



Assessing the Impact of Central Bank Digital Currency (CBDC) Adoption on the Transition Towards a Knowledge-Based Economy: A Meta-Analysis

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Abstract:

This comprehensive meta-analysis studies the impact of aligning central bank digital currency (CBDC) choices with Algeria's 2022 Action Plan on the country's transition to a knowledge-based economy. It studies seven different CBDC adoption scenarios and their alignment with the objectives of economic diversification, governance improvement, social development and environmental sustainability.

The results highlight the importance of choosing the right CBDC characteristics, such as centralisation, technology platform, access and distribution, to meet Algeria's unique development goals. The findings underscore the critical role of CBDCs in Algeria's transition to a knowledge-based economy, and highlight the importance of careful planning and informed decision-making when adopting CBDCs.

Key words: Central Bank Digital Currency, Algeria, Knowledge-Based Economy, Action Plan 2022, Meta-Analysis

JEL Classification Codes: E42, O38, O43, G21

1. Introduction

In recent years, the global financial landscape has experienced a significant transformation due to the emergence of Central Bank Digital Currencies (CBDCs). These digital representations of a nation's fiat currency, regulated and issued by the central bank, have garnered substantial attention from policymakers, financial institutions, and the public (Auer et al., 2020). CBDCs represent a fundamental shift in how societies engage in transactions, store value, and access financial services. Their impact extends far beyond traditional finance and extends into broader economic and societal domains. The intention to launch the Algerian Digital Dinar goes in line with this (Alberola-Ila & Mattei, 2022).

1.1. Significance of CBDC Adoption in Transitioning towards a Knowledge-Based Economy

The adoption of CBDCs holds profound implications for economies in transition towards a knowledge-based paradigm. A knowledge-based economy relies on intellectual capabilities, innovation, and efficient use of information and technology as its cornerstones. In such an economy, the generation, dissemination, and application of knowledge become the primary drivers of growth, productivity, and competitiveness (Djeflat, 2021; Djilali & Benounissa, 2015).

CBDCs, with their potential to modernize the financial sector, play a pivotal role in facilitating this transition. They provide a digital foundation for the modernization and transformation of payment and financial infrastructure, enabling seamless transactions, enhancing financial inclusion, and fostering innovation. Furthermore, CBDCs can act as catalysts for economic diversification, governance enhancement, social development, and environmental sustainability – all critical components of a knowledge-based economy (Prasad, 2021).

1.2. Research Question and Objectives

Given the growing significance of CBDCs in reshaping economies and their alignment with knowledge-based economic goals, this comprehensive meta-analysis

seeks to investigate the influence of CBDC adoption on Algeria's pursuit of a knowledge-based economy (Homoliak et al., 2023). To address this, the study explores seven distinct scenarios, each representing a unique set of CBDC attributes and characteristics.

Specifically, this research aims to:

1. Identify the most suitable Central Bank Digital Currency (CBDC) solution for advancing the goal of facilitating the transition towards a knowledge-based economy in Algeria.
2. Analyze the alignment between Algeria's development goals, as outlined in the Action Plan 2022, and the attributes of various CBDC solutions (Services du Premier Ministre, 2022).
3. Evaluate the potential impact of CBDC adoption on four key areas: economic diversification, governance enhancement, social development, and environmental sustainability.
4. Provide insights and recommendations for policymakers, central banks, and relevant stakeholders in Algeria to make informed decisions regarding CBDC adoption in alignment with the country's knowledge-based economic aspirations (Boukhari, 2021).

In the following chapters, an in-depth analysis of the various CBDC scenarios and their potential contributions to Algeria's knowledge-based economy will be conducted. This research aims to shed light on the pivotal role of CBDCs in shaping the future of economies and their transformative potential in fostering knowledge-driven growth (Hamza, 2021; Seddik, 2020).

2. Methodological Framework (Meta-analysis).

2.1. Defining the Research Question

Scope and Goal Selection

Within Algeria's Action Plan for 2022, this study focuses on a single goal to assess the impact of Central Bank Digital Currency (CBDC) adoption on Algeria's progress toward a knowledge-based economy.

Research Question and Hypotheses

The research question is: "To what extent does the type of Central Bank Digital Currency (CBDC) adopted by Algeria significantly contribute to the transition toward a knowledge-based economy, considering various CBDC attributes?"

Two hypotheses are formulated: the Null Hypothesis (H0) suggests no significant relationship between CBDC type and Algeria's knowledge-based economy transition, while the Alternative Hypothesis (H1) posits that CBDC attributes significantly impact Algeria's knowledge-based economy transition, offering insights for Algerian decision-makers.

2.2. Research Phases

Phase 1: Literature Search

In this phase, an extensive literature review was conducted, covering CBDC Types and Characteristics, Global CBDC Trends, Motivations for CBDC Adoption, Algeria's Stated Goals, Alignment with Stakeholder Goals, and Politico-Economic Factors.

Phase 2: Preliminary Data Analysis

During this phase, a preliminary data analysis was carried out, focusing on Development Goals Comparison, CBDC Solutions, and Alignment with Islamic Banking and Knowledge Economy (KE).

Phase 3: Choice of the Effect Size Measure

In Phase 4, the research methodology included defining scenarios, quantitative and qualitative comparison, and employing Multi-Criteria Decision Analysis (MCDA) techniques.

Phase 4: Choice of the Analytical Method Used

Phase 5 involved selecting an appropriate analytical method, combining quantitative and qualitative comparison, and using Multi-Criteria Decision Analysis (MCDA) techniques.

Phase 5: Choice of Software

In Phase 6, software tools were chosen for classification and benchmarking, as well as for MCDA, specifically spreadsheet software and 1000Minds software, respectively (1000minds, 2023).

3. Data Collection and Analysis

In this section, the methods and sources used for data collection and analysis to assess the impact of Central Bank Digital Currency (CBDC) adoption on Algeria's progression towards a knowledge-based economy are delineated.

3.1. Data Collection Methods and Sources

The data collection process involved a combination of primary and secondary sources. Primary data sources comprised key documents explicitly expressing Algeria's goals and intentions, including the National Action Plan for 2022 (Services du Premier Ministre, 2022), as well as additional goals set for Algeria by other stakeholders, including the UN System Report for 2022 (Nations Unies & Algérie, 2022), the World Bank Country Report on Algeria (World Bank, 2022), and AAOIFI Standards (AAOIFI, 2023). Secondary data sources encompassed academic literature, government documents, CBDCtracker, press outlets, and general statistics (CBDC Tracker, 2023).

3.2. Data Analysis Techniques

The collected data underwent rigorous analysis, including content analysis for qualitative assessment. Qualitative analysis compared Algeria's goals from primary sources to evaluate alignment for fostering a knowledge-based economy.

Table 1: Specific Goals from Action Plan 2022 relevant for KE

Specific Goals within UN Category: Economic Diversification
Acceleration of the Digital Transition and Development of Start-ups Distance Education and Training Reforms Employment Promotion via Professional Training Facilitating Access to E-Payment for Start-Ups (Wilaya) Human Capital Development Improving Investment Climate Promotion of Business and Entrepreneurship Development Framework Promotion of Business Angels Simplification of Business Creation Procedures
Specific Goals within UN Category: Environment
Energy Transition and Green Growth Ensuring Energy Sector's Contribution to National Economy Ensuring Energy Security and Accessibility for National Economy Strategic Development of Energy and Mining Sectors Strategic Development of the Energy and Mining Sectors
Specific Goals within UN Category: Governance
Consolidating and Integrating the Treasury in the Interbank Payment and Clearing System Densifying the Banking and Insurance Network Development of E-Governance Digitalizing and Internationalizing the Algerian Banking System Digitization and Public Services Economic Diplomacy for Economic Recovery Implementing the New State Accounting Plan Modernization of Budgeting and Forecasting Models Modernization of the Banking and Financial System Modernizing Payment Systems, Especially E-Payment Protection of Identity and National Memory Strengthening Cyber-Defense Resources and Capabilities
Specific Goals within UN Category: Social Development
Economic Impact of COVID-19 Higher Education and Knowledge Economy Protection and Promotion of Childhood and Adolescence Training and Development

Source: Own elaboration based on Action Plan (Services du Premier Ministre, 2022).

Quantitative analysis involved ranking CBDC solutions based on their attributes. Notably, the 'Interest-Bearing CBDC' was identified as incompatible with Islamic banking principles. Further quantitative analysis considered various CBDC attributes such as Centralization vs. Decentralization, Technology Platform, Distribution Type(s), Accessibility, Privacy Level, Transaction Speed and Scalability, Smart Contracts and Programmability, Interoperability, Security Measures, Legal Framework, Monetary Policy Control, Identity Verification, Accessibility and Inclusion, Cross-Border Usability, User Experience, and Transaction Costs.

Table 2: Ranking of CBDC Solutions for IB

Rank	Value	Solutions
1	8.5	Smart Contract-Enabled CBDC, Programmable CBDC
2	8	Token-Based CBDC, Permissioned CBDC
3	7	Green CBDC, Offline CBDC, Energy-Efficient CBDC
4	5,5	Stablecoin Backed by CBDC, Microtransaction CBDC, Demurrage-Charged CBDC, Community CBDC
5	5	Hybrid CBDC, Multi-CBDC Arrangement, Cross-Border CBDC, Interoperable CBDC, Instant Settlement CBDC, Smartphone-Based CBDC, Hardware Wallet-Integrated CBDC, Cross-Platform CBDC, Two-Tiered CBDC, Regional CBDC, Sector-Specific CBDC, Time-Limited CBDC, Universal Basic Income (UBI) CBDC, Asset-Backed CBDC, Cultural Heritage CBDC, Educational CBDC, Healthcare CBDC, Disaster Relief CBDC
6	4,5	Experimental CBDC
7	3	Wholesale CBDC, Retail CBDC, Account-Based CBDC, Non-Interest-Bearing CBDC, Digital Identity-Linked CBDC, Regulated CBDC
8	1	Interest-Bearing CBDC
9	1,5	Anonymous CBDC, Permissionless CBDC, Privacy-Focused CBDC

Source: Own elaboration based on AAOIFI standards (AAOIFI, 2023).

3.3. Criteria for Evaluating CBDC Impact

The criteria for evaluating the impact of CBDC on Algeria's knowledge-based economy were determined systematically. These criteria aligned with Algeria's Action Plan 2022 and focused on economic diversification, governance enhancement, social development, and environmental sustainability. Additionally, criteria assessed the relevance of CBDC attributes to the knowledge-based economy, scalability, adaptability, and alignment with Algeria's unique context.

Through qualitative and quantitative data analysis and well-defined evaluation criteria, this study aimed to provide a comprehensive assessment of CBDC scenarios in the context of Algeria's knowledge-based economy transition.

4. Results

In this section, the findings of the meta-analysis for seven scenarios are presented, with a focus on highlighting key trends and relationships between CBDC attributes and the knowledge economy transition.

4.1. Impact on Economic Diversification

Token-Based and Permissioned CBDCs were environmentally friendly, aligning with economic development goals. Conversely, Smart Contract-Enabled and Programmable CBDCs consumed more energy, making them less environmentally friendly.

4.2. Impact on Governance Enhancement

Token-Based CBDCs stood out for transparency and traceability, while anonymity features were less favorable.

4.3. Impact on Social Development

Top solutions include Token-Based, Permissioned, and Smart Contract-Enabled CBDCs, prioritizing transparency and security, with Digital Identity-Linked CBDC as the next option.

4.4. Impact on Environmental Sustainability

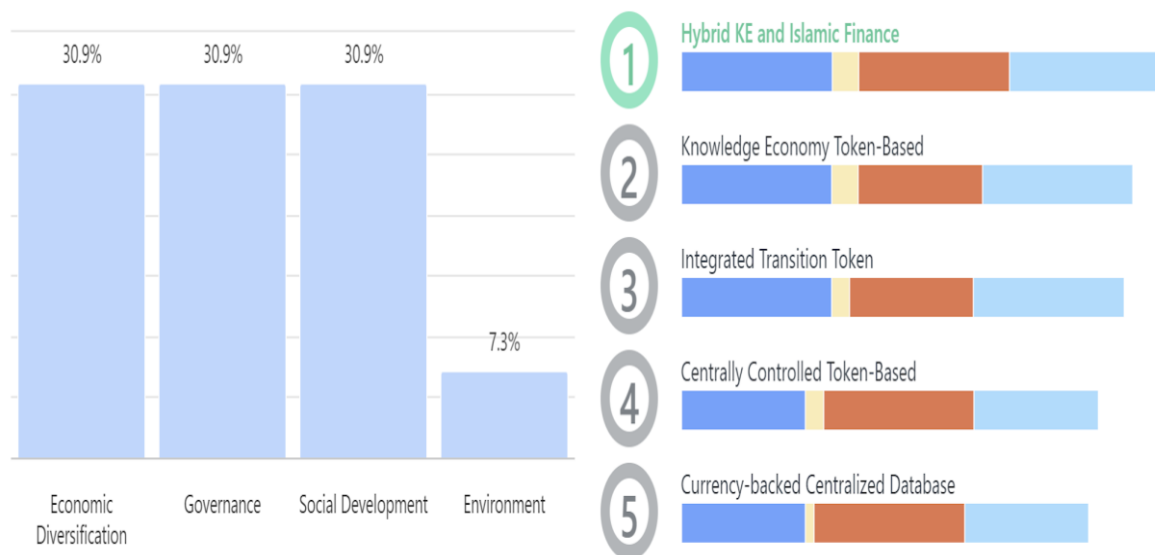
Green CBDCs with energy efficiency align with Algeria's environmental goals, while high-energy consumption solutions like Experimental and Privacy-Focused CBDCs were excluded.

4.5. Cross-Scenario Comparisons

In the analysis, CBDC solutions were evaluated in three critical dimensions: Economic Diversification, Governance, and Social Development, with Environmental considerations assigned a lower weight. It is noteworthy that the Knowledge Economy and Islamic Finance Token-Based CBDC outperformed oil-backed solutions in fostering a knowledge-based economy in Algeria.

This finding merits further investigation to understand its underlying factors and implications for Algeria's CBDC adoption in promoting a knowledge-based economy.

Figure 1: Results from MCDA



Source: Own elaboration with 1000minds, left side representing trade-offs, right side ranking with total score.

4.6 Synthesis of Findings

In the analysis of various CBDC scenarios, it became evident that the adoption of a Central Bank Digital Currency (CBDC) holds significant potential for Algeria's transition towards a knowledge-based economy (KE). While several scenarios were explored, the top-performing solutions consistently included Token-Based CBDC, Permissioned CBDC, and Smart Contract-Enabled CBDC. These options excelled in enhancing governance, modernization, economic diversification, and social development, with a favorable balance of privacy and security.

Notably, the integration of Islamic finance principles alongside KE goals yielded promising results, offering a holistic approach to economic development. However, further investigation is recommended to understand the reasons behind this favorable performance. Additionally, the Green CBDC solution demonstrated a commitment to environmental sustainability, aligning with Algeria's focus on responsible development practices and the need to consider environmental impacts, even with abundant energy resources.

In conclusion, CBDC adoption in Algeria presents an opportunity to catalyze economic transformation and strengthen the country's position in the global economic landscape. The selection of an appropriate CBDC solution should prioritize characteristics that support KE, governance, modernization, and social development while considering environmental sustainability. Further research and detailed analysis are encouraged to inform Algeria's strategic decisions in this pivotal domain.

5. Interpretation of Results and Implications

5.1 Aligning CBDC Adoption with Knowledge-Based Economy Transition

Analyzing the impact of CBDC adoption on Algeria's knowledge-based economy transition reveals that the Knowledge Economy Token-Based scenario performed slightly less in terms of governance compared to the Hybrid KE and Islamic Finance scenario. In the context of transitioning towards a knowledge-based economy, it's clear that active government involvement is crucial. This involvement is necessary to support

the knowledge economy sectors, reallocate resources, and create essential infrastructure, particularly in regional areas.

5.2 Alignment with Development Goals and Stakeholder Interests

CBDC solutions in Algeria align with a multitude of priorities and interests. Algeria's focus on currency stability, sovereignty, and economic landscape significantly influences this alignment. On a regional scale, the African Union seeks interoperability for potential shared currencies or harmonized markets. Similarly, the Arab League places great importance on Sharia compliance, creating opportunities for alignment with sustainability standards in Europe and the US. This aspect adds a layer of significance to the considerations surrounding CBDC adoption and its potential alignment with various economic and ethical principles.

Moreover, international organizations such as the UN and the World Bank prioritize governance, security, privacy, and transparency, making alignment with these principles crucial for credibility and responsible CBDC adoption.

The Hybrid KE and Islamic Finance scenario excels in aligning with this diverse array of demands and interests. It accommodates Algeria's priorities while also supporting the African Union's vision and complying with Sharia principles. Additionally, it resonates with international organizations, addressing their key concerns.

In summary, the Hybrid KE and Islamic Finance scenario emerges as a comprehensive solution, aligning harmoniously with the demands and interests of various stakeholders. This alignment enhances credibility, investment attractiveness, and shared goals, making it a compelling choice for CBDC adoption in Algeria and beyond.

5.3 Trade-offs in CBDC Adoption

Trade-offs are integral to the evaluation of CBDC solutions, and they play a crucial role in shaping the path of adoption (Garrone et al., 2023; Renaud et al., 2020). Here are

the key trade-offs identified in our analysis, and the corresponding choices made in this research under the given MCDA configuration:

Social Development over Environmental Sustainability: Solutions that significantly contribute to social development have been prioritized over those primarily focused on environmental sustainability. A balanced approach has been taken in this research to consider both aspects.

Economic Diversification over Governance Integration: Solutions that promote economic diversification may not seamlessly integrate with existing governance systems, and vice versa. Striking a balance is critical for a harmonious transition, with a focus on economic diversification.

Economic Diversification over Social Development: Solutions that drive economic diversification may not automatically contribute to social development, and vice versa. Ensuring both aspects are addressed is essential for holistic development, with an emphasis on social development.

Economic Diversification over Environmental Sustainability: Solutions that focus on economic diversification may not align with environmental sustainability goals. Balancing these factors is necessary for responsible development, with a preference for economic diversification.

Governance Enhancement over Social Development: Solutions that enhance governance may not necessarily boost social development, and vice versa. Achieving a harmonious synergy between these aspects is key, with a focus on governance enhancement.

Balancing All Dimensions: The research choices aim to find solutions that align with all these aspects simultaneously, recognizing the complexity of CBDC adoption and the need for careful consideration of Algeria's development goals and stakeholder interests.

In total, 16 trade-offs have been addressed under the given MCDA configuration to arrive at the research's conclusions and recommendations. In summary, the priorities in this research were ranked from Economic Diversification as the top priority, followed

by Governance over Social Development, and finally Environmental Sustainability. This ranking was based on the urgency of achieving economic stability and the importance of establishing a strong rule of law as foundational elements for the success of other developmental aspects.

6. Conclusion

In conclusion, this comprehensive meta-analysis sheds light on the intricate relationship between Central Bank Digital Currency (CBDC) adoption and Algeria's transition towards a knowledge-based economy. The study underscores the significance of selecting the right CBDC attributes, including centralization, technology platform, access, and distribution, to align with Algeria's unique development objectives.

These findings underscore the critical role that the type of CBDC plays in advancing Algeria's transition to a knowledge-based economy, as has been demonstrated throughout this article. They emphasize the importance of meticulous planning and decision-making in CBDC adoption. Given the significant impact that CBDCs can have on economic development, it is imperative to make informed choices. Poor decisions could potentially hinder the development of a knowledge-based economy.

While certain principles can guide decision-makers when balancing trade-offs and choices regarding CBDCs, it's vital to recognize that a comprehensive understanding of their full impact is essential. To achieve this, in-depth case studies and interviews with business leaders are necessary. These studies can provide valuable insights into how the transition towards a knowledge-based economy is unfolding within Algerian companies.

These insights extend beyond Algeria's borders, offering valuable guidance to countries considering CBDC adoption. As CBDCs gain increasing prominence globally, nations must carefully consider their economic attributes and goals when choosing the most fitting CBDC solution. The trade-offs made during this adoption process, whether

favoring economic diversification, governance enhancement, social development, or environmental sustainability, carry profound implications.

For future research, delving deeper into the specific impacts of CBDC adoption on economic diversification, governance, social development, and the environment can provide a more nuanced understanding of the underlying dynamics. Additionally, exploring how CBDC strategies align with other national development plans and stakeholder interests in diverse countries can unveil the array of approaches to CBDC adoption worldwide.

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