Financial System 2030

VADUZ ROUNDTABLE

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Content

Preface

This document is the result of a two-day, hybrid roundtable discussion by a group consisting of 23 experts from five continents. This ninth edition of the Vaduz Roundtable "Financial System 2030" continues a discussion series of forward-thinking leaders and visionaries from different institutions, disciplines, and countries. The initiators of the Vaduz Roundtable "Financial System 2030", Prince Michael of Liechtenstein and Thomas Puschmann, would like to cordially thank all experts for their participation and their input to this report.

With this peer group, we hope to support the definition of the future pillars of the "Financial System 2030". As constituted in the foundational meeting from June 8th – 10th 2018 and re-verified in the following roundtables, this group focuses on the following four goals:

- **Establish** an institutionalized peer group for a regular exchange of the financial system of the future that combines interdisciplinary expertise from practice, academia, public institutions, and policy.
- **Develop** a vision for the future of the financial system from the perspective of the different points of view.
- **Connect** the relevant stakeholders and persons through a neutral platform to discuss relevant issues on a regular basis.
- **Foster** the definition of relevant social, political, economic, and technological cornerstones, and standards.

The discussions were conducted in accordance with the Chatham House Rule, an approach that was invented 1927 and has been successfully applied in many discussions since. It states that anyone who participates in the meeting is free to use the information from the discussion but is not allowed to reveal who made any comment. The purpose is to increase the openness of the discussion.

Executive Summary

There could be no better time to discuss the pillars of the future financial system than now. This ninth Vaduz Roundtable "Financial System 2030" was held during the beginning of a financial system turmoil with Silicon Valley Bank, Signature Bank and Credit Suisse as the principal actors. Although these banks' collapses have different reasons, their failures once more demonstrate that the financial sector is and remains vulnerable. In addition to these dramatic events over the past few weeks, the crypto asset industry has also had its critical moments. Amongst the examples are the FTX bankruptcy and the stablecoin events around TerraUSD and BlockFi. The result of all this is that both decentralized finance (DeFi) and centralized finance (CeFi) are impacted. So, what might a future, more stable, and secure financial system look like? This question was once more part of the discussion of this roundtable.

This report ties in with the findings of the previous five Vaduz Roundtables on the "Financial System 2030" and develops them further based on the developments since then as well as the discussions of the two-day roundtable from March 10th – 11th 2023. It provides a more in-depth view of the future pillars of the "Financial System 2030" and shows potential fields of relevant lines of development. The roundtable discussions are based on the structure that was identified during the first Vaduz Roundtable and was again verified in the subsequent editions. This structure revealed that the "Financial System 2030" might change with respect to (1) citizens, consumers, robots, and machines, (2) money, market structure, and business models and (3) (de-)regulation, all of which are increasingly driven by the impact of (4) technology.

While the first Vaduz Roundtable provided for a high-level overview, the subsequent Vaduz Roundtables gave more insights into specific developments in each of these four fields. This ninth Vaduz Roundtable report on the "Financial System 2030" has a special focus on each of these four areas including (1) banknote design and CBDC, CBDC and financial inclusion, blockchain use cases (citizens, consumers, robots, and machines), (2) quantum computing, sovereignty, substitution, and the splinter net, from data to AI (technology), (3) the market impact of a regulatory sandbox, e-CNY, and digital Euro (money, market structure, and business models) as well as (4) the crypto regulation dilemma and towards an optimal crypto regulation ((de-) regulation).

As an outcome of this roundtable, the peer group uses the "Vaduz Architecture" for documenting and describing the developments of the Financial System 2030 for structuring discussions within and outside of this group.

1. Four Forces of the Financial System 2030

In these times, the stability of both the traditional (centralized financial system; CeFi) and the new (decentralized financial system; DeFi) financial system is under high pressure. And so is the connection between them. But what impacts the stability of the financial system? In general, the stability of a system, and this also applies to a financial system, requires different factors to be determined. One major factor is complexity. Highly complex systems are often not transparent to their users, thus their control can be very difficult. Just like natural ecosystems, a financial system should be balanced in between sustainability and diversity and interconnectivity (Litaer 2010). The sustainability of any complex system can be measured with a single metric: its structural diversity and interconnectivity, which has its optimal balance in a small, so-called "window of viability". Reducing diversity and interconnectivity automatically leads to a monoculture and a collapse of the entire system because of brittleness. On the other hand, too much diversity leads to stagnation. Therefore, the optimal window of viability can only be identified by including different factors, such as currencies, market structure, regulation, etc. However, the identification of this optimal window is a challenging task when all these different factors must be considered as relevant and are dependent on each other.

This roundtable focuses on the four complexity factors "citizens, consumers, robots, and machines", "technology", "money, market structure and business models", and "(de-) regulation" (see Figure 1). Together, these four complexity forces towards the "Financial System 2030" have been identified as a major result of the first Vaduz Roundtable and were further detailed in the subsequent Vaduz Roundtables:

- Citizens, consumers, robots, and machines (Chapter 2)
- Technology (Chapter 3)
- Money, market structure and business models (Chapter 4)
- (De-)Regulation (Chapter 5)

The ninth Vaduz Roundtable on the "Financial System 2030" again concentrated on these topics and deep dived into them to identify potential solution approaches. But it also observed further challenges and discussion points for most of them ahead of us, which clearly show that the "Financial System 2030" is an ongoing development rather than a single future scenario.

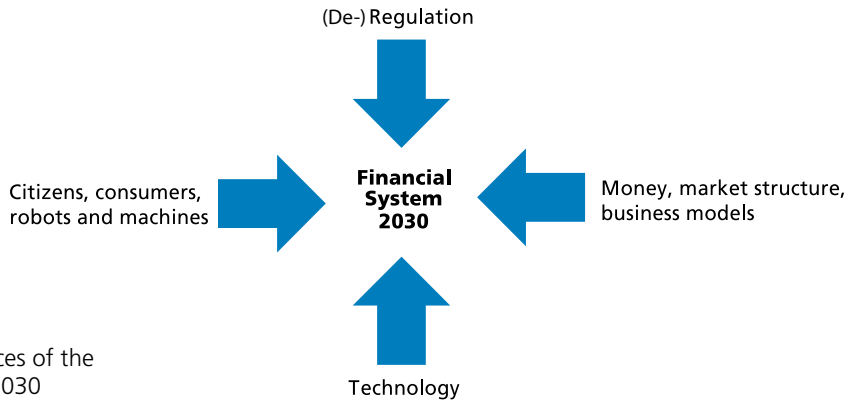

Figure 1: Four Forces of the Financial System 2030

2. Citizens, Consumers, Robots and Machines

Banknote Design and CBDC

Central bank digital currency (CBDC), here specifically a retail CBDC, is currently the only digital, user-accessible form of money that is a liability of the central bank. Because of these attributes, it might have the potential to expand financial inclusion. However, a CBDC is not a payment instrument with properties common across countries, but instead reflects various instruments with significant differences. That is why it is imperative to gather further knowledge about the design of a retail CBDC, and how it will derive value from these different attributes that ultimately make it become more accessible to all. For example, in Africa it used to be very popular to use payment cards to transfer money from one person to another by simply texting the code on the back of the payment card which then automatically releases the amount for which the payment card is authorized. Later, other forms of mobile payment emerged, such as M-Pesa in Kenia, or QR code payments, such as Bharat, etc.

A good illustration of how people in Africa still today use money is a very traditional one. In Africa, people sometimes visit soothsayers who call their ancestors and usually pay a consultation fee for this. Very often, these soothsayers only accept cash, as they want to touch and feel the money. In a broader study of existing digital and mobile payment systems in Nigeria, India, Mexico, and Indonesia, the following areas were explored as relevant (Narula et. al. 2023):

1. **Monetary ecology:** What are the sets of instruments that people use to pay? For example, people use all kinds of instruments like different banknotes, animals, etc.

2. **Monetary repertoires:** What you can do with those instruments and how? For example, in many countries people use different repertoires to ultimately get US banknotes.

The key results from this analysis are that (1) social intermediaries matter which means that there are always humans involved because, for example, there is only one person in the village who has a mobile phone, because of financial illiteracy, etc. (2) Another important takeaway is that digital networks are often unreliable, so there needs to be a fallback (e.g., induced by natural catastrophes, etc.). And (3), trust is paramount in whether people will stick with a payment mechanism, including banknotes. But how can this trust be transferred to digital payment mechanisms? In an interview in North India, one person claimed:

"Sometimes money gets stuck while executing a transaction. The money neither goes back to the customer's account and neither can I give money to the customer. This has led many customers in the post office blaming the postmaster for stealing the money from the customer's account. Customers are not willing to wait for the money to be sent back to their account. Hence, I stopped offering this service to everyone."

One important aspect in this context is fraud. For example, the Paytm Spoof app is used by scanning the QR codes in a merchants outlets, the fraudsters use this moment to identify the

merchant details and then use the same data to create their customized payment page and manipulate merchant owners to believe that they have paid with the exact bill amount (s. Figure 2).

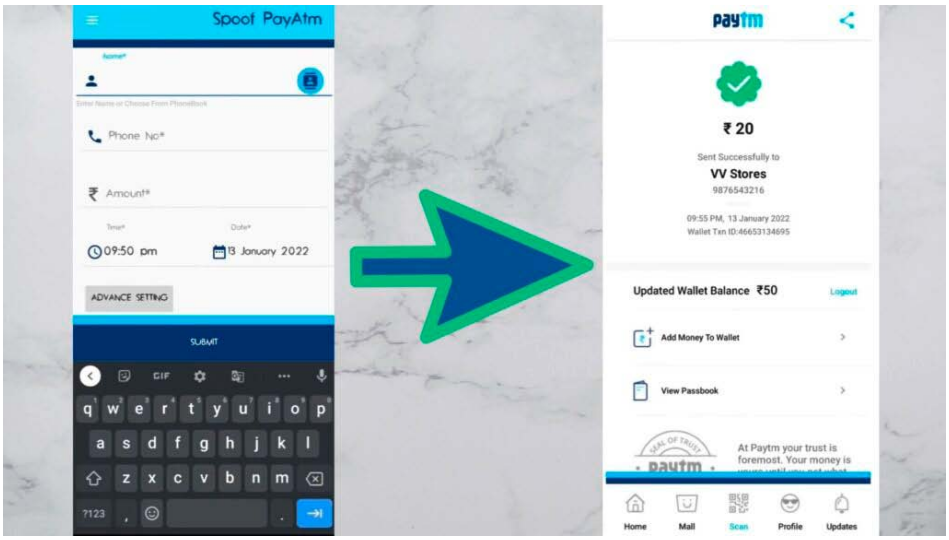

Figure 2: Paytm Spoof App Fraud (Marshal 2022)

That is why an important element of trust in the case of banknotes is the authenticity on which banknote designers have already spent a great deal of time. The same is true for digital payment systems. An example for the role of trust in digital payments is CurrentC, a payment system which was founded in 2011 by a consortium of retailers in the US, including Walmart, Target, Best Buy, CVS, Shell, Olive Garden, Lowes, Michaels, Sears and more. These firms started a company called MCX, or Merchant Customer Exchange, which by then covered more than 110,000 retail locations and processed $1 trillion in payments annually. The overall aim was to cut out credit cards with their fees. However, the project failed for various reasons. One of them was that nobody knew who was behind this initiative (no branding of the founding companies). Another one was focusing on solving the retailers' problem instead of a customer problem, while knowing that credit cards are very popular in the US. Purchases made over CurrentC were debited directly from customers' bank accounts. Finally, the payment process was very complex for users as it required a QR code instead of simply swiping a credit card. All these reasons show that there is a need to use banknote insights to ensure that the durability of that idea is transposable to other forms of currency. Table 1 summarizes the differences between cash and digital forms of money, from which requirements for the future design of CBDCs can be derived. For example, CBDC designers might consider the benefits of self-custody, instead of the currently favored intermediary custody.

Differences	Cash	Digital Forms of Money
Custody	Self-custody	Intermediated custody
Access	Anyone	Authenticated and authorized individuals
Finality	Instant settlement and reversability	Delayed settlement and often complex dispute arbitration
Data	No data trails	Data trails which require privacy rules
Distance	Short distances	Long distances (e.g., remittances)

Table 1: Differences of Cash and Digital Forms of Money (according to (Narula et al. 2023))

Case Study 1: Central Reserve Bank of Peru

- The Central Reserve Bank of Peru (BCRP) is currently evaluating the benefits and risks of issuing a CBDC. This comes in parallel with the increasing de-dollarization of the Peruvian economy, where dollarization of credit has fallen from 80% in 2000 to 23% in 2021. Since the comprehensive modernization of its payment infrastructure, which went live in 2000, the BCRP today has three essential roles: (1) a regulatory function; (2) a managerial role for the dual currency RTGS system; and (3) a user role in settling BCRP monetary and FX instruments, as well as intraday operations. In 2021, the growth of digital payments was fostered by digital wallets and immediate payments which allows real-time payments. However, Peru currently faces the following challenges for the introduction of digital payments:
  - **Low financial inclusion:** According to Global Findex around 57% of adults did not have access to bank accounts in 2017 for various reasons like no bank branches near to them, no internet access not enough income, as banks charge fees for operating accounts. And in some cases, people don't trust in the financial system (Peru had a financial crisis in the 1990s). Peru sees a retail CBDC as a potential answer to foster financial inclusion. For this, the central bank analyzes different use cases like mobility, where today in most cases still cash is used. Other use cases are payments for informal workers (around 70% of the entire workforce), where today cash is used (s. Figure 3) as well as government subsidies which could be transferred via such as CBDC. Another potential would be to also raise taxes via this channel.
  - **Isolated systems:** Many financial services systems are not interconnected. For example, digital wallets mostly work as closed-loop systems. In 2022, Peru issued a regulation to force payment services providers to provide interoperability with other providers and actors of the financial system.

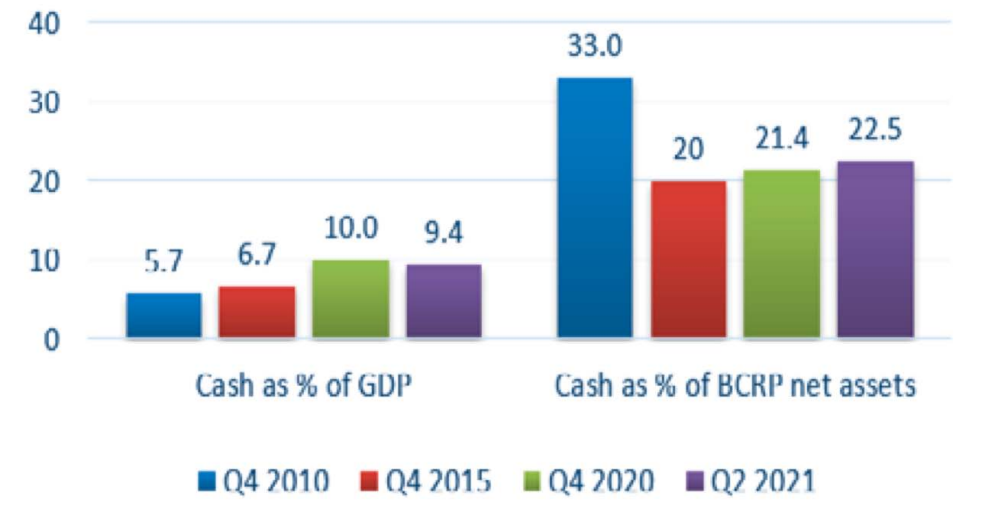

Figure 3: Cash in Circulation in Peru

- Currently, Peru works on a regulatory framework to foster innovation in this field together with the private sector. One of the aims is to identify taxes (e.g., of merchants based on their digital payments). However, copying other architectures from other countries is not easy. For example, Brazil and Mexico have much larger populations that already uses forms of digital payments, while Peru has only a limited amount of people using such services as of today. Similarly, other South American countries also have high unbanked populations (e.g., Mexico 63%, Colombia 54%, Brazil 30%, and Chile 26%; s. Figure 4).
- Peru has also been ranked within the top 10 for the use of crypto currencies (von Luckner et al. 2021).

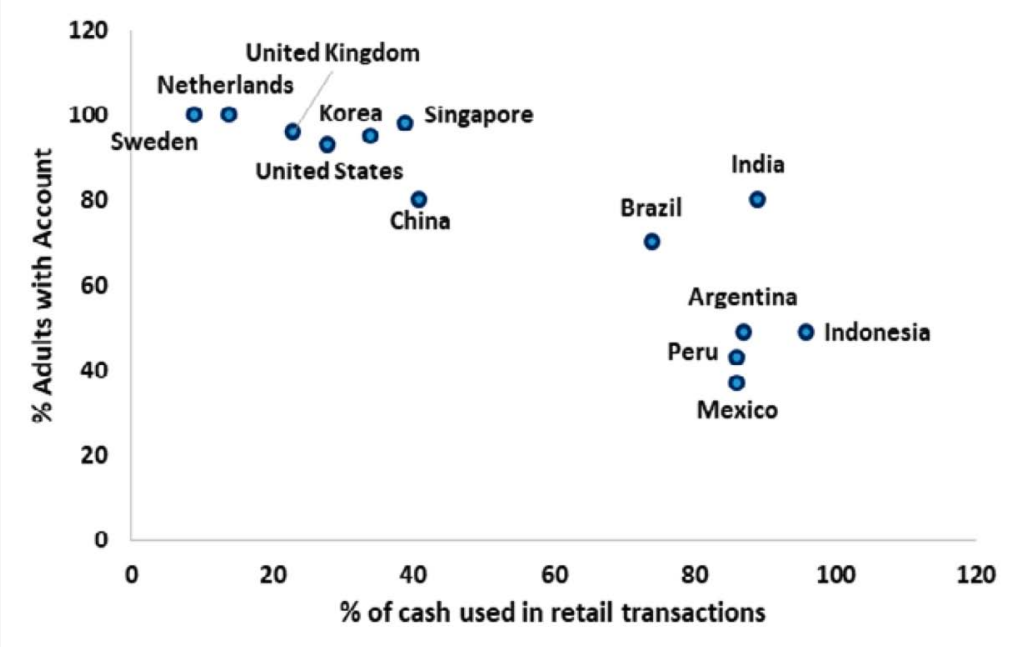

Figure 4: Percent of Cash used in Retail Transactions (McKinsey 2020)

Source: Central Bank of Peru

Blockchain

A recent study found that the most blockchain use cases were explored in the financial industry between 2017-2020, followed by communications and media, as well as manufacturing (s. Figure 5). From a country specific view, especially Germany, the Netherlands, France, and Sweden are the most important countries regarding mining for permissionless blockchains.

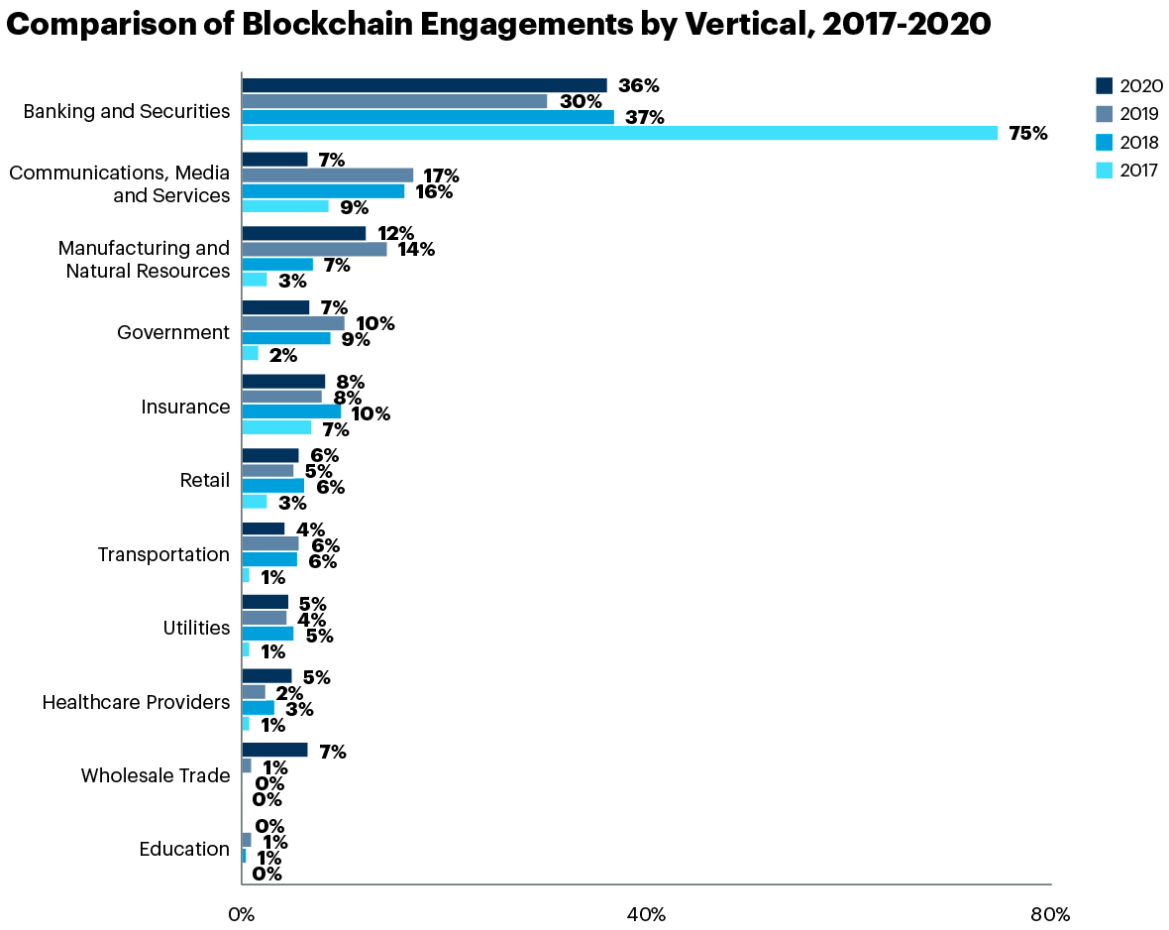

Figure 5: Comparison of Blockchain Engagements by Vertical 2017-2020 (Gartner 2019).

Case Study 2: Regulatory Instruments for Blockchain Development in the European Union

- To foster growth in the blockchain field, the European Union initiated the following activities:
  - A public-private partnership for the development of a blockchain services infrastructure for the public sector.
  - The International Association for Trusted Blockchain Applications (INATBA) which offers public and private developers and users of DLT a global forum to interact with regulators and policymakers.
  - Investments in EU innovation and start-ups for which around Euro 380 million have been invested.
  - Promoting and enabling a legal framework and interoperable standards as well as skills development.
  - Setting up a regulatory sandbox for blockchain which connects start-ups to regulators for legal advice.

- Since the second fintech action plan was adopted in 2020, the EU has worked out various legislations like MiCA for crypto asset service providers, PILOT as a sandbox for DLT for securities trading, Art 45h EUDI regulation for E-ledgers and Art 30 Data Act for smart contracts. Some areas are still under work, such as the use of GDPR in the context of enterprise blockchains, etc. However, many industries like the energy sector (peer-to-peer trading of solar energy) are still managed by intermediaries which make the use of such models impossible.
- Another important topic for the financial services industry is tokenization of assets. A recent survey identified that for more than 80% tokenization is a relevant topic but 88.5% see the current regulatory framework in Europe might be limiting Europe's ability to become a leader in this field globally (https://bankenverband.de/media/files/Tokenise_Europe_2025_2Abfij0.pdf).

Source: European Commission

3. Technology

Quantum Computing

Quantum computing emerged in the 1980s and gained interest only in the 1990s with the introduction of Shor's algorithm (factoring integers in polynomial time) as well as Grover's algorithm (speed up an unstructured search problem quadratically) that could threaten existing cryptographic methods used to protect communication and data models. Figure 6 shows the differences of the best classical algorithm number field sieve compared to Shor's algorithm used by quantum computing. Quantum computers exceed classical binary computers in their performance because their quantum bits (so called "qubits") cannot only represent the values 0 or 1 at a given time but both values at the same time (so called "superposition"). For example, a traditional computer can only use 0 or 1, even if the value is slightly different from that. This means that traditional computers remove such errors (often called "noise") from the system. In contrast, quantum computers have a higher error rate as a qubit can be any combination of 0 and 1, and therefore can also have values in between. This means that the same calculation must be made several times to ensure that the output is correct. But this also means that the lower the error rate, the better the results of a quantum computer. Another important characteristic of quantum computers is that all qubits are interconnected. If one qubit changes its state, the other does too, even if they are separated in space. This also has a significant improvement in terms of calculation speed. All of these differences show that quantum computers require new hardware, new software, and new algorithms to harness the performance advantage over traditional computers (Grumbling & Horowitz 2019).

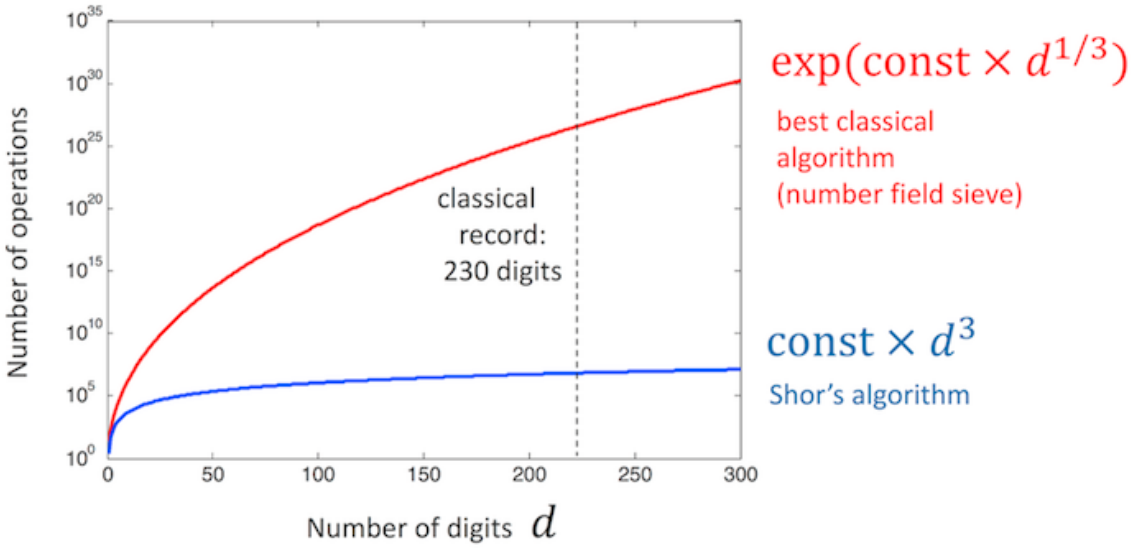

Figure 6: Classical versus Quantum Algorithms (IBM Quantum n.d.)

In assessing where quantum computing will have its most utility potential, it is important to mention that the primary benefits of quantum computing arise from its increased computing power in contrast to classical computers. As of today, no practical applications have been developed, despite some experiments that have already been conducted. In general, quantum computing allows to analyze large data sets more effectively. However, due its multidimen-

sional approach specific software for quantum computers will also enable novel ways of how problems are analyzed. With this, problems can be solved in a reasonable time frame, which cannot be solved with traditional computers. Quantum problems are not programmed like traditional software. Instead, a matrix of multiple elements is loaded into a quantum computer. The difference between the classical binary programming and the novel multi-dimensional optimization is that quantum computers require highly trained quantum experts to (1) define the problem and (2) the way how it is processed to benefit from this new approach. The situation is therefore comparable with the use of the first computers in the 1950s, when financial institutions needed to hire and train staff for the use of this new technology. But what are concrete applications of quantum computing?

One example is quantum sensors. Classical sensors are unable to detect quantum activities in the physical world. Quantum sensors play an important role in measuring quantum properties through quantum entanglement, quantum interference, and quantum state compression. Such sensors utilize photonic, atomic, and solid-state systems to detect small-scale changes in time, gravity, temperature, pressure, magnetic fields, etc. They provide optimized precision and reliability that overcomes the limitations of current sensor technologies. Potential applications for this are weather forecasting, healthcare, seismology, etc. However, because quantum computing is not fully developed yet, organizations often use a hybrid approach, which means that a combination of quantum elements and classic computers take advantage of both to solve highly complex problems. An example for this is quantum communication, which applies the principle of superposition to transmit the mixture of both 1s and 0s and transfer encoded information through networks. However, it requires repeaters to cover long distances, which are vulnerable points in such a communication network. An application of particular importance to the financial industry is quantum key distribution which aims to replace traditional key management models. In this case, quantum cryptography ensures secure key exchange for communication, identifies eavesdropping and offers guaranteed lifetime key encryption to withstand malicious attacks. For example, a quantum random number generator (QRNG) allows for better accuracy without post-processing. Today, there are no commercial products for this.

Cryptographic Algorithm	Type	Purpose	Impact from quantum computing
AES	Symmetric key	Encryption	Larger key sizes needed
SHA-2, SHA-3	-	Hash functions	Larger output needed
RSA	Public key	Signatures, key establishment	No longer secure
ECDSA, ECDH	Public key	Signatures, key exchange	No longer secure
DSA	Public key	Signatures, key exchange	No longer secure

Table 2: Impact of Quantum Computing on Cryptographic Algorithms (NIST 2016)

Based on this, the National Institute of Standards and Technology (NIST) in the U.S. recommends two primary algorithms to be implemented for most use cases: CRYSTALS-KYBER (key-establishment) and CRYSTALS-Dilithium (digital signatures). -In addition, the signature schemes FALCON and SPHINCS+ will also be standardized. Other standardization efforts emerge from ISO/IEC 27001 and 27002, ISO 15408, RFC 2196, etc.

Sovereignty, Substitution, and the Splinter Net

Since the introduction of the first internet service providers (ISPs) in 1993 and the introduction of the Internet Corporation for Assigned Names and Numbers (ICANN) in 1998, the internet is currently undergoing a fundamental revolution, mostly since the introduction of Bitcoin in 2009, which is since then very often also called the internet of value or the financial internet (Wong 2022). Two developments are major drivers of this development. First, in July 2022, the World Wide Web Consortium (W3C) announced that Decentralized Identifiers (DIDs) are now an official Web standard. This new type of verifiable identifiers, which do not require a centralized registry, will enable both individuals and organizations to take greater control over their online information and relationships, while also providing greater security and privacy (W3C 2022). As Figure 7 shows, these DIDs are separated in methods (e.g., send data) and method-specifier identifiers (e.g., personal data). DIDs will be an important component for managing personal and organizational data.

Figure 7: Decentralized Identifiers (W3C 2022)

Second, the emergence of wallets has led to an enormous increase of wallets around the world. The number of digital wallets is expected to increase from 3.4 billion in 2022 to 5.2 billion in 2026 (Juniper 2022). Since most of the browsers will soon have wallets integrated, this number is expected to increase even more rapidly now. Just recently, for example, Microsoft announced that the Internet Explorer will soon be equipped with a digital wallet too. In addition to this development, the W3C has released a standard for a payment request API in September 2022, which has the aim to standardize payment processes between a merchant, user agent, and payment method provider. But what connection do IDs and digital wallets have? Digital IDs will be operated via digital wallets in most cases. An example is the planned EU Digital Identity. Digital wallets are also an enabler of the machine-to-machine economy, where machines automatically communicate with each other and conduct payments to each other. If there is a wallet in every device (robots, cars, etc.), the ongoing reconfiguration of global value chains might also be affected by these wallets.

Whether CBDCs will be implemented on the internet by using W3C standards is still an open question. As of today, the CBDC implementations or prototypes are not using any of these standards. Instead, they are developed on custom platforms, which might in the future lead to a "splinter net", an internet which is divided along geopolitical lines. If life follows art, it is not hard to imagine a splintered world and political economy akin to George Orwell's dystopia in 1984 - a world divided into three global networks belonging to the states of Oceania, Eurasia, and East Asia could emerge (s. Figure 8). These could be divided by major CBDCs - a digital dollar, a digital euro, and a digital yuan - with Bitcoin perhaps serving as the currency

for “disputed territories”. However, there are also positive signs. For example, at the G20 in Bali in 2022, the central banks from Indonesia, Malaysia, Philippines, Singapore, and Thailand sealed a cooperation agreement for regional payment connectivity based on the BIS moderated mBridge project. But it remains unclear how the development of cross-border payment systems and CBDC integration will continue.

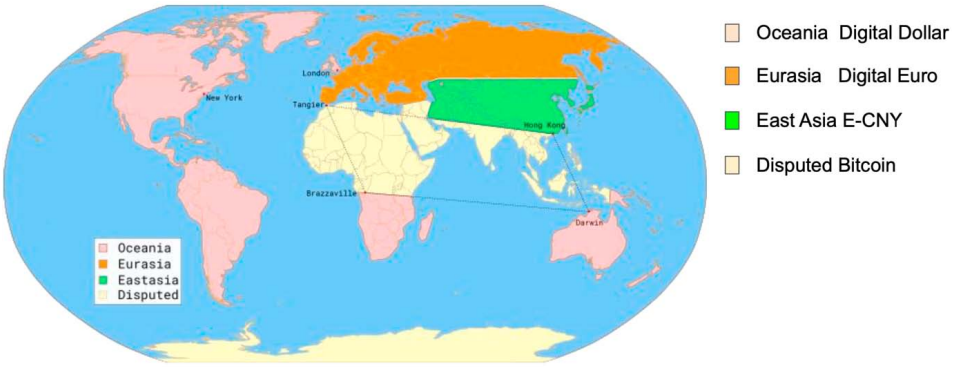

Figure 8: Map Depicting the Three Superstates of Nineteen Eighty-Four, with the “disputed area” in light yellow (Orwell 1984)

As a result, this might lead to several financial systems rather than one single financial system. Is the peak globalization also the peak of the internet? Will the financial internet lead to a societal change through the separation of money and state, just as this happened to the church and state during secularism? Or will there be another way of separating monetary and fiscal policy? What if the financial internet might increase internet surveillance in the name of tax purposes? All these questions will be raised in the future and answers need to be provided.

From Data to AI

Over the past decades, the volume (amount of data), velocity (the speed with which data is processed) and variety (the sources of data and formats) of data has increased and today is most referred to as “big data”. Big data may be structured (e.g., tables), semi-structured or unstructured (e.g., social media). Sources of big data can include various stakeholders, such as governments, businesses, individuals, machines, etc. Most sources have been traditional and include examples such as sales data, consumer behavior data, etc. However, in recent years, alternative sources of data emerged, which includes data generated by individuals (e.g., social media, news, web searches, etc.), by business processes (e.g., transaction data, corporate data, etc.) and by sensors (e.g., satellites, geolocation, IoT). Although big data analysis provides potentials for business decisions, it also holds challenges such as data quality, selection bias, etc. A more advanced form of big data analysis is artificial intelligence (AI), which has emerged as a major domain in computer science since the 1950s:

“With the increasingly important role of intelligent machines in all phases of our lives - military, medical, economic and financial, political - it was thus odd to keep reading articles with titles such as Whatever Happened to Artificial Intelligence? This was a phenomenon that Turing had predicted, that machine intelligence would become so pervasive, so comfortable, and so well

integrated into our information-based economy that people would fail to even notice it." (Ray Kurzweil, https://www.kurzweilai.net/turing-s-prophecy).

The release and diffusion of ChatGPT shows that Turing's prediction has become reality now. AI is being integrated into various applications. The following case study shows some example application areas of AI within BBVA.

Case Study 3: BBVA

- BBVA today runs around 1,500 AI models and adds around 200 models every year. A typical retail client is touched around 40 times every day with a model.
- The Time-to-Value, the time which is required from defining a business problem to using a data model in practice, often takes up to one year and covers the phases planning & design, data phase, analytical phase, full production in data and full production in channels. Very often the data that is required it not available or exists in various forms (e.g., an account balance might exist up to ten times or even more with in a bank, depending on the data included).
- Old machine learning (supervised ML) reaches a limit independent of the amount of data used at a certain point (s. Figure 5). This is especially true for structured data which needs to be complemented with unstructured data to increase data variety. For unstructured data labelling is required. Labelling puts unstructured data in a specific context and meaning and makes it machine readable. In contrast to that deep learning does not require labelling because it learns by itself in an unsupervised way.

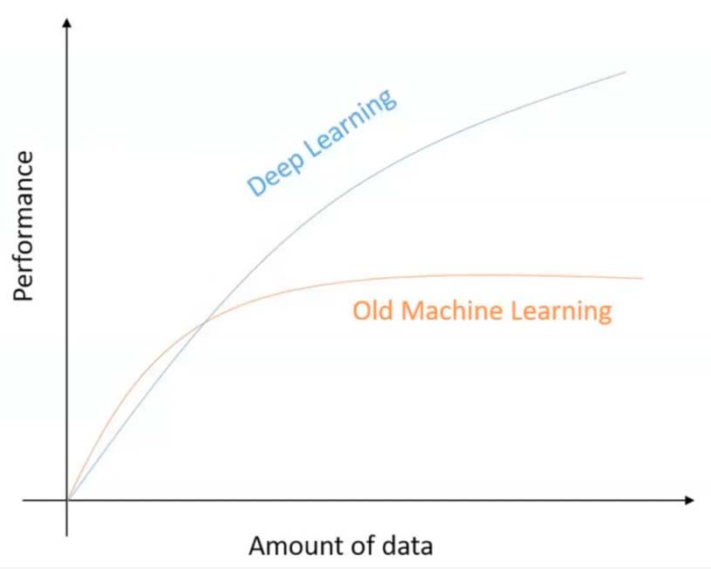

Figure 9: Relationship between Data and the Performance of AI Models

- An important component for deep learning is foundational models. These foundational models are built on extremely large, not annotated datasets. From these foun-

dational models, small, annotated datasets can be derived and fine-tuned. While traditional, supervised learning models require large amounts of data, foundational models can work with small amounts of labeled data and can be implemented much faster. Other advantages are real-time updates, higher robustness, lower resource-intensiveness, and lower human expertise to develop the foundational models.

- Currently, large language models (LLM) like ChatGPT are being increasingly used in all kinds of applications. For the version 3 the LLM was trained by deep learning and foundational models with around 175 billion parameters and 195 billion words (web crawling, books, Wikipedia, etc.). ChatGPT-4 has then used 100 trillion parameters and 300 billion words.
- Banks are at the forefront to use machine learning applications, followed by insurers. For example, in the UK, most application areas are in customer engagement, risk management and compliance as well as other areas like HR and legal ((Bank of England 2022), s. Figure 8). However, this also poses some critical question, for example, in the case a client is not fairly treated. This clearly requires internal quality assurance processes. Another area of concern is when computers generate content which is then used again by machine learning algorithms which could create content that is unpredictable. A third area is the inclusion of interaction data with clients (e.g., client-advisor meetings) for credit decisions as well as other areas of risk management, etc. For this, a specific AI model governance was introduced which allows auditors to check each of these models.

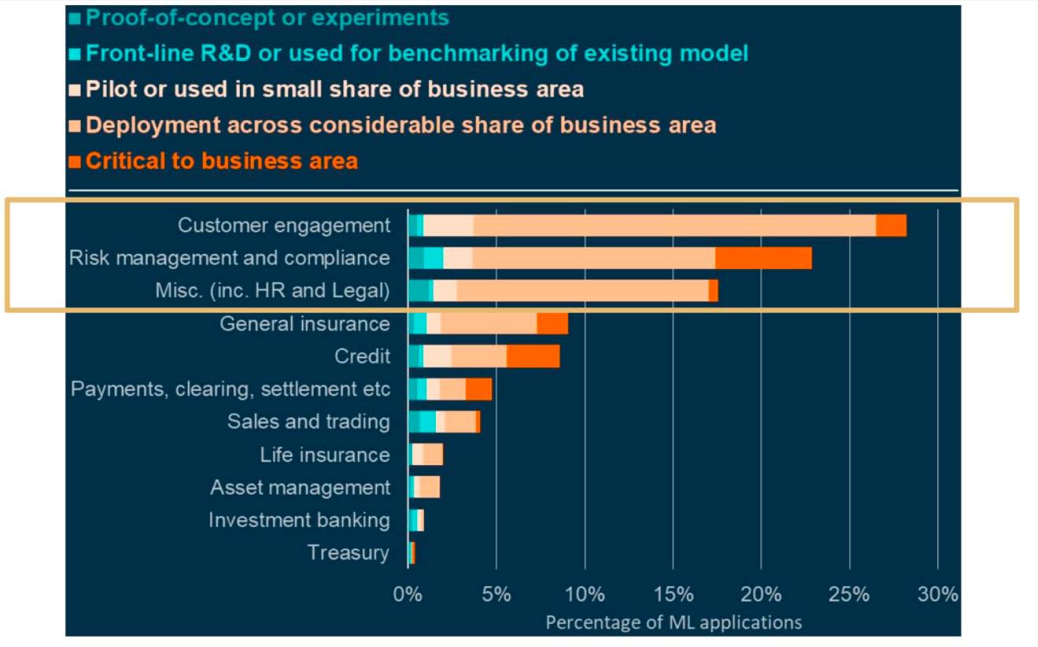

Figure 10: Foundational Models Accelerate AI Adoption in Banking (Bank of England 2022)

Source: BBVA

4. Money, Market Structure and Business Models

The Market Impact of a Regulatory Sandbox

Regulation is facing a trilemma between financial innovation, market integrity, and rules simplicity (Yadav and Brummer 2019). To achieve a better balance towards financial innovation, a regulatory sandbox was introduced by the British regulator in 2016. Back in 2012, following the financial crisis, the UK government created the Financial Conduct Authority (FCA), to replace the former Financial Services Authority (FSA). As a result, the new regulator also became the new pacemaker to encourage innovation in the financial industry. In 2016, the FCA's Innovate Department launched the world's first regulatory sandbox, which "allows innovators to trial new products, services and business models in a real-world environment without some of the usual rules applying" (Ofgem 2018). Since then, around 200 companies (from a total of around 8,000 fintech companies in the UK) have gone through this sandbox. Already by 2021, 73 sandboxes have been launched in 57 countries. Currently, most regulators provide the sandbox as a service to proof that the firms who apply are compliant with existing rules. However, a specific learning environment for the regulators has not yet been established. For example, the FCA's sandbox model comprises four steps (Deloitte 2018):

- The **first step** for a company is to submit an application that includes a company's business plan and describes how it meets the sandbox's eligibility criteria. As part of this process, the FCA may contact other organizations to obtain clarification or further information before deciding on the application. Once accepted, firms normally stay between three and six months in the sandbox.

- The **second step** is to complete all required paperwork and set up the capabilities to obtain the necessary authorizations, typically with restrictions such as the number of customers and/or the volume of transactions.

- The **third step** is testing. In many cases, it might take between several weeks to several months to receive all necessary authorizations. But even after a company is authorized, setting up all capabilities for testing can be very time-consuming, especially for customer acquisition and opening a business bank account.

- The **fourth step** is the exit. After the end of the testing period, companies need to transition out of the sandbox. As part of this process, companies have clearly defined exit plans regarding customer transition etc. In addition, firms need to submit a final report to the FCA.

After the companies have exited the sandbox, the companies must decide on how to continue their business. Most apply for a "variation of permission" to lift the restrictions imposed during the test. Most companies choose this option, while only a few reconsider their business model and regulatory position to become unregulated.

In general, the major benefit of the regulatory sandbox is that it reduces the costs of entering the financial services industry, as regulatory costs are in most cases the biggest part of launching a new business in the financial sector. However, it is not clear who benefits most from this

sandbox approach: On the one hand, policy makers emphasize the benefits to the economy and the public and on the other hand, entrepreneurs and investors see it as an instrument for more investment opportunities and high growth. These results are confirmed by two studies, which state that the likelihood of being accepted into the sandbox increases the credibility of firms with both investors and customers alike (Deloitte 2018) and an entry into the sandbox is associated with a higher probability of raising funding and an increase of about 15% in the average amount of funding raised (Cornelli et al. 2022). In another study (Hellmann et al. 2022) found evidence of positive externalities even at the industry level. Participation in the sandbox by one start-up is followed by increased entry and more money being raised by other start-ups in the same industry. In addition, there is some evidence that the sandbox screens out better companies, but there is no evidence that companies' momentum significantly increases after their participation in the sandbox. This means that the positive effect on a single company is lower than on the industry as a whole. Another effect of the industry-level increase of market entry and money being raised might be companies that try to avoid regulation by observing the sandbox outcomes very closely.

Central Bank Digital Currencies

Case Study 4: e-CNY

- The e-CNY pilot operated in just ten regions across China before it was introduced to the Olympic Games venues in Beijing and Zhangjiakou in February 2022. Currently the e-CNY is used by 90 million users in seven pilot regions in China.
- The e-CNY aims to create a digital version of the renminbi that meets the growing demand for money in the digital economy era. With this, the E-CNY can be defined as the digital version of fiat currency issued by the People's Bank of China (PBoC) and operated by authorized operators. It is convertible with physical RMB on a 1:1 basis, and both are components of the fiat currency system. Meanwhile, it is a value-based, quasi-account-based and account-based hybrid payment instrument, with legal tender status and loosely coupled account linkage, and supports managed anonymity.
- The e-CNY system is based on a two-tier architecture in which the PBoC is responsible for issuance and disposal, network connections and wallet management. Additionally, it selects commercial banks as authorized operators to provide e-CNY exchange services. The e-CNY has four major aims:

    - **First,** the e-CNY aims to improve the efficiency of central bank payment systems. As an important financial infrastructure, the e-CNY system will further fulfil the diversified payment needs of the general public and improve efficiency of financial infrastructures.

    - **Second,** the e-CNY will provide a backup or redundancy to the retail system. While BigTech companies have become very important for retail payments that might lead to systemic risks, the e-CNY is a direct claim on the central bank which reduces such risks.

- **Third,** the e-CNY supports equal access to digital payments and can improve financial inclusion. As the use of cash has been declining over the past years, public's direct access to cash can be enabled by the e-CNY system.

- **Fourth,** the e-CNY can improve cross-border payments, while being compliant with monetary sovereignty, foreign exchange policies as well as regulatory and compliance requirements.

- Currently, the system is based on four different wallet categories based on the different KYC levels. The first one can be opened with a mobile phone number. For the second and third category, which allows for higher amounts of transaction, the entire bank account information must be presented. A fourth category requires the wallet account to be opened at a bank branch. This then allows transactions without any limits. Importantly, the e-CNY is not intended to substitute the cash system, however, complement it for so long, as cash is demanded by the public for payments. In addition, the e-CNY system aims to provide anonymity for small-value transactions and the ability to trace high-value transactions in the case of illegal and criminal activities and to comply with AML/CFT requirements. Finally, the e-CNY aims to provide programmability (e.g., by deploying smart contracts, enabling conditional payments, guaranteed payments, etc.).
- Another important characteristic is the e-CNY interoperability. It today supports the major e-commerce platforms in China by providing a e-CNY payment by aligning with those platforms' payment settlement mechanisms (s. Figure 11). This can either be a jump app payments method, where users jump from the eCommerce provider's app to the e-CNY app or a closed loop payments method, where users pay within the merchant's wallet having the e-CNY checkout completely integrated in the own wallet (s. Figure 11). In addition, the e-CNY is also interoperable with traditional payment gateway integration mechanisms, such as payment terminals in shops, QR codes, etc.

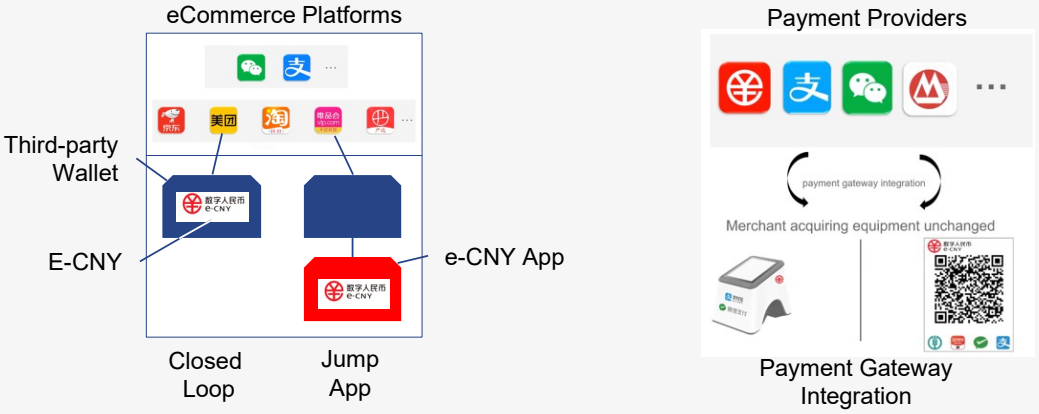

Figure 11: e-CNY Interoperability

- A new functionality of the e-CNY is the so-called "Cash Red Packet" which allows users to make money presents to individuals and collect money from groups (s. Figure 12). This connects the e-CNY app also to other social media platforms.

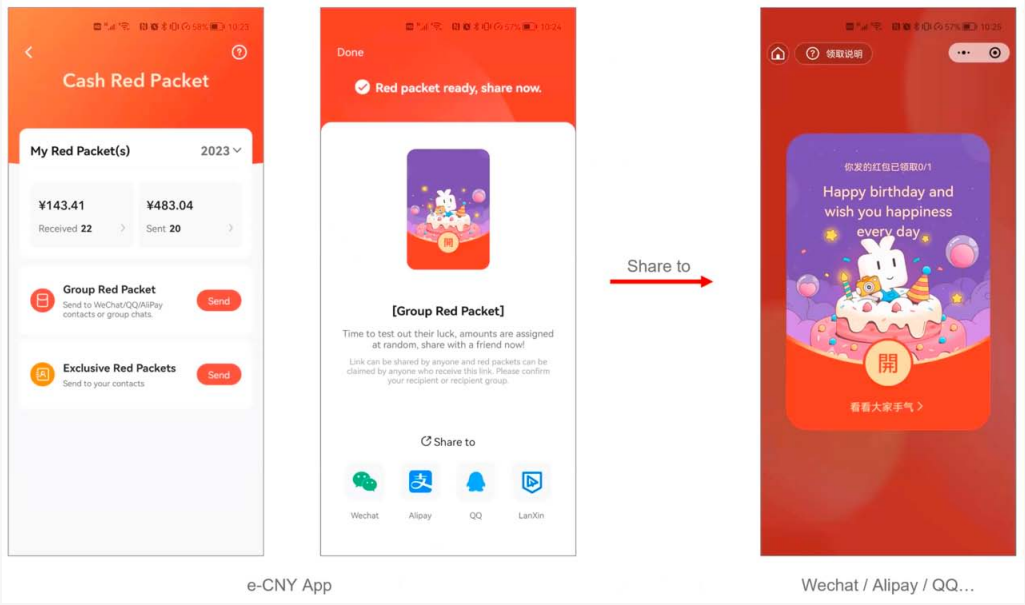

Figure 12: Cash Red Packets

- Another dimension of interoperability is cross-border interoperability which is also part of the G20's initiative on using CBDCs as an instrument to solve the issue of slow and costly cross-border payments. This might follow three guiding principles:
  - **No disruption:** The issuance and use of different CBDCs and their use for cross-border payments should not disrupt the status quo of each involved jurisdiction.
  - **Compliance:** Cross-border arrangements with CBDC should comply with all involved jurisdictions.
  - **Interoperability:** Interoperability between different CBDCs of different jurisdictions could be processed though the conversion of different currencies at the virtual "border" of digital wallets using a blockchain platform for currency exchange (s. Figure 13). An example is the mBridge project which was explored by 20 central banks (s. https://www.bis.org/about/bisih/topics/cbdc/mcbdc_bridge.htm). Exemplary use cases are international trade, supply chain financing, etc.

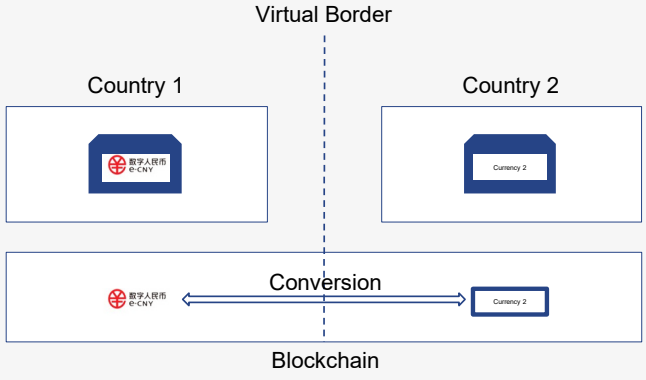

Figure 13: Future Scenario for Cross-border CBDC Conversion

Source: People's Bank of China

Case Study 5: Digital Euro

- The digital Euro is discussed as a complement to cash and central bank deposits. It is understood as a digital central bank liability for retail payments of citizens and businesses in the entire euro area and shall have the following characteristics:

  - Complementing, not substituting, cash and wholesale central bank deposits.
  - Supervised intermediaries (payment service providers (PSPs), such as banks) will facilitate the distribution of a digital euro.
  - Source of innovation and public good, shall not crowd out banks nor hinder innovation in payments.

- The main reasons for the digital euro are (1) to ensure access to public money and its role as monetary anchor and (2) to protect the European strategic autonomy and monetary sovereignty, while avoiding market dominance of private providers. This shall be insured by defining five core principles for the digital euro, namely:

  - Conversion: Convertible at par with other forms of the euro.
  - Trust: Should be trusted like all other forms of the euro.
  - Neutrality: Shall not crowd out private initiatives and solutions.
  - Accessibility: Widely accessible on equal terms throughout euro area.
  - Risk: Should not create financial or other undue risks to the Eurosystem.

- Currently, the digital euro focuses on person-to-person, consumer-to-business and X2G/G2X payment scenarios. It does not consider b2b and machine-initiated payments. The Eurosystem is considering a payment scheme approach which aims at developing a common rules-based framework for participants to develop their products. These scenarios will be implemented based on three foundational design choices (s. Figure 14). This covers first an online solution (the offline solution is planned for a later phase), privacy principles regarding personal data, transaction data for AML/CFT and settlement without tracking holdings and transaction patterns of users as well as tools to control the amount of digital euro in circulation, such as holding limit options and remunerations. However, a full anonymity and full transparency to the central bank are not to be pursued. Instead, the baseline scenario is that limited data is transparent to the intermediaries for customer onboarding and AML/CFT purposes, as is the case for electronic payments today. The settlement of digital euros which are transferred between two parties could therefore be done by so-called hierarchical deterministic (HD) wallets. In this case the infrastructure would only "see" payments between randomly created wallet addresses, as such a HD wallet creates randomly generates key that are backed up in the wallet. For cross-border payments, the digital euro is based on the same principle as the e-CNY, where a virtual border between two countries exists. This means that a digital euro can only be used domestically to reduce the risk of "eurorization" etc.

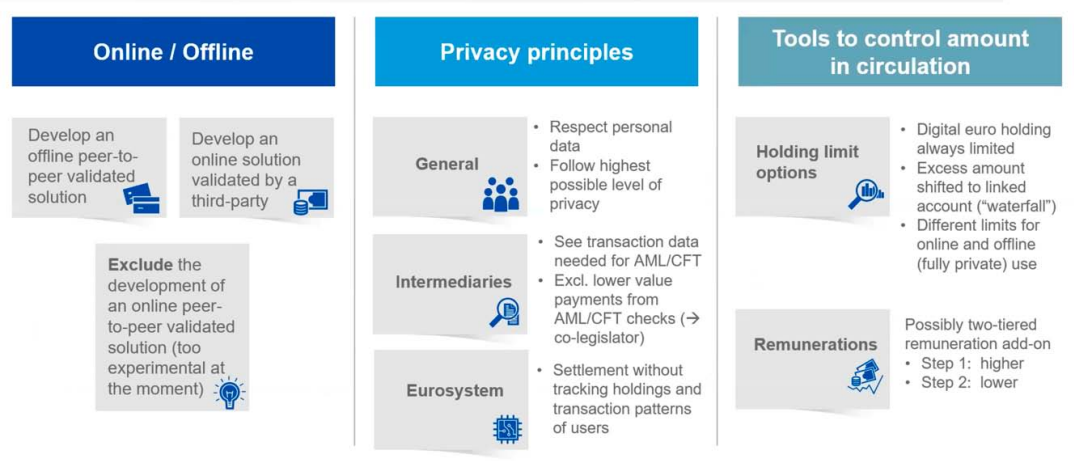

Figure 14: Digital Euro Function Design Choices

- The digital euro will not be programmable but it will allow for conditional or automated payments. Table 3 summarizes all the requirements of the digital euro.

Requirement	Type
Enhanced digital efficiency	The digital euro should keep pace with state-of-the-art technology at all times in order to best address the needs of the market as regards, among other attributes, usability, convenience, speed, cost efficiency and programmability. It should be made available through standard interoperable front-end solutions throughout the entire euro area and should be interoperable with private payment solutions.
Cash-like features	To match the key distinctive features of cash, a digital euro aiming to tackle a decline in the acceptance of cash should permit offline payments. Moreover, a digital euro should be easy for vulnerable groups to use, free of charge for basic use by payers and should protect privacy. It should have a strong European branding.
Competitive features	The digital euro should have features which are at the technological frontier. It should offer the basis for providing functionalities that are at least as attractive as those of the payment solutions available in foreign currencies or through unregulated entities.
Monetary policy option	If considered to be a tool for improving the transmission of monetary policy, the digital euro should be remunerated at interest rate(s) that the central bank can modify over time.
Back-up system	If aiming to improve the overall resilience of the payment system, the digital euro should be widely available and transacted via resilient channels that are separate from those of other payment services and can withstand extreme events.
International use	The digital euro should be potentially accessible outside the euro area in a way that is consistent with the objectives of the Eurosystem and convenient to non-euro area residents.
Cost saving	(if launched for cost efficiency): The design of the digital euro should achieve a reduction in the cost of the current payments ecosystem.
Environmentally friendly	The design of the digital euro should be based on technological solutions that minimise its ecological footprint and improve that of the current payments ecosystem.
Ability to control the amount of digital euro in circulation	The digital euro should be an attractive means of payment, but should be designed so as to avoid its use as a form of investment and the associated risk of large shifts from private money (for example bank deposits) to digital euro.

Cooperation with market participants	A project to introduce a digital euro should be carried out in line with best practices in IT project management. The digital euro should then be made available on an equal basis in all euro countries through supervised intermediaries, which could leverage their existing customer-facing services and avoid the costly duplication of processes.
Compliance with the regulatory framework	Although central bank liabilities are not subject to regulation and oversight, in issuing the digital euro the Eurosystem should still aim at complying with regulatory standards, including in the area of payments.
Safety and efficiency in the fulfilment of the Eurosystem's goals	The digital euro should be designed in a safe and efficient way. Its project and operating costs should be estimated and compared with the expected benefits, considering alternative solutions in any future scenario. The provision of non-core services should be left to supervised private entities.
Easy accessibility throughout the euro area.	The digital euro should be made available through standardised front-end solutions throughout the entire euro area and should be interoperable with private payment solutions. It should be easily accessible by anyone, including citizens who currently do not participate in the financial system (for example, those who do not have an account at a commercial bank), and should be easy to use. The digital euro would need to co-exist with cash.
Conditional use by non-euro area residents	The design of the digital euro should include specific conditions for access and use by non-euro area residents, to ensure that it does not contribute to excessively volatile capital flows or exchange rates. Such conditions could take the form, for instance, of limits or adequate remuneration policies for holdings of digital euro of non-euro area residents.
Cyber resilience	Digital euro services will need to be highly resilient to cyber threats and capable of providing a high level of protection to the financial ecosystem from cyberattacks. In the event of successful attacks, the recovery time should be short, and the integrity of the data protected.
Ability to control the amount of digital euro in circulation	The digital euro should be an attractive means of payment, but should be designed so as to avoid its use as a form of investment and the associated risk of large shifts from private money (for example bank deposits) to digital euro.

Table 3: Requirements of a Digital Euro (ECB 2020)

- The digital euro project was started in the fourth quarter of 2021 based on a governing council decision. After a prioritization of use cases (Q1/2022), the definition of privacy levels and offline/online availability (Q2/2022), the discussion of design options and the distribution model (Q3/2022) as well as a focus on the settlement model, the role of intermediaries and the amount in circulation (Q4/2022), the current focus in Q1/2023 is on the compensation model, the access to the digital euro ecosystem, value added services, advanced functionalities and prototyping results. This will be followed by a governing council decision to launch the realization phase in autumn 2023.

Source: European Central Bank

5. (De-)Regulation

The Crypto Regulation Dilemma

Over the past years, the regulatory message has flipped from being crypto friendly to being more crypto critical. Although recent regulation is not just about being restrictive, the industry observed hardening pronouncements made by (IMF 2023), (Financial Stability Board 2022), (EU 2022) as well as the US' Lummis-Gillibrand Act and the UK's HMT consultation paper, which are an outcome of some of the market failures like FTX. For example, on January 3rd 2023, the Board of Governors of the Federal Reserve System (Federal Reserve), the Federal Deposit Insurance Corporation (FDIC), and the Office of the Comptroller of the Currency (OCC) collectively, the agencies were issuing a statement on crypto-asset risks to banking organizations and came to the conclusion that "(…) issuing or holding as principal crypto-assets that are issued, stored, or transferred on an open, public, and/or decentralized network, or similar system is highly likely to be inconsistent with safe and sound banking practices." (Federal Reserve 2023). This can be interpreted as an answer to the many fraud-like activities that happened over the past years within the crypto sector. Examples are artificially inflated crypto trading volumes, no KYC, and no AML in the name of financial inclusion or lies about deposit protection (FDIC). These events demonstrate that some form of regulation is required. But how can it look like?

Towards an Optimal Crypto Regulation

While significant policy attention is placed on digital assets created in the crypto economy, only little attention has been paid to what the economic innovation potential of web3 could entail (Chiu 2021). Is there a broader commercial sphere that can be both enabled and governed by regulation, and not just a financial sphere? This means that financial regulation should be designed in a way that it considers broader implications of the crypto economy on the whole digital economy. For many of these models it might be more productive to consider enterprise law instead of focusing only on financial regulation. Amongst the examples are digital tokens, which are used by entrepreneurs as an incentive to partner with other firms or security token offerings (STOs) which are often being referred to as an alternative approach to IPOs for smaller companies which could foster innovation for SMEs. These STOs are the followers of the former ICOs, which have been banned in many countries. But at least, those crypto economic models have proven beneficial for funding the development of technology start-ups. For this, the European MiCAR regime, for example, demands a mandatory disclosure via white papers, which have been sent to authorities and can then be published and marketed 20 days after the notification. MiCAR also includes other requirements for this. However, given the early stage of such initiatives in the development, there might be different approaches for this as well, such as disclosures for pre-development projects may be tentative and more skeletal but relevant disclosures might be useful (e.g., team qualifications and expertise, description of the project concept, etc.), staged financing models which require funds to be held in escrow and can only be released according to certain milestones (which would also allow the refund of unspent balances), etc. Other examples for novel web3 approaches are peer-to-peer services in gaming, file storage (e.g., Filecoin), direct sales of digital goods (e.g., art, music, collectibles), etc. All these examples are a result of the new possibilities to directly exchange values of all kinds on the internet. Another important element of web3 models is payments. For this, stablecoins

have most recently emerged. However, today, MiCAR, for example, argues that only authorized entities can issue stablecoins.

When it comes to regulation, there is a conflict because centralized systems and decentralized systems both have their benefits and challenges. While centralized systems can be points of cybersecurity attacks and fraud, decentralized systems today do not have any processes in place for withdrawing transactions or any other issues related to centralized auditing. A major difference of all blockchain-related models is the absence of intermediaries. For example, are protocol providers intermediaries and with what responsibilities (e.g., whitelists of participating organizations) and how can KYC be performed? So, the question is if there are gaps in today's enterprise laws which would call for action to establish a new enterprise law for blockchains and a new DAO law? For example, many decentralized businesses are formed as companies. Also, this might make sense for a DAO, where a separate legal personality for the community of the DAO is beneficial. For example, this is the case for DAOs like PleasrDAO as the owner of the Doge meme NFT, where the lack of personality can raise queries re the ownership of the NFT as fractionalized token holding is not the same as the ownership of the whole NFT. As such, DAOs may have different governance, and especially exit protocols for token holders, which is unlikely to be created under existing organizational law. This explains why DAOs cannot be companies. Companies have clearly separated governance bodies, while DAOs do not have any division of responsibility. In addition, enterprise laws do not cater to specifics of peer-to-peer and automated technologies and DAOs at scale could become platforms. So, one path forward could be to establish a DAO law, which allows more flexibility for certain innovative businesses that can then be more agile and are not restricted by constraints of existing enterprise laws. However, the characteristics of decentralized finance show that an enterprise law could be a key element, while financial regulation might be too specific. In other words, it might be more beneficial to internalize governance standards via enterprise law instead of externalizing standards via regulation.

6. Summary: The Vaduz Architecture for Developing the Financial System 2030

The Vaduz Architecture, which was introduced during the sixth Vaduz Roundtable, serves as an instrument to document and describe the complexity levels of the Financial System 2030. This roundtable edition contributed to the Vaduz Architecture in the following fields:

- **Businesses:** Businesses in the financial sector benefit from using regulatory sandboxes that have been introduced around the world in different countries. They reduce the costs of becoming part of the financial industry, since regulatory costs are very high. But these benefits also spread to the industry level since participation in the sandbox by one start-up is followed by increased entry and more money being raised by other start-ups in the same industry.

- **Technology:** Quantum computing is a strong driver of change in all areas of information technology. It is a game changer, as it redefines all other IT related fields like AI, blockchain, etc. However, currently, users follow a hybrid approach as the technology is not fully available yet and old technology is still in place in many areas. This requires organizations to define transition phases, where, for example, old cryptographic algorithms can be combined with new ones. Another important field is decentralized identifiers (DIDs), which just recently were defined as a standard by the W3C, and which allow users and organizations to take greater control of their data. This is complemented by digital wallets, which are now embedded in almost every web browser, and thus become available for everyone on a global scale. However, this also raises new questions when different CBDCs are used in different regions of the world leading which might lead to a "splinter net". A fourth important field is AI, where just recently ChatGPT has gained much attention. The emergence of so-called foundational models which are built on extremely large, unannotated datasets allows users to apply AI more easily and at a fraction of the cost than previous, supervised AI models.

- **Regulation:** While regulation has concentrated on financial institutions in the past, it must now deal with novel approaches like DeFi and crypto assets. Over the past years the regulatory trend has shifted from being crypto-friendly to being more crypto-critical. However, only little attention has been paid to the innovation potential of web3 which is fuelled by the promising potentials of the internet of value and the possibilities of the financial internet for novel peer-to-peer approaches in gaming, file storage, music and all kinds of digital goods. By taking a closer look at the current regulatory approaches, it turns out that financial regulation might not be a one size fits all solution. Alternatively, enterprise law approaches might provide a better fit for certain areas as, for example DAOs. However, they also have some gaps, such as missing flexibility for allowing separated governance bodies in DAO environments.

- **Nations/states/communities:** The introduction of various CBDCs could potentially lead to a more fragmented financial and business world due to the "splinter net". China, for example has already introduced its CBDC, the e-CNY, while Europe is preparing the launch of the digital Euro later and the US is still working on a conceptual stage. The e-CNY, for ex-

ample, will improve cross-border payments and interoperability with e-commerce platforms in China by using jump app payment methods or closed loop payment methods, where users pay within the merchant's wallet. While this interoperability is of great benefit within one country, nations currently define virtual borders for the use of CBDC. This means that the use of CBDC outside a country is currently unclear or even out of scope. This means that a certain CBDC is converted into another CBDC when this CBDC crosses borders. In both discussed examples, the CBDC is used as a two-tiered approach, in which only supervised and authorized institutions are allowed to provide access to digital Euros or the e-CNY. With this, for example, the digital euro focuses on person-to-person, consumer-to-business and X2G/G2X payment scenarios. It does not consider b2b and machine-initiated payments yet.

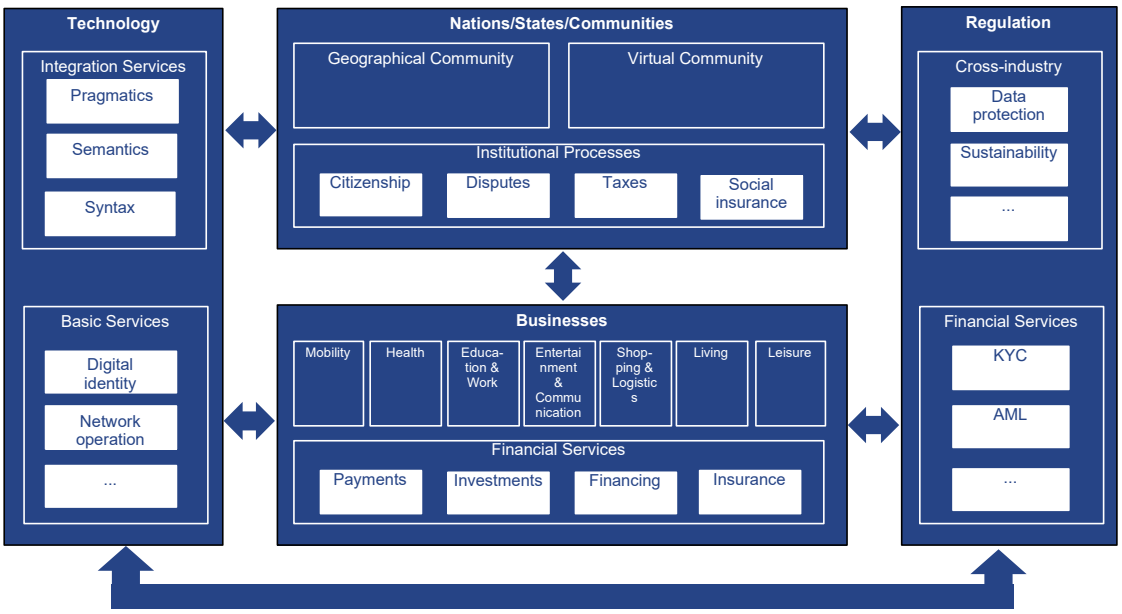

Figure 15: Vaduz Architecture "Financial System 2030"

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List of Figures and Tables