

Challenges of the introduction of the digital euro - search for a compatibility model for North Macedonia

Ilievski, Andrej; Pečarić, Mario

Source / Izvornik: **Southeast European Review of Business and Economics (SERBE), 2022, 3, 9 - 25**

Journal article, Published version

Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

<https://doi.org/10.20544/SERBE.06.02.22.P01>

Permanent link / Trajna poveznica: <https://urn.nsk.hr/urn:nbn:hr:192:015609>

Rights / Prava: [In copyright](#)/[Zaštićeno autorskim pravom.](#)

Download date / Datum preuzimanja: **2025-01-02**



SVEUČILIŠTE U RIJECI
EKONOMSKI FAKULTET

Repository / Repozitorij:

[Repository of the University of Rijeka, Faculty of Economics and Business - FECRI Repository](#)



SOUTHEAST EUROPEAN REVIEW OF BUSINESS AND ECONOMICS

Vol.3, Issue 2, 2022

*CHALLENGES OF THE INTRODUCTION OF THE DIGITAL
EURO-SEARCH FOR A COMPATIBILITY MODEL FOR
NORTH MACEDONIA*

Andrej Ilievski, Mario Pecaric

*ANALYSIS OF THE IMPORTANCE OF THE BANK LOANS
AS FINANCING SOURCE OF SMEs IN KOSOVO AND
NORTH MACEDONIA*

Filloreta Kunoviku Demiri, Qazim Tmava, Ajtene Avdullahi

*DETERMINANTS OF CORPORATE GROWTH: EMPIRICAL
INVESTIGATION OF THE SOUTHEAST EUROPEAN
COMPANIES*

Aleksandar Naumoski

*DIGITALIZATION OF BUSINESS IN EUROPEAN
UNION - STATE AND PRIORITIES*

Zoya Ivanova, Ivan Marinov

*FINANCING ROMANIAN SMES - CHALLENGES AND
OPPORTUNITIES DURING THE PANDEMIC CRISIS*

Laura Vasilescu, Catalina Sitnikov

*PAY PERCEPTION AND EMPLOYEES INTENT
TO LEAVE, STUDY OF THE MACEDONIAN
NON - BANKING FINANCIAL SECTOR*

*Ivana Panova, Ana Tomovska Misoska, Elena Bundaleska,
Snezana Hristova*

FACULTY
OF ECONOMICS
- PRILEP

CHALLENGES OF THE INTRODUCTION OF THE DIGITAL EURO - SEARCH FOR A COMPATIBILITY MODEL FOR NORTH MACEDONIA

Andrej Ilievski¹, Mario Pečarić²

Abstract

The introduction of the digital euro will have an impact on the implementation of the financial policy of North Macedonia. Based on an assessment of its own interests and capabilities, North Macedonia can decide on a model for compatibility with the digital euro. The paper analyses three possible models for cross-border system compatibility. Assuming that a digital euro provides a new channel for the transmission of domestic monetary policy shocks, the basic cross-border effects of the introduction of the digital euro can be summarised as an increase in euroisation, a reduction in monetary policy independence and a reduction in the creditor function of last resort. These effects need to be countered with integrated smart features such as automatic remuneration and bilateral cooperation with the ECB or a combination of these models. According to the analysis, this functionality can be achieved through the model, which is a technological bridge between the systems, as opposed to the model, which is a separate system, or the model, which is integrated. Although the proposed model is the most desirable in terms of potential gains and addressing potential risks, this model involves the development of an own digital currency (digital denar).

Keywords: Digital Euro, Compatibility Model for North Macedonia, Digital euro Challenges.

¹University American College Skopje, Skopje, North Macedonia
E-mail: andrej.ilievski@uacs.edu.mk

²University of Split, Faculty of Economics, Business and Tourism; University of Rijeka, Faculty of Economics and Business, Rijeka, Croatia
E-mail: mpecaric@efst.hr

1. Introduction

Research on the advantages and disadvantages of introducing centralised central bank digital currencies (CBDCs) has been particularly topical recently. Indeed, numerous advantages are highlighted and a number of pilot projects exist, regardless of the degree and size of countries. Due to the importance of the euro area and the euro integration process, the introduction of the digital euro is of particular importance in research.

Digital euro might benefit the EU's overall economic policy (EU) by providing a secure digital asset with cutting-edge functions alongside currency, it might be able to meet the evolving payment needs of a modern economy. The public sector may end up being in the greatest position to provide the security, scope, level of accessibility, and convenience required to permit individuals, companies, and financial institutions to engage in the digital payment industry.

Depending on the model chosen, not only the non-euro countries of the EU are affected, but also third countries, especially those in the process of European integration, including North Macedonia. Unfortunately, there are very few studies of this kind, even in conceptual form, both because of the uncertainty about the final model of the digital euro, whose introduction is more important especially for retail than for wholesale, and because of the passive attitude of small open economies, whose fate is expected sooner or later in the Eurozone, so that the strategy of waiting is the most acceptable.

One of the main objectives of the introduction of the digital euro is to expand the international role of the euro. According to ECB the digital euro will be introduced alongside cash, and it would not replace it (European Central Bank, 2020). Thus, there is one goal of expanding the international importance of the euro, which is to be expected to be affected in a certain way in North Macedonia. North Macedonia is highly euroized country (high share of credit and deposit euroization) with a fixed exchange rate pegged to the euro. The issue of currency sovereignty is not crucial for the country. Remittances from abroad in euro are a significant source of foreign exchange in the country. Additionally, North Macedonia has agreement with the ECB for the use of repo agreement which provide exchange rate stability.

Taking into account the adopted account-based model of the introduction of the digital euro on the one hand, and the interests of North Macedonia on the other, the paper analyses the strategy and fundamentals of a model-based solution approach that would be compatible with the digital euro and would allow for rapid integration with minimal adjustment costs. The main objective of this paper is to open the conceptual issues of the impact of the introduction of the digital euro for North Macedonia, as well as to highlight the limitations and obstacles.

Macedonia has to rely more on its own development, although this implies the use of an interlink model, which implies the use of the positive effects of digital currency through a system that will be compatible or linked to the ECB.

The ECB analysis highlights the necessity for a cap on the usage of a digital euro outside the eurozone, particularly when considering the cross-border effects. To be coordinated through international coordination with other central banks, such a limit may be required to stop uncontrollable capital flows (Report on a digital euro, 2020). To ensure that it does not cause unduly volatile money flows or exchange rates, the architecture of the digital euro should incorporate certain conditions for access and use by citizens outside the euro region.

The National Bank of North Macedonia cannot, however, be coerced into beginning construction on their own CBDC. Nonetheless, the National Bank of North Macedonia is still now free to decide whether to become a partner in the system's architecture. Later, as the technology gap between the Eurozone and North Macedonia widens, it is more likely that North Macedonia will have to embrace pre-made EU solutions to maintain control over currency flows and its own monetary policy. Therefore, the National Bank of North Macedonia would be best served to re-evaluate its position on a digital denar and start working aggressively with the EU now to create a cross-currency system that is appropriate for its domestic monetary policy (Pečarić et al, 2022).

Within the proposed BIS (2021) models as a theoretical starting framework and taking into account the constraints of North Macedonia, an active adaptation strategy is proposed. The challenges of the digital euro are an opportunity to improve and reform the financial system of North Macedonia with the help of FinTech's in order to make finances more efficient. For the case of North Macedonia, we propose Networked CBDC systems. It might expand on these potential enhancements and offer more protection.

The contents of the paper are reproduced below: The second part is devoted to the possible choice of the digital euro model and the cross-border implications of the digital euro. The focus is on the trade-off between the choice of model and the expected impact, with financial technologies aimed at achieving the objectives. Based on the findings of the second part, the possible strategies and models of compatibility with the digital euro in Northern Macedonia are analysed in order to select a conceptual model. New insights on this topic can be found in the concluding remarks at the end.

2. Digital Euro

2.1 The digital Euro probable model

According to Pečarić et al (2022), we can anticipate that the most likely design of a digital euro will be legal tender constructed on a hybrid account-based system with potential tokenization features at a later stage. Cipollone (2021) emphasises that the creation of the digital euro is a very complex project from an economic, technical, legal and organisational point of view. The choice of an institutional solution is a weighing of the advantages and disadvantages of the identified models in the context of achieving the set objectives with the introduction of the digital euro. The new means of payment must be widely available, even to those who do not have a bank account, easy to use, secure and resistant to cyber-attacks or network failures. It must also protect privacy while allowing for verification. One of the biggest challenges will be to limit bank disintermediation. Although this risk is probably overestimated, it is crucial for Europe as European businesses, especially SMEs, rely heavily on bank intermediation. Papers and publications from ECB list two main models, the account-based model and the token-based model. The account-based model is further divided into direct retail, indirect retail and hybrid digital euro retail. Each of the models has its advantages and disadvantages (Pečarić et al. 2022).

The analyses show that the objectives of the digital euro are best achieved in an account-based model - a hybrid retail form - as it enables improved digital efficiency at a very high level, it has similar characteristics to cash and it enables competition and digital transformation of the European Union and the banking sector. In addition, the security system will be fulfilled, the international role of the euro will be significantly strengthened, cost savings will be clearly visible and environmental sustainability will also be fulfilled. Financial inclusion is much more promoted, financial stability is visible, anonymity of transactions is not fulfilled in any model, including this one. The main arguments in favour of the account-based model, or more precisely the hybrid model, are the use of the infrastructure already in place, which allows for lower costs for the introduction of the digital euro, technological resilience and resource efficiency.

2.2. Cross-border effects of a digital euro

Through integrated smart features like automatic remuneration, bilateral engagement with euro-embedded nations, or a mix of those two strategies, cross-border effects, particularly those relating to currency substitution and currency hoarding, will need to be addressed. Without these

protections, adverse effects could occur both within the Eurozone and in the afflicted counties outside of it.

The ECB analysis highlights the necessity for a cap on the usage of a digital euro outside the eurozone, particularly when considering the cross-border effects. To be coordinated through international coordination with other central banks, such a limit may be required to stop uncontrollable capital flows (Report on a digital euro, 2020). To ensure that it does not cause unduly volatile money flows or exchange rates, the architecture of the digital euro should incorporate certain conditions for access and use by citizens outside the euro region. The adoption of a digital euro is projected to have several cross-border implications.

First, by providing a new conduit for the transmission of domestic monetary policy shocks, a digital euro might enhance their cross-border spillover effects. New digital forms of payments might evade existing capital flow management techniques, such as CBDCs, if not prohibited by design or policy. Existing transaction verification procedures may be rendered useless by new payment instruments and service providers. To guarantee that measures to monitor capital flows remain resilient in the digital era, existing rules and implementation procedures must develop. CBDCs with careful design and modern technology, on the other hand, may be able to aid.

Second, the availability of a digital euro might lead to currency replacement and "erosion" in third countries, especially those with weak currencies and weak economic foundations, as well as those with significant trade relations to the EU. The cross-border availability of CBDCs might minimize the cost of obtaining, holding, and issuing foreign money, depending on design and regulation. International currencies already have strong network effects, and decreased prices might make existing established international currencies even more appealing.

The issuing of CBDCs by foreign central banks might boost the standing of some international currencies while hurting others. This might lead to more widespread currency replacement with a foreign CBDC, especially in nations where inflation is strong and exchange rates are unpredictable. Currency substitution is already widespread and persistent, as noted in IMF (2020) (foreign currency deposits exceed 50 percent in more than 18 percent of countries worldwide). While a lack of trust in a country's own currency is the primary cause of currency replacement, quick currency substitution because of domestic issues may jeopardize governments' efforts to improve domestic policy.

Third, broad adoption of a digital euro outside of the euro area might have a considerable impact on the affected nations' monetary sovereignty. Currency substitution on a large scale would jeopardize monetary policy

independence and pose hazards to both the originating and receiving countries. Shifts in foreign demand for CBDCs might result in major changes in capital flows, which could alter monetary policy in the issuing nation. This might stifle the monetary transmission mechanism, which is how policy-induced changes in monetary instruments like short-term nominal interest rates impact macroeconomic variables. Foreign currency issued by nations whose business cycles differ from those of the host country would result in inadequate monetary policy control and more unpredictable inflation in the latter, with a disproportionate impact on poorer and more vulnerable families.

Fourth, currency substitution might jeopardize the domestic central bank's capacity to act as a lender of last resort. Because the central bank is unable to create foreign currency to provide liquidity support when domestic banks have large liabilities denominated in foreign currency, which can occur because of large-scale currency substitution, the central bank must rely on foreign reserves or liquidity provision by foreign central banks.

3. Model for North Macedonia

For CBDCs to promote the improvement of cross-border payments, a variety of factors would need to be taken into consideration. The BIS (2021) report approaches these issues from two perspectives: first, from a practical view on how a cross-border payment infrastructure with CBDCs could be set up; and second, from a macro-financial perspective, looking at the potential increase in cross-border flows, potential dangers to financial stability and currency substitution, as well as reserve currency configurations and backstops.

There are two fundamentally distinct ways to think about cross-border payments with CBDCs. The first scenario presupposes that anyone inside and outside of a given jurisdiction can purchase a retail CBDC, with little to no coordination between the issuing central banks. In this scenario, foreign residents would automatically have access to it provided the design supports anonymous payments like cash. In reality, though, a small number of central banks are taking such systems into consideration. Contrary to cash, the CBDC's technology and legal framework might be used to apply a variety of cross-border use restrictions. The domestic layout of a CBDC affects this first situation. The second scenario implies some level of CBDC interoperability based on access and settlement agreements to permit the cross-border use of CBDCs from two or more jurisdictions. Such agreements can link wholesale and retail CBDCs across international borders, involve close coordination between central banks, and include technical, market-

structure, and regulatory issues. This second scenario, which is the main subject of the research, depends on the interoperability infrastructure's design decisions.

Other factors being equal, cheaper, and speedier cross-border transactions might raise the likelihood of local banking sector and currency runs. Currency substitution, or the exchange of one currency for another, might happen swiftly. A run on the banking system in many emerging and developing nations is already virtually a run on the national currency as money flee the country (Leaven and Valencia, 2018). Furthermore, decreased transaction costs in foreign currencies may result in increased foreign currency risk for families, businesses, and perhaps institutions, posing a danger to financial stability.

Transaction security, population inclusion on a massive scale, and cost effectiveness are only a few of the major advantages of a CBDC system (Bindseil, 2020). The risk of the deposit bank going bankrupt is also eliminated by a digital euro, making it safer than deposit money. However, the advantages of a digital euro must be evaluated against the hazards of its implementation, and it should only be implemented in a fashion that is tailored to the unique characteristics of the financial system. This creates dangers for the Macedonian financial system considering the potential issuance of the digital euro. On the other hand, as individuals start relying more and more on digital payments and banknote usage finally declines, a concentration danger may arise. Due to economies of scale, there will always be a higher degree of concentration in this situation; hence, bigger firms would likely create oligopolies or monopolies and possibly raise the cost of payment services. Consequently, prices for goods and services will rise, which could reduce the Macedonian economy's productivity. Second, because of the strategic importance of payments to economies, there is a danger that larger international actors in the sector might quickly gain control of the Macedonian payments industry, putting the country in a weakened position where it would be difficult to maintain its own currency sovereignty (Pečarić et al, 2022).

3.1 Models of cross-border CBDC system compatibility

Compatible CBDC systems (Model 1) might supplement existing central bank money markets as a way of settling cross-border transactions. A greater range of cross-border and cross-currency "front-end" payment services might be available if open, competitive, and interoperable domestic payment systems are developed, allowing a more diversified group of banks and non-banks wholesale access to central bank money for payment

settlement. This might help to decrease payment fragmentation and concentration.

CBDC systems that are networked (Model 2) might expand on these potential gains while also adding security. PvP settlement, in example, might be integrated via a technological bridge between household systems. New technologies (e.g., Bank of Canada (BOC) and Monetary Authority of Singapore (MAS) (2019)) might make this possible. Common clearing methods, especially when linked to FX trading venues, might potentially improve efficiency.

Finally, a single mCBDC system (Model 3) might be able to deliver the same benefits as connected systems, but with more integration. For example, rather than requiring routing or special settlement instructions through an interface, all FX settlements would be PvP by default (see Glossary). Trading venues might potentially be linked into mCBDC systems, reducing complexity, fragmentation, and concentration in FX markets (assuming the correct designs) (Bank of Thailand and Hong Kong Monetary Authority (2020)). Such a model has been employed for Project Dunbar and Project Aber (see SAMA and CBUAE (2019, 2020)), and it even goes a step further with the joint issuing of a CBDC used in the single mCBDC arrangement (see SAMA and CBUAE (2019, 2020)). The issued CBDC was virtually guaranteed a fixed exchange rate to both local currencies for the length of the proof of concept because both the Saudi riyal and the UAE dirham are tied to the US dollar.

Table 1. Potential improvements of various CBDC arrangements related to the current frictions in cross-border payments.

Frictions cross-border Payments	Model-1 mCBDC arrangement based on compatible CBDC systems	Model-2 mCBDC arrangement based on interlinked CBDC systems	Model-3 single mCBDC multi-currency system
Legacy technology platforms	Compatible systems allow for efficiency gains in existing banking relations	A common clearing mechanism could reduce the number of relationships and provide economies of scale	A single system does not require such relations (however, a single system may add to operational costs)
Limited	CBDCs can be open 24/7, eliminating any mismatch of		

operating hours	operating hours		
Fragmented and truncated data formats	Compatible message standards allow payments to flow without data loss or manual intervention	The message standard (e.g. ISO 20022) adopted by the interlinkage would act to harmonize standards across systems	Single message standard across the system eliminates mismatches
Unclear FX rates and unclear incoming fees	Compatibility requirements for wallet providers could enable users to calculate fees and rates prior to a payment	Common calculation of rates and fees for transfers using any interlinkage would aid transparency	A single system would likely be designed to include options for FX conversion
Long transaction chains	CBDCs could settle instantly, reducing the need for status updates		
Complex processing of compliance checks	Compatible compliance regimes reduce uncertainty and costs	Interlinking systems do not impact multiple or conflicting compliance requirements	Single set of access requirements means compliance could be equivalent across the system

Source: Adapted from Auer R., Haene and Holden (2021), "Multi-CBDC arrangements and the future of cross-border payments", BIS Papers No 115

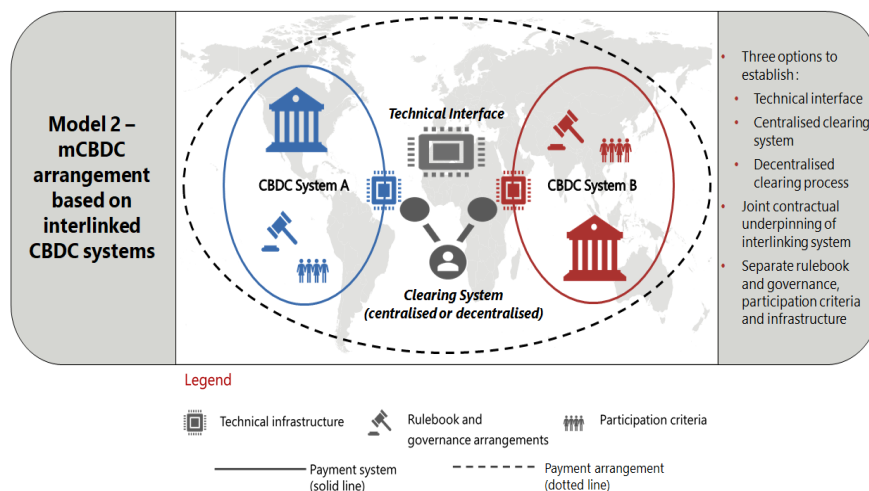
It's impossible to determine which type of collaboration between the other central banks will have with the ECB after the previous discussion. It will depend on the level of integration into the European financial system. Differences may emerge based on how well a state meets the requirements for adopting the euro in general. Later on, as the technology gap between the Eurozone and other non-EU countries widens, it becomes

more possible that they will be forced to embrace pre-designed EU solutions in order to maintain control over monetary flows and its own monetary policy. It is thus in the central banks of other countries that are highly euroized best interests to actively engaging with the EU at this early stage in order to develop a cross-currency system that is suitable for its domestic monetary policy.

3.2 Models of cross-border CBDC and North Macedonia

Connecting payment systems is a difficult task and often requires compatibility measures. In reality, this can take two forms: (a) a common technological interface or (b) a common clearing mechanism (which in the case of CBDCs could be through decentralised mutual accounts or a more centralised common clearing house or system). Participants in one system can send payments to participants in another system thanks to a common technical interface supported by contractual arrangements between the systems. A common clearing method (Figure 1) follows a different strategy and connects systems through specific clearing accounts instead. Arrangements for CBDCs could include foreign exchange provided by central banks or private companies. A trusted third party could serve as a clearing mechanism for participating central banks in a more centralised model. For example, if CBDC is provided domestically through a hybrid CBDC architecture that allows the private sector to connect to the central bank server in a flexible manner, this would favour common technological interfaces and a centralised common clearing mechanism. Directly offered CBDCs would arguably be better suited to a decentralised approach, with central banks providing users with foreign exchange or access to other currencies through bilateral arrangements with other central banks. Building a robust ecosystem with the right balance of incentives for users to use the system safely and efficiently is a significant undertaking with considerable risk. In particular, if CBDC is distributed by the private sector, major difficulties may arise due to disruption of incumbents' business models (e.g. a new connection might require too much investment from participants or compete with their existing profitable services). A lack of comprehensive compatibility may also entail costs and risks that would make the use of interconnection unattractive. In the past, simply linking systems without spending money on broader coordination to achieve interoperability has not been sufficient to enable effective cross-border payments. However, if systems have a high level of interoperability, improvements in security and efficiency are possible. Systems that are interconnected can perform various functions that are not possible in purely informal arrangements (e.g. PvP maintained through a technical interface) (Auer, Haene and Holden, 2021).

Figure 1: mCBDC arrangements based on linking multiple CBDC systems – Model 2



Source: Auer, Haene, and Holden (2021).

Interestingly, the BIS survey Auer et al. (2021) findings show that more most central banks are undecided regarding to mCBDC. Furthermore, model that is feasible for more than a quarter of central banks are contemplating incorporating interoperable capabilities to lessen frictions in cross-border and cross-currency settlement when constructing their CBDC. According to the responses, interlinking the local CBDC system with a foreign system is the mCBDC configuration, which is the most favoured option. Most central banks are also considering taking on operational responsibilities. The level of involvement might possibly range widely, from direct liquidity provision to monitoring and facilitating FX conversions.

Similar, we propose this model because:

- It is better to work on this issue and to be ready
- The Macedonian central bank will show that is capable to concept own CBDC
- Having in mind that Macedonian economy is highly dependent from the remittances from abroad this will lower the costs and lower the percentage of cash transfer across the borders (thefts, penalties etc)
- In the meantime, Macedonia can integrate into the payment infrastructure, so later when enter in EU to be ready. In order to achieve a higher degree of payment integration with the EU, the system for cross-border payments in euros through the connection

of the Macedonian Interbank Payment System (MIPS) with the payment system TARGET 2 (Trans-European Automated Real-time Gross settlement) Express Transfer system) should be re-established.

- This will encourage the private sector (especially banks but other financial institutions as well to promote innovations in the sphere of payments)

Through a technical interconnection between domestic systems, PVP settlement could be integrated. According to the Bank of Canada (BOC) and the Monetary Authority of Singapore (MAS) (2019), new technologies may make this possible through creative methods. Additionally, when connected to FX trading venues, common clearing processes may offer increased efficiency.

But, on other hand this is optimistic considering the until now the behaviour of National Bank of Republic of North Macedonia (NBRNM). Namely, although NBRM was connected through the Central bank of Italy in TARGET 2, in 2018 this possibility was terminated and still there is lack of will to re-establish. Namely, in early 2017, the National Bank of the Republic of Macedonia began operating a system for cross-border payments in euros, by connecting the Macedonian Interbank Payment System (MIPS) with TARGET 2 of the Eurosystem and for that purpose, the Bank's MIPS was upgraded to making euro payments and connecting to TARGET 2 through the Bank of Italy and thus MIPS has grown into dual-currency system for payments in denars and euros (NBRNM, 2017). Later, with the changes made to the Macedonian Interbank Payment System Operating Rules, without more detailed explanation except that Central bank of Italy increased the fees, NBRNM restricted this channel (NBRNM, 2019).

4. Conclusion

North Macedonia, as a small open economy in the process of EU integration, must take into account the changes in the Eurozone monetary system with the introduction of the digital euro. One of the objectives of the introduction of the digital euro is to strengthen the international role of the euro as a world reserve currency. Although the model for the introduction of the digital euro is likely to take the form of a hybrid account base model, which primarily concerns the retail sector, the need to develop a strategy or compatible model arises due to the cooperation of North Macedonia and its monetary policy with the Eurozone.

With regard to the introduction of CBDC, central banks have to choose between reactive and inactive or proactive. If the central bank takes a passive stance, it draws on the experience of other central banks that were CBDC pioneers and follows the development. While this may seem prudent, there are a number of unintended consequences, given recent technological advances in the financial industry (Ilievski and Delova-Jolevska, 2021). Networked CBDC systems (Model 2) could extend these potential benefits while enhancing security. For example, PvP settlement could be integrated via a technological bridge between household systems. A common clearing mechanism could reduce the number of relationships and provide economies of scale. The message standard chosen by the link (e.g. ISO 20022) would help to unify standards between systems. Transparency would be improved through the use of a standard formula for calculating rates and charges for transfers. The impact of different or conflicting compliance requirements will not be affected by interconnected systems. Economies of scale and a common billing system could help reduce linkages. Interconnection would help to unify standards between systems as the messaging standard (e.g. ISO 20022) is accepted by it. Transparency would be improved by adopting standardised rates and charges for transfers over any given link. Multiple or conflicting compliance standards are not affected by interconnected systems.

Systems that are interconnected can perform different functions that are not possible in purely informal arrangements (e.g. PvP maintained through a technical interface) (Auer, Haene and Holden, 2021). However, when CBDC is distributed by the private sector, major difficulties may arise because incumbents' business models are disrupted (e.g. a new connection may require too much investment from subscribers or compete with their existing profitable services). Lack of interoperability may also bring costs and risks that would make the use of the connection unattractive. However, high interoperability of systems can lead to greater security and efficiency.

References

Alt R., Beck R. and Smits M. (2018). FinTech and the transformation of the financial industry. Article in *Electronic Markets* · August 2018

Arner DW, Barberis JN, Walker J, Buckley RP, Dahdal AM and Zetzsche DA (2020a) Digital finance & the COVID-19 crisis. University of Hong Kong Faculty of Law Research Paper No. 2020/017. Available at: <http://www.ssrn.com/link/U-Hong-Kong-LEG.html> (accessed 12.08.2020).

Auer R., Boar C., Cornelli G., Frost J., Holden H. and Wehrli A. (2021b). CBDCs beyond borders: results from a survey of central banks. *BIS Papers* No 116. <https://www.bis.org/publ/bppdf/bispap116.pdf> (accessed: 12.08.2022)

Auer, R, P Haene and H Holden (2021a): “Multi-CBDC arrangements and the future of cross-border payments”, *BIS Papers*, no 115, March.

Bijlsma M., van der Cruijssen, C., Jonker, N. and Reijerink, J. (2021). What triggers consumer adoption of CBDC? Working Paper No. 709, De Nederlandsche Bank NV

Bindseil, U. (2020): “Tiered CBDC and the financial system”, *ECB Working Paper Series*, No 2351 / January 2020

BIS (2021). Central bank digital currencies for cross-border payments. Report to the G20, July 2021. <https://www.bis.org/publ/othp38.pdf> (accessed: 12.08.2022)

Caciatori I. and Cherobim APMS (2021). Defining categories of Fintechs: A Categorization Proposal Based on Literature and Empirical Data. *FUTURE STUDIES RESEARCH JOURNAL SÃO PAULO*, V.13, N.3, pp. 386 – 408

Gai KK, Qiu MK, Sun XT (2018a) A survey on FinTech. *J NetwComput Appl* 103, pp. 262–273

Castiglione A, Pizzolante R, De Santis A, Carpentieri B, Castiglione A, Palmieri F (2015) Cloud-based adaptive compression and secure management services for 3D healthcare data. *Future Gener Comput Syst* 4, pp. 120–134

Castiglione A, De Santis A, Soriente C (2007) Taking advantages of a disadvantage: digital forensics and steganography using document metadata. *J Syst Softw*80(5), pp. 750–764

European Central Bank, Report on a digital euro, October 2020, p. 6, available at https://www.ecb.europa.eu/pub/pdf/other/Report_on_a_digital_euro~4d7268b458.en.pdf (accessed: 09.08.2022).

Gai KK, Qiu M, Tao L, Zhu Y (2016) Intrusion detection techniques for mobile cloud computing in heterogeneous 5G. *Secur Commun Netw* 9(16), pp. 3049–3058

Ge RY, Feng J, Gu B, Zhang PZ (2017) Predicting and deterring default with social media information in peer-to-peer lending. *J Manage Inform Syst* 34(2), pp. 401–424

Gomber P, Kauffman RJ, Parker C, Weber BW (2018) On the FinTech revolution: interpreting the forces of innovation, disruption, and transformation in financial services. *J Manag InfSyst* 35(1), pp. 220–265

Ilievski, A and Delova-Jolevska, E (2020). Are we ready for Central Bank Digital Currency?. *Southeast European Review of Business and Economics* Volume 1, Issue 2, June 2020, pp. 8-21.

Iman N (2018) Is mobile payment still relevant in the fintechera? *Electron Commer R A* 30, pp. 72-82

KIEP (2020). Financial Inclusion Through Fintech in the Digital Economy. KIEP APEC Study Series 20-03. Published December 30, 2020

Lee I, Shin YJ (2018) FinTech: ecosystem, business models, investment decisions, and challenges. *Bus Horizons* 61(1), pp. 35–46

NBRNM (2017). Press release of the NBRM, 28 March 2017. <https://www.nbrm.mk/ns-newsarticle-press-release-of-the-nbrm-28-march-2017.nspix> (accessed: 12.08.2022)

NBRNM (2019). Mips operating rules No. 20031/1 from 17.06.2019 year. https://www.nbrm.mk/mips_operating_rules.nspix (accessed: 12.08.2022)

Pečarić M., Jozipović S. Ilievski A. (2022). The expected impact of a digital euro on non-Eurozone EU member's states and EU candidate countries: The case of Croatia and North Macedonia. Proceedings of International Scientific Conference Economics of Digital Transformation (EDT) 2021 DIGITOMICS (Inprint)

Pham, TP., Quddus, A., Asad, AI., Popesko, B., Hussain, S. (2021) Conference Paper · January 2021.

Singh S, Sahni MM, Kovid RK (2020) What drives FinTech adoption? A multi-method evaluation using an adapted technology acceptance model. *Manag Decision*.

Suryono RR, Budi I, Purwandari B (2021) Detection of Fintech P2P lending issues in Indonesia. *Heliyon* 7(4):e06782

Söylemez Y. (2020). Fintech Ecosystem and Banking: The Case of Turkey. Chapter 14. Research Anthology on Concepts, Applications, and Challenges of FinTech

The Monetary Authority of Singapore and the Bank of Thailand (2021). Media release - Singapore and Thailand Launch World's First Linkage of Real-time Payment Systems. Available at: <https://www.mas.gov.sg/news/media-releases/2021/singapore-and-thailand-launch-worlds-first-linkage-of-real-time-payment-systems> (accessed: 09.08.2022).

Wamba SF, Kamdjoug JRK, Bawack RE, Keogh JG (2020) Bitcoin, blockchain and FinTech: a systematic review and case studies in the supply chain. *Prod Plan Control* 31(2–3), pp. 115–142

Wen S, Zhou W, Zhang J, Xiang Y, Zhou W, Jia W (2013) Modeling propagation dynamics of social network worms. *IEEE Trans Parallel Distrib Syst* 24(8), pp. 1633–1643

Yin H, Gai KK (2015) An empirical study on preprocessing high-dimensional class-imbalanced data for classification. In: Proceedings of the IEEE international symposium on big data security on cloud, New York, USA, pp. 1314–1319

Zhang J, Chen C, Xiang Y, Zhou W, Xiang Y (2013) Internet traffic classification by aggregating correlated naive Bayes predictions. *IEEE Trans Inf Forensics Secur* 8(1), pp, 5–15

Zhang Y, Soong B (2004) Performance evaluation of GSM/GPRS networks with channel re-allocation scheme. *IEEE Commun Lett* 8(5), pp. 280–282