e-CNY and Digital Economy in China

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Abstract: This paper highlights the inescapable trend of digital currency growth by examining past currency patterns, and explores the ties between digital currency and the digital economy. With the case of China, this paper forecasts the future improvement pattern of digital money. In the midst of the fast growth of private cryptocurrencies, China developed the digital currency with the goal of serving the digital economy and committing to the globalization of the digital renminbi and the digital economy. While Europe and the United States were experiencing continued stagnation in 2022, China has entered the cycle of loose monetary and fiscal policy. China views digital fiat money and digital economic development as a breakthrough to drive the transformation of the current economic system, new inventive growth, and the safety of the whole supply chain in the context of the scissors gap. It has become one of the forefront countries in the digital field, with numerous experiences that can be learned by countries around the world. This paper also creates the concept and calculation formula of the e-CNY Index, sets the year 2022 as the first year of the e-CNY with the initial value of the index at 100; it also gives suggestions for creating and calculating the China-style Digital Economy Index. The importance of these indices as new tools for tracking and evaluating the digital macroeconomy in China is presented, providing a promising direction for future in-depth research on digital fiat currency.

Key words: e-CNY; digital economy; globalisation
INTRODUCTION

With the huge transformation of the global economy from industrialization to digitalization, countries are actively laying out the digital economy and digital currency. The digital economy has become a new engine of economic growth and has put forward the requirements of a new era for economic development and industrial transformation. Private digital currencies have become more and more popular over the years, coin speculation has become a popular behaviour, and official digital fiat currencies are constantly on the agenda. China is at the forefront of the world in the development and application of digital fiat currencies, as well as in combining the great trend of digital economy transformation. Especially in the uncertain year of 2022, China's e-CNY has become the focus of digital currency and the two-way amplification effect of digital currency and digital economy development is gradually emerging. Specifically, Digital renminbi (RMB) or Electronic Chinese Yuan (e-CNY) or Digital Currency Electronic Payment (DCEP) is a central bank digital currency issued by China's central bank, the People's Bank of China (Xu, 2022). The purpose of this paper is to provide a comprehensive explanation of the development of e-CNY and digital economy based on the logic from concept to formula model, providing promising directions for more research workers.

1. Chinese Currency in The History of Money

The history of the development of money shows that money has gradually evolved from physical money to credit money (Ingham, 1998). In the early days, physical money acted as a medium of exchange and performed the monetary function of a measure of value by virtue of its scarcity, portability, and storage resistance, which improved the efficiency of economic activities and freed them from the restriction of the single transaction mode of barter. With the advancement of smelting technology and the establishment of state power, money completed the transformation from physical money to metallic money and shifted from full-value metallic money to under-value metallic money. The credit attributes of legal tender were initially developed at this point. However, the actual supply of metallic money was constrained by mining and refining technology and scale, which was difficult to match the growth of tradable social wealth, easily causing deflation and ‘wastage of metal in minting coins’ speculation, and even triggering monetary imbalance and war between different countries.

Along with the advancement of paper-making technology and the increase of national sovereignty, paper money secured by sovereign credit was created (Kahaner, 1997). Money was separated from metal value and transformed into a reference for social wealth, becoming a pure value symbol to facilitate sovereign states to issue legal tender based on the total amount of tradable wealth in society. Driven by the dual factors of the credit money system and several technological revolutions leading to productivity progress, the total amount of social assets and the total wealth of society denominated in money increased by leaps and bounds. Even so, in terms of anti-counterfeiting and durability, credit banknotes also require a lot of resources and technologies to process and modify the paper, resulting in a certain manufacturing cost.
With a huge number of bases, this manufacturing cost becomes very large. Small coin minting, on the other hand, requires materials such as aluminium-magnesium alloy, stainless steel, nickel-plated steel cores, and copper-plated steel cores, which are even more costly than paper money.

In addition, the cost of transporting and storing physical cash in commercial banks and other institutions is also quite high. Due to the high cost and the considerations of banknote carrying and anti-theft and anti-counterfeiting, the process of making electronic money and digital money has been accelerated. Today, electronic money has developed by leaps and bounds. People can use various payment methods, such as PayPal, Apple Pay, Alipay, and so on, to make transactions. Cryptocurrencies such as Bitcoin and Libra have also been widely circulated. China is the first country to launch a digital legal currency, and it is also the only country that has experienced the evolution history of full currency from physical money, metallic money, to e-money and digital money.

Electronic currency and digital currency have strong similarities, but it should be noted that digital currency is a currency created based on digital technology and can realise the function of currency in a specific digital field, while electronic currency usually refers to the electronic presentation of legal currency, such as the display of currency balances and the electronic operation form of transfer and collection in the mobile banking of commercial banks. To sum up, electronic currency is essentially an electronic presentation of legal tender, while digital money is essentially a digital programme blockchain code that is recognised and used in a certain domain category. While electronic money cannot be transferred offline, e-CNY can be transferred in an offline state of both parties through APP with chips solving hidden trouble. This realises the function of hard currency.

2. Status Quo of Global Digital Legal Currency

According to the Bank for International Settlements (BIS) data, all major economies are actively laying out the research and development of digital currencies. About 86% of the central banks in 65 countries or economies have already conducted research on digital currencies, and the number of central banks conducting experiments or proof-of-concept has increased from 42% in 2019 to 62% in 2020. According to public information, the central banks of the US, UK, France, Canada, Sweden, Japan, Russia, South Korea, Singapore and the European Central Bank have announced their considerations and plans for digital currencies in recent years, and some have started or even completed joint testing across borders and continents, such as the sandbox testing of digital currency interoperability seamlessly in Singapore in cooperation with the UK. Although different countries are looking at digital currencies in different directions, some focusing on the wholesale type for large trade and some on the retail type for small-value consumption, the underlying logic of digital fiat currencies is the same. They are all designed to counter digital currencies issued by the private sector or digital fiat currencies of other sovereign countries. When a country's sovereignty loses control over the currency in circulation (including digital
currency), its sovereignty will be seriously threatened, which is unacceptable and intolerable at the level of state power (Goodman, 2019).

At present, there are three main attitudes towards digital currency in the world: active promotion in countries such as China and Europe; a wait-and-see review in the United States; and firm rejection by a few countries. Although China actively promotes digital currency, it only recognises e-CNY, and all other private digital currencies are not legally recognised. The United States’ attitude is also evolving under scrutiny, and the concept of a digital dollar was proposed in early 2022 in a change of pace, reflecting the rich theoretical experience the U.S. government has accumulated in the development of the digital dollar from the wild exploration of private digital currency. Financial authorities in Europe and the United States, as well as Japan and Singapore, have embarked on the exploration of joint digital currencies, demonstrating that these countries are not only exploring the technical means of digital fiat money but are also attempting to achieve a barrier-free cross-border circulation of international digital fiat money, or even a digital fiat currency that is recognised worldwide. From the study *Central bank digital currencies: foundational principles and core features* released by the Bank for International Settlements on October 9, 2020, which was jointly researched and completed by the Bank of Canada, European Central Bank, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England and the Board of Governors of the Federal Reserve System, the development trends of the world digital fiat currency alliance are beginning to emerge.

Although capitalist and socialist countries have different ideologies, they both seek a digital legal currency solution for mutual integration in the economic field. The future world will develop into a two-level or even multi-level universal digital currency structure. Perhaps in the infinitely distant future, the final competition outcome of the digital legal currencies of various countries may be end-up as a digital super currency, which would be calculated by a package of digital currencies of countries in the world with reference to their national strength, which is the most scientific and fair digital currency that dynamically adjusts and changes with the contribution rate of each country to the world economic development.

In the current global financial environment, the euro shows increasing potential to overtake the dominant currency status of the US dollar. As the membership of the EU expands further, the popularity of the euro continues to catch up with the U.S. dollar. The Russia-Ukraine war in 2022 changes the relationship between Europe and the United States from Trump's tariff confrontation to Biden's full solidarity, providing a good political background for the euro to expand its international influence. Although the US Federal Reserve’s constant rate hikes have had a devaluation impact on currencies other than the US dollar in the short term, the euro is bound to be more influential than ever in the non-US dollar currency system later.

Significantly different from Europe and the United States, China's central bank established a digital legal
currency research group as early as 2014 (Chorzempa, 2021). Today, the e-CNY is relatively mature and has been promoted in three pilots, expanding its application scenarios and scope. In December 2020, the Central Bank Digital Research Institute and UnionPay launched business cooperation to jointly study innovative applications in online and offline payment scenarios and other fields, solve technical problems such as double-spending, and realise the application scenarios of e-CNY for daily bill payment, food delivery service, shopping and consumption, and e-government, etc.

The People's Bank of China (PBoC) has released a digital version of legal tender known as E-CNY, which is also called DCEP. It is traded for the public by designated entities such as commercial banks. It supports loosely-coupled account linkage and offline payment functions based on a generic account structure. It is equivalent to banknotes and coins and introduces some innovative features like blockchain and smart contracts to support controlled anonymity. The DCEP implements the "one currency, two repositories, and three centres" operating structure and the "central bank & commercial bank" dual issuance model. It is positioned as the M0, and its expectation is to act as and replace part of the cash in circulation, especially the annual natural incremental use of cash. According to China's central bank statistics from the end of 2016 to the end of 2021, the M0 balance was RMB 6.83 trillion, RMB 7.06 trillion, RMB 7.32 trillion, RMB 7.72 trillion, RMB 8.43 trillion and 9.08 trillion respectively, continuing to grow. The design of the use of e-CNY is also delicate. The requirements for the small value consumption demand side maintain a zero-threshold attitude, and even people without Chinese nationality can apply for and use e-CNY. From the perspective of large-value transactions, company verification and qualification verification are required for users, and different rule requirements and conveniences are given for different flow amounts.

The DCEP is built on blockchain technology and overcomes blockchain's typical disadvantages. The stored transaction information on the blockchain is publicly distributed (Trump et al., 2018), and the blockchain information is continuously added as transactions occur, constituting an increasingly long chain of digital codes, overlaid with mathematical function formulas for encryption, which is currently considered one of the most secure technologies. However, it is unable to support high-speed and high-frequency mass transactions due to the possibility of privacy leakage by making transaction information public as well as the distributed and large number of calculations to be performed for each encryption. Obviously, it is contrary to the nature of money, which was created to facilitate transactions. These are the problems that e-CNY needs to solve urgently. Under the unified top-level design rules, combined with the advantages of blockchain, the central bank adopts a centralised computing method to achieve controllable anonymity and high-speed computing with innovative technologies such as asymmetric encryption, traceability, and smart contracts coupled with blockchain technology, which perfectly solves the above problems. It lays the technical foundation for the expansion of DCEP. For example, the e-CNY retains the centralised technical characteristics, which can greatly improve the transaction efficiency, reaching a processing capacity of 300,000 transactions per second, while the decentralised Bitcoin Alliance platform can only process about 7 transactions per second, which cannot meet the demand for the essential functions of currency.
3. Liquidity Analysis of e-CNY to The Money Market

The money market liquidity can be divided into three dimensions:

(1) Narrow liquidity, which reflects the amount of available funds in the banking system, represents the liquidity situation in the overall money market and is the starting point of liquidity transmission.

(2) Broad liquidity, which reflects the liquidity situation of the corporate/personal/non-bank entities, represents the liquidity of the entire real economy.

(3) Financial liquidity, reflecting the situation of the funding surface used to allocate financial assets such as stocks and bonds.

Financial liquidity is the most special and is usually characterised by asymmetric flows in both directions. For example, after the vast majority of retail investors convert their cash into equity assets, whether at a profit or a loss, their stock market funds are realised as M0, which is usually not used for consumption, but for reinvestment or long-term savings. This liquidity preference has resulted in a positive M0 to M2 differential. At the same time, stock market funds do not afford the credit multiplier amplification effect, so the M0 funds growth rate is the source of the rising stock market. Without considering the particular point in time when financing and sharing out bonus in the stock market, the vast majority of the time the cash taken up by speculative transactions in the stock market and other financial markets is what could have been involved in the amplifying effect of the money multiplier on the development of the real economy, and excessive speculation in the stock market is very damaging to the development of the real economy. Changes in the liquidity of financial asset markets have therefore become an area of regulatory focus (Gongol and Vodová, 2014).

![Three Dimensions of Liquidity](image)

Figure 1: Three Dimensionality of E-CNY’s Liquidity

People's Bank of China is at the centre of the e-CNY operation system, responsible for issuing e-CNY to commercial banks and managing the entire life cycle, while designated operators and related commercial institutions are responsible for providing e-CNY exchange and circulation services to the public, completing the "two-tier management".
The DCEP is distributed to the market through the "central bank-commercial bank" channel in three dimensions of liquidity and can be accurately issued and tracked through technical means, which plays a role of precise execution and real-time feedback on the central bank's monetary policy, financial policy, and fiscal policy. These are unattainable with paper money.

The DCEP, a new macro-control currency tool, is of great significance. Based on digital technology and big data, the central bank can track and monitor all e-CNY issued in real time, count the total amount and structure of currency in real time, and provide data support for the formulation of monetary policy. At the same time, through the use of blockchain smart contract technology, the central bank can set effective conditions such as time, quantity, and investment direction in advance in the process of placing DCEP, so as to achieve traceability, programmability, and even set specific effective time-limited rules to enable monetary policy regulation more direct, precise and effective. The flow of digital currency can also be known throughout the process, and accurate statistics can be realised for the value chain of the whole industry, which can be used as the basis for the further adjustment of monetary and fiscal policies. Reserve requirements, the discount rate, and open market operations are tools of traditional monetary policy instruments, which influence the pace of macroeconomic development by adjusting the market demand for money. However, the statistics of market currencies often have a certain error rate, and DCEP can provide more accurate data, avoiding the liquidity trap of "a shift of focus from the real economy to the virtual economy" and potential resistance by human factors to counter-cyclical regulation.

From a microscopic point of view, the DCEP will bring technological innovation to the identity authentication methods of commercial banks and payment institutions (Zou and others, 2021), thereby improving payment efficiency and operational credit efficiency, reducing currency manufacturing costs and use costs, decreasing the likelihood of corruption and other delicts, and optimising anti-money laundering systems. Furthermore, it will also have a positive impact on commercial banks' payment and settlement, business processing, operating costs, compliance and service quality, facilitating the realisation of inclusive financing, lowering social financing costs and thresholds, reducing the risk of bad and doubtful debts, and greatly enhancing the financial environment in China's digital economy. These advantages and experiences can be directly extended and replicated in the implementation of digital legal tender in other countries.

4. Three Stages of e-CNY Development

From a development perspective, the development of e-CNY generally goes through three main stages. The first stage is the infrastructure construction, top-level design, and pilot tests of e-CNY, and China has basically completed the main tasks of the first period. Stage two is the expansion of e-CNY in China's internal circulation and consumption, as well as testing the effect of the central bank's monetary control
policy on e-CNY issuance and the impact of e-CNY on the paper money system, and even using the negative interest rates and other unused monetary tools to enhance regulation. The third stage will focus on the globalisation and internationalisation of e-CNY to match China's national power and economic development level. All three stages will keep pace with the development of China's digital technology. E-CNY serves and is supported by digital technology. China will improve its own digital economy system internally, replicate and expand this model externally, and gradually internationalise the e-CNY.

Likewise, laws and regulations, as well as international agreements and contracts, will be synchronised with the development of e-CNY. The widespread circulation of e-CNY will require a reworking of existing legal provisions on fiat money. In the Law of the People's Republic of China on the People's Bank of China and the Regulation of the People's Republic of China on the Administration of Renminbi, the scope of fiat currency will be expanded from banknotes to banknotes and e-CNY. Besides, the internationalisation of the e-CNY also requires safeguards in the form of multilateral agreements and contracts from partner countries, international cooperation in the form of signing or acceding to treaties, conventions or agreements, and strengthened legal regulation of cross-border payments of the e-CNY. With the weakening of the US dollar’s dominance, more and more countries are seeking and accepting new settlement methods. In particular, the export pricing, trading, and exchange listing of petroleum, new energy, heavy metals, and Chinese specialty commodities are the main application areas for the internationalisation of e-CNY. Since 2009, China has signed bilateral local currency swap agreements with a number of countries, including Malaysia, Belarus, South Korea, Iceland, and Singapore, established the RMB Qualified Foreign Institutional Investor (RQFII) pilot and continuously expanded the quota to more countries. This is a successful experience in the internationalisation of RMB banknotes, which provides important support and inspiration for the future internationalisation of e-CNY. In 2021, the People's Bank of China has made it clear that it will actively participate in multilateral exchanges with international organisations such as the Financial Stability Board (FSB), the Bank for International Settlements (BIS), the International Monetary Fund (IMF) and the World Bank (WB); respond to the initiatives of international organisations such as the Group of Twenty (G20) to improve cross-border payments and conduct research regarding the applicability of the central bank's digital currency in cross-border areas. It also follows the three requirements of "harmless", "compliance" and "interconnectivity" to gradually promote the nationalisation process of e-CNY.

As of now, e-CNY is in the transition stage from Stage 1 to Stage 2. The promotion of e-CNY requires the support of application channels and scenarios. As a fiat currency, it should be unconditionally accepted within the scope of national sovereignty, and its digital nature also means that e-CNY payment settlement must be unconditionally recognised and supported in mobile payment scenarios. To achieve this, the Chinese government has guided and required mobile payment companies, such as WeChat and Alipay, UnionPay's Cloudflare, Meituan, and Pinduoduo, to interoperate between digital currency and paper money at their payment ports. When the digital domain is interconnected, the promotion of e-CNY and everything else will come to fruition. However, the transition phase is also fraught with challenges.
At present, the public’s acceptance of e-CNY is still very low (Xu, 2022), and there are many overlapping scenarios for the use of e-CNY and mobile payment, and the hasty introduction of restrictions on overlapping use may do more harm than good.

Under the trend of the promotion of e-CNY, all related parties must grasp the positioning. With the general trend of promoting e-CNY, it is important for all parties to grasp their own positioning. The central bank embarks on the currency issuance and payment business, while private companies can only do wide-area payment business or special narrow-area environment token business, such as mobile game currencies, which is impossible to change to fiat money theoretically.

5. The Present and Future of the Globalisation of the e-CNY

PBoC has established RMB clearing banks in over 25 countries and regions outside of mainland China (Ho, 2010). Currently, RMB accounts for 10.92% of the IMF SDR. According to People’s Bank of China (PBoC) statistics, the cross-border RMB transaction volume reached 19.67 trillion yuan in 2019, and this amount increased to 28.39 trillion yuan in 2020, a year-on-year increase of 44.3%. In 2021, RMB cross-border receipts and payments amounted to CNY 36.6 trillion, up 29 percentage points year-on-year, an increase of nearly 30% over the previous year’s RMB cross-border payments and receipts. RMB cross-border receipts and payments accounted for 48.4% of the total amount of domestic and foreign currency cross-border receipts and payments in the same period, a record high and an increase of about one percentage point over the previous year. Although the internationalisation of the RMB has gradually accelerated and the RMB has become the world's fifth largest currency year-round, it is highly disproportionate to the actual size of China's economy and the scale of its foreign trade and investment. This is directly related to the fact that the current cross-border payment transfers and clearing are highly dependent on the SWIFT system and the Clearing House Interbank Payment System (CHIPS) under the US dollar system. Combined with China's currency clearing system CIPS, the e-CNY is likely to become an alternative to cross-border payments in pursuit of cross-border transaction currency status that matches the comprehensive national strength and foreign trade levels.

The world monetary pattern has undergone some subtle changes since the Russia-Ukrainian War: Russia has been kicked out of the SWIFT system; Israel has added RMB to foreign exchange reserves at 2%; and Saudi Arabia has proposed yuan-priced oil contracts. All these have given new opportunities for boosting the standing of DCEP.

As the US dollar impacts negatively on other countries due to the excessive increase as well as the unilateral freezing of US dollar assets and foreign exchange reserves of sanctioned countries by European and American countries, more national concerns have been strengthened. As an alternative to the US dollar, the China yuan has entered the vision of financial experts in more and more countries.
The internationalisation of DCEP is also a way to internationalise the RMB. To achieve an internationalised digital economy eco-system that recognises the RMB, China needs to internationalise its digital technology infrastructure and digital technology. Just like the internationalisation of different telecommunication technologies such as GSM and MACD in Europe and the US decades ago, the internationalisation of CBDC is unworkable without the internationalisation of digital technology infrastructure.

DCEP has been validated for theoretical and technical as well as practical stability and reliability through three batches of pilot cities. The first batch of pilot cities includes Shenzhen, Suzhou, Xiong'an, Chengdu, and the venues of the Winter Olympics. The second batch of e-CNY pilots in six regions, including Shanghai, Hainan, Changsha, Xi'an, Qingdao, and Dalian. Moreover, Tianjin, Chongqing, Guangzhou, Fuzhou, Xiamen, and cities set to host the Asian Games in the Zhejiang province are added to the pilot programme.

The selection of these cities has taken into account factors such as major national development strategies, regional coordinated development strategies and the industrial and economic characteristics. The current pilot provinces and cities basically cover different regions such as the Yangtze River Delta, the Pearl River Delta, Beijing-Tianjin-Hebei, central, western, northeastern and northwestern China, which is conducive to the trial assessment of the application prospects of e-CNY in different regions of China. The common feature of these locations is that the digital infrastructure for technology is well developed, and there are many application scenarios for the e-CNY. Therefore, these places can be used as pilots to explore the advantages and risks of DCEP. In the future, the promotion of e-CNY must first improve the seamless connection between the cloud, terminal, support section, server, and user end in various places, which needs to match the development of communication technologies such as 5G and gigabit broadband in different places. Then, the experience of the pilot will be replicated and expanded to continuously increase the breadth and depth of the use of DCEP. Once risks arise, they will be restricted to the sandbox of the pilot at different stages of expansion, and problems will be identified and solved in the process of development (Analytica, 2022). Eventually, the nationalisation and internationalisation of the e-CNY can be realised.

According to the most recent PBoC data, as of the end of 2021, there were more than 8 million e-CNY application scenarios, 261 million personal wallets were opened, and the total transaction value was 87.565 billion yuan. These huge pilot data not only fully verified the feasibility of the e-CNY's own circulation, but also provided new guidance for the direction of digital technology development.

The Institute of Digital Currency of the People's Bank of China has signed a memorandum of cooperation with the Hong Kong Monetary Authority and has also joined the Multiple Central Bank Digital Currency Bridge Projects (m-CBDC Bridge) led by the Bank for International Settlements Innovation Centre (BISIH) to explore legal digital currency-related practises with BIS innovation sub-centres and central
banks in different regions/countries (e.g., Hong Kong and Singapore).

With the continuous internationalisation of digital technology in China, the scope of the e-CNY pilot and the process of internationalisation will continue to expand and accelerate. However, it cannot be ignored that a historical problem in the process of RMB internationalisation has not been resolved. The internationalisation of e-CNY must have exchange ports and cash-out channels, etc., which touches on China’s foreign exchange controls. According to the regulations, Chinese residents can bring a maximum of USD 5,000 or RMB 20,000 in foreign currency out of China, and a maximum of USD 50,000 or RMB 300,000 can be remitted out of China in a year. If over USD 5,000 is brought in China, a declaration must be made to China Customs, and a "Foreign Exchange Carrying Permit" must be applied if over USD 5,000 is brought out of China. The policy does not allow or encourage residents to engage in foreign exchange speculation, which is obviously in conflict with the internationalisation of the RMB.

A mature financial service system and financial market allows the free exchange and circulation of currency, and even a mature and stable currency derivative trading market to enhance the resilience of the currency ecosystem. Due to special historical reasons such as foreign exchange controls, the RMB cannot become a popular currency in global circulation (Dobson and Masson, 2009). The difficulty of RMB internationalisation is not only the suppression of competition by international powers, but also the reasons for China's own restrictions. However, the e-CNY development is currently in the midst of a period of domain localization (e.g., local pilot regions and business activities), so the issue of internationalisation is not as urgent.

6. The Promotion and Application of e-CNY

The e-CNY boom is accompanied by a global background of digital currency development. With the explosion of cryptocurrencies such as Bitcoin in recent years, an ecosystem of digital finances based on cryptocurrency has emerged. In response to this trend, Facebook, known for its global social network, changed its name to Meta Platforms. Represented by Meta, many companies are looking to shift from a real-life community platform to building a digital community platform. Platform builders populate digital communities with things that have real-world characteristics, using NFT, EDFI and other derivative technologies to enable mutual cashing of virtual assets with digital currencies and electronic money. However, the illegal cost of the virtual world platform is low, and the legal guarantee for authenticating ownership is weak. In addition, different platforms can develop similar scenario assets, which are completely incomparable to the uniqueness of real-world resources. Different metaverse platforms are not connected. The grabbing of stock customers and the safety and security of their own platforms are challenges. Companies, as managers and designers of the metaverse, are prone to losing fairness and legal security. This is the original problem that WEB3.0 needs to solve.
There are now more than 10,000 influential cryptocurrencies with a total market capitalisation of over US$1 trillion. Cryptocurrencies such as Bitcoin use blockchain and crypto technology to attract many customers with their "decentralised" and "completely anonymous" nature. However, Bitcoin lacks intrinsic value, lacks a reference for its price, and is inefficient and energy-intensive to trade. The fact is that customers of cryptocurrencies are not consumers, because there are so few real-life scenarios for their use. Customers buy private digital currencies solely for speculative profit, making them an easy breeding ground for Ponzi schemes and a payment tool for illegal economic activities such as money laundering. In recent years, some commercial organisations have introduced so-called "stable currencies", which attempt to maintain stability by anchoring them to sovereign currencies or related assets. However, what if stable currencies can be symmetrically pegged to sovereign currencies, and people abandon them in favour of derivative stable currencies?

Digital currency includes both digital fiat currency and private digital currency. Although both are named after digital concepts, their connotations are different. Private digital currencies, take Bitcoin as an example (Kaplanov, 2012), are asset-based currency that originated or are used in a niche, and because of its better encryption and natural limitation, it has been identified by a particular industry chain as a sort of asset hedge and a way for assets to evade regulation. And for the majority of people, Bitcoin is just a tool used for speculation, not for payment and settlement. At the same time, because of its scarcity, its inherent deflation belongs to the properties of metal-like money and cannot become legal tender under the credit system, because fiat money theoretically needs to be issued indefinitely to meet the infinite growth of economic development.

The e-CNY's digital technology makes it a tool for measuring the value of data assets and serves as a medium of exchange for trading data assets, realising the direct connection between currency and data assets, which is better than private digital currencies.

E-CNY is an innovation in digital currency. It can be circulated without barriers in the traditional economy and digital economy under the guarantee of the legal system, which can greatly promote the development and integration of the traditional economy and digital economy. These aspects cannot be done by private digital currencies such as Bitcoin, nor by other electronic currencies.

Private digital currencies are essentially in competition with banks based on a credit system. However, digital currency is currently being speculated as a currency with value-added and only has the attribute of a metal-like currency, while its function in the digital economy is weakened. It is believed that in the future, digital currencies will inevitably move towards the bank profitability of deposit and loan earning spread and take on its monetary attributes.

For commercial banks, digital currency is both a challenge and an opportunity. Traditional commercial banks must accelerate the transformation to digital banking and improve the upgrade for digital currency
transactions, storage, lending and other functions as soon as possible. The e-CNY issuance rules show the central bank's precise real-name and flat management of the currency, which is a huge advantage in macro-regulation and micro-tracking. However, for commercial banks under the current credit system, it is undoubtedly a big negative, which will compress the profit methods of commercial banks, reduce the money multiplier effect, further reduce the volume of money supply M0, and even reduce the volume of M1 and M2. This takes away commercial bank profits disguised as financial inclusion, lowering the cost and threshold of market financing, which is good for the public. Many people believe that e-CNY issuance is increasing M0, however, in the absence of the money multiplier effect and commercial banks' storage and lending amplification effect, it is shrinking the money supply, including M0, M1 and M2. Therefore, the e-CNY has continued to be adjusted in the banking sector of China's A-shares from the time it was set. It is also influenced by the downside of the real estate industry. The transformation of the banking industry from traditional banks to digital and tech-based banks has become imminent and trendy (Galazova and Magomaeva, 2019).

Another type of risk arises from the digital currency itself. During daily use, e-CNY is positioned as M0 only at the design stage, but many commercial banks have set up mechanisms for cashing out bills in e-CNY in order to enhance people's recognition and acceptance of digital fiat money, which conflicts with the e-CNY’s main position. The reason is that, after the e-CNY is cashed into paper money, it may be used for wealth management, savings, or even private lending, rather than just consumption. Merchants usually use the bills for investment and savings purposes for interest. Customers who convert digital currency into paper money may be more inclined to use it for investment and savings rather than consumption. The only way to avoid this is to set interest rate differentials and increase the cost of encashment. But the reality is that the e-CNY is not a necessity right now, and once the cash in cost is set, it is not conducive to the implementation of the promotion. Furthermore, when larger amounts of e-CNY are directly transferred from M0 to M1 and M2, it can cause deflation and disruption of central monetary policy. On the contrary, if the public only recognises e-CNY when the creditworthiness of commercial banks is reduced, there will be a concentrated run on commercial banks to turn deposits into e-CNY, or trigger financial disintermediation and outbreak of new monetary policy disorder, or even aggravate the danger of financial risks of commercial banks. In conclusion, accurate placement of e-CNY can be done, but accurate spending is more difficult, especially if it can be cashed out, which will break the definition of the M0 attribute of e-CNY and trigger financial risks.

7. Digital Economy

The e-CNY is not only based on Beijing-Tianjin-Hebei, the Yangtze River Delta, Guangdong-Hong Kong-Macao Greater Bay Area and international trade along the Belt and Road, but also constitutes one of the necessary elements of the digital economy system in China to provide new growth and enhance the efficiency of China's economic development.
The Chinese version of the Digital Economy Classification defines the basic concept of the digital economy in two dimensions: "digital industrialisation" and "digitalisation of industry" and divides it into five categories: digital product manufacturing, digital product service, digital technology application, digital-driven development, and digital efficiency improvement. The first four categories are "digital industrialisation", which is the core part of the digital economy and aims at building digital infrastructure and solutions; the fifth category is "digitalisation of industry", which focuses on the use of digital technologies and facilities to improve the efficiency of existing industries, with an emphasis on the application side.

The new economic development pattern is dominated by the domestic economic cycle and takes the advancement of supply-side structural reform as the main thread and focuses on the digital construction and interoperability of production, distribution, circulation, and consumption in all aspects. On the production side, the government introduces high-end production factors and scarce resources to make up for domestic production needs and improve digital hardware and technical foundations. In terms of distribution, the government has strengthened the infrastructure to realise smart scenes, smart villages, smart cities, and smart countries, increasing employment and income. On the circulation side, the government is working to improve the efficiency of the industry and solve problems such as obstacles to internal flows. On the consumption side, the government is committed to delivering high-quality goods to match people's aspirations for a better life.

In April 2020, the General Office of the State Council issued a notice about Comprehensive Reform of the Market-oriented Allocation of Factors, which for the first-time listed data, land, labour, capital, and technology as the five elements. It directly provides the theoretical foundation for data, the core production element of the digital economy.

Regarding the development of the digital economy, added value of the digital economy in 47 major countries around the world reached $38.1 trillion in 2021. China's digital economy reached $7.1 trillion, accounting for 18.5% of the total of 47 countries, second only to the United States at $15.3 trillion. China's digital economy grew to 45.5 trillion yuan (see Figure 2), ranking second in the world in terms of total volume and increasing its share of Gross Domestic Product (GDP) to 39.8%. From the digital economy as a proportion of GDP ratio, China is still far below Germany, the United Kingdom, the United States of more than 65%. In terms of growth rate, the digital economies of major countries around the world are growing quickly, with Norway's digital economy growing by 34.4% year-on-year, ranking first in the world.

The digital economy provides important support for the global economic recovery. In 2021, the added value of the digital economy in 47 countries is $38.1 trillion, up 15.6% year-on-year, accounting for 45% of GDP. Industrial digitalization is still the main engine of digital economy development, accounting for 85% of the digital economy. Among them, the digitalization of the tertiary industry leads the
transformation and development of the industry, and the digital economy of the primary, secondary and tertiary industries accounted for 8.6%, 24.3% and 45.3% of the added value of the industry respectively.

![Figure 2. China’s Total Digital Economy and Its Proportion in GDP](image)

China's digital economy is based on the foundation of the Internet economy since 2000 where the point of industrial upgrade starts from a higher level. Issued in December 2021, the “14th Five-Year” Development Plan for the Digital Economy defines the digital economy as the direction of economic transformation and a new growth point. The details are shown in Table 1.

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Year 2020</th>
<th>Year 2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>The added value of the core industries of the digital economy as a percentage of GDP (%)</td>
<td>7.8</td>
<td>10</td>
</tr>
<tr>
<td>Number of active IPv6 users (100 million)</td>
<td>4.6</td>
<td>8</td>
</tr>
<tr>
<td>Number of gigabit broadband users (million)</td>
<td>6.4</td>
<td>60</td>
</tr>
<tr>
<td>Scale of software and information technology service (trillion)</td>
<td>8.16</td>
<td>14</td>
</tr>
<tr>
<td>Application penetration rate of industrial Internet platform (%)</td>
<td>14.7</td>
<td>45</td>
</tr>
<tr>
<td>Online retail sales (trillion)</td>
<td>11.76</td>
<td>17</td>
</tr>
<tr>
<td>E-commerce transaction scale (trillion)</td>
<td>37.21</td>
<td>46</td>
</tr>
<tr>
<td>Scale of e-government services users (100 million)</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 1: Main Indicators of Digital Economy Development During The 14th Five-Year Plan

Observing the development law of the digital economy in China, the digital economy is an ecosystem of high coordination and efficiency of productive factors generating productive value that is highly dependent on digital technology in terms of functional flow and information interaction. It is an upgraded form of the traditional non-digital economic model. To facilitate a better understanding of the digital

\[\text{Table 1 derives from Wind, which is a must-have macro- and industry-data analysis tool for economists, macro-analysts, strategy analysts and industry researchers in the Greater China region, with the powerful index calculation and graphical functions.}\]
The digital economy is a complex ecosystem that relies heavily on digital technology to achieve high efficiency, both in terms of functional flows and information interactions in the organisational level. Cross-domain and cross-border commerce is most efficiently achieved with a unified form of digital currency, which is also most in line with the essential requirements of the digital economy, hence the increasing importance of the e-CNY.

8. Two-way Application of e-CNY in Digital Economy

The development of the human economy has given rise to physical money and now the development of the digital economy is requiring the emergence and upgrading of digital money. With the development of the digital economy, China's cash usage rate M0 has recently been on a downward trend. According to the 2019 China Payment Diary Survey conducted by the People's Bank of China, the number and value of transactions for mobile phone payments accounted for 66% and 59% respectively, while the number and value of cash transactions were 23% and 16% respectively, and the number and value of bank card transactions were 7% and 23% respectively, and 46% of respondents did not have cash.
transactions during the survey period. This is in line with the pattern of currency matching rapid economic development.

The e-CNY is designed with reserved programmability ports, paving the way for the network effect of open SDKs and APIs to be realised at a later stage. The e-CNY achieves programmability by loading smart contracts that do not affect the function of the currency, enabling the e-CNY to make automatic payment transactions according to the conditions and rules agreed by both parties to the transaction, and promoting business model innovation. Based on this, expanding digital currency application scenarios is the current focus of efforts to promote the e-CNY, which can start with the following directions:

(1) Digital Government Construction

Through online government service platforms, residents can apply for government services online. It is expected that online government services will improve the transparency of government affairs and even the openness of data packages, which will give rise to the flourishing of new industries such as assistance services and data analysis. E-CNY and digital ID cards will gradually become a necessity in people's lives, and there may be a strong binding requirement for both. Some digital platforms in villages, with TV screens and cell phone screens as terminals, have realised services and information to reach the people precisely, realising the sinking of quality resources such as medical care, education, and agricultural technology, allowing farmers to truly enjoy the benefits of modern development with digital forms of resources.

At the same time, the combination of a digital government platform and e-CNY is a kind of accurate supervision for the local government. From project budget to execution, the flow and use of funds can be accurately monitored through e-CNY appropriation and debt release, preventing government employees’ corruption and laziness in performing duties. Eventually, the performance of the government can be objectively judged by the proportion of input to output of e-CNY.

(2) Digital Countryside Development

E-commerce in digital villages will benefit from the sinking of digital economy technology into the rural fields, providing new growth points for the economic development of the vast number of towns. E-CNY will have a huge positive effect on financial inclusion. China's rural Internet users have reached more than 284 million, and the national rural online retail sales amounted to approximately 2.05 trillion yuan, and the agricultural products’ online retail sales amounted to more than 422.1 billion yuan. According to Action Plan for the Development of Digital Countryside (2022-2025), by 2025, important progress will be made in the development of digital countryside, with the creation of a number of rural e-commerce product brands with high visibility, good quality, and characteristics, as well as the improvement of rural culture and rural digital governance system. For the development of a rural digital economy, commercial banks will use e-CNY to give farmers a new inclusive policy of financing and lending. Moreover, the popularity of e-CNY in the cyber star economy will serve farmers more conveniently and safely and will combat tax evasion and false sales.
(3) Technology Companies’ Development
The Internet industry and software and information services industries are expected to flourish with the development of the digital economy. The e-CNY will play a great role in businesses for transactions and financing, stimulating the development of innovative technologies such as AI, cloud computing, big data and blockchain. Besides, the e-CNY will facilitate entrepreneurs’ meticulous observation and judgment on industry development and market segmentation. This stimulates the “Entrepreneurship and Innovation among All the People” policy to a certain extent.

(4) Transaction Supervision
For cross-border transactions, the traditional cross-border transactions usually use corporate accounts to settle payments in a uniform manner with monthly, quarterly, or even annual bookkeeping. However, the payment process sometimes results in commercial disputes over misplaced payment numbers and can even become a channel for criminals to launder money. The point-to-point accurate payment function and double offline settlement feature of e-CNY greatly facilitate cross-border real-time transactions. Controlled anonymity also enables accurate monitoring of illegal money laundering practices while safeguarding the privacy of both parties to the transaction.

(5) Computing Resources from the Eastern Areas to the less Developed Western Regions
Furthermore, with the completion of the overall layout for the national integrated big-data centre system, a large number of digital business scenarios, such as data processing, transportation, computing, and other upstream and downstream business interactions in various segments, will generate demand for e-CNY settlement. The government will set up a professional data exchange. Existing stock, futures, and equity exchanges may pilot the requirement of opening accounts with e-CNY as a tied account. In the future, the account opening rules will be upgraded to require all accounts to be tied to e-CNY for transactions and operations, replacing the current rules for tied bank card accounts, which have the risk of customer information leakage and money laundering crimes.

The number of 5G and gigabit broadband users in China is expected to exceed 600 million by 2025, enabling a seamless connection between a large number of terminals and the cloud and laying the foundation for a complete and high-speed infrastructure for e-CNY promotion. As the digital economy matures, digital trading will usher in a phase of rapid development, with various exchanges emerging and even digital trading intermediary services following suit.

(6) Green Finance
It is the area where the e-CNY can make a big impact. “The PBoC will continue to explore the use of financial technology to develop green finance. The application of big data, artificial intelligence, blockchain and other financial technology tools in green finance holds great promise.” said Yi Gang, the governor of PBoC. The size of China's domestic and foreign currency green loans exceeded 13 trillion yuan by 2021, accounting for 7.18% of the total domestic credit stock of 181 trillion yuan.
(Figure 4) Additionally, the size of green bond stock exceeded 1 trillion yuan, ranking second in the world. Policies will strongly support the green finance sector. Green financial products such as green credit, green bonds, green leases, and green trusts can only be effective when the funds are used for green purposes. In August 2020, China UnionPay launched a digital bank card in conjunction with 12 banks. It is predicted that a digital credit card dedicated to green industry finance may also be launched in the future.

![Figure 4: Balance and Growth Rate of Domestic And Foreign Currency on Green Loans of Major Financial Institutions. Source: Wind](image)

(7) Foreign Trade
Foreign trade, especially commodities, will also be the main area for digital currency. The international and domestic environment is changing day by day, and the commodity trading market has been gradually seeking settlement in currencies other than the US dollar. China, as a major buyer of commodities, can gradually use an approach that benefits itself by establishing international contracts and gradually promoting e-CNY settlement options, starting with friendly countries and Belt and Road countries.

(8) Digital ID Card
Consumer areas such as digital payment scenarios combined with digital ID cards will also benefit from the promotion of e-CNY. More and more scenarios for identification and binding digital economies have appeared, and digital ID cards have come into being. The combined use of digital ID cards and e-CNY can conveniently serve the payment fields with high identification requirements.

(9) Digital Government and Industry Rules
E-CNY can use technology to enable the regulation of digital government and industry rules (Jiang
Digital currency has inherent advantages in finance (Xu, Chen and Kou, 2019). For example, e-CNY can achieve targeted and fixed interest rate differential treatment in financing loans; for bonds, it can achieve traceability in the use of funds, enhance default risk mechanisms and return mechanisms, and avoid illegal acts such as money laundering and pyramid schemes. According to statistics in 2018, China recovered 3.54 billion yuan of stolen money in cases of job-related crimes, investigated and dealt with pyramid schemes involving 8.72 billion yuan, and cracked smuggling cases involving a value of nearly 7 billion yuan. If the traceability of e-CNY's blockchain technology is utilized, both the regulation of funds and their retrieval can be turned into a cloud business and made to run automatically, greatly reducing the cost to state public officials. In 2020, the People's Bank of China issued a total of 68 fines against non-cash payment institutions, with the highest one-off penalty amounting to RMB 116 million, setting a new record for the highest payment penalty amount. extremely costly.

In the future, social attributes (e.g., e-CNY and digital ID cards, digital enterprise licenses, and other licenses) are likely to be strongly bound while weakly bound to biological attributes (e.g., face recognition and fingerprint recognition of cell phones) to realise digital data generation and supervision and management of real people's identity and asset trajectories, etc. These data and digital currency, digital transactions, digital transmission, digital arithmetic, will constitute the elemental parts of the digital economic and financial system.

9. Quantifying e-CNY Developmental Levels

The development level of e-CNY can be quantified from both the application side (that is, the demand side) and the supply side, just like the statistical method of GDP. We believe that the application side is more accurate, because the output of the supply side may be disturbed by short-term sharp fluctuations, for example, a spurt of concentrated explosion in the early stage of the policy dividend, but the momentum is not enough. It will even enter a liquidity trap at certain bubble-generating times due to liquidity preference, generating capital idling in the financial sector. However, the volume of scenarios, frequency of use, and purchase of application devices are all closely bound to the e-CNY usage data, and the data quantification is more realistic and reliable. Based on this logic, this paper sets up two indices: the e-CNY Index and the China-style Digital Economy Index.

9.1 e-CNY Index

There are two logics that can be used to establish e-CNY indices: one is an index similar to the USD index, the digger index, etc. that links the currency to economic fundamentals, and the other is a simple index logic similar to private digital currencies such as Bitcoin. Obviously, the first logic is more in line with common sense, while the second is highly susceptible to speculative volatility because it is not backed by real value.
When choosing the first logic, it is important to note the difference in the connotation logic between the e-CNY index and the RMB exchange rate. The e-CNY index reflects more on the scope and volume of using e-CNY, while the RMB exchange rate reflects the strength of exchanging RMB for other legal currencies. In general, the two have a homogeneous reinforcing effect, i.e. the higher the e-CNY Index, the more recognised the e-CNY is, and the stronger the exchange rate of the RMB into other currencies. Similarly, the stronger the RMB exchange rate is, the more recognised the e-CNY will be, and theoretically, the more scenarios and devices related to the e-CNY will be available, so the stronger the e-CNY index will be.

Because in 2022, the e-CNY application pilot version is available on all app stores, all users are free to download and open the e-CNY wallet on request, and e-CNY has already achieved all monetary functions in 2022, such as cross-border payment cooperation with Hong Kong Monetary Authority (HKMA), large tax payment (e.g., Haigang Group paid over 100 million e-CNY in a single tax payment), foreigners loose coupling applications (e.g., Winter Olympics scenarios), government transfer payments (e.g., Wenchang receiving e-CNY fiscal allocations in Hainan province), loans in e-CNY (e.g., Qingdao), and massive micro-, small and medium-sized application scenarios (e.g., consumption and settlement,). It is possible that in 2022 the e-CNY customer base is open to the public and all currency attributes and functions are implemented, so this paper recognises 2022 as the first year of the e-CNY. All scenarios and volumes of using e-CNY in this year are mathematically synthesised and calculated according to the following weighting formula, and then the final result is set and processed to 100 to facilitate the comparison of subsequent data with the first-year data. The initial formula is given by:

\[ \text{InitiDigital RMB Index} = W_1 \times \text{Circulation Amount} + W_2 \times \text{Transaction Volume} + W_3 \times \text{Transaction Tool} \\
+ W_4 \times \text{Transaction District} + W_5 \times \text{Transaction Purpose} \\
+ W_6 \times \text{Total Amount of Exchange between Digital Currency and Paper Currency} \\
+ W_7 \times \text{Total Volume of Exchange between Digital Currency and Paper Currency} \\
+ W_8 \times \text{Equipment Number for Customers} + W_9 \times \text{Equipment Number for Businesses} + \text{Covariates} \]

where \( W_1, W_2, W_3, W_4, W_5, W_6, W_7, W_8 \) and \( W_9 \) are parameters of different variables. The calculated initial value is fitted to 100 to obtain a benchmark ratio value, and subsequent years' statistical values can be directly converted to Index values using the benchmark ratio value. \( W_1, W_2, W_3, W_4, W_5, W_6, W_7, W_8 \) and \( W_9 \) can be calculated by:

\[ W_j = \frac{d_j}{\sum_j d_j} \]  

\((j = 1,2, ..., 9)\)

where \( d_j \) are variables (i.e., circulation amount, transaction volume, transaction tool, transaction district, transaction purpose, total amount of exchange between digital currency and paper currency, total volume of exchange between digital currency and paper currency equipment number for customers and equipment number for businesses) in the above model.
In addition to the above methods, for more convenient access to the data for statistics, this paper also introduces another method regarding the e-CNY index according to the data from government:

Digital RMB Index = \( C' + F' + DI' + (E' - I') + T' + D' \)

where \( C' \) means consumption for businesses and consumers using e-CNY to complete transactions; \( F' \) means financial payments using e-CNY to complete transactions; \( DI' \) means digital investment using e-CNY to complete transactions; \( E' \) means export amounts using e-CNY to complete transactions; \( I' \) means import amounts using e-CNY to complete transactions; \( T' \) means taxes paid using e-CNY to complete transactions; \( D' \) means loans and saving deposits using e-CNY to complete transactions.

Then this paper calculates the trend ratio (TR) and coupling coordination index (CCI) for each economic data of digital fiat currency as a percentage of each data of fiat currency, so as to reveal the changing trend and coordination of digital fiat currency as a percentage of economic activities. To provide data support for a more systematic study of the two-way promotion relationship between digital fiat currency and digital economy.

\[
\begin{align*}
TR_C &= \frac{C'}{C} \\
TR_F &= \frac{F'}{F} \\
TR_{DI} &= \frac{DI'}{DI} \\
TR_{E,I} &= \frac{E'}{E} - \frac{I'}{I} \\
TR_T &= \frac{T'}{T} \\
TR_D &= \frac{D'}{D}
\end{align*}
\]

where \( C \) means total amount of consumption for businesses and consumers; \( TR_C \) means trend ratio for consumption for businesses and consumers; \( F \) means total amount of financial payments; \( TR_F \) means trend ratio for financial payments; \( DI \) means total amount of digital investment; \( TR_{DI} \) means trend ratio for digital investment; \( E \) means total export amounts; \( I \) means total import amounts; \( TR_{E,I} \) means trend ratio for difference between import and export amounts; \( T \) means total amount of taxes paid; \( TR_T \) means trend ratio for taxes paid; \( D \) means total amount of loans and saving deposits; \( TR_D \) means trend ratio for loans and saving deposits. Then general trend ratio can be calculated by:

\[
TR = \sqrt{TR_C \times TR_F \times TR_{DI} \times TR_{E,I} \times TR_T \times TR_D}
\]

In particular, \( TR_0 \) represents 2022 as the first year of the e-CNY, \( TR_1 \) represents the year 2023. By analogy, \( TR_n \) represents the year \((2022 + n)\). Then the formula for calculating the dispersion degree \( S \) of developmental level is as follows:

\[
S = \sqrt{\frac{(TR_1 - \overline{TR})^2 + (TR_2 - \overline{TR})^2 + \cdots + (TR_n - \overline{TR})^2}{n}}
\]
The trend ratio can quantify and predict the development trend of e-CNY and provide a dynamic tracking indicator tool for managers’ macro regulation and control. The coordination index can quantitatively evaluate whether the development of e-CNY matches the current economic development, and there will be several possible outcomes such as over-development, under-development and appropriate development, providing a data basis for the Chinese government to formulate the rhythm and timing of the e-CNY strategic policy. The formula for calculating the coupling degree \( COU \) and coordination index \( COO \) is as follows:

\[
COU(TR_C, TR_F, TR_DI, TR_EJ, TR_T, TR_D) = 6 \times \left[ \frac{TR_C \times TR_F \times TR_DI \times TR_EJ \times TR_T \times TR_D}{(TR_C + TR_F + TR_DI + TR_EJ + TR_T + TR_D)} \right]^{\frac{1}{6}}
\]

\[
COO = \beta_1 TR_C + \beta_2 TR_F + \beta_3 TR_DI + \beta_4 TR_EJ + \beta_5 TR_T + \beta_6 TR_D
\]

Then the formula for the coupling coordination index (CCI) is as follows:

\[
CCI = \sqrt{COU \times COO}
\]

By comparing the CCI, governments can assess the coordination between the development rate of the e-CNY and the development rate of China's economy. If China's central bank could make public the daily e-CNY transaction heat map, including data related to regional locations, total volume and amount, on the premise of controlled anonymity, then providing data for more in-depth economic research and financial innovation is possible. Since 2022 is the first year and there is no data for subsequent years yet, while data in various fields has not yet been made public by the Chinese central bank, we present the concept and implications in this paper for the time being to provide direction for subsequent scientific research after the data is made public.

### 9.2 China-style Digital Economy Index

The Chinese version of *Statistical Classification of Digital Economy and its Core Industries* divides it into five major categories: digital product manufacturing, digital product service, digital technology application, digital factor-driven, and digital efficiency improvement industries. We add the separate GDP of these five categories of industries in China together as the China-style digital economy index (CDEI) and then calculate its percentage of the GDP of the whole economy. The formula is as follows:

\[
CDEI = GDP_{digital\ product\ manufacturing\ industry} + GDP_{digital\ product\ service\ industry} + GDP_{digital\ technology\ application\ industry} + GDP_{digital\ factor-driven\ industry} + GDP_{digital\ efficiency\ improvement\ industry}
\]

\[
Importance\ of\ CDEI = \frac{CDEI}{GDP}
\]

where \( GDP_{digital\ product\ manufacturing\ industry} \) means GDP in digital product manufacturing industry; \( GDP_{digital\ product\ service\ industry} \) means GDP in digital product service industry; \( GDP_{digital\ technology\ application\ industry} \) means GDP in digital technology application industry; \( GDP_{digital\ factor-driven\ industry} \) means GDP in digital factor-driven industry; \( GDP_{digital\ efficiency\ improvement\ industry} \) means GDP in digital efficiency improvement industry; \( GDP \) means Gross Domestic Product in China.
With the transition from industrialization to digitalization, this index can be relied on to evaluate the degree of modernization and future economic development of a country. A vertical comparison of the trend of the index can predict the prospect of the country's digital economic development; a horizontal comparison of the size of the index can be used to evaluate the country's current main industry contribution to economic development.

It is worth noting that a large part of the contribution of the e-CNY index will be realised through the digital fiat currency, but the two do not have an include and be included relationship, the overlapping part of the two has an amplifying effect, because each link of the circulation of digital fiat currency will contribute to the e-CNY index, so the e-CNY index (overlapping part) has a certain multiplier effect on the CDEI. The detailed effect model could be a direction for future scientific research.

10. Summary

Although 2022 is the first year of e-CNY, the frequent international events have brought great challenges and uncertainties to the economic development around the world. After the Russia-Ukraine war, economic globalisation gradually turned into economic semi-globalisation. In the process of de-globalisation, the games of economic development began to shift from the global scale to the regional scale. Stagflation has become a fact due to the environment, combined with the current currency overdraft, the impact of the epidemic and various other factors such as the energy crisis and war sanctions. With a large time horizon, a wide range of countries and industries affected, and few ways to mitigate the problem, this stagflation may well be the most difficult stagflation in human history to deal with. The recession that will immediately follow stagflation could also be the biggest in human economic history. Perhaps this is a bit pessimistic but looking at the typical stagflation in human economic history, the triggering factors, structural factors, and ideological confrontation are the most serious since the Second World War. Moreover, we seem to have abandoned the most useful tool for alleviating stagflation-using technological innovation and economic globalisation to reduce costs and stimulate consumption.

The confrontation between the East and West camps has reached its peak, and henceforth technological innovation based on people's welfare will give way to technological innovation based on national confrontation in the military race. And the result of de-globalisation will inevitably lead to a waste of resources, reduced productivity efficiency, duplication of R&D and manufacturing, etc. Combined with the decline in consumer demand and the decline in production and investment enthusiasm, a vicious cycle of economic recession seems to have become the gray rhino in front of the world. If we want to get out of the predicament and out of stagflation, a new economic model of digital economy has become the best choice. Human economic model substitution and technological consumption upgrades are the source of every progress in history. In this historical change, which country steps on the right rhythm and walks in the forefront, which country will be the biggest beneficiary.
Since the 14th Five-Year Plan, with the development of e-CNY, China has been simultaneously building new digital infrastructure and implementing digital scenarios in the areas of manufacturing power, data exchange construction, high-speed network transmission, and quantum computing, etc. The mutual promotion of e-CNY and the digital economy has entered a high-speed stage. In particular, China's strict zero-COVID policy, which started in 2020, lasted for nearly three years until the end of 2022. Although the strict management of the movement of people has had a severe impact on economic development, the digital economy has seen continuous high growth in the past three years, especially in terms of digital industrialization, which has served to stabilise macroeconomic growth. Countries around the world should continuously pay attention to the trend of the e-CNY Index and the China-style Digital Economy Index to reflect on the pros and cons for the development of digital economy in their own countries.

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