, the ECB published an opinion proposing to clarify and strengthen certain prudential requirements and the role of the ECB and other important members of the European System of Central Banks. The ECB's opinion warned against the use of certain types of stablecoin for payment purposes. It advocated for strengthening the prudential requirements for issuers of stablecoins by imposing stress testing and liquidity requirements at least as stringent as those in the money market funds regulation. The ECB has also called for EU-wide supervision to ensure a comprehensive risk assessment and to avoid fragmentation given the cross-border nature of cryptocurrencies and stablecoins. For its part, the ECB has started digitising the euro. The Governing Council launched a 24-month study phase on a possible digital euro project. During the design phase, the Eurosystem will focus on a possible functional design

for the digital Euro that is based on user needs, while at the same time helping to prevent illicit activities and avoiding any negative impact on financial stability and monetary policy (ECB, 2021).

In this section, we have described how the ECB's approach to cryptocurrencies is evolving. Cryptocurrencies were first mentioned in 2012, but at the time they were considered a very narrow phenomenon. In 2017, the market capitalization of cryptocurrencies increased dramatically and the possibility of an ECB virtual currency started to be discussed. The ECB only began to pay more attention to cryptocurrencies and their analysis and regulation in 2019 and did not begin to develop real regulatory mechanisms until 2021 when the market capitalization of cryptocurrencies reached 2 trillion in US dollars. Also in 2021, the research phase of the digital euro project started. We can see, therefore, that the ECB has tried for years to ignore cryptocurrencies and has only dealt with warnings about the risks of cryptocurrencies, but realizing that cryptocurrencies can break the monopoly of central bank functions, it has not only started to develop regulatory mechanisms for virtual currencies in recent years but has also started to develop its cryptocurrency, the digital Euro.

Since then, the ECB's position on crypto-assets has evolved, reflecting the growing importance of these assets in the financial system. One of the key concerns for the ECB has been the potential impact of crypto-assets on financial stability. Scholars (Hermans et al., 2022) have argued that crypto-assets pose a systemic risk to financial stability, particularly if they become a substitute for fiat currency. They noted that the lack of regulation and oversight in the crypto-assets market could lead to price volatility and contagion effects, which could spill over into the wider financial system. However, not all scholars share this view. For example, (Manaa et al., 2019) argued that the potential benefits of crypto-assets, particularly in terms of financial inclusion and privacy, outweigh the risks posed by these assets. They suggested that policymakers should adopt a balanced approach that seeks to mitigate the risks while also promoting the potential benefits of crypto-assets.

## Conclusions

In this article, we have discussed the attitude of central banks towards cryptocurrencies, focusing mainly on the European Central Bank. This research consisted of several phases. Firstly, based on an analysis of the academic literature, we have shown that cryptocurrencies as whole have properties of medium of exchange, store of value, and unit of account. We found a positive correlation between a country's level of economic development and the level of regulation and integration of cryptocurrencies into the economic system. We discuss not only what the ECB's approach to cryptocurrencies is, but also how it will evolve. According to the data obtained in the study, it was only in 2021 that the ECB started to react

to cryptocurrencies as an equivalent monetary instrument and created a regulatory mechanism, and started to develop the Digital Euro project. Until then, the ECB has only played the role of an alert observer. However, as cryptocurrencies reached very high levels of capitalization and turnover, central banks had to deal with the problem of how to maintain the effectiveness of the monetary policy. They achieve this in five ways.

First, raise interest rates on crypto assets, central banks need to buy and sell many crypto assets.

Secondly, central banks should seek to improve the default currency and make it a more stable account unit. The independence of central banks supports modern monetary policy based on the wisdom and expertise of members of the Committee on Financial Policy, which provides the best hope for maintaining a stable balance sheet. Central banks also benefit from financial policy formulation technologies: large-scale data, artificial intelligence, and machine learning can improve economic forecasts.

Thirdly, the Government Authority should regulate the use of crypto assets in order to prevent regulatory arbitration, and any unfair competitive advantage of crypto assets could be derived from simpler regulations. This includes strict measures to prevent money laundering and funding terrorism, strengthen consumer protection and effectively tax crypto transactions.

Fourthly, central banks should continue to attract funds as settlement mechanisms. For example, by issuing digital tokens to supplement physical cash and bank reserves, central bank money can be used in the digital world. The digital currency of such central banks can be exchanged in a decentralized manner, as well as crypto assets.

Fifthly, the central bank's digital currency could help counteract the monopoly power of strong external networks to private payment networks. It could help individuals and small businesses with low or expensive access to banking services to reduce transaction costs and facilitate long-distance transactions. Unlike cash, digital currencies are not limited by their number of coins. From the point of view of monetary policy, when demand for reserves declines, central banks transmit policy interest rates to other economies by using digital currencies carrying interest rates. The use of these currencies will also help central banks to generate income from currency issuance and to continue financing their activities and distributing profits to governments.

In the digital era, central banks face both challenges and opportunities. Central banks must maintain public confidence in decentralized financial currencies and play in digital, shared, and decentralized service economies. It can be more stable than crypto assets and can remain relevant as a means of exchange in the digital economy by making central bank money attractive.

## Disclosure statement

Authors have any competing financial, professional, or personal interests from other parties.

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## APPENDIX 1

Type of regulation by country and real GDP per capita

Country	Type of Regulations <sup>1</sup>	GDP per Capita (2021) <sup>2</sup>
Luxemburg	Partial permission	133 590
Switzerland	Permitted (regulated)	91 911
USA	Permitted (regulated)	70 248
Israel	Permitted (regulated)	52 170
Canada	Permitted (regulated)	51 988
Germany	Partially regulated	51 203
Hong Kong	No regulation	49 800
New Zealand	Permitted (regulated)	48 781

Country	Type of Regulations <sup>1</sup>	GDP per Capita (2021) <sup>2</sup>
United Kingdom	No regulation	46 510
United Arab Emirates	Partially regulated	44 315
France	No regulation	43 659
Japan	Permitted (regulated)	39 312
Taiwan <sup>3</sup>	Partially regulated	33 143
Estonia	Partially regulated	27 943
Czech Republic	Permitted (regulated)	26 821

<sup>1</sup> Data by (Krivoruchko et al., 2018) and (Chenguel, 2023)

<sup>2</sup> World bank data (World Bank, n.d.)

<sup>3</sup> Taiwan GDP per capita retrieved from the Statista database (Statista, n.d.)



*Continued Appendix I*

*End of Appendix I*

Country	Type of Regulations <sup>1</sup>	GDP per Capita (2021) <sup>2</sup>
Slovakia	Permitted (regulated)	21 392
China	Partially outlawed	12 556
Russia	Partially regulated	12 194
Malaysia	Outlawed	11 109
Kazakhstan	No regulation	10 373
Brazil	No regulation	7507
Belarus	No regulation	7303
Thailand	Partially regulated	7066
South Africa	Partially regulated	7055
Ecuador	Partially regulated	5965
Namibia	Outlawed	4866
Ukraine	Partially regulated	4835
Indonesia	Outlawed	4332

Country	Type of Regulations <sup>1</sup>	GDP per Capita (2021) <sup>2</sup>
Jordan	Outlawed	4103
Iran	Partially outlawed	4091
Vietnam	No regulation	3756
Egypt	Outlawed	3699
Algeria	No, any regulation	3690
Philippines	Outlawed	3460
Bolivia	Partially outlawed	3345
Bangladesh	No regulation	2457
India	Outlawed	2256
Nigeria	Partially outlawed	2065
Kirgizstan	Outlawed	1277
Nepal	Outlawed	1208

**APPENDIX 2**

Results of multinomial logit regression	
	Dependent variable:
	type
(Intercept): Partially outlawed	0.296 (0.953)
(Intercept): Outlawed	1.502 (0.944)
(Intercept): Partially regulated	-0.302 (0.670)
(Intercept): Permitted	-1.434* (0.852)
gdp: Partially outlawed	-0.0001 (0.0001)
gdp: Outlawed	-0.0002 (0.0002)
gdp: Partially regulated	0.00002 (0.00002)
gdp: Permitted	0.00004* (0.00002)
Observations	40
R <sup>2</sup>	0.175
Log Likelihood	-51.644
LR Test	21.886*** (df = 8)

Note: \* p \*\* p \*\*\* p<0.01