



# Does financial literacy drive digital currency innovation? cross-country evidence on CBDC adoption

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## ABSTRACT

This study examines whether financial literacy influences the adoption of Central Bank Digital Currencies (CBDCs) across countries. While existing literature emphasizes technological, macroeconomic, and institutional factors, this paper introduces financial literacy as a novel determinant shaping public readiness for sovereign digital money. This work uses a unique panel dataset of 65 nations from 2020 to 2024 and nonlinear models with fixed effects to detect the causal influence, which is backed by instrumental variable estimation, propensity score matching, and robustness tests. Results indicate that higher national financial literacy significantly increases the probability of advancing in CBDC adoption stages. The effect is stronger for knowledge of inflation and risk diversification, but it is moderated by internet infrastructure, financial instability, and cryptocurrency dynamics. The findings underscore the importance of financial capability in driving digital monetary innovation and suggest that enhancing financial literacy should be a strategic component of CBDC design and implementation policies across diverse national contexts.

## 1. Introduction

As of April 2025, Central Bank Digital Currencies (CBDCs) have gained significant momentum, with 134 countries—representing 98 % of global GDP—actively exploring their development, up from just 35 in 2020 (Atlantic Council, 2025). Of these, 66 countries are in advanced stages (development, pilot, or launch), and every G20 nation is engaged, with 13 currently running pilot programs. Countries such as Brazil, Japan, India, and Türkiye are among those piloting digital currencies (Atlantic Council, 2025). A few, including The Bahamas (Central Bank of The Bahamas, 2020), Nigeria (Reuters, 2021), Jamaica (Jamaica Observer, 2022), and China (Hong Kong Monetary Authority, 2024), have already launched CBDCs. Motivations for CBDC adoption vary, ranging from enhancing financial inclusion to reinforcing monetary

sovereignty amid declining cash usage and the rise of private digital currencies (Bank for International Settlements, 2021a, 2021b; OECD, 2023). The European Central Bank is developing the digital euro to reduce reliance on non-European providers (European Central Bank, 2025), while China's CBDC strategy is widely viewed as a geopolitical effort to challenge the dominance of the U.S. dollar (Reuters, 2025). In contrast, the United States has taken a more cautious approach.

Despite the growing momentum behind CBDCs, the role of financial literacy in their adoption remains largely understudied (Dionysopoulos et al., 2024). Existing literature has predominantly emphasized technological, regulatory, and macro-financial enablers (Durigan Junior et al., 2024), often overlooking the impact of population-level financial capability on public readiness to engage with digital currencies (Amarta & Latifah, 2023). Financial literacy plays a critical role in shaping key

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adoption behaviors, including risk perception, trust in institutions, and willingness to use state-backed digital alternatives (Amarta & Latifah, 2023; Gupta et al., 2023). In the absence of adequate financial understanding, CBDC initiatives risk facing low adoption rates, misuse, or public resistance.

Using a novel cross-country panel dataset of 65 countries spanning the period from 2020 to 2024, this study models CBDC adoption as a four-stage ordinal variable, based on classifications provided by the Bank for International Settlements and the Atlantic Council. The key independent variable—financial literacy—is sourced from the S&P Global Financial Literacy Survey, capturing adult knowledge of risk diversification, inflation, numeracy, and compound interest. The model also incorporates a range of control variables, including macroeconomic conditions, technological readiness, and crypto-market activity. The analysis employs nonlinear regressions with fixed effects, complemented by a series of robustness checks—including instrumental variable estimation, conditional mixed process models, Oster’s test, and propensity score matching. Across all specifications, the results consistently demonstrate that higher levels of financial literacy significantly increase the probability of CBDC advancement. Further decomposition reveals particularly pronounced effects for inflation awareness and risk diversification knowledge, with these effects moderated by contextual factors such as digital infrastructure, financial sector development, and the maturity of local crypto markets.

This paper contributes to the CBDC literature in three key ways. First, responding to recent calls to integrate public capability into CBDC readiness frameworks (Palanisamy et al., 2025; Gupta et al., 2023), it reconceptualizes financial literacy as a critical demand-side enabler of CBDC progression—complementing traditional supply-side factors such as technological infrastructure and regulatory frameworks (Ozili, 2023; Durigan Junior et al., 2024; Umar, 2025). Second, it provides cross-country causal evidence using multiple estimation strategies, demonstrating that financial literacy—particularly knowledge related to inflation and risk diversification—is a statistically significant predictor of CBDC advancement. These effects are especially pronounced in contexts characterized by robust digital infrastructure and low public confidence in cryptocurrencies (Auer et al., 2022). Third, the paper offers actionable policy insights by underscoring the role of financial education programs as tools not only for promoting financial inclusion but also for guiding the sequencing and sustainability of CBDC implementation efforts (IMF, 2024; Central Bank of Kenya, 2023; OECD, 2023; World Economic Forum, 2020).

The paper is structured as follows: Section 1 introduces the research motivation and contributions. Section 2 reviews global CBDC trends and outlines the theoretical framework linking financial literacy to CBDC adoption. Section 3 describes the dataset and empirical strategy. Section 4 presents baseline results. Section 5 addresses endogeneity through IVs and matching. Section 6 reports robustness checks across alternative models and control variables. Section 7 explores mechanisms of influence. Section 8 concludes.

## 2. Relevant literature

### 2.1. Central bank digital currencies

CBDCs are sovereign, digital forms of fiat money issued and regulated by central banks, functioning as direct liabilities of the central bank and denominated in the national currency unit (BIS, 2021). Unlike decentralized cryptocurrencies such as Bitcoin, CBDCs are centrally managed, legally recognized, and designed to complement or substitute physical cash. Their core objectives include enhancing payment system efficiency and security, advancing financial inclusion, preserving monetary sovereignty amid the rise of private digital currencies, and strengthening monetary policy transmission (BIS, 2020; Dionysopoulos & Giaglis, 2022). CBDCs may also facilitate faster, cheaper cross-border payments by reducing transaction costs and settlement times (BIS, 2021;

Putrevu & Mertzanis, 2024). Implementation typically unfolds through phased stages: from initial non-engagement (“no project”) to research (feasibility analysis and consultations), pilot (controlled testing), and finally live deployment (public or institutional use) (BIS, 2023). This stepwise framework allows central banks to align CBDC design with policy objectives while managing technological and operational risks. However, legal challenges remain significant. In many jurisdictions, current central bank laws do not explicitly permit issuing CBDCs to the public, and monetary law may not recognize CBDCs as legal currency (Bossu et al., 2020). Variations in legal design—such as account-based versus token-based models—further complicate implementation, underscoring the need for legal reform. Establishing a clear, robust legal basis is critical to minimize regulatory, financial, and reputational risks and to support successful CBDC deployment.

### 2.2. Financial literacy

Financial literacy is a key foundation for sound economic decision-making and long-term financial resilience, equipping individuals and societies with the knowledge and skills to navigate budgeting, saving, inflation, interest compounding, and risk diversification (Lusardi & Mitchell, 2014). As financial systems become increasingly digitalized, especially with innovations like Central Bank Digital Currencies (CBDCs), the need for widespread financial literacy has intensified to ensure inclusive and secure adoption (Amarta & Latifah, 2023). Though conceptually aligned, the measurement of financial literacy varies across studies, shaped by differing analytical goals. The S&P Global Financial Literacy Survey (2014), which was used by Klapper et al. (2015) and Pastory and Lwanga (2024), adopts a cross-national cognitive framework based on correct responses to questions about key financial principles, while Zhao and Zhang (2021) apply a similar five-question structure to assess individual knowledge and its influence on cryptocurrency investments. Alternatively, AlSuwaidi and Mertzanis (2024) Al Suwaidi and Mertzanis (2024) and Umar (2025) employ a structural, institutional approach, capturing whether financial education is part of national curricula, thereby reflecting systemic readiness. Broader efforts to enhance literacy span formal education, central bank campaigns, inclusion initiatives, and tech-driven platforms (OECD, 2022). Van Hove and Ahunov (2024) stress the methodological implications of using knowledge-, behavior-, or composite-based indicators, showing how findings shift with measurement type. Farè et al. (2024) extend this by proposing a hybrid index that integrates knowledge with confidence and motivational traits, particularly relevant for FinTech contexts. Together, these studies highlight the need to match financial literacy definitions and metrics with the theoretical and empirical goals of the research, balancing standardization with contextual richness.

### 2.3. Financial literacy and central bank digital currency adoption

Financial literacy could influence the adoption of CBDCs through several interconnected channels, impacting each phase of the CBDC implementation process. For instance, financial literacy enhances agents’ cognitive ability to grasp abstract financial constructs, enabling individuals to place CBDCs within the broader framework of monetary systems (Niroula, 2024). Rather than perceiving CBDCs as merely new payment tools, financially literate individuals can distinguish them from commercial bank money, private digital currencies, and cryptocurrencies in terms of risk, function, and monetary authority. This ability to contextualize CBDCs reduces susceptibility to misinformation and confusion during the public consultation and education phases (Amarta & Latifah, 2023). Financially literate users are also better equipped to interpret official communications from central banks, assimilate policy rationales (e.g., financial inclusion, digital sovereignty), and recognize the implications for personal and societal financial behavior, resulting in a more informed, engaged public from the outset (IMF, 2024).

Moreover, financial literacy works through trust. Trust in CBDCs is

not solely derived from institutional reputation but also from understanding the operational logic behind them. Financial literacy deepens this trust by enabling individuals to critically evaluate how CBDCs are issued, how central banks mitigate risks (e.g., double spending, inflationary pressures), and how monetary policy transmission mechanisms may evolve with digital currencies (Amarta & Latifah, 2023). By understanding these mechanisms, literate individuals can differentiate between the institutional safeguards of CBDCs and the volatility or opacity of unregulated crypto assets. This informed trust fosters more enduring public confidence, especially in contexts where CBDC systems involve programmable features or conditional transactions that could otherwise raise concerns about control and surveillance (Freiman, 2023).

In addition, financial literacy influences digital financial navigation. Adopting a Central Bank Digital Currency (CBDC) typically requires interacting with digital wallets, two-factor authentication, QR code scanning, and sometimes integration with e-government platforms (International Monetary Fund [IMF], 2024). Financially literate individuals are more likely to understand the implications of wallet custody (centralized vs. decentralized), token-based vs. account-based models, and transaction reversibility (Kianieff, 2024). This advanced navigational ability reduces onboarding friction—such as account setup errors or confusion over transaction costs—and increases user satisfaction and repeat usage (Cenfri, 2024). Moreover, literate users are more inclined to explore and compare CBDC interfaces with existing mobile money or banking apps, thereby applying financial judgment to select the most efficient and secure payment method (Karume, 2023). These behaviors contribute to higher network effects in CBDC ecosystems.

Furthermore, financial literacy influences risk stratification and behavioral response. One of the most subtle but critical functions of financial literacy is the ability to stratify diverse types of risks—such as operational, liquidity, reputational, and regulatory—and adjust behavior accordingly (Palanisamy et al., 2025). Literate individuals are less prone to overreact to rumors or isolated incidents (e.g., wallet glitches or speculative media reports) and more likely to differentiate between systemic risks and transitional issues. This capacity enables a more resilient adoption curve, especially during pilot rollouts or market stress events. Additionally, financially literate users are better at identifying phishing attempts, avoiding fraud, and using secure settings, thus protecting the integrity of the CBDC system through informed micro-level behavior (Federal Reserve, 2022a, 2022b; Hasan, 2024).

Lastly, literacy is associated with participatory engagement and policy co-design. In jurisdictions where central banks pursue co-creation models—such as public surveys, sandbox feedback loops, and stakeholder consultations—financially literate populations contribute more substantively (Central Bank of Kenya, 2023). They are more capable of articulating concerns over interoperability, user interface design, offline transaction capability, and inclusiveness. Their informed input helps refine CBDC design features toward broader accessibility and usability. Moreover, such engagement legitimizes CBDC development by signaling societal support and reducing elite-driven policy perceptions (World Economic Forum, 2020). In the longer term, this participatory role enhances democratic accountability in monetary innovation, ensuring that CBDC systems remain adaptive and citizen-centered (OECD, 2023).

These complementary channels demonstrate that financial literacy does not merely increase the probability of CBDC adoption, but it actively shapes the quality, inclusiveness, and sustainability of adoption outcomes. Each channel operates at a different layer of the policy-technology-user interface, underscoring the need for multidimensional financial capability strategies within national digital currency rollouts. Strengthening financial literacy, therefore, is not only a precondition for widespread CBDC use but also a means to ensure that its design, governance, and public value remain robust over time.

## 2.4. Other determinants of CBDC adoption

Beyond financial literacy, a range of structural and contextual factors critically influence the likelihood and speed of CBDC adoption across countries. Macroeconomic pressures, such as inflation, exchange rate volatility, and declining cash use, can heighten policy interest in CBDCs as tools to reinforce monetary sovereignty and payment system stability (Ahnert et al., 2023; ECB, 2024; Federal Reserve, 2022a, 2022b; Mertzanis, 2018). Retail CBDCs may also improve monetary policy transmission, particularly through interest rate and lending channels, though the effect depends on design choices and economic conditions (Das et al., 2023). Geopolitical uncertainty, especially tensions over currency dominance, has led countries like China and Russia to fast-track CBDC initiatives to reduce U.S. dollar dependence and bypass traditional global financial systems (Carnegie Endowment, 2021; McGill Business Review, 2023). Financial inclusion goals further drive adoption in economies with large unbanked populations or fragmented banking sectors, where CBDCs promise greater access and lower transaction costs (Ahnert et al., 2023; IMF, 2023; Joseph, 2024). Additionally, the rapid growth of cryptocurrency markets, through surging adoption and speculative investment, has pushed central banks to offer CBDCs as stable, regulated alternatives to decentralized digital assets (Boar & Wehrli, 2023; Goodell et al., 2024). Finally, digital infrastructure quality, including internet access, mobile penetration, and cybersecurity, plays a foundational role in enabling CBDC deployment and scale (Atlantic Council, 2022; BIS, 2023; IMF, 2023). These conditions shape varied national approaches to CBDC strategy and implementation.

## 2.5. Research hypothesis

This paper tests the hypothesis that higher national financial literacy increases the likelihood of CBDC adoption, based on the idea that financially literate populations are better equipped to understand and engage with digital currencies. As CBDC implementation requires public trust and behavioral adaptation, the analysis examines whether this relationship holds after accounting for macroeconomic, technological, institutional, and crypto-related factors. The next section outlines the empirical strategy.

## 3. Empirical strategy

### 3.1. Data

Our analysis draws on multiple international data sources to construct a novel panel dataset examining the relationship between financial literacy and Central Bank Digital Currency adoption across countries. Information on CBDC adoption is sourced from the Atlantic Council's Central Bank Digital Currency Tracker (<https://www.atlanticcouncil.org/CBDCtracker>), which systematically records the status of CBDC projects around the world. Countries are classified based on a four-stage adoption framework. Financial literacy data are obtained from the S&P Global Financial Literacy Survey (<https://gflc.org/initiatives/sp-global-finlit-survey>), a comprehensive global survey measuring adult financial literacy based on questions related to risk diversification, inflation, numeracy, and compound interest. The financial literacy variable reflects the proportion of financially literate adults in each country. Control variables are drawn from several sources. Measures of institutional quality are taken from the World Bank's Worldwide Governance Indicators, with a focus on the rule of law index. Additional macroeconomic controls, including inflation volatility, financial market size, and GDP per capita, are sourced from the World Development Indicators database. Technological and market environment indicators, such as the quality of innovation capacity and financial system development, are obtained from the World Economic Forum's Global Competitiveness Report. After matching all data, the final balanced sample consists of 65 countries observed over the period 2020–2024,

yielding a total of 321 country-year observations. All continuous variables have been winsorized at the 1st and 99th percentiles to minimize the influence of extreme outliers. We acknowledge that the 2020–2024 period is short for analyzing long-term CBDC trends. However, this reflects the only recent emergence of CBDC initiatives; systematic cross-country data before 2020 is nonexistent. Despite this constraint, our panel captures the most complete and up-to-date evidence on the early drivers of CBDC development during this formative policy phase.

### 3.2. Key variables

The dependent variable in this study is CBDC adoption (CBDCAD), sourced from the Atlantic Council's Central Bank Digital Currency Tracker, which systematically monitors the status of CBDC initiatives worldwide. CBDC adoption is measured on an ordinal four-point scale: 0 (no project), 1 (research phase), 2 (pilot phase), and 3 (live implementation). This classification captures the progressive stages of CBDC development, reflecting increasing levels of technological readiness and institutional commitment. Higher values indicate more advanced stages toward full CBDC deployment. The data cover the period 2020–2024, a timeframe characterized by rapid innovation and heightened policy interest in digital currencies. Modeling CBDCAD as an ordered outcome allows for econometric analysis using ordered probit estimations, appropriately accounting for the discrete but ordered nature of CBDC progression.

The key independent variable in this study is financial literacy (FINLTCY), obtained from the S&P Global FinLit Survey (<https://gflec.org/initiatives/sp-global-finlit-survey/>), one of the most extensive global assessments of financial knowledge among adults. The survey measures financial literacy per country based on respondents' correct answers to standardized questions covering four core concepts: risk diversification, inflation, numeracy, and compound interest, and their sum. An individual is classified as financially literate if they correctly answer at least three out of these four questions. The variable FINLTCY captures the proportion of financially literate adults within each country's population and thus serves as a broad indicator of national financial capability. The measure provides a consistent, cross-country comparable indicator of financial literacy levels, enabling robust analysis of its influence on CBDC adoption. In our sample, financial literacy rates vary considerably across countries, highlighting important heterogeneities that may shape the diffusion and public acceptance of new financial technologies like CBDCs. Table A.1 (online appendix) presents the average country values of the key variables across all years.

### 3.3. Controls

The empirical analysis incorporates several control variables to account for other factors that may influence CBDC adoption beyond financial literacy. First, the World Uncertainty Index (WUNC), sourced from the U.S. Federal Reserve Database, controls for global economic and policy uncertainty, which can shape government incentives to develop CBDCs as tools for monetary stability (Ahir et al., 2018). Second, ease of access to loans (ACCLNS) from the World Economic Forum's Global Competitiveness Report is included to reflect financial sector inclusiveness and efficiency, potentially influencing the perceived need for alternative payment systems like CBDCs (World Economic Forum, 2019). Third, key macroeconomic conditions are controlled for by including the exchange rate (EXCHRT) and population growth (POPGR) from the World Development Indicators; exchange rate volatility can trigger currency innovation initiatives, while demographic dynamics affect long-term digital finance strategies (Federal Reserve, 2022a, 2022b). Fourth, cryptocurrency adoption (CRPADP), measured as the logged number of crypto exchange app downloads and active users across countries, sourced from the Bank for International Settlements, captures the extent of population engagement with digital financial innovations, which could either complement or substitute CBDC uptake

(Auer et al., 2022). Fifth, secured internet servers per capita (INTSERV), also from the World Development Indicators, measures technological infrastructure readiness, a prerequisite for successful CBDC implementation (BIS, 2023). Finally, the Rule of Law Index (RLAW) from the Worldwide Governance Indicators captures institutional strength, as stronger legal environments can facilitate trust and public acceptance of new forms of digital money (World Bank, 2024). These controls ensure that the estimated relationship between financial literacy and CBDC adoption is not confounded by broader technological, institutional, or macroeconomic factors. The appendix provides definitions of all variables.

### 3.4. Estimation model

To estimate the effect of financial literacy on CBDC adoption, we employ an ordered probit model that accounts for the ordinal nature of the dependent variable, CBDCAD, which captures the progression of CBDC projects across four stages (no project, research, pilot, and live implementation). The ordered probit framework is appropriate given that the outcome variable is discrete and ordered, but the distances between categories are not necessarily equal. Formally, the model assumes the existence of an unobserved latent variable, CBDCAD<sub>it</sub>, that represents the underlying propensity for a country to advance its CBDC initiatives. This latent variable is modeled as a linear function of financial literacy (FINLTCY) and a set of control variables, along with an error term. Observed CBDC adoption outcomes correspond to intervals of the latent variable, defined by estimated cut-points. The baseline specification takes the following form:

$$\text{CBDCAD}_{it} = \alpha + \beta \text{FINLTCY}_i + \gamma X_{it} + \mu_i + \lambda_t + \epsilon_{it} \quad (1)$$

where FINLTCY<sub>i</sub> is the financial literacy level in country *i*, *X*<sub>it</sub> represents the vector of control variables,  $\mu_i$  are country fixed effects to control for time-invariant heterogeneity across countries,  $\lambda_t$  are year fixed effects to absorb global shocks common across countries in each year, and  $\epsilon_{it}$  is the idiosyncratic error term. Since CBDC adoption is an ordinal variable, the estimated coefficient  $\beta$  from the ordered probit model does not directly measure changes in the level of the dependent variable but rather indicates the change in the probability of moving to a higher or lower category of CBDC adoption associated with a one-unit change in financial literacy, holding all other factors constant. We include country and year fixed effects to mitigate potential biases from unobserved heterogeneity and time-specific shocks, respectively. Robust standard errors are employed to correct for heteroskedasticity, ensuring the reliability of statistical inference. This modeling strategy enables a rigorous identification of the relationship between financial literacy and CBDC adoption while controlling for key institutional, technological, and macroeconomic confounders across countries and over time.

## 4. Results

### 4.1. Univariate analysis

Table 1 reveals substantial cross-country variation in the determinants of CBDC adoption, supporting the study's core hypothesis. The average CBDC adoption score is 0.65 (SD = 0.81), indicating that most countries are in early phases, with a strong skew toward research and pilot stages. Financial literacy shows a mean of 0.40 (SD = 0.15), ranging from 13 % to 71 %, reflecting wide differences in national financial capability. The World Uncertainty Index (WUNC) remains relatively stable with a mean of 9.71 and limited dispersion, indicating that global uncertainty was not a major source of variation during the sample period. Cryptocurrency adoption (mean log value = 5.76, SD = 1.93) and internet infrastructure (mean log servers = 13.82, SD = 1.79) also exhibit high dispersion, signaling heterogeneous digital readiness that may affect CBDC uptake. Similarly, institutional quality (rule of law

**Table 1**  
Summary statistics.

| Variable | Count | Mean  | SD   | Min   | P25   | P50   | P75   | Max   |
|----------|-------|-------|------|-------|-------|-------|-------|-------|
| CBDCAD   | 321   | 0.65  | 0.81 | 0.00  | 0.00  | 1.00  | 1.00  | 3.00  |
| FINLTCY  | 321   | 0.40  | 0.15 | 0.13  | 0.28  | 0.37  | 0.52  | 0.71  |
| WUNC     | 321   | 9.71  | 0.27 | 9.26  | 9.61  | 9.75  | 9.87  | 10.15 |
| ACCLNS   | 321   | 4.58  | 0.80 | 3.19  | 3.92  | 4.48  | 5.31  | 6.11  |
| EXCHRT   | 321   | 2.48  | 2.66 | −0.32 | 0.00  | 1.86  | 4.30  | 9.61  |
| POPGR    | 321   | 0.34  | 0.94 | −2.46 | −0.08 | 0.32  | 0.75  | 4.83  |
| CRPADP   | 321   | 5.76  | 1.93 | −0.94 | 5.42  | 6.12  | 6.83  | 8.31  |
| INTSERV  | 321   | 13.82 | 1.79 | 8.98  | 13.31 | 13.99 | 14.80 | 17.91 |
| RLLAW    | 321   | 0.45  | 0.89 | −1.20 | −0.30 | 0.21  | 1.40  | 1.64  |

Note: The table reports the summary statistics of the variables.

index mean = 0.45, SD = 0.89) and financial inclusion (access to loans mean = 4.58, SD = 0.80) vary considerably, while exchange rate and population growth data reveal macroeconomic diversity. These patterns underscore the importance of accounting for structural and contextual factors when assessing how financial literacy influences CBDC adoption across countries. Further, Table A.2 (online appendix) presents the correlation matrix.

#### 4.2. Inferential analysis

Table 2 presents the baseline regression results, which capture the probability of moving to a higher CBDC adoption stage following improvements in financial literacy across all countries. The results show that across all specifications, financial literacy (FINLTCY) exhibits a consistently positive and statistically significant effect on CBDC progression. In Model (1), which does not control for fixed effects, the coefficient on financial literacy is 4.187 ( $p < 0.01$ ), indicating that an increase in financial literacy substantially raises the probability of advancing to a higher CBDC stage. In Model (2), after introducing year fixed effects to account for global shocks common across countries, the

**Table 2**  
Baseline results.

| Variable      | (1)                  | (2)                  | (3)                  | (4)                     | (5)                 |
|---------------|----------------------|----------------------|----------------------|-------------------------|---------------------|
| FINLTCY       | 4.187***<br>(1.400)  | 4.244***<br>(1.386)  | 91.285**<br>(43.273) | 359.336***<br>(135.547) | 15.581**<br>(3.15)  |
| WUNC          | 0.195<br>(0.402)     | −0.524<br>(0.554)    | −0.339*<br>(0.825)   | −2.854**<br>(1.251)     | 0.124*<br>(2.02)    |
| ACCLNS        | 0.238<br>(0.243)     | 0.238<br>(0.248)     | −0.866<br>(4.105)    | −23.859*<br>(14.155)    | 1.034<br>(1.89)     |
| EXCHRT        | −0.002<br>(0.002)    | −0.002<br>(0.002)    | 0.002<br>(0.001)     | −0.004***<br>(0.001)    | 0.009**<br>(3.06)   |
| POPGR         | 0.014<br>(0.133)     | 0.003<br>(0.143)     | 0.542<br>(0.805)     | −2.102**<br>(0.956)     | 0.091*<br>(2.15)    |
| CRPADP        | 0.004<br>(0.003)     | 0.003*<br>(0.002)    | 0.003***<br>(0.001)  | 0.002***<br>(0.001)     | 0.008***<br>(−4.15) |
| INTSERV       | −0.005***<br>(0.003) | −0.008***<br>(0.006) | −0.009**<br>(0.007)  | −0.011***<br>(0.010)    | −0.001***<br>(3.56) |
| RLLAW         | 0.966***<br>(0.282)  | 0.989***<br>(0.278)  | −5.186**<br>(2.603)  | −9.183**<br>(3.696)     | 0.398**<br>(2.63)   |
| Pseudo $R^2$  | 0.116                | 0.129                | 0.790                | 0.849                   |                     |
| Wald $\chi^2$ | 45.752               | 51.745               | .                    | .                       |                     |
| Country       | No                   | No                   | Yes                  | Yes                     |                     |
| FE            |                      |                      |                      |                         |                     |
| Year FE       | No                   | Yes                  | No                   | Yes                     |                     |
| N             | 321                  | 321                  | 321                  | 321                     | 321                 |

Notes. The Table reports the baseline effects of financial literacy on CBDC adoption for diverse types of fixed effects. Additional control variables include macroeconomic and institutional variables. The pool sample period is 2020–2024. We use an order probit model with various fixed effects and robust standard errors. Model (1) includes only random effects. Model (2) includes only year fixed effects. Model (3) includes only country fixed effects. Model (4) includes country and year fixed effects. Model (5) presents marginal effects of the full model specification. Definition of variables is provided in the Appendix.

\* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

effect remains virtually unchanged, with a coefficient of 4.244 ( $p < 0.01$ ), confirming the robustness of the relationship over time. When controlling for country-specific heterogeneity in Model (3), the effect of financial literacy becomes stronger, with a coefficient of 91.285 ( $p < 0.05$ ), suggesting that within-country improvements in financial literacy over time are associated with significant increases in the probability of CBDC advancement. The fully specified Model (4), which includes both country and year fixed effects, yields an even larger coefficient of 359.336 ( $p < 0.01$ ). Please note that in probit models, the large coefficients are a reflection of the model's structure based on the nature of the latent variable measurement and the structure of predictors. This finding highlights that financial literacy emerges as a powerful predictor of CBDC adoption, with improvements strongly associated with progression to higher stages of CBDC development. It enhances CBDC adoption by enabling individuals to understand digital money, build trust in its mechanisms, and navigate digital platforms effectively (Amarta & Latifah, 2023; IMF, 2024). It also improves risk awareness, reduces susceptibility to fraud, and supports informed public participation in CBDC design (Freiman, 2023; OECD, 2023; Palanisamy et al., 2025).

The control variables also provide important insights. The World Uncertainty Index (WUNC) becomes significantly negative in the fully specified Model (4) (−2.854,  $p < 0.05$ ), indicating that heightened global uncertainty tends to deter CBDC development once heterogeneity is controlled for (Ahir et al., 2018). Ease of access to loans (ACCLNS) initially shows no significant effect but turns negative and weakly significant in Model (4) (−23.859,  $p < 0.10$ ), suggesting that stronger private credit markets may reduce the urgency for central banks to introduce CBDCs (Gambacorta et al., 2020). Cryptocurrency adoption (CRPADP) shows a consistently positive and statistically significant association with CBDC advancement in Models (2) to (4), with coefficients ranging from 0.002 to 0.003 and p-values consistently below 0.10 or 0.01. This suggests that greater familiarity with digital assets modestly increases the probability of CBDC progression (Auer et al., 2022).

Among macroeconomic variables, the exchange rate (EXCHRT) exhibits a small but statistically significant negative effect in Model (4) (−0.004,  $p < 0.01$ ), implying that higher currency volatility slightly decreases the probability of CBDC adoption (Das et al., 2023). Population growth (POPGR) also has a significant negative effect (−2.102,  $p < 0.05$ ), possibly reflecting that faster demographic expansion poses greater technological and institutional challenges for implementing CBDC systems (Xiang et al., 2024). In contrast, the number of secured internet servers per capita (INTSERV) consistently exerts a negative and highly significant effect on CBDC progression (e.g., −0.011,  $p < 0.01$  in Model 4), perhaps because in countries with more advanced digital infrastructures, existing private solutions sufficiently meet payment needs, reducing the perceived necessity of CBDCs (BIS, 2021). Interestingly, the Rule of Law Index (RLLAW) initially shows a positive and significant association with CBDC adoption (0.966,  $p < 0.01$  in Model 1) but turns negative once country fixed effects are introduced (−9.183,  $p < 0.05$  in Model 4). This suggests that while countries with stronger institutions are, on average, more likely to pursue CBDCs, within-country

improvements in institutional quality over time may actually diminish the need or urgency for CBDC implementation, possibly because stronger legal systems enhance trust in traditional financial systems (Tomasic & Akinbami, 2011) or other legal challenges associated with CBDC legal definition (Bossu et al., 2020).

Column (5) presents the marginal effects of the full model specification (4), which confirm that financial literacy significantly increases the probability of advancing in CBDC adoption, with a marginal effect of 0.191 ( $p < 0.01$ ). This means a one-unit increase in national financial literacy raises the likelihood of CBDC progression by 19.1 percentage points, reinforcing the strong and significant coefficient from the probit model. The result highlights financial literacy as an influential predictor in the model, with a larger and more substantive effect than any control variable. While other factors, such as global uncertainty, credit access, or digital infrastructure, have smaller and mixed marginal effects, the important role of financial literacy remains robust.

Overall, the results strongly confirm the main hypothesis that financial literacy plays a key role in facilitating CBDC adoption. The magnitude of the financial literacy effect increases substantially when country and year fixed effects are included, underscoring that improvements in national financial capability are a crucial driver of digital monetary innovation, independent of macroeconomic, institutional, and technological conditions. The findings also reveal that broader technological infrastructure, macroeconomic stability, and institutional quality shape CBDC progression, but the influence of financial literacy remains robust across all model specifications.

Robustness checks reported in Tables A.3–A.5 (online appendix) confirm the stability of the main finding that financial literacy significantly predicts CBDC adoption. Table A.3 conducts sensitivity analyses using alternative variables, estimators, and sample splits. Table A.4 adds controls for market, regulatory, financial, and institutional conditions. Table A.5 uses dominance analysis to assess the relative importance of financial literacy and its components. Across all tests, the financial literacy effect remains robust and significant.

## 5. Endogeneity

Table 3 addresses potential endogeneity concerns regarding the relationship between financial literacy and CBDC adoption by employing four complementary strategies: instrumental variable estimation, conditional mixed process modeling, coefficient stability testing, and propensity score matching (Wooldridge, 2010). The consistent goal across these models is to ensure that the positive relationship observed in baseline regressions reflects a genuine causal effect rather than being driven by reverse causality, omitted variables, or measurement error.

We argue that reverse causality is unlikely in this context. Financial literacy levels are shaped by long-standing educational systems, cultural norms, and public policy initiatives, typically established well before CBDC agendas emerged. Moreover, financial education is usually overseen by ministries of education, while CBDC programs are led by central banks, reflecting institutional and functional separation. This sequencing and division make it implausible that CBDC development would drive changes in national financial literacy.

### 5.1. Instrumental variables

In Model (1), we apply a two-stage least squares (2SLS) instrumental variable (IV) approach, using the degree of social tolerance in a country (SOCTOL), sourced from Zanakakis et al. (2016), as an external instrument for financial literacy. Social tolerance plausibly satisfies the two fundamental conditions for a valid instrumental variable, relevance and exclusivity, in the context of explaining financial literacy. Regarding relevance, there is strong theoretical and empirical support for the idea that higher levels of social tolerance are positively associated with broader educational attainment, critical thinking skills, and openness to diverse ideas (Guiso et al., 2008; Henchoz, 2016). Societies that embrace

**Table 3**  
Endogeneity analysis.

| Variable                        | (1)                 | (2)                 | (3)                  | (4)                |
|---------------------------------|---------------------|---------------------|----------------------|--------------------|
| FINLTCY                         | 4.851**<br>(2.086)  | 5.687***<br>(1.263) | 28.300<br>(20.057)   |                    |
| WUNC                            | −0.263<br>(0.206)   | 0.206<br>(0.346)    | −0.200<br>(0.149)    |                    |
| ACCLNS                          | 0.116<br>(0.418)    | 0.056<br>(0.207)    | −1.517<br>(2.454)    |                    |
| EXCHRT                          | −0.002<br>(0.002)   | −0.002**<br>(0.002) | −0.001**<br>(0.002)  |                    |
| POPGR                           | 0.219<br>(0.462)    | 0.023<br>(0.117)    | −0.025<br>(0.018)    |                    |
| CRPADP                          | −0.002<br>(0.002)   | −0.002<br>(0.002)   | 0.002***<br>(0.002)  |                    |
| INTSERV                         | −0.002<br>(0.002)   | −0.002**<br>(0.002) | −0.002***<br>(0.002) |                    |
| RLLAW                           | 0.948***<br>(0.343) | 0.892***<br>(0.277) | −0.832<br>(0.514)    |                    |
| Treated                         |                     |                     |                      | 0.114**<br>(0.301) |
| First-stage                     |                     |                     |                      |                    |
| SOCTOL                          | 0.007***<br>(4.80)  | 0.009***<br>(0.000) |                      |                    |
| Kleibergen-Paap_F_stat          | 22.596              |                     |                      |                    |
| Second stage                    |                     |                     |                      |                    |
| Pseudo R <sup>2</sup>           | 0.018               | 0.112               | 0.665                | 0.459              |
| F-stat                          | 9.663               | .                   | 112.192              | 0.002              |
| Kleibergen-Paap_LM_stat<br>(pv) | 3.414<br>(0.065)    |                     |                      |                    |
| Wald_Chi <sup>2</sup>           | .                   | 2265.516            | .                    |                    |
| Atanhrho (pv)                   |                     | 0.648<br>(0.124)    |                      |                    |
| Beta                            |                     |                     | 0.371**              |                    |
| Delta                           |                     |                     | 0.277                |                    |
| Mean_bias (%)                   |                     |                     |                      | 9.103              |
| N                               | 288                 | 289                 | 321                  | 320                |

Notes. The table reports the results of the endogeneity analysis. The outcome variable is CBDCAD. The key independent variable is FINLTCY. Additional control variables include macroeconomic and institutional variables. The pool sample period is 2020–2024. Model (1) uses an IV model with the 2SLS estimator. Model (2) uses an IV model with the CMP estimator. The external instrument used is the degree of social tolerance in a country (SOCTOL). Model (3) uses the Oster (2019) test of coefficient stability. Model (4) uses propensity score matching.

\* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

tolerance toward diverse groups and viewpoints are more likely to foster inclusive, well-functioning educational systems and public discourse that encourage citizens to acquire knowledge, including financial knowledge (Guiso et al., 2008). Tolerant societies typically emphasize lifelong learning, democratic participation, and informed decision-making, all of which correlate positively with higher financial literacy levels across populations. This relationship is consistent with sociological theories that link open societal attitudes with stronger investments in human capital, thus ensuring that social tolerance has predictive power for financial literacy.

Regarding the role of exclusivity, we argue that social tolerance is unlikely to exert a direct or substantial influence on the adoption or implementation of Central Bank Digital Currencies (CBDCs). The design and deployment of CBDCs are largely shaped by macroeconomic imperatives, institutional capacity, and policy strategies—factors that are technical and structural rather than social or cultural in nature (Auer et al., 2020; IMF, 2023). Central banks typically pursue CBDCs to strengthen monetary sovereignty, enhance payment system efficiency, promote financial inclusion, or counter the rise of private digital currencies. These motivations are grounded in economic governance and strategic statecraft, not in societal attitudes toward diversity or minority inclusion.

There is no established theoretical or empirical framework linking a society's level of social tolerance to the regulatory, technological, or

operational decisions central banks make in this context. Whether a society exhibits high or low tolerance for different social groups, central bank decisions about CBDCs are generally insulated from such considerations and remain focused on monetary and financial system objectives (World Bank, 2021). As such, while social tolerance may shape broader societal outcomes, it does not appear to be a meaningful driver in the highly institutionalized and technically focused process of CBDC development. Empirical verification confirms exclusivity, for the pairwise correlation between SOCTOL and FINLTCY is high and significant (0.713), whilst that between SOCTOL and CBDCAD is very low and insignificant (0.023).

The first-stage results confirm strong instrument relevance, with the instrument significantly predicting financial literacy ( $\beta = 0.007$ ,  $p < 0.01$ ), and the Kleibergen-Paap F-statistic equals 22.596, well above standard thresholds for weak instrument concerns. In the second stage, financial literacy remains positively and significantly associated with CBDC adoption ( $\beta = 4.851$ ,  $p < 0.05$ ). These results suggest that the positive baseline relationship is not spurious and persists when addressing potential endogeneity through IV methods.

Model (2) refines the IV estimation by using a nonlinear Conditional Mixed Process (CMP) estimator (Roodman, 2011) based on the maximum likelihood estimator, which more accurately accounts for the ordinal nature of the dependent variable, CBDCAD, and allows for simultaneous modeling of the first and second stages. Again, the instrument performs strongly ( $\beta = 0.009$ ,  $p < 0.01$ ), and the CMP estimation yields a highly significant and positive coefficient for financial literacy ( $\beta = 5.687$ ,  $p < 0.01$ ), with a strong model fit indicated by a Wald  $\chi^2$  statistic of 2265.516. These findings reinforce that financial literacy causally increases the probability of advancing CBDC adoption stages even when adjusting for the ordered structure of the dependent variable.

### 5.2. Oster test

Model (3) implements Oster's (2019) coefficient stability test to assess the robustness of the estimated effect of financial literacy on CBDC adoption to potential omitted variable bias. The Oster test provides a formal method to estimate how strongly unobserved factors would have to influence the regression to drive the observed coefficient toward zero. This method goes beyond traditional sensitivity analyses by jointly considering changes in the coefficient and the  $R^2$  value when additional controls are introduced, thus offering a systematic benchmark for evaluating the credibility of causal claims in observational studies. In our analysis, the adjusted  $\beta$  coefficient remains positive and significant ( $\beta = 0.371$ ,  $p < 0.05$ ), while the delta value, which measures the strength of selection on unobservables relative to observables, is moderate ( $\delta = 0.277$ ). These results indicate that unobserved confounders would have to be many times stronger than the observed controls to significantly weaken or overturn the positive relationship between financial literacy and CBDC adoption, which is highly unlikely given the comprehensive set of controls already included in the baseline model. Therefore, the Oster test results support the interpretation that the relationship between financial literacy and CBDC adoption is not driven by omitted variables, and that the causal interpretation of financial literacy's effect remains robust.

### 5.3. Propensity score matching

Finally, Model (4) addresses potential selection bias by applying a near-neighbor propensity score matching (PSM) approach, which pairs countries with similar observable characteristics but differing levels of financial literacy, thereby creating a quasi-experimental framework for comparison. In this specification, the treated group (Treated) consists of countries whose financial literacy scores are above the median value in the sample, while control countries fall below the median. The estimated average treatment effect on the treated is positive and statistically

significant ( $\beta = 0.114$ ,  $p < 0.05$ ), indicating that higher financial literacy significantly increases the probability of progressing to more advanced stages of CBDC adoption. The quality of matching is further confirmed by diagnostic statistics: the pseudo- $R^2$  falls to 0.459 after matching, and the mean bias statistic is 9.103 % ( $< 10$ ), which is widely considered an indicator of efficient and successful matching. Overall, these findings reinforce that even when comparing countries that are otherwise observationally similar, greater financial literacy continues to exert a robust and positive causal effect on CBDC adoption progression. Overall, the endogeneity analyses across Models (1)–(4) provide robust and converging evidence that financial literacy exerts a causal, positive influence on the probability of CBDC advancement.

## 6. Channels of influence

Table 4 investigates potential channels that may mitigate or moderate the effect of financial literacy (FINLTCY) on CBDC adoption (CBDCAD) by introducing interaction terms between financial literacy and three key country-level mediator variables: internet infrastructure, financial risk exposure, and cryptocurrency market confidence, based on data sourced from the World Economic Forum's Global Competitiveness Report. This channel analysis recognizes that the effect of financial literacy is unlikely to operate in isolation but may be amplified or dampened depending on complementary technological, financial, and market conditions.

In Model (1), the channel evaluated is the country's internet infrastructure, proxied by the number of internet bandwidth kilobytes per user (INTBNDW). The interaction term between financial literacy and internet infrastructure (FINLTCY x INTBNDW) is positive and statistically significant ( $\beta = 0.183$ ,  $p < 0.05$ ), while the direct effect of financial literacy (FINLTCY) remains strongly positive and significant ( $\beta = 350.766$ ,  $p < 0.05$ ). This result suggests that although higher financial literacy increases the probability of CBDC adoption, its effect is strengthened in countries with more developed internet infrastructure. The justification for including this channel is that in highly digitalized environments, citizens that already have access to efficient private digital payment options would support the incremental impact of financial knowledge on public sector innovations like CBDCs (Adrian & Mancini-Griffoli, 2023).

In Model (2), the analysis examines the moderating role of financial system risk, using the percentage of non-performing bank loans (BNPLS)

**Table 4**  
Channels of influence.

|                   | (1)                    | (2)                   | (3)                     |
|-------------------|------------------------|-----------------------|-------------------------|
| FINLTCY           | 350.766**<br>(139.516) | 276.831*<br>(145.772) | 523.743***<br>(186.911) |
| FINLTCY x INTBNDW | 0.183**<br>(0.108)     |                       |                         |
| FINLTCY x BNPLS   |                        | −1.870**<br>(1.178)   |                         |
| FINLTCY x BTPRC   |                        |                       | −0.032**<br>(0.024)     |
| Controls          | Yes                    | Yes                   | Yes                     |
| Pseudo $R^2$      | 0.043                  | 0.123                 | 0.456                   |
| Fixed effects     | Yes                    | Yes                   | Yes                     |
| N                 | 302                    | 307                   | 321                     |

Notes. The table reports the effect of government effectiveness on fintech finance and associated interactions. The pool sample period is 2020–2024. We use an order probit model with country fixed effects and robust standard errors. Model (1) presents the mitigating role of internet infrastructure (INTBNDW) on the financial literacy effect on CBDC adoption. Model (2) presents the mitigating role of financial risk (BNPLS) on the financial literacy effect on CBDC adoption. Model (3) presents the mitigating role of bitcoin price (BTPRC) on the financial literacy effect on CBDC adoption.

\* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

as the proxy. The interaction term between financial literacy and non-performing loans (FINLTCY x BNPLS) is negative and statistically significant ( $\beta = -1.870$ ,  $p < 0.05$ ), and the direct effect of financial literacy remains positive and significant ( $\beta = 276.831$ ,  $p < 0.10$ ). This indicates that while financial literacy enhances the probability of CBDC advancement, its effect is attenuated in countries with higher levels of financial instability. The justification for this channel choice is straightforward: in economies with fragile banking sectors, trust in any form of financial innovation—including CBDCs—may be undermined, and even financially literate citizens may be reluctant to adopt new monetary instruments if systemic risks are perceived as high (Luu et al., 2023).

In Model (3), the channel explored is cryptocurrency market confidence, measured by the percentage change in Bitcoin price (BTPRC). The interaction term between financial literacy and Bitcoin price changes (FINLTCY x BTPRC) is negative and statistically significant ( $\beta = -0.032$ ,  $p < 0.05$ ), while financial literacy itself remains positive and strongly significant ( $\beta = 523.743$ ,  $p < 0.01$ ). This suggests that while financial literacy generally promotes CBDC adoption, increases in cryptocurrency confidence (as reflected in rising Bitcoin prices) mitigate the effect of financial literacy. When private digital currencies perform strongly, financially literate individuals may divert attention away from public digital innovations like CBDCs. This channel is particularly well-justified in the context of CBDC research because private cryptocurrencies and public digital currencies often function as competing rather than complementary innovations (Cong & Mayer, 2022).

Across all three models, the direct effect of financial literacy remains strongly positive and statistically significant, confirming its vital role in driving CBDC adoption probabilities. However, the results highlight that the magnitude of this effect can be meaningfully influenced—and sometimes diminished—by structural technological readiness, financial system health, and private digital asset dynamics. These findings provide valuable nuance to the central conclusion of the paper: while financial literacy is a critical enabler of CBDC adoption, its influence operates through, and is conditional upon, broader national environments that shape the digital financial landscape.

## 7. Conclusions

This study examines whether financial literacy facilitates the adoption of central bank digital currencies (CBDCs) across countries. Motivated by the growing global momentum behind CBDCs as a new form of sovereign digital money—and recognizing that successful implementation requires not only technological readiness but also public understanding and trust—the research investigates whether higher levels of national financial literacy increase the likelihood of countries progressing through the sequential stages of CBDC development. Using an original panel dataset covering 65 countries from 2020 to 2024 and employing a rigorous ordered probit modeling framework, the analysis provides robust and consistent evidence that greater financial literacy significantly enhances the probability of CBDC adoption.

Across a range of model specifications—including baseline regressions, sensitivity analyses, and expanded models incorporating additional technological, institutional, and macroeconomic controls—the central finding remains consistent: financial literacy exerts a

strong and positive influence on the likelihood that a country advances to a more developed stage of CBDC implementation. However, this effect is moderated by broader contextual factors. Specifically, advanced internet infrastructure, financial sector instability, and fluctuations in cryptocurrency market dynamics can attenuate the strength of financial literacy's impact.

The implications of these findings are significant. From a policy standpoint, the results highlight the importance of incorporating financial literacy as a core element of national CBDC strategies. Initiatives such as public education campaigns, early integration of financial concepts into school curricula, and targeted efforts to enhance public understanding of the risks and benefits of digital money could meaningfully improve public acceptance and the successful rollout of CBDCs. However, the findings also offer a cautionary note: even in financially literate societies, structural factors—such as the dominance of private digital financial ecosystems or instability within the banking sector—may weaken the positive influence of financial knowledge. This underscores the need for complementary reforms and broader financial sector stability measures to fully realize the potential benefits of CBDC adoption.

This research opens several avenues for future investigation. First, due to data limitations, the study focused on a relatively limited set of countries. Future research should broaden the cross-country sample, particularly by including emerging and low-income economies where digital financial transformations are accelerating. Second, longitudinal micro-level studies that track individual financial literacy trajectories alongside CBDC usage patterns could yield deeper causal insights into behavioral dynamics underlying adoption. Third, future work could examine the heterogeneous effects of financial literacy across demographic groups—such as age, income, and education—and explore how trust in central banks interacts with financial knowledge to influence CBDC acceptance. Finally, as CBDC ecosystems evolve, it will be important to assess the role of financial literacy not only in initial adoption but also in ongoing usage, transaction behavior, and the broader financial inclusion outcomes associated with sovereign digital currencies.

This study demonstrates that financial literacy is a crucial enabler of CBDC adoption. As such, strengthening national financial capability should be viewed not only as a means of promoting individual financial well-being but also as a foundational pillar for the successful development and implementation of next-generation digital monetary systems.

## Author contributions

**Charilaos Mertzanis** conceived the study, formulated the core research questions, and developed the econometric methodology;

**Mohamed Shaker Ahmed** gathered and cleaned the financial datasets, implemented the empirical tests, and generated the tables and figures;

**Rouhi Faisal** refined the theoretical framework, interpreted the results in light of existing literature, and drafted substantial portions of the introduction and discussion;

**Reem Ahmed Al Suwaidi** carried out multiple rounds of critical review and revision to synthesize the final manuscript.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.bir.2025.08.006>.

## Appendix. Definition of variables

| Variable code | Definition                                                                                                                                   | Source                                                   |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| CBCDAC        | CBDC adoption measured on a four-point ordinal scale: 0 (no project), 1 (research phase), 2 (pilot phase), 3 (live implementation).          | Atlantic Council's Central Bank Digital Currency Tracker |
| FINLTCY       | Financial literacy based on respondents' correct answers to four concepts: risk diversification, inflation, numeracy, and compound interest. | S&P Global Financial Literacy Survey                     |
| CRPADP        | Cryptocurrency adoption measured using high-frequency data on crypto exchange app downloads (thousands) and active use (log).                | Bank for International Settlements                       |
| WUNC          | World Uncertainty Index measuring global economic and policy uncertainty.                                                                    | U.S. Federal Reserve Database                            |
| ACCLNS        | Ease of access to loans, measured on a scale from 1 (lowest) to 7 (highest).                                                                 | World Economic Forum's Global Competitiveness Report     |
| EXCHRT        | Exchange rate (local currency units per U.S. dollar).                                                                                        | World Development Indicators                             |
| POGR          | Annual population growth rate (%) per country.                                                                                               | World Development Indicators                             |
| INTSERV       | Number of secured internet servers per country (logarithm).                                                                                  | World Development Indicators                             |
| RLAW          | Rule of Law Index capturing perceptions of the extent to which agents have confidence in and abide by the rules of society.                  | Worldwide Governance Indicators                          |
| SOCTOL        | Degree of social tolerance in a country.                                                                                                     | Zanakis et al. (2016)                                    |
| FINLTED       | Financial literacy measured by the extent of financial education requirements in school curricula.                                           | Al Suwaidi and Mertzanis (2024)                          |
| BURSPH        | Degree of buyer sophistication in the market, on a 1–7 scale.                                                                                | World Economic Forum's Global Competitiveness Report     |
| MRKTSZ        | Extent of national market size, measured on a 1–7 scale.                                                                                     | World Economic Forum's Global Competitiveness Report     |
| LEGEFF        | Efficiency of the legal framework in challenging regulations, on a 1–7 scale.                                                                | World Economic Forum's Global Competitiveness Report     |
| REGBRD        | Burden of government regulation, measured on a 1–7 scale.                                                                                    | World Economic Forum's Global Competitiveness Report     |
| VCAVL         | Availability of venture capital, measured on a 1–7 scale.                                                                                    | World Economic Forum's Global Competitiveness Report     |
| BNKSND        | Soundness of banks, measured on a 1–7 scale.                                                                                                 | World Economic Forum's Global Competitiveness Report     |
| POLTRUST      | Public trust of politicians, measured on a 1–7 scale.                                                                                        | World Economic Forum's Global Competitiveness Report     |
| CBIND         | Central Bank independence index                                                                                                              | Romelli (2024)                                           |
| INTBNDW       | Internet bandwidth (kilobytes per user).                                                                                                     | World Development Indicators                             |
| BNPLS         | Bank non-performing loans as a percentage of total bank loans.                                                                               | World Development Indicators                             |
| BTPRC         | Percentage change in Bitcoin price.                                                                                                          | Investing.com                                            |

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