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CENTRAL BANK DIGITAL CURRENCIES: A REVIEW OF GLOBAL TRENDS IN ADOPTION, FINANCIAL INCLUSION, AND THE ROLE OF COUNTRY CHARACTERISTICS

Abstract

The global adoption of Central Bank Digital Currencies (CBDCs) represents a pivotal shift in monetary systems, driven by technological advancements and economic imperatives. While a small number of official digital currencies are in circulation, many nations are launching pilot programs to address financial inclusion challenges and enhance economic resilience. This study aims to identify the determinants of digital currency adoption across 116 countries, using logistic regression to analyze the effects of economic, technological, institutional, and financial factors.

The results show that higher GDP levels significantly increase the likelihood of active CBDC adoption by 332.1 percent and pilot adoption by 212.6 percent, reflecting the role of economic development. Greater internet usage improves the odds of active adoption by 12.7 percent and pilot adoption by 13.4 percent, while financial inclusion indicators, such as account ownership, increase the likelihood of adoption by 59 percent for active initiatives and 141 percent for pilot projects. Monetary freedom positively influences active adoption by 31.1 percent, and higher interest rates increase the odds by 20.8 percent. Conversely, business freedom negatively affects active adoption by 27.5 percent and pilot adoption by 29.1 percent, suggesting that countries with strong private-sector digital payment solutions may rely less on CBDCs.

These findings represent the transformative potential of digital currencies to improve financial inclusion and economic participation. Policymakers should prioritize investments in digital infrastructure and financial inclusion initiatives to facilitate the integration of digital currencies into national economies and empower underserved populations globally.

Keywords

monetary systems, digital currencies, financial inclusion, technological connectivity, economic indicators, digital innovation

JEL Classification

E58, G28, E52

INTRODUCTION

Central Bank Digital Currencies (CBDCs) can transform the global financial landscape, combining digital innovation with monetary policy evolution to promote financial inclusion. As of November 2024, four CBDCs are in circulation: DCash (Eastern Caribbean), JAM-DEX (Jamaica), eNaira (Nigeria), and Sand Dollar (Bahamas), with many other nations launching pilot programs (The Atlantic Council, 2024). Economic indicators, institutional frameworks, technological infrastructure, and financial inclusion imperatives influence CBDC adoption (Tan, 2023; Chu et al., 2022). Additionally, the overall perspective of citizens and their sentiment toward CBDCs is another critical determinant influencing adoption trends, reflecting how public

attitudes and trust shape the feasibility of implementing digital currencies. The public reaction towards a CBDC varies among countries with a mixed sentiment around the world. Using machine learning tools, Sangeeta et al. (2023) analyzed public tweets and measured public sentiment. They found overall positive global sentiment especially within developed countries which could explain the motivation for the CBDC adoption among central banks of those countries.

At a global level, several key trends have catalyzed interest in CBDCs. The rapid digitalization of financial transactions, propelled by advancements in blockchain technology and electronic payment systems, has created an environment for exploring the potential of CBDCs as a medium of exchange (Tan & Lanquist, 2023). Additionally, the imperative of fostering financial inclusion and addressing challenges associated with cross-border transactions have prompted central banks worldwide to consider CBDCs as tools for enhancing financial stability and efficiency (Tercero-Lucas, 2023; Tan, 2023). Central banks, such as European Central Bank, not only research CBDCs for nationwide application, but also seek dialogues with neighboring central banks to explore integrating CBDC with existing payment infrastructures, aiming to facilitate remittance and trade activities. (Soderberg et al., 2022)

CBDCs promise greater efficiency and accessibility in financial transactions, potentially bridging gaps in financial access and empowering underserved communities. This transformative potential has sparked intense interest among policymakers, economists, and technologists worldwide.

1. LITERATURE REVIEW

CBDCs represent a transformative innovation in the evolution of monetary systems, combining the efficiencies of digital technologies with the regulatory oversight of central banks. Globally, the momentum for CBDC development has grown significantly, with four currencies officially launched: DCash in the Eastern Caribbean, JAM-DEX in Jamaica, eNaira in Nigeria, and Sand Dollar in the Bahamas (The Atlantic Council, 2024). Additionally, several other countries, including China, Australia, and those in the Euro Area, are conducting pilot programs for their digital currencies, such as the Digital Euro, eAUD, and e-CNY. Table 1 presents a list of countries with launched or pilot CBDC programs. These efforts reflect a global response to declining cash usage, the rise of digital payments, and the need to modernize payment infrastructures, particularly following the acceleration of digitization during the COVID-19 pandemic (Tercero-Lucas, 2023). Moreover, initiatives like Facebook's Libra further prompted central banks to assert monetary control and explore CBDCs as viable alternatives to private digital currencies (Didenko et al., 2020).

CBDCs can be broadly categorized into retail and wholesale systems. Retail CBDCs aim to serve the general public as a digital alterna-

tive to cash, facilitating everyday transactions, while wholesale CBDCs are designed to enhance interbank settlements and institutional financial operations (Shapoval, 2020; Ozili, 2022a). This segmentation displays the adaptability of CBDCs to meet diverse economic and financial needs. For instance, Jamaica's JAM-DEX and Nigeria's eNaira focus on promoting financial inclusion, whereas China's e-CNY and the Euro Area's Digital Euro emphasize improving cross-border payment efficiency and enhancing monetary sovereignty (Eastern Caribbean Central Bank, n.d.; European Central Bank, 2024, Ozili, 2022b).

1.1. Drivers of CBDC adoption

CBDC adoption is propelled by several key motivations. Enhancing financial inclusion can be considered a primary driver, as digital currencies offer a viable solution for integrating unbanked and underbanked populations into formal financial systems. By enabling secure and affordable transactions without the need for physical bank branches, CBDCs address critical gaps in financial access. Examples include Jamaica's JAM-DEX and Nigeria's eNaira, which provide no-fee digital wallets and tiered account systems tailored to underserved populations (Bank of Jamaica, 2023; Ogunrinde,

Table 1. List of countries with launched or pilot CBDC program

Country	Status	Currency	Year launched
Eastern Caribbean			
Anguilla, Antigua and Barbuda, Dominica, Grenada, Montserrat, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines	Launched	Dcash	2021
The Bahamas	Launched	Sand Dollar	2020
Jamaica	Launched	JAMDEX	2022
Nigeria	Launched	eNaira	2021
Euro Area			
Austria, Belgium, Croatia, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Portugal, Slovakia, Slovenia, Spain	Pilot	Digital Euro	
Australia	Pilot	eAUD	
China	Pilot	e-CNY	
Ghana	Pilot	e-Cedi	
Hong Kong	Pilot	e-HKD	
India	Pilot	Digital Rupee	
Iran	Pilot	Digital Rial	
Israel	Pilot	Digital Shekel	
Japan	Pilot	Digital Yen	
Kazakhstan	Pilot	Digital Tenge	
Malaysia	Pilot	Unnamed	
Russia	Pilot	Digital Ruble	
Saudi Arabia	Pilot	Unnamed	
Singapore	Pilot	Digital Singapore Dollar	
South Africa	Pilot	Digital Rand	
South Korea	Pilot	Unnamed	
Sweden	Pilot	E-Krona	
Tunisia	Pilot	Unnamed	
Turkey	Pilot	Digital Lira	
United Arab Emirates	Pilot	Digital Dirham	
Ukraine	Pilot	e-Hryvnia	

2023). Additionally, the deployment of CBDCs can alleviate inefficiencies in payment systems. Leveraging technologies such as distributed ledger technology (DLT) and blockchain, CBDCs enhance transaction security, reduce costs associated with traditional banking, and expand financial access in areas with limited connectivity through offline payment capabilities (Sethaput & Innet, 2023; Chu et al., 2022).

Another significant motivation stems from the rise of cryptocurrencies and stablecoins, which have gained traction as alternatives to traditional currencies. CBDCs offer central banks an opportunity to provide state-backed digital currencies, ensuring monetary policy effectiveness and addressing the risks posed by decentralized financial systems (Opore & Kim, 2020; Tang, 2023). This is particularly relevant in economies where private digital currencies challenge existing financial institutions and regulatory frameworks (Ozili, 2022a).

1.2. Country characteristics and implications for CBDC adoption

A foundational aspect of CBDC adoption is the necessity for a well-developed digital infrastructure. Matsui and Perez (2021) identify the financial development index as a key determinant in the success of CBDC projects, asserting that countries with advanced digital infrastructure are more likely to develop effective CBDC initiatives. Guley and Koldovski (2023) who note that CBDCs can streamline payment systems and reduce transaction costs, which are only achievable when supported by robust digital frameworks, corroborate this assertion. Moreover, the design choices made in implementing CBDCs are heavily influenced by the underlying digital infrastructure. Allen et al. (2020) who highlight the need for a resilient and secure infrastructure that can support large-scale user onboarding and authentication, which is essential for widespread CBDC adoption, also

presented this. The authors argue that a modular design, which allows for flexibility and scalability, is crucial in adapting to future technological advancements and user needs.

CBDCs are expected to deliver numerous benefits, including reduced transaction costs, increased accessibility, and strengthened financial integrity. The ability of CBDCs to provide a traceable and secure currency enhances their potential to combat fraud, money laundering, and illicit financial activities, particularly in cash-dominated economies (Dupuis et al., 2021; Ozili, 2024). Furthermore, state-backed digital currencies foster public trust by addressing privacy and security concerns often associated with private digital currencies (Zarifis & Cheng, 2023; Guley & Koldovski, 2023). In low- and middle-income countries, CBDCs present a transformative opportunity to enhance financial inclusion, modernize payment systems, and increase tax revenue through improved transparency and traceability (Arewa et al., 2024). The introduction of CBDCs aligns with financial inclusion theory, which emphasizes expanding access to financial services as a driver of economic growth and equity (Allen et al., 2016; Arun & Kamath, 2015; Boar & Wehrl, 2021). By bridging gaps in access to banking and digital payment systems, CBDCs have the potential to empower marginalized populations and promote inclusive economic participation (Foo et al., 2024; Maryaningsih et al., 2022).

However, systemic challenges also arise with CBDC adoption. Account-based CBDCs, which require the direct involvement of central banks in customer transactions, may disrupt traditional banking services. This disruption can lead to reduced bank deposits, increased funding costs, and potential instability within the banking sector. Balancing innovation with financial stability remains a critical consideration for central banks, as missteps in design or implementation could amplify systemic risks (Fernández-Villaverde et al., 2021; Keister & Sanches, 2022). On the other hand, CBDCs contribute to systemic resilience by addressing challenges posed by private digital currencies and decentralized financial systems. By maintaining control over the monetary supply and ensuring regulatory compliance, central banks can leverage CBDCs to safeguard financial stability while fostering innovation in payment systems (Auer et al., 2020).

The implementation of CBDCs requires robust legal and regulatory frameworks to ensure their seamless integration into existing financial systems. Key issues include privacy, security, and interoperability. For CBDCs to succeed, financial regulations must evolve to address the unique challenges posed by digital currencies, such as ensuring consumer protection and managing data privacy concerns (Nabilou, 2019). Coordination among central banks, governments, and private stakeholders is crucial for aligning CBDC initiatives with national and international payment ecosystems (Shapoval, 2020; Soderberg et al., 2023).

Regulatory frameworks must also mitigate risks related to monetary control and economic stability. While CBDCs provide central banks with tools to enhance monetary policy effectiveness, their introduction must be carefully managed to prevent unintended consequences, such as the disintermediation of traditional financial systems (Ozili, 2022a; Auer et al., 2020).

Regional experiences with CBDCs provide valuable lessons. The Bahamas' Sand Dollar demonstrated the importance of leveraging mobile technology to address geographic dispersion, while China's e-CNY pilot highlighted the potential for large-scale adoption through integration with existing payment systems (IMF, 2021; Elston, 2023). Similarly, Australia's eAUD pilot explored the use of DLT for wholesale transactions, highlighting the adaptability of CBDCs to different financial infrastructures (Eyers, 2023). Blockchain and DLT technologies not only ensure secure and efficient transactions but also enable offline capabilities, expanding accessibility in regions with limited connectivity (Chu et al., 2022; Sethaput & Innet, 2023).

1.3. Research gaps and hypotheses

Although considerable research has explored CBDC adoption and the motivations driving countries to pursue digital currencies, certain gaps remain. These gaps include understanding the roles of institutional frameworks, macroeconomic conditions, financial inclusion, and technological readiness in shaping CBDC adoption.

This study aims to bridge these gaps by examining data from 116 countries, focusing on how specific

country characteristics influence the likelihood of CBDC adoption. The hypotheses of the study predict that:

- H1: Stronger institutional frameworks, including robust property rights, efficient judicial systems, and higher government integrity, will increase the odds of CBDC adoption.*
- H2: Greater financial inclusion, reflected by widespread financial institution account ownership, higher mobile banking usage, and increased adoption of digital payment platforms, will enhance the odds of CBDC adoption.*
- H3: Technological readiness, demonstrated by higher internet penetration and advanced digital infrastructure, will increase the odds of CBDC adoption by enabling integration of digital currencies into financial ecosystems.*
- H4: Higher GDP per capita and favorable macroeconomic conditions such as lower inflation and higher interest rates will increase the odds of CBDC adoption by reflecting economic stability and monetary policy flexibility.*
- H5: Greater levels of business and monetary freedom, including the ease of starting and operating businesses, openness in trade policies, price stability, and stronger investment protections, will increase the odds of CBDC adoption by creating an environment conducive to financial innovation.*

2. METHODOLOGY

Using logistic regression analysis, this study examines how various country-specific characteristics relate to the likelihood of CBDC adoption. This section outlines the data, variables and analytical framework of the study.

2.1. Study sample

The study's sample includes 116 countries representing diverse economic, institutional, and technological contexts. Countries were selected to capture the full spectrum of CBDC development stages, from

active pilot programs to official launches. Data were sourced from multiple databases, including central bank websites, the Atlantic Council CBDC Tracker, the World Bank Database, and The Heritage Foundation's Economic Freedom Index. Economic indicators data are collected from World Bank Database and Trading Economics Database while Legal and Institutional Environment, Fiscal Policy and Governance, Business and Economic Freedom, and Financial Infrastructure and Access to Financial Services variables data are collected from Economic Freedom Index of The Heritage Foundation.

The sample was intentionally balanced between developed and developing economies, facilitating comprehensive cross-country comparisons and enabling the exploration of regional heterogeneity in CBDC adoption.

2.2. Variables

The study utilizes one dependent variable with two variations and several independent variables categorized into five groups, each representing distinct dimensions influencing CBDC adoption. The dependent variable captures the stage of CBDC adoption. The first variation, Pilot, is a binary variable coded as 1 if a country has initiated a pilot program for a CBDC and 0 otherwise. The second variable, Active, is a binary variable coded as 1 if a country is conducting active research, has a pilot program, or has launched a CBDC and 0 otherwise, providing a broader measure of engagement with CBDC development.

The independent variables include economic, institutional, fiscal, business, and technological dimensions.

GDP represents the economic output per individual, measured in USD. Inflation captures annual inflation as a percentage, indicating macroeconomic stability, while Interest rate measures the cost of capital and monetary policy flexibility. The GINI index represents income inequality, with higher scores indicating greater inequality.

Institutional factors include Property rights, a score ranging from 0 to 100 that represents the protection of property ownership rights and indicates a robust legal framework, and Judicial effectiveness, which assesses the efficiency of the judicial system in re-

solving disputes. Government integrity measures transparency and corruption in governance, providing insights into the institutional quality.

Fiscal policy and governance variables include Tax burden, which evaluates tax rates and complexity, with higher scores indicating a favorable fiscal environment. Government spending assesses the level and efficiency of public expenditures, while Fiscal health reflects debt levels and fiscal sustainability, both scored on a scale from 0 to 100.

Business and economic freedom variables include Business freedom, which captures the ease of starting and operating businesses, Labor freedom, reflecting the flexibility of labor market policies, and Trade freedom, which measures openness in trade policies. Monetary freedom assesses price stability and monetary policy effectiveness, while Investment freedom reflects the ease of investing and investor protections. Financial freedom measures the strength and independence of financial institutions within the economy.

Technological and financial infrastructure indicators include Internet usage, measured as the percentage of individuals using the internet, highlighting digital connectivity. Financial institution account ownership reflects the proportion of adults with accounts in formal financial institutions, serving as a proxy for financial inclusion. Owns a debit card represents the percentage of adults who own a debit card, while Owns a debit or credit card expands this to include credit cards. Used phone/internet to check account balance indicates the adoption of mobile or internet banking for balance inquiries and Used phone/internet for payments reflects the proportion of adults using digital platforms for payments. Store money in a financial institution captures the proportion of individuals who save money in formal financial institutions.

The descriptive statistics provide an overview of the key variables analyzed in this study. Table 2 presents detailed summary statistics, including the mean, median, standard deviation, range, minimum, and maximum values for each variable.

Table 2. Descriptive statistics

Economic indicators	N	Mean	Median	St. dev.	Range	Min	Max
GDP	116	807590.38	78457.18	2937425.39	25437473.14	2226.86	25439700
Inflation	116	16.78	8.4	34.91	253.5	1.4	254.9
Interest rate	116	10.12	5.75	15.2	130.1	-0.1	130
GINI index	116	36.5	35.1	7.73	39.8	23.2	63
Legal and institutional environment							
Property rights	116	59.22	54.2	24.62	100	0	100
Judicial effectiveness	116	53.9	50.25	26.58	94.4	3.4	97.8
Government integrity	116	48.67	42.5	23	93.5	6.5	100
Fiscal policy and governance							
Tax burden	116	76.96	78	12.05	57.9	42.1	100
Government spending	116	63.79	70	23.63	95.2	0	95.2
Fiscal health	116	53.33	61.15	31.03	99.1	0	99.1
Business and economic freedom							
Business freedom	116	65.66	67.8	14.64	64.4	30.8	95.2
Labor freedom	116	57.27	57.6	9.11	45.4	33.4	78.8
Monetary freedom	116	73.58	76.6	13.32	87.1	0	87.1
Trade freedom	116	72.47	74.5	9.38	52.7	42.3	95
Investment freedom	116	61.59	65	19.14	90	0	90
Financial freedom	116	53.79	50	17.68	80	10	90
Financial Infrastructure and Access to Financial Services							
Internet usage	116	73.31	82	22.99	91	9	100
Financial institution account	116	0.67	0.74	0.29	0.86	0.14	1
Owns a debit card	116	0.52	0.53	0.32	0.98	0.01	0.99
Owns a debit or credit card	116	0.54	0.58	0.33	0.98	0.02	1
Used a mobile phone or the internet to check account balance	116	0.52	0.53	0.23	0.87	0.12	0.99
Use a mobile phone or the internet to make payments, buy things, or to send or receive money using a financial institution account	116	0.37	0.32	0.28	0.93	0.01	0.94
Store money using a financial institution	116	0.46	0.39	0.31	0.92	0.06	0.98

The economic indicators exhibit significant heterogeneity among countries. The mean GDP is \$807 billion, with a median of \$78 billion, reflecting the wide economic disparity between the countries in the sample and presence of high-income economies alongside lower-income nations. Inflation rates also show considerable variation, ranging from 1.40% to 254.90%, with a mean of 16.78%, indicative of differing macroeconomic stability. Interest rates range from -0.10% to 130.00%, averaging 10.12%, reflecting diverse monetary policy environments. The GINI index, a measure of income inequality, ranges from 23.20 to 63.00, with a mean value of 36.50, illustrating varying levels of economic equity.

Legal and institutional environment variables also demonstrate variability. Property rights have a mean score of 59.22 out of 100, with a standard deviation of 24.62, indicating disparities in governance and institutional strength. Judicial effectiveness and government integrity have mean scores of 53.90 and 48.67, respectively.

In the fiscal policy and governance category, tax burden has a high mean score of 76.96, with relatively lower variability (standard deviation of 12.05), while government spending and fis-

cal health show greater dispersion with means of 63.79 and 53.33, respectively. This variation points to differing fiscal priorities and capacities among sample countries.

Business and economic freedom indicators show significant diversity. Business freedom has a mean score of 65.66, while trade and monetary freedom average 72.47 and 73.58, respectively. However, investment and financial freedom exhibit lower average scores, 61.59 and 53.79, respectively.

The financial infrastructure and access to financial services variables reflect the digital and financial inclusion of countries. Internet usage averages 73.31%, with a range spanning from 9% to 100%, highlighting uneven access to digital infrastructure. Ownership of financial institution accounts and debit cards averages 67% and 52%, respectively, with mobile banking and digital payment usage showing lower averages (37% and 46%), indicating gaps in financial accessibility in some countries.

Table 3 presents the correlation matrix of the study's variables, which displays the correlation coefficients for each pair of variables, with values ranging from -1 to 1. Positive coefficients indicate

Table 3. Correlation matrix

	Active	Property rights	Judicial effectiveness	Government integrity	Tax burden	Government spending	Fiscal health	Business freedom	Labor freedom	Monetary freedom	Trade freedom	Investment freedom
Active	1											
Property rights	0.0366	1										
Judicial effectiveness	0.0503	0.8495	1									
Government integrity	0.0851	0.8596	0.9016	1								
Tax burden	-0.0072	-0.3127	-0.4319	-0.4457	1							
Government spending	0.1357	-0.4979	-0.5361	-0.566	0.5831	1						
Fiscal health	-0.0356	-0.0045	-0.1045	-0.0629	0.0574	0.036	1					
Business freedom	0.061	0.7651	0.7353	0.8224	-0.2595	-0.51	0.0133	1				
Labor freedom	0.1664	0.6432	0.6966	0.6954	-0.2704	-0.407	-0.0969	0.6262	1			
Monetary freedom	0.0482	0.6432	0.4642	0.4316	0.0004	-0.182	0.0104	0.4101	0.4264	1		
Trade freedom	0.0384	0.7441	0.6753	0.7481	-0.0975	-0.4389	0.0925	0.8135	0.5937	0.4441	1	
Investment freedom	-0.1562	0.6771	0.5828	0.6224	-0.2201	-0.3631	0.0166	0.5789	0.4435	0.4589	0.6495	1
Financial freedom	-0.0504	0.6943	0.6276	0.6797	-0.2209	-0.3897	-0.0282	0.7182	0.5473	0.578	0.6797	0.7805
Financial institution account	0.2572	0.4665	0.5683	0.6183	-0.2618	-0.4988	-0.0603	0.6734	0.5602	0.1221	0.5167	0.1869
Owns a debit card	0.22	0.4447	0.5152	0.5872	-0.2535	-0.501	-0.0694	0.6557	0.548	0.0672	0.5367	0.2112
Owns a debit or credit card	0.2425	0.4642	0.5408	0.6115	-0.2722	-0.5116	-0.0772	0.6698	0.5507	0.0782	0.5519	0.2301

Table 3 (cont.). Correlation matrix

	Active	Property rights	Judicial effectiveness	Government integrity	Tax burden	Government spending	Fiscal health	Business freedom	Labor freedom	Monetary freedom	Trade freedom	Investment freedom
Used phone/int. to check acc. bal.	0.2045	0.4319	0.4987	0.5839	-0.3977	-0.508	-0.0002	0.5103	0.5142	-0.0079	0.4512	0.2983
Used phone/int payments	0.2607	0.4748	0.5784	0.6508	-0.3819	-0.5148	-0.0218	0.6122	0.5538	0.0839	0.4944	0.2792
Store money in a fin. inst.	0.2574	0.5434	0.646	0.6866	-0.3572	-0.5452	-0.045	0.6654	0.6081	0.1893	0.5323	0.2531
Internet usage	0.1929	0.4306	0.4679	0.5708	-0.1372	-0.4035	-0.02	0.714	0.4528	0.1279	0.5685	0.2902
GDP	0.3533	0.2114	0.3233	0.3776	-0.3135	-0.2702	-0.3382	0.4051	0.3375	0.0206	0.2366	0.0487
Inflation	-0.085	-0.375	-0.267	-0.2975	0.086	0.0708	-0.0016	-0.3703	-0.2703	-0.5835	-0.2623	-0.2061
Interest rate	-0.006	-0.5086	-0.4171	-0.4399	0.119	0.2696	-0.0775	-0.5541	-0.3644	-0.4917	-0.4721	-0.2965
GINI index	0.08	-0.3184	-0.2552	-0.3443	0.151	0.4131	-0.174	-0.3	-0.2599	-0.1926	-0.2879	-0.2094
	Financial freedom	Financial institution account	Owens a debit card	Owens a debit or credit card	Used phone/int. to check acc. bal.	Used phone/int. payments	Store money in a fin. inst.	Internet usage	GDP	Inflation	Interest rate	GINI index
Financial freedom	1											
Financial institution account	0.377	1										
Owens a debit card	0.3855	0.9426	1									
Owens a debit or credit card	0.3951	0.9572	0.9919	1								
Used phone/int. to check acc. bal.	0.3756	0.7626	0.7825	0.8007	1							
Used phone/int payments	0.4082	0.9096	0.88	0.8998	0.9221	1						
Store money in a fin. inst.	0.4165	0.9436	0.8894	0.9098	0.8053	0.9214	1					
Internet usage	0.4297	0.6969	0.7313	0.7374	0.5547	0.6094	0.6305	1				
GDP	0.2311	0.5173	0.501	0.5095	0.4172	0.5136	0.5013	0.3567	1			
Inflation	-0.3661	-0.0883	-0.0369	-0.048	0.0097	-0.0804	-0.1712	-0.0398	-0.1304	1		
Interest rate	-0.4376	-0.3249	-0.2889	-0.2935	-0.1314	-0.2181	-0.4025	-0.3435	-0.1234	0.6032	1	
GINI index	-0.2371	-0.2913	-0.2741	-0.2773	-0.2108	-0.2263	-0.3141	-0.313	-0.055	-0.0244	0.229	1

Note: This table illustrates the correlation matrix of all variables in this study, including economic indicators, legal and institutional frameworks, fiscal policies, business and economic freedoms, financial infrastructure. Each cell in the matrix represents the correlation coefficient between two variables, ranging from -1 to 1. A positive correlation coefficient indicates a direct relationship, while a negative coefficient signifies an inverse relationship. The magnitude of the correlation coefficient reflects the strength of the relationship, with values closer to 1 or -1 indicating a stronger correlation.

direct relationships, while negative coefficients denote inverse relationships. The strength of these associations is reflected in the magnitude of the coefficients, where values closer to 1 or -1 signify stronger correlations.

2.3. Research method

In this study, logistic regression was employed to estimate the likelihood of CBDC adoption based on the independent variables through odds ratio (OR). In logistic regression, the odds

ratio is a measure of association that quantifies how a one-unit increase in an independent variable affects the odds of an event occurring (e.g., CBDC adoption), holding all other variables constant. The model was specified as:

$$P(Y = 1 | X) = \frac{1}{1 + \exp(-\beta_0 - \sum(\beta_k X_k))}, \quad (1)$$

where Y is the dependent variable (CBDC adoption), X_k are the independent variables, β_k are the regression coefficients, and β_0 is the intercept.

The analysis calculated odds ratios and significance levels to assess the relative contribution of each variable to CBDC adoption.

3. RESULTS

The logistic regression analysis results provide a comprehensive understanding of how economic, institutional, technological, and financial variables shape countries' likelihood of adopting CBDCs, either actively or in pilot programs. This section presents the findings in detail, interprets them, and describes the tables and figures to support the analysis. Further, the hypotheses are tested, and their outcomes are discussed.

3.1. Key findings for active CBDC adoption

The logistic regression analysis for active CBDC adoption reveals several significant predictors. Table 4 summarizes these results, showing the odds ratios, standard errors, and significance levels.

The findings highlight that Business freedom is inversely associated with active CBDC adoption (OR = 0.725, $p < 0.01$). Specifically, a one-unit increase in business freedom reduces the likelihood of adoption by 27.5%. This counterintuitive result suggests that countries with less restrictive business environments may already possess robust private sector solutions for digital payments, reducing the urgency to adopt CBDCs.

In contrast, Monetary freedom is positively associated with active CBDC adoption (OR = 1.311, $p < 0.05$). A one-unit increase in monetary freedom increases the odds of CBDC adoption by 31.1%, highlighting the role of flexible monetary policies in supporting digital currency initiatives. This partially supports *H5*, which posits that Monetary freedom fosters CBDC adoption, while business freedom's negative association indicates that private-sector-driven digital solutions may replace the need for CBDCs.

Financial inclusion indicators also play a crucial role. Financial institution account ownership significantly increases the likelihood of CBDC adop-

Table 4. Logistic regression results

Predictor	Active				Pilot			
	Odds ratio	Std. err.	z	p> z	Odds ratio	Std. err.	z	p> z
Property rights	1.115*	0.069	1.760	0.079	1.089*	0.053	1.740	0.082
Judicial effectiveness	1.000	0.037	0.010	0.991	1.005	0.033	0.140	0.891
Government integrity	1.034	0.055	0.640	0.524	1.015	0.046	0.330	0.739
Tax burden	0.995	0.041	-0.130	0.900	0.978	0.035	-0.620	0.533
Government spending	1.006	0.024	0.230	0.817	1.000	0.022	-0.010	0.995
Fiscal health	1.021	0.018	1.180	0.237	1.024	0.016	1.500	0.133
Business freedom	0.725***	0.087	-2.690	0.007	0.709***	0.076	-3.220	0.001
Labor freedom	0.980	0.054	-0.370	0.714	1.028	0.051	0.560	0.576
Monetary freedom	1.311**	0.147	2.420	0.016	1.133	0.119	1.190	0.235
Trade freedom	1.002	0.090	0.020	0.980	1.048	0.082	0.610	0.545
Investment freedom	0.982	0.043	-0.420	0.672	0.972	0.037	-0.740	0.461
Financial freedom	0.913*	0.044	-1.880	0.061	0.967	0.039	-0.830	0.407
Financial institution account	1.59***	1.440	2.610	0.009	2.41***	1.780	2.290	0.022
Owns a debit card	0.004	0.021	-1.080	0.279	0.003	0.015	-1.190	0.234
Owns a debit or credit card	0.001	0.000	-1.470	0.140	0.001	0.001	-1.040	0.297
Used phone/int. to check acc. bal.	1.427	1.136	0.620	0.533	5.744	0.404	0.250	0.804
Used phone/int. payments	1.894	1.533	0.360	0.716	15.511	1.105	0.390	0.700
Store money in a fin. inst.	3.587	16.642	0.280	0.783	8.507	0.367	0.500	0.620
Internet usage	1.127**	0.060	2.260	0.024	1.134***	0.053	2.720	0.007
GDP	4.321**	2.926	2.160	0.031	3.126**	1.818	1.960	0.050
Inflation	0.982	0.027	-0.650	0.515	0.972	0.027	-1.030	0.304
Interest rate	1.208**	0.096	2.400	0.017	1.117	0.080	1.540	0.123
GINI index	1.019	0.062	0.310	0.760	1.033	0.054	0.630	0.526
Cons	0.000	0.000	-2.570	0.010	0.000	0.000	-1.640	0.100
R ²	0.53				0.47			

tion (OR = 1.59, $p < 0.01$), with countries having higher account penetration being 59% more likely to implement CBDCs. Similarly, Internet usage (OR = 1.127, $p < 0.05$) increases the odds of adoption by 12.7%, reinforcing the importance of digital connectivity in creating the infrastructure necessary for CBDC implementation. These findings strongly support *H2*, which emphasizes financial inclusion, and *H3*, which highlights the significance of technological readiness in CBDC adoption.

Macroeconomic factors such as GDP (OR = 4.321, $p < 0.05$) and Interest rate (OR = 1.208, $p < 0.05$) also emerge as significant predictors. Countries with higher GDP levels are 332.1% more likely to adopt CBDCs actively, reflecting the capacity of wealthier nations to invest in digital innovation. Similarly, higher interest rates increase the odds of adoption by 20.8%, suggesting that monetary policy considerations influence the adoption of digital currencies. These findings strongly support *H4*, which posits that economic prosperity and macroeconomic stability are conducive to CBDC adoption.

Variables such as Property rights, Judicial effectiveness, Government integrity, and fiscal policy measures like Tax burden and Government spending were statistically insignificant. This indicates that while governance and fiscal metrics are crucial for broader economic stability, they may not directly affect decisions regarding CBDC implementation. These findings do not support *H1*, which hypothesized a significant role for institutional frameworks. The model for active CBDC adoption achieves an R^2 value of 0.53, explaining 53% of the variability in adoption status and indicating strong explanatory power.

3.2. Key findings for pilot CBDC adoption

For pilot CBDC programs, a similar set of predictors emerged as significant. Table 4 also presents these findings, showing the odds ratios and significance levels for variables influencing pilot adoption.

Business freedom negatively affects the likelihood of piloting CBDCs (OR = 0.709, $p < 0.01$). A one-unit increase in business freedom reduces the odds of pilot adoption by 29.1%, aligning with

the findings for active adoption. This suggests that countries with more open business environments may already have private sector-driven digital payment solutions, reducing the need for CBDC exploration.

Financial institution account ownership (OR = 2.41, $p < 0.01$) is a strong predictor of pilot CBDC adoption. Countries with higher account penetration are over twice as likely (a 141% increase in odds) to initiate pilot programs. Similarly, Internet Usage (OR = 1.134, $p < 0.01$) increases the odds of piloting a CBDC by 13.4%, underscoring the importance of digital infrastructure in enabling CBDC experimentation. These findings strongly support *H2* and *H3*.

Economic development, measured by GDP (OR = 3.126, $p = 0.05$), also significantly influences pilot adoption. Countries with higher GDP levels are 212.6% more likely to initiate CBDC pilot programs, reflecting their capacity to invest in exploratory projects. This finding aligns with *H4*, which posits that wealthier nations are more likely to adopt CBDCs.

A marginally significant effect was observed for Property Rights (OR = 1.089, $p < 0.1$), with a one-unit increase in property rights associated with an 8.9% increase in the odds of piloting a CBDC. This partially supports *H1*, suggesting that secure property rights may create a favorable environment for digital currency experimentation.

Non-significant predictors included Labor Freedom, Trade Freedom, and Inflation, indicating that these factors may not directly influence the decision to pilot CBDCs. The model for pilot CBDC adoption achieves an R^2 value of 0.47, explaining 47% of the variability in adoption status and indicating moderate explanatory power.

3.3. Hypothesis testing

The results of the analysis provide robust evidence to support several of the hypotheses formulated in this study. *H1*, which posited that stronger institutional frameworks would increase the odds of CBDC adoption, receives limited support. While property rights showed a marginally significant positive effect on pilot CBDC adoption, other in-

stitutional variables such as judicial effectiveness and government integrity were not significant predictors.

H2, which proposed that financial inclusion enhances CBDC adoption, is strongly supported. Financial institution account ownership significantly increased the likelihood of active (59%) and pilot (141%) CBDC adoption.

H3, which emphasized the role of technological readiness, is also strongly supported. Internet usage significantly increased the likelihood of active (12.7%) and pilot (13.4%) CBDC adoption, underscoring the importance of digital ecosystems.

H4, which posited that economic development and macroeconomic stability influence CBDC adoption, is strongly supported. GDP significantly increased the odds of active (332.1%) and pilot (212.6%) adoption. Interest rates also positively influenced active adoption (20.8%).

H5, which suggested that business and monetary freedom positively influence CBDC adoption, receives partial support. Monetary freedom significantly increased the likelihood of active adoption (31.1%). However, business freedom negatively influenced both active and pilot adoption, suggesting that countries with less restrictive environments rely on private-sector solutions, reducing the urgency for CBDCs.

3.4. Interpretation of results

The results confirm the critical role of digital and financial infrastructure in shaping CBDC adoption, particularly through financial inclusion and technological readiness. Significant variables such as financial institution account ownership and internet usage highlight the necessity of robust digital ecosystems for the success of CBDC initiatives. Economic development, represented by GDP, emerged as a strong determinant, reflecting the capacity of wealthier nations to allocate resources for digital transformation, while interest rates also play a supportive role.

Conversely, the negative association of business freedom with CBDC adoption suggests that countries with strong private-sector digital payment

solutions may have less urgency to adopt CBDCs. The insignificance of most governance and fiscal policy variables indicates that these factors may not directly influence CBDC decisions, although the marginal significance of property rights in pilot programs suggests some institutional factors could play a limited role.

These findings provide actionable insights for policymakers and central banks, emphasizing the need to prioritize digital and financial inclusion measures, strengthen technological infrastructure, and leverage economic development to facilitate CBDC initiatives effectively.

4. DISCUSSION

The findings of this study provide valuable insights into the determinants of CBDC adoption and contribute to the ongoing discourse on digital finance and financial inclusion. By identifying the critical roles of economic development, technological infrastructure, and financial inclusion, this study aligns with existing literature while introducing new perspectives on the relatively limited significance of fiscal health and governance metrics in the context of CBDC adoption.

The results align with previous studies highlighting the importance of robust digital infrastructure in driving CBDC adoption. Matsui and Perez (2021) identify advanced digital infrastructure as critical for effective CBDC initiatives, while Guley and Koldovski (2023) emphasize its role in streamlining payment systems and reducing transaction costs. Allen et al. (2020) further highlights the necessity of resilient, scalable infrastructures to support user onboarding and future technological advancements. This study reinforces these conclusions by demonstrating that higher internet usage and broader access to financial services significantly increase the likelihood of a country launching or piloting a CBDC. The evidence underscores the necessity of a strong digital ecosystem as a foundation for digital currency implementation, suggesting that nations prioritizing digital readiness are better equipped to integrate CBDCs into their financial systems.

Economic development emerged as another key predictor of CBDC adoption, with higher GDP levels significantly associated with active and pilot CBDC programs. This finding supports theories suggesting that wealthier nations are better positioned to invest in complex financial technologies (Allen et al., 2016). Advanced economies often have the necessary resources, institutional capacity, and access to technological expertise to experiment with and integrate CBDCs. These countries may also have more robust financial markets and higher public trust in financial institutions, further facilitating CBDC adoption.

This study diverges from certain expectations in the literature regarding fiscal health and governance. Ahnert et al. (2022) argued that sound fiscal policies and strong governance frameworks are essential for digital currency adoption. However, the findings of this study suggest that these factors are not statistically significant predictors of CBDC adoption. This could indicate that the adoption of CBDCs is driven more by technological and financial inclusion considerations than by broader fiscal governance mechanisms. For instance, the insignificance of variables such as tax burden and government spending may reflect the relatively low fiscal

impact of pilot CBDC programs compared to full-scale implementation.

The results also highlight the significance of financial inclusion as a central motivator for CBDC adoption, particularly in emerging markets. Variables such as Financial institution account ownership and Internet usage were strong predictors of both active and pilot CBDC programs. These findings align with the financial inclusion literature, which emphasizes the potential of CBDCs to bring unbanked populations into formal financial systems by reducing transaction costs and improving access to financial services.

While technological and economic factors were prominent in the analysis, some governance and institutional variables, such as property rights and judicial effectiveness, exhibited limited significance. Property rights demonstrated a marginal effect on pilot CBDC adoption but were not significant for active programs. This may suggest that institutional factors play a more nuanced or indirect role, possibly mediated by other elements like regulatory frameworks or geopolitical considerations. Further research is needed to explore these dynamics, particularly in the context of regulatory harmonization and cross-border digital currency initiatives.

CONCLUSIONS

This study aimed to investigate the factors influencing the adoption of CBDCs and to identify the underlying country-specific characteristics that drive their implementation. Using logistic regression analysis on a dataset of 116 countries, the research highlights the significant predictors and provides a deeper understanding of the dynamics surrounding CBDC adoption.

The results demonstrate that CBDC adoption is shaped by economic, technological, and financial inclusion factors. Countries with higher levels of digital infrastructure, as evidenced by internet penetration, and greater financial institution account ownership are significantly more likely to adopt CBDCs, underscoring the importance of technological readiness and financial inclusion. Macroeconomic conditions, particularly GDP, play a major role in enabling adoption, while interest rates provide secondary support by reflecting monetary policy flexibility.

Additionally, monetary freedom positively influences CBDC adoption, while business freedom is inversely associated, suggesting that countries with strong private-sector digital payment solutions may have less urgency to adopt CBDCs. The marginal significance of property rights for pilot programs also highlights the context-specific influence of governance factors, though broader fiscal and governance variables, such as tax burden and government spending, are generally not significant predictors.

These findings underline the transformative potential of CBDCs in promoting financial inclusion and fostering economic resilience. By bridging gaps in access to financial services, CBDCs offer a pathway

for unbanked and underbanked populations to participate in the formal financial system, contributing to broader economic inclusion and development goals. Moreover, the role of technological readiness highlights the need for investments in digital infrastructure to support the successful integration of CBDCs into existing financial ecosystems.

Moving forward, this research underscores the need for continued empirical analysis to explore the long-term impacts of CBDCs on financial stability, monetary policy, and economic development. Policymakers must prioritize proactive collaboration with industry stakeholders to design and implement CBDCs that align with national development goals and foster inclusive, resilient financial systems. As more countries transition from pilot programs to full-scale CBDC launches, the insights gained from their experiences will be invaluable for shaping the future trajectory of digital currencies globally.

FUTURE PROSPECTS AND POLICY IMPLICATIONS

The findings of this study offer important insights for policymakers and central banks aiming to adopt or pilot CBDCs. First, the strong association between digital infrastructure and CBDC adoption highlights the need for investments in technological readiness. Expanding internet access, improving digital literacy, and enhancing the accessibility of mobile financial services are critical steps to ensure the successful integration of CBDCs into national financial systems. Policymakers should also consider developing comprehensive digital strategies that address infrastructure gaps and promote technological innovation. The results support earlier studies that emphasize the importance of robust digital infrastructure and financial inclusion in driving CBDC adoption.

Second, the emphasis on financial inclusion as a driver of CBDC adoption highlights the potential of digital currencies to promote economic equity. CBDCs can reduce transaction costs, improve access to financial services, and include unbanked populations in formal financial systems. These benefits are particularly relevant for emerging markets and developing economies, where financial exclusion remains a significant challenge. Policymakers should view CBDCs as a tool for advancing broader inclusion goals, integrating digital currency initiatives into national strategies for economic development and poverty alleviation.

Finally, future research should focus on understanding the long-term implications of CBDC adoption. While this study identifies the determinants of CBDC adoption, further investigation is needed to assess the outcomes of these initiatives. Key areas of interest include the impact of CBDCs on financial stability, monetary policy transmission, and cross-border trade. Additionally, as more countries transition from pilot programs to full-scale implementation, empirical data on the operational performance of CBDCs will be invaluable for evaluating their effectiveness as tools for promoting financial inclusion and economic resilience.

By addressing these areas, future studies can provide deeper insights into the opportunities and challenges associated with CBDCs, informing both academic research and policymaking in the rapidly evolving landscape of digital finance.

AUTHOR CONTRIBUTIONS

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