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Central Bank Digital Currencies and Monetary Policy Transmission: Implications for Financial Stability

ABSTRACT

This study aimed to examine the effects of central bank digital currency (CBDC) development and utilization on monetary policy transmission and financial stability, with emphasis on the mediating roles of payment-system efficiency and resilience, banking-sector intermediation, bank disintermediation risk, and liquidity and funding pressure. This quantitative, applied, and explanatory cross-sectional study was conducted among 384 professionals in Tehran working in central banking, commercial and specialized banks, fintech companies, payment service providers, financial institutions, and academic or research organizations. Data were collected using a researcher-developed questionnaire assessing CBDC development, monetary policy transmission, banking-sector intermediation, bank disintermediation risk, liquidity and funding pressure, payment-system efficiency and resilience, and financial stability. Reliability and construct validity were evaluated using Cronbach's alpha, composite reliability, average variance extracted, and HTMT ratios. Data analysis was performed with SPSS 27 and SmartPLS 4 using partial least squares structural equation modeling and 5,000-resample bootstrapping. CBDC development significantly improved monetary policy transmission ($\beta = 0.641$, $p < 0.001$) and payment-system efficiency and resilience ($\beta = 0.584$, $p < 0.001$), while increasing bank disintermediation risk ($\beta = 0.493$, $p < 0.001$) and liquidity and funding pressure ($\beta = 0.382$, $p < 0.001$) and reducing banking-sector intermediation ($\beta = -0.217$, $p = 0.001$). Monetary policy transmission ($\beta = 0.348$, $p < 0.001$), payment-system efficiency and resilience ($\beta = 0.301$, $p < 0.001$), and banking-sector intermediation ($\beta = 0.196$, $p < 0.001$) positively affected financial stability, whereas bank disintermediation risk ($\beta = -0.241$, $p < 0.001$) and liquidity and funding pressure ($\beta = -0.188$, $p < 0.001$) had negative effects. The total effect of CBDC development on financial stability was positive and significant ($\beta = 0.329$, $p < 0.001$), and the model explained 63.8% of the variance in financial stability. CBDCs can strengthen financial stability primarily through enhanced monetary policy transmission and payment-system resilience, although these benefits may be partly offset by bank disintermediation and funding pressures, underscoring the need for carefully calibrated CBDC design and implementation.

Keywords: Central Bank Digital Currency; Monetary Policy Transmission; Financial Stability; Bank Disintermediation; Payment-System Resilience; Banking-Sector Intermediation

Introduction

The rapid digitalization of financial systems has transformed the institutional foundations of money, payments, and monetary governance. Among the most consequential developments in this transformation is the emergence of central bank digital currencies (CBDCs), which represent a digital form of sovereign money issued and backed by a central bank. Unlike privately issued cryptocurrencies and many forms of digital assets whose value is determined by decentralized networks or market conditions, CBDCs are designed to preserve the defining characteristics of central bank money while adapting them to increasingly digitalized economic environments. Their development reflects not only technological change but also a

broader reconfiguration of the relationship between monetary authorities, commercial banks, payment infrastructures, households, firms, and financial markets. As cash usage declines in some economies and private digital payment instruments become increasingly important, central banks face pressure to preserve public access to sovereign money, improve payment efficiency, and maintain monetary sovereignty in an environment increasingly characterized by technological innovation and privately created digital assets [1, 2]. The expansion of digital currencies has therefore moved CBDCs from a largely theoretical policy concept to an increasingly important component of debates concerning the future architecture of domestic and international monetary systems.

The motivations for issuing a CBDC are multidimensional and differ across advanced, emerging, and developing economies. Central banks may pursue digital currency initiatives to increase payment efficiency, reduce transaction costs, promote financial inclusion, strengthen competition in payment services, improve monetary sovereignty, enhance the resilience of payment infrastructure, or respond to the expansion of private cryptocurrencies and stablecoins. Institutional, technological, economic, and regulatory factors all contribute to differences in the willingness and capacity of countries to develop CBDCs [3]. In emerging economies in particular, CBDC design must address structural characteristics such as the importance of the banking sector, relatively high dependence on cash, heterogeneous access to digital infrastructure, financial inclusion gaps, and the potential vulnerability of banking systems to liquidity shocks [4]. At the same time, successful implementation depends not only on central-bank capacity but also on public willingness to adopt and use the new form of money. Evidence from the literature on digital currency adoption indicates that perceived usefulness, trust, security, technological accessibility, regulatory certainty, privacy concerns, and social acceptance can materially influence users' willingness to transition toward digital monetary instruments [5]. Consequently, CBDC development is not simply a technological modernization project; it constitutes a potentially structural reform of the monetary and financial system.

One of the most important questions arising from CBDC development concerns its implications for monetary policy transmission. Conventional monetary policy operates through several interrelated channels, including the interest-rate channel, bank-lending channel, balance-sheet channel, expectations channel, asset-price channel, and exchange-rate channel. Central banks typically influence financial conditions by adjusting policy rates, supplying or withdrawing reserves, conducting open-market operations, and communicating expectations regarding future policy. These decisions then propagate through the banking system and financial markets before affecting borrowing costs, consumption, investment, inflation, and aggregate demand. The introduction of a widely accessible CBDC may alter this transmission architecture by establishing a more direct monetary relationship between the central bank and non-bank economic agents. This potentially changes the speed, scope, and effectiveness of policy transmission because households and firms could hold central-bank liabilities directly rather than accessing central-bank money primarily through commercial banks and physical cash. Research on the relationship between CBDCs and monetary policymaking has emphasized that digital central bank money can create new instruments for monetary management while modifying traditional relationships among policy rates, liquidity, money demand, and bank deposits [6].

From a monetary-policy perspective, CBDCs could strengthen transmission in several ways. A digital liability of the central bank may permit monetary-policy signals to be transmitted more rapidly to households and firms, especially if the CBDC is interest-bearing or if its remuneration structure is linked to the policy rate. Such a framework could potentially strengthen the pass-through of changes in central-bank rates to broader market rates, increase the effectiveness of liquidity

management, and reduce frictions caused by delays in the transmission of monetary decisions through commercial intermediaries. In addition, the availability of programmable or technologically integrated forms of sovereign money could improve the operational flexibility of monetary authorities under specific policy arrangements. Comparative analyses of digital currencies and monetary-policy frameworks suggest that widespread adoption of CBDCs can influence banking models, the structure of deposits, the demand for money, and the manner in which monetary policy reaches the real economy [7]. More broadly, the technological evolution of digital money may expand the range of mechanisms through which monetary authorities can influence economic behavior, particularly as monetary technologies become more closely integrated with payment networks, digital identity systems, and real-time settlement mechanisms [8].

Nevertheless, the potential benefits of stronger monetary-policy transmission are accompanied by significant financial-stability concerns. The most frequently discussed risk is bank disintermediation. If households and firms can freely convert commercial bank deposits into risk-free central-bank digital money, CBDCs may become a substitute for bank deposits, particularly when users perceive central-bank liabilities as safer than private bank liabilities. This substitution could reduce the deposit funding available to commercial banks, increase their reliance on wholesale or central-bank funding, raise funding costs, and ultimately affect their capacity to extend credit. Empirical and theoretical work examining the possibility of bank disintermediation suggests that the magnitude of this effect depends critically on CBDC design, remuneration, access rules, holding limits, and the competitive response of commercial banks [9]. The relationship is therefore unlikely to be linear or uniform. A carefully designed CBDC may coexist with commercial bank intermediation, whereas a highly attractive, unrestricted, and interest-bearing CBDC could potentially accelerate migration away from conventional bank deposits.

This issue becomes particularly important during periods of financial stress. In conventional banking systems, deposit withdrawals and bank runs are constrained to some extent by physical, institutional, and transactional frictions. A highly liquid and universally accessible CBDC could reduce these frictions and make it easier for depositors to move funds rapidly from commercial banks into central-bank money. As a result, the same technological features that improve payment efficiency during normal conditions could accelerate digital bank runs during periods of uncertainty. Systematic research on CBDCs and financial stability has therefore emphasized that the effects of digital sovereign money are inherently two-sided: CBDCs may strengthen payment-system resilience and improve monetary control while simultaneously creating new channels for liquidity shocks and deposit flight [10]. These competing mechanisms make financial stability one of the central dimensions that must be considered in CBDC design and evaluation.

The design of a CBDC is especially important because not all digital currencies issued by central banks would produce identical effects. Key design variables include whether the CBDC is retail or wholesale, account-based or token-based, interest-bearing or non-interest-bearing, subject to quantitative holding limits, directly managed by the central bank or distributed through financial intermediaries, and interoperable with domestic or international payment systems. Reviews of CBDC design and implementation emphasize that these choices shape not only technological feasibility but also monetary-policy effectiveness, privacy, financial inclusion, commercial-bank competition, and systemic stability [2]. Adoption challenges further include cybersecurity concerns, public trust, technological literacy, infrastructure limitations, privacy concerns, regulatory ambiguity, and the risk that users may not perceive sufficient advantages over existing payment instruments [11]. Consequently, policy assessment must extend beyond the question of whether a CBDC should exist and instead examine how

its design affects the transmission of monetary policy and the stability of the institutions through which credit and liquidity circulate.

The broader monetary implications of CBDCs also arise in the context of competition between sovereign and non-sovereign forms of money. The proliferation of cryptocurrencies, stablecoins, tokenized financial assets, and other forms of digital money has created what may be viewed as an increasingly complex monetary ecology in which central banks no longer operate within a system dominated exclusively by physical currency and commercial bank deposits. Analyses of shadow money and digital currency have argued that central banks may need to adapt their traditional role as providers of liquidity and guarantors of monetary stability to a financial system in which multiple technologically differentiated forms of money coexist [12]. CBDCs can be interpreted as one institutional response to this transformation because they allow central banks to provide sovereign digital money directly within the same technological environment in which private payment instruments and crypto-assets increasingly operate. At the same time, such a development may alter the boundary between central banking and commercial banking, creating new questions concerning the appropriate scope of central-bank activity.

These changes are also legally and institutionally significant. CBDCs raise questions concerning monetary law, central-bank mandates, legal tender status, privacy, data governance, liability, operational responsibility, financial integrity, and the legal basis for issuance. International analysis has emphasized that CBDC implementation requires a clear legal framework defining the authority of the central bank, the rights of users, the status of digital central-bank liabilities, and the responsibilities of intermediaries and technology providers [13]. The legal status of digital assets is also relevant in the context of international economic law, particularly where cross-border payments, financial sanctions, dispute settlement, and monetary sovereignty intersect with emerging forms of digital currency [14]. These considerations demonstrate that the effectiveness and stability implications of CBDCs cannot be separated entirely from the legal architecture governing their issuance and circulation.

Cross-border interoperability represents another important dimension of CBDC development. If national CBDCs are designed in isolation, they may reinforce fragmentation across payment systems. By contrast, interoperable technical and regulatory standards may facilitate faster, cheaper, and more transparent cross-border payments while improving the compatibility of national digital currency infrastructures. Principles concerning global interoperability therefore emphasize common standards, technical compatibility, regulatory coordination, cybersecurity, and mechanisms for preserving monetary sovereignty while enabling cross-border functionality [15]. Although the present study primarily focuses on domestic monetary-policy transmission and financial stability, interoperability remains relevant because international capital flows, exchange-rate expectations, and cross-border financial transactions may influence domestic demand for CBDCs and the broader stability of digital monetary systems.

Technological infrastructure is equally central to the operation of CBDCs. Digital currency systems frequently rely on advanced distributed or centralized ledger technologies, secure digital identification, cryptographic protocols, and real-time transaction-processing systems. The increasing integration of blockchain-based architectures into financial management and accounting illustrates how digital currencies can affect not only monetary transactions but also record keeping, transparency, auditability, and managerial processes [16]. These technological developments can reduce settlement delays and increase transaction traceability, but they can also introduce operational risks, cybersecurity vulnerabilities, data-governance problems, and system dependencies. Accordingly, financial stability in a CBDC environment depends not merely on monetary variables but also on the resilience of the technological infrastructure supporting digital money.

The implementation of CBDCs also requires institutions to develop adequate analytical and information-processing capabilities. Although business-intelligence research is not specific to central banking, organizational maturity in information systems, data integration, analytical capacity, technological infrastructure, and decision-support processes is relevant to institutions operating within increasingly digital financial environments [17]. Central banks and financial institutions managing CBDC ecosystems must process large volumes of transaction data, identify emerging liquidity pressures, monitor risks, detect unusual financial behavior, and evaluate rapidly changing patterns in payment activity. The ability to transform digital transaction data into reliable policy intelligence may therefore become increasingly important for the effectiveness of monetary policy and the early identification of systemic risks.

In Iran, these issues assume particular importance because the development of digital monetary instruments occurs within a financial system characterized by a bank-centered structure, persistent inflationary pressures, exchange-rate volatility, sanctions-related constraints, and rapidly expanding electronic payment technologies. Research examining the practical implementation of CBDCs in Iran has identified challenges related to infrastructure, public trust, legal regulation, cybersecurity, financial literacy, bank preparedness, and the compatibility of CBDCs with the existing monetary and payment system [18]. In addition, empirical examination of CBDC-related news in Iranian financial markets suggests that information concerning digital sovereign currency can affect market expectations and financial behavior even before full-scale implementation [19]. This finding is important because monetary transmission operates not only through observed transactions but also through expectations, confidence, and anticipatory responses among financial-market participants.

The Iranian context is also relevant because CBDC implementation may affect monetary sovereignty and technological independence under conditions of international financial restrictions. Digital monetary infrastructure may provide opportunities for domestic payment modernization while simultaneously introducing legal, technological, and international constraints. Research on the nature of cryptocurrencies and digital currencies has emphasized their role in the broader development of monetary technologies and the transformation of conventional monetary instruments [8]. At the same time, the legal implications of digital assets in environments shaped by sanctions and cross-border restrictions demonstrate that technological innovation cannot be separated from broader institutional and geopolitical conditions [14]. These circumstances make it particularly important to investigate CBDCs as both a monetary-policy instrument and a potential source of structural change in the banking system.

A further challenge concerns the distinction between the expected macroeconomic advantages of CBDCs and their actual adoption by users. Even a technologically sophisticated CBDC will have limited influence on monetary-policy transmission if households and firms do not adopt it at a meaningful scale. Conversely, rapid adoption could have stronger implications for bank deposits and systemic liquidity than anticipated. Systematic evidence on user adoption demonstrates that technology acceptance, trust, perceived security, ease of use, policy communication, institutional credibility, and perceived economic benefit are critical determinants of participation in digital currency ecosystems [5]. Adoption therefore acts as an important link between technical design and macro-financial outcomes. This is also consistent with research emphasizing that CBDC adoption challenges must be addressed through public education, strong cybersecurity, user-friendly infrastructure, credible policy frameworks, and carefully calibrated implementation strategies [11].

Despite the rapidly expanding international literature, significant uncertainty remains regarding the net effect of CBDCs on financial stability. Existing studies often examine monetary-policy transmission, payment efficiency, bank

disintermediation, legal design, technological infrastructure, or adoption separately. Yet these dimensions are interconnected. A CBDC that strengthens monetary-policy transmission may simultaneously increase deposit substitution; one that improves payment-system resilience may also facilitate rapid movements of liquidity during stress; and a design that protects bank intermediation may weaken the attractiveness and policy effectiveness of the digital currency. Critical reviews of the CBDC literature have therefore called for more integrated analysis of the trade-offs among monetary effectiveness, financial innovation, banking stability, and institutional design [1]. Similarly, discussions of the challenges that digital currencies pose for central banks emphasize the need to understand how new forms of money interact with established monetary-policy frameworks and financial institutions rather than assessing them only as payment technologies [20].

These concerns suggest that the relationship between CBDCs and financial stability should be conceptualized as a system of simultaneous and potentially offsetting pathways. Stronger transmission of central-bank policy can contribute to stability by improving policy responsiveness, reducing delays in monetary adjustment, and strengthening the capacity of monetary authorities to influence financial conditions. Greater payment efficiency can similarly reduce operational frictions and support systemic resilience. However, deposit substitution, increased bank funding costs, reduced traditional intermediation, and the possibility of rapid digital withdrawals may create destabilizing pressures. The overall outcome therefore depends on the relative magnitude of these positive and negative mechanisms as well as on institutional design and the characteristics of the domestic financial system [9, 10]. For emerging economies, the balance is especially consequential because banking systems often remain the principal source of financial intermediation and monetary-policy transmission, making abrupt changes in deposit structures potentially more disruptive [4].

Accordingly, a comprehensive empirical assessment should examine CBDC development not merely as an independent technological innovation but as a structural factor capable of influencing monetary policy transmission, payment-system resilience, banking-sector intermediation, bank disintermediation risk, liquidity and funding pressures, and ultimately financial stability. Such an approach is particularly relevant in Tehran, where monetary policymakers, banking professionals, financial technology specialists, payment-system experts, and academics operate at the center of Iran's monetary and financial decision-making environment. Drawing on the perceptions and professional judgments of these stakeholders provides an empirical means of evaluating how CBDC development may reshape the channels linking central-bank policy to the broader financial system.

The aim of this study was to examine the effects of central bank digital currency development and utilization on monetary policy transmission and financial stability in Tehran, with particular emphasis on the mediating roles of payment-system efficiency and resilience, banking-sector intermediation, bank disintermediation risk, and liquidity and funding pressure.

Methodology

This study employed a quantitative, applied, and explanatory cross-sectional research design to investigate the effects of central bank digital currencies (CBDCs) on monetary policy transmission and to determine their implications for financial stability. The research framework was developed on the premise that the introduction and widespread use of a retail CBDC can alter the channels through which monetary policy decisions affect liquidity conditions, interest rates, bank deposits, credit creation, payment behavior, and ultimately the stability of the financial system. The study population consisted of professionals with relevant knowledge and practical experience in monetary policy, banking, financial markets, digital

payments, financial technology, and macroeconomic analysis working in Tehran, Iran. The target population included employees and specialists affiliated with the Central Bank of the Islamic Republic of Iran, public and private commercial banks, specialized banks, financial and credit institutions, payment service providers, fintech companies, and academic and research institutions active in the fields of monetary economics and banking. To ensure that respondents possessed sufficient professional knowledge to assess the economic and financial consequences of CBDC implementation, eligibility criteria required participants to hold at least a bachelor's degree in economics, banking, finance, accounting, management, information technology, or a closely related discipline and to have a minimum of three years of professional or research experience in banking, monetary policy, financial markets, digital finance, or payment systems. Individuals who had insufficient familiarity with digital currencies or monetary and banking mechanisms, as well as questionnaires with substantial missing information or uniform response patterns, were excluded from the final analysis. The final sample consisted of exactly 384 participants from Tehran. Participants were selected using a stratified purposive sampling approach to achieve adequate representation of professionals from the central banking, commercial banking, financial technology, payment services, and academic sectors. Within each professional stratum, eligible respondents were approached through institutional networks and professional channels. The sample size was considered sufficient for multivariate analysis and structural equation modeling because it provided an adequate number of observations relative to the number of latent constructs and estimated structural relationships included in the proposed model. Participation was voluntary, respondents were informed of the academic purpose of the study, and confidentiality and anonymity were maintained throughout data collection. No personally identifying information was included in the analytical dataset, and participants could discontinue their participation at any stage without consequence.

Data were collected using a structured researcher-developed questionnaire designed to measure the principal mechanisms through which the introduction of a CBDC could influence monetary policy transmission and financial stability. Questionnaire development was based on the theoretical mechanisms of monetary transmission, financial intermediation, digital payment systems, bank liquidity, and systemic financial risk. The instrument consisted of two main sections. The first section collected general demographic and professional information, including age, gender, educational level, field of specialization, occupational sector, organizational position, and years of professional experience. The second section assessed the study constructs using multiple-item scales measured on a five-point Likert continuum ranging from 1, representing strongly disagree, to 5, representing strongly agree. The principal explanatory construct was CBDC development and utilization, which captured respondents' assessments of the accessibility, usability, technological efficiency, transaction speed, security, public acceptance, and potential scale of CBDC adoption within the monetary and payment system. Monetary policy transmission was operationalized through items examining the extent to which a CBDC could affect the interest-rate channel, liquidity channel, bank-lending channel, money-demand channel, expectations channel, and the speed with which central bank policy decisions are transmitted to households, firms, financial institutions, and financial markets. Additional items assessed potential changes in the effectiveness of policy-rate adjustments, liquidity management, direct transmission of central bank money to the public, responsiveness of deposits and lending rates to monetary policy decisions, and the capacity of the central bank to influence aggregate demand under a more digitalized monetary system. Financial stability was measured through indicators reflecting banking-sector liquidity, deposit stability, credit provision, bank funding conditions, systemic risk, resilience to financial shocks, payment-system continuity, and confidence in financial institutions. Because

CBDC implementation may generate both stabilizing and destabilizing effects, the questionnaire also included items measuring bank disintermediation risk, deposit substitution, the possibility of rapid transfers from commercial bank deposits to central bank digital money during periods of financial stress, changes in bank funding costs, liquidity pressures, and the potential acceleration of digital bank runs. Conversely, stabilizing dimensions included improvements in payment-system resilience, settlement efficiency, monetary-policy responsiveness, transaction transparency, and the capacity of monetary authorities to manage liquidity under conditions of financial stress.

Content validity of the questionnaire was evaluated before the main data collection by a panel of specialists in monetary economics, banking, financial technology, and quantitative research methodology. The experts examined the relevance, clarity, comprehensiveness, and conceptual consistency of the items and assessed whether each indicator appropriately represented its intended construct. Items considered ambiguous, repetitive, or insufficiently related to the conceptual framework were revised or removed before administration of the final instrument. A pilot assessment was subsequently conducted with a small group of eligible professionals who were not included in the final sample to examine item comprehensibility, completion time, response consistency, and the preliminary reliability of the measurement scales. Internal consistency in the final dataset was evaluated using Cronbach's alpha and composite reliability, with coefficients of 0.70 or greater considered indicative of satisfactory reliability. Convergent validity was examined through standardized indicator loadings and average variance extracted, with an average variance extracted value of at least 0.50 considered acceptable. Discriminant validity was evaluated using the heterotrait-monotrait ratio of correlations, with values below 0.85 interpreted as evidence that the latent constructs represented empirically distinguishable concepts. Indicator collinearity was additionally examined through variance inflation factors to ensure that excessive multicollinearity did not adversely affect estimation of the measurement or structural models.

Data analysis was conducted using IBM SPSS Statistics version 27 and SmartPLS 4. Prior to hypothesis testing, the dataset was screened for incomplete responses, data-entry errors, univariate outliers, inconsistent response patterns, and missing values. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were calculated to summarize the demographic and professional characteristics of participants and the distribution of responses to the principal study variables. Skewness and kurtosis were examined to describe distributional characteristics, while correlations among the principal constructs were calculated as an initial assessment of the direction and magnitude of their associations. Potential multicollinearity among predictor constructs was evaluated using variance inflation factors, with values below 5 regarded as indicating the absence of problematic collinearity. Because the conceptual model incorporated several latent multidimensional variables and simultaneous direct, indirect, and potentially competing relationships between CBDC implementation, monetary policy transmission mechanisms, banking-sector responses, and financial stability, partial least squares structural equation modeling was employed as the principal analytical technique. The analysis followed a two-stage procedure consisting of evaluation of the measurement model followed by assessment of the structural model. In the measurement model, indicator reliability was evaluated using outer loadings, while construct reliability was assessed using Cronbach's alpha and composite reliability. Convergent validity was determined on the basis of average variance extracted, and discriminant validity was assessed using the heterotrait-monotrait ratio. Indicators with insufficient loadings were examined carefully and were retained or removed according to their statistical performance and theoretical importance rather than on statistical criteria alone.

After establishment of satisfactory reliability and construct validity, the structural model was evaluated to estimate the relationships among CBDC implementation, monetary policy transmission, banking-sector intermediation, and financial stability. Standardized path coefficients were used to determine the direction and magnitude of the hypothesized relationships. Statistical significance was examined using a nonparametric bootstrapping procedure with 5,000 resamples, and relationships were considered statistically significant at a two-tailed probability level of $p < 0.05$. The coefficient of determination (R^2) was calculated for endogenous constructs to assess the proportion of variance explained by the model, while effect sizes (f^2) were examined to determine the relative contribution of individual explanatory constructs. Predictive relevance was assessed using Q^2 values obtained through the appropriate predictive procedure, with values greater than zero indicating meaningful out-of-sample predictive relevance for the endogenous constructs. The standardized root mean square residual was also examined as an indicator of overall model fit, with values below 0.08 interpreted as evidence of an acceptable correspondence between the empirical data and the proposed structural model. Particular attention was given to the mediating role of monetary policy transmission in the relationship between CBDC implementation and financial stability. Indirect effects were therefore estimated through bootstrapping to determine whether changes in the efficiency and strength of monetary transmission constituted a mechanism through which CBDC implementation affected financial stability. At the same time, the analysis examined whether potential bank disintermediation and liquidity pressures operated as risk mechanisms that could partially offset the benefits associated with more efficient monetary-policy transmission. This analytical framework enabled the study to distinguish between the direct effects of CBDC development on financial stability and the indirect effects transmitted through monetary-policy and banking-sector channels, thereby providing an integrated empirical assessment of the monetary and systemic consequences of central bank digital currency implementation.

Findings and Results

The final analytical sample consisted of 384 professionals working in banking, monetary policy, financial technology, payment services, and related academic and research fields in Tehran. Of the participants, 236 (61.5%) were male and 148 (38.5%) were female. The mean age of respondents was 39.42 years ($SD = 8.17$), with ages ranging from 27 to 62 years. Regarding educational attainment, 72 participants (18.8%) held a bachelor's degree, 211 (54.9%) held a master's degree, and 101 (26.3%) held a doctoral degree. In terms of professional affiliation, 71 respondents (18.5%) were employed in central banking or monetary-policy-related institutions, 139 (36.2%) worked in commercial or specialized banks, 74 (19.3%) were employed in fintech companies or payment service providers, 58 (15.1%) were academics or researchers specializing in economics, finance, banking, or digital finance, and 42 (10.9%) worked in other financial and credit institutions. Participants had an average of 11.36 years of relevant professional experience ($SD = 6.14$), indicating that the majority of the respondents had substantial exposure to banking, financial markets, monetary policy, payment systems, or digital financial services. Specifically, 77 participants (20.1%) had between 3 and 5 years of relevant experience, 112 (29.2%) had between 6 and 10 years, 126 (32.8%) had between 11 and 15 years, and 69 (18.0%) had more than 15 years of professional experience. These characteristics indicated that the study drew primarily on respondents with advanced educational qualifications and considerable professional experience, providing an appropriate empirical basis for evaluating the expected effects of central bank digital currencies on monetary policy transmission and financial stability.

Table 1*Descriptive Statistics and Measurement Model Assessment of the Study Constructs*

Construct	Mean	SD	Cronbach's α	Composite Reliability	AVE	Loading Range
CBDC Development and Utilization	3.87	0.63	0.891	0.917	0.648	0.742–0.856
Monetary Policy Transmission	3.94	0.59	0.918	0.934	0.671	0.761–0.882
Banking-Sector Intermediation	3.48	0.67	0.876	0.908	0.623	0.731–0.847
Bank Disintermediation Risk	3.71	0.72	0.903	0.926	0.678	0.764–0.879
Liquidity and Funding Pressure	3.65	0.69	0.887	0.915	0.644	0.748–0.861
Payment-System Efficiency and Resilience	4.03	0.57	0.910	0.932	0.696	0.782–0.894
Financial Stability	3.82	0.61	0.921	0.938	0.685	0.773–0.891

As shown in Table 1, the mean scores of the principal constructs were generally above the theoretical midpoint of 3.00, suggesting that respondents predominantly perceived CBDC implementation as capable of materially affecting monetary transmission and the structure and stability of the financial system. Payment-system efficiency and resilience recorded the highest mean score ($M = 4.03$, $SD = 0.57$), indicating particularly strong agreement that CBDC implementation could improve payment speed, settlement reliability, operational continuity, transaction efficiency, and the resilience of the monetary infrastructure. Monetary policy transmission also received a relatively high assessment ($M = 3.94$, $SD = 0.59$), suggesting that respondents generally expected CBDCs to enhance the speed and effectiveness with which central bank decisions influence liquidity conditions, interest rates, money demand, expectations, and economic activity. CBDC development and utilization had a mean of 3.87 ($SD = 0.63$), while financial stability had a mean of 3.82 ($SD = 0.61$), indicating broadly favorable but not unequivocal assessments of the systemic consequences of CBDC adoption. At the same time, relatively high scores were observed for bank disintermediation risk ($M = 3.71$, $SD = 0.72$) and liquidity and funding pressure ($M = 3.65$, $SD = 0.69$), demonstrating that respondents recognized substantial potential risks associated with the transfer of funds from commercial bank deposits into central bank digital money. Banking-sector intermediation showed the lowest mean among the constructs ($M = 3.48$, $SD = 0.67$), reflecting greater uncertainty concerning whether the overall intermediation role of commercial banks would be strengthened or weakened under widespread CBDC adoption. Measurement-model indicators demonstrated satisfactory psychometric properties. Cronbach's alpha coefficients ranged from 0.876 to 0.921 and composite reliability values ranged from 0.908 to 0.938, exceeding the conventional threshold of 0.70 and confirming strong internal consistency. Average variance extracted values ranged from 0.623 to 0.696, all exceeding 0.50 and therefore supporting convergent validity. Standardized indicator loadings ranged from 0.731 to 0.894, showing that all retained indicators loaded adequately on their intended latent constructs. Accordingly, no item required removal from the final measurement model, and the constructs demonstrated sufficient reliability and convergent validity for subsequent structural analysis.

Table 2*Discriminant Validity and Collinearity Assessment*

Construct	CBDC	MPT	BSI	BDR	LFP	PER	FS	VIF Range
CBDC Development and Utilization	—							1.42–2.36
Monetary Policy Transmission	0.704	—						1.55–2.71
Banking-Sector Intermediation	0.583	0.612	—					1.47–2.44
Bank Disintermediation Risk	0.548	0.437	0.598	—				1.51–2.68
Liquidity and Funding Pressure	0.526	0.421	0.641	0.738	—			1.59–2.83
Payment-System Efficiency and Resilience	0.672	0.694	0.507	0.386	0.401	—		1.44–2.57
Financial Stability	0.615	0.742	0.658	0.604	0.627	0.731	—	1.63–2.96

Note. Values below the diagonal represent HTMT ratios. CBDC = Central Bank Digital Currency Development and Utilization; MPT = Monetary Policy Transmission; BSI = Banking-Sector Intermediation; BDR = Bank Disintermediation Risk; LFP = Liquidity and Funding Pressure; PER = Payment-System Efficiency and Resilience; FS = Financial Stability.

The results presented in Table 2 confirmed satisfactory discriminant validity among all latent variables included in the structural model. HTMT values ranged from 0.386 to 0.742, remaining below the conservative threshold of 0.85 in every case. The highest HTMT value was observed between monetary policy transmission and financial stability (HTMT = 0.742), which was theoretically expected because more effective monetary policy transmission represents one of the principal mechanisms through which CBDC adoption could affect macro-financial stability. Nevertheless, the value remained sufficiently below the threshold to establish empirical distinction between the two constructs. A relatively strong association was also observed between bank disintermediation risk and liquidity and funding pressure (HTMT = 0.738), reflecting the close conceptual relationship between deposit substitution and potential deterioration in commercial bank funding conditions. Payment-system efficiency and resilience was also closely associated with financial stability (HTMT = 0.731), suggesting that improvements in payment infrastructure constituted an important but empirically distinct component of financial-system resilience. All remaining HTMT coefficients were substantially below 0.70 or only moderately above this level, indicating adequate separation of the constructs. Collinearity diagnostics also demonstrated that multicollinearity was not problematic. Variance inflation factor values across the measurement and structural models ranged from 1.42 to 2.96, which was considerably below the threshold of 5.00. These findings indicated that the estimated structural relationships were unlikely to be distorted by excessive overlap among predictor variables and provided additional support for proceeding with estimation of the hypothesized path model.

Table 3

Structural Model Results for the Direct Relationships

Structural Path	β	SE	t	p	f^2	Result
CBDC Development → Monetary Policy Transmission	0.641	0.041	15.634	<0.001	0.696	Significant
CBDC Development → Payment-System Efficiency and Resilience	0.584	0.046	12.696	<0.001	0.517	Significant
CBDC Development → Bank Disintermediation Risk	0.493	0.051	9.667	<0.001	0.321	Significant
CBDC Development → Liquidity and Funding Pressure	0.382	0.055	6.945	<0.001	0.176	Significant
CBDC Development → Banking-Sector Intermediation	-0.217	0.064	3.391	0.001	0.061	Significant
Monetary Policy Transmission → Financial Stability	0.348	0.052	6.692	<0.001	0.183	Significant
Payment-System Efficiency and Resilience → Financial Stability	0.301	0.049	6.143	<0.001	0.146	Significant
Banking-Sector Intermediation → Financial Stability	0.196	0.054	3.630	<0.001	0.067	Significant
Bank Disintermediation Risk → Financial Stability	-0.241	0.056	4.304	<0.001	0.096	Significant
Liquidity and Funding Pressure → Financial Stability	-0.188	0.052	3.615	<0.001	0.059	Significant
CBDC Development → Financial Stability	0.164	0.058	2.828	0.005	0.042	Significant

The structural model results in Table 3 revealed that CBDC development and utilization had significant relationships with all major monetary and financial mechanisms included in the model. The strongest direct effect originating from CBDC development was observed for monetary policy transmission ($\beta = 0.641$, $t = 15.634$, $p < 0.001$), with a large effect size ($f^2 = 0.696$). This result demonstrated that greater development and adoption of CBDCs was associated with substantially stronger and more rapid transmission of central bank policy measures. In practical terms, increased use of digital central bank money was associated with greater responsiveness of money demand, liquidity conditions, market expectations, and financial conditions to monetary-policy decisions. CBDC development also exerted a substantial positive effect on payment-system efficiency and resilience ($\beta = 0.584$, $t = 12.696$, $p < 0.001$, $f^2 = 0.517$), confirming that greater CBDC utilization was associated with improved transaction efficiency, settlement reliability, payment continuity, and technological resilience. However, the results simultaneously demonstrated the presence of material banking-sector risks. CBDC development significantly

increased bank disintermediation risk ($\beta = 0.493$, $t = 9.667$, $p < 0.001$) and liquidity and funding pressure ($\beta = 0.382$, $t = 6.945$, $p < 0.001$), indicating that migration of financial resources from commercial bank deposits toward central bank digital money could reduce the stability of conventional bank funding. CBDC development also exhibited a statistically significant negative relationship with banking-sector intermediation ($\beta = -0.217$, $t = 3.391$, $p = 0.001$), suggesting that extensive substitution of CBDCs for deposit money could weaken the traditional role of commercial banks in deposit mobilization and credit intermediation.

The determinants of financial stability displayed both positive and negative pathways. Monetary policy transmission had the strongest positive direct effect on financial stability ($\beta = 0.348$, $t = 6.692$, $p < 0.001$), indicating that improvements in the effectiveness of monetary policy transmission were associated with stronger macro-financial stability. Payment-system efficiency and resilience also had a substantial positive effect on financial stability ($\beta = 0.301$, $t = 6.143$, $p < 0.001$), demonstrating the stabilizing contribution of reliable digital payment infrastructure. Banking-sector intermediation contributed positively to financial stability ($\beta = 0.196$, $t = 3.630$, $p < 0.001$), whereas bank disintermediation risk had a significant negative effect ($\beta = -0.241$, $t = 4.304$, $p < 0.001$), and liquidity and funding pressure similarly reduced financial stability ($\beta = -0.188$, $t = 3.615$, $p < 0.001$). Importantly, CBDC development maintained a statistically significant positive direct association with financial stability even after accounting for these mediating mechanisms ($\beta = 0.164$, $t = 2.828$, $p = 0.005$), although its direct effect was smaller than its effect through monetary policy transmission and payment-system resilience. This pattern indicated that the financial-stability implications of CBDCs were multidimensional: CBDCs could contribute to stability through more effective monetary transmission and stronger payment infrastructure while simultaneously introducing risks through deposit substitution, bank disintermediation, and greater funding pressure.

Table 4.

Indirect Effects, Explained Variance, Predictive Relevance, and Overall Model Assessment

Model Component	Effect / Statistic	β / Value	t	p	Interpretation
CBDC $\rightarrow$ MPT $\rightarrow$ Financial Stability	Indirect effect	0.223	5.912	<0.001	Significant positive mediation
CBDC $\rightarrow$ PER $\rightarrow$ Financial Stability	Indirect effect	0.176	5.321	<0.001	Significant positive mediation
CBDC $\rightarrow$ BSI $\rightarrow$ Financial Stability	Indirect effect	-0.043	2.682	0.007	Significant negative mediation
CBDC $\rightarrow$ BDR $\rightarrow$ Financial Stability	Indirect effect	-0.119	3.998	<0.001	Significant negative mediation
CBDC $\rightarrow$ LFP $\rightarrow$ Financial Stability	Indirect effect	-0.072	3.214	0.001	Significant negative mediation
CBDC $\rightarrow$ Financial Stability	Total indirect effect	0.165	4.406	<0.001	Net positive indirect effect
CBDC $\rightarrow$ Financial Stability	Total effect	0.329	5.882	<0.001	Significant positive total effect
Monetary Policy Transmission	R ²	0.411	—	—	Moderate explanatory power
Payment-System Efficiency and Resilience	R ²	0.341	—	—	Moderate explanatory power
Bank Disintermediation Risk	R ²	0.243	—	—	Moderate explanatory power
Liquidity and Funding Pressure	R ²	0.146	—	—	Modest explanatory power
Banking-Sector Intermediation	R ²	0.047	—	—	Limited explanatory power
Financial Stability	R ²	0.638	—	—	Substantial explanatory power
Monetary Policy Transmission	Q ²	0.268	—	—	Predictive relevance established
Payment-System Efficiency and Resilience	Q ²	0.231	—	—	Predictive relevance established
Financial Stability	Q ²	0.402	—	—	Strong predictive relevance
Overall model	SRMR	0.061	—	—	Acceptable model fit

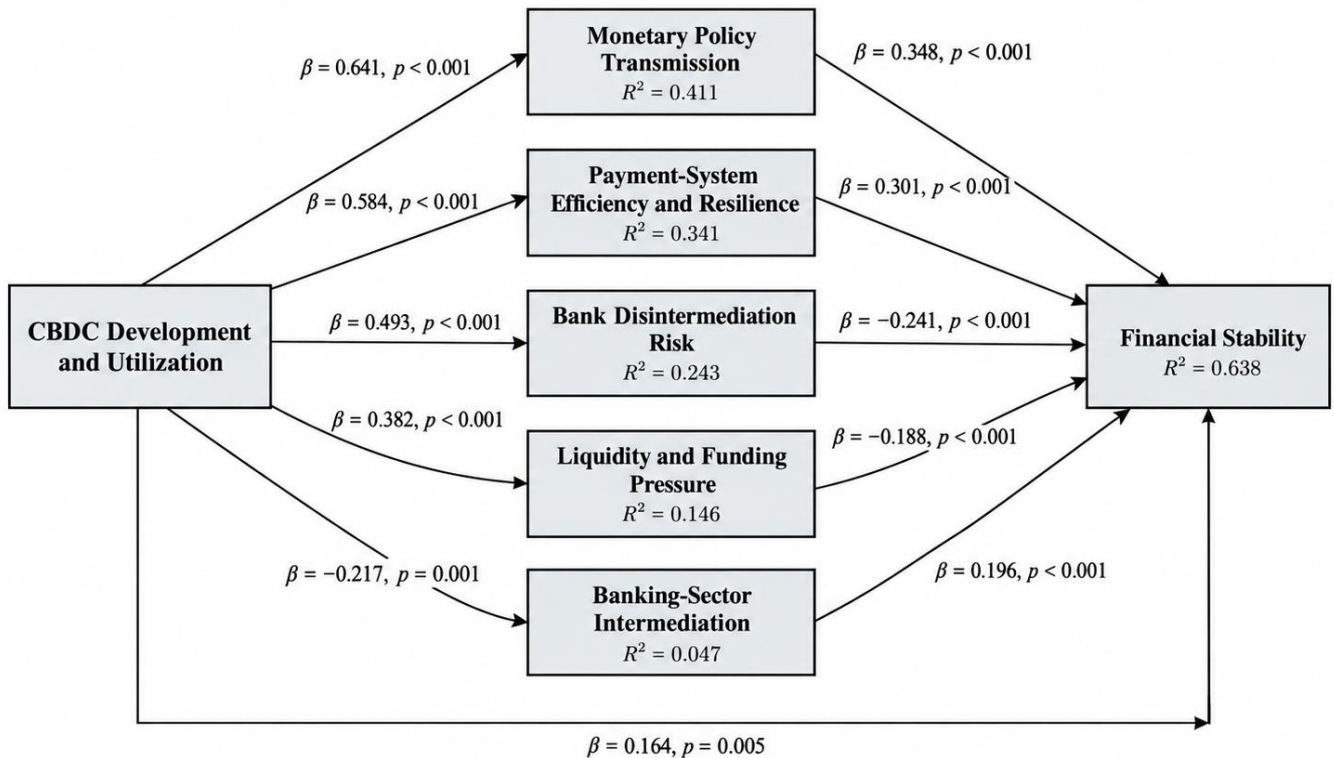
Table 4 provides evidence regarding the mediating mechanisms through which CBDC development influenced financial stability and the explanatory and predictive performance of the overall structural model. The strongest positive indirect pathway was observed through monetary policy transmission, with CBDC development exerting a significant indirect effect

on financial stability through improved transmission effectiveness ($\beta = 0.223$, $t = 5.912$, $p < 0.001$). This result showed that a substantial portion of the stabilizing effect of CBDCs arose from their capacity to strengthen the link between central bank decisions and broader financial and economic conditions. The indirect pathway through payment-system efficiency and resilience was also positive and statistically significant ($\beta = 0.176$, $t = 5.321$, $p < 0.001$), indicating that greater operational efficiency, payment continuity, settlement security, and technological resilience represented a second major channel through which CBDCs could improve financial stability. In contrast, three statistically significant negative indirect pathways were identified. The indirect effect through bank disintermediation risk was $\beta = -0.119$ ($t = 3.998$, $p < 0.001$), making it the strongest destabilizing pathway. The pathway through liquidity and funding pressure was also negative ($\beta = -0.072$, $t = 3.214$, $p = 0.001$), while the indirect effect through reduced banking-sector intermediation was smaller but remained statistically significant ($\beta = -0.043$, $t = 2.682$, $p = 0.007$). Taken together, these findings demonstrated that CBDC introduction did not have a uniformly positive or negative effect on the financial system. Instead, the overall result reflected the balance between monetary and payment-system benefits and banking-sector funding and intermediation risks.

Despite the negative indirect mechanisms, the aggregate indirect effect of CBDC development on financial stability remained positive and significant ($\beta = 0.165$, $t = 4.406$, $p < 0.001$). When this indirect effect was combined with the direct effect of CBDC development on financial stability, the total effect increased to $\beta = 0.329$ ($t = 5.882$, $p < 0.001$). Thus, within the empirical model, the combined positive effects transmitted through monetary policy effectiveness and payment-system resilience were greater than the negative effects associated with bank disintermediation and funding pressures. The explanatory power of the model was also satisfactory. CBDC development explained 41.1% of the variance in monetary policy transmission and 34.1% of the variance in payment-system efficiency and resilience. It accounted for 24.3% of the variation in bank disintermediation risk and 14.6% of the variation in liquidity and funding pressure. The explanatory power for banking-sector intermediation was comparatively limited ($R^2 = 0.047$), indicating that traditional banking intermediation was influenced by numerous organizational, regulatory, structural, and macroeconomic factors beyond CBDC development alone. Most importantly, the full structural model explained 63.8% of the variance in financial stability ($R^2 = 0.638$), representing substantial explanatory power for a model of macro-financial perceptions and institutional mechanisms. Predictive relevance was also established because Q^2 values for monetary policy transmission (0.268), payment-system efficiency and resilience (0.231), and financial stability (0.402) were all greater than zero. The comparatively high Q^2 value for financial stability indicated particularly strong predictive relevance for the central outcome construct. Finally, the standardized root mean square residual was 0.061, below the criterion of 0.08, supporting an acceptable overall fit between the proposed theoretical model and the observed data.

Figure 1

Structural Model of the Effects of Central Bank Digital Currency Development on Monetary Policy Transmission and Financial Stability



The structural configuration summarized in Figure 1 illustrates the dual mechanism through which CBDC development affected financial stability. On the stabilizing side of the model, CBDC development strongly enhanced monetary policy transmission ($\beta = 0.641, p < 0.001$) and payment-system efficiency and resilience ($\beta = 0.584, p < 0.001$), both of which subsequently exerted significant positive effects on financial stability. These relationships constituted the dominant positive transmission channels in the model. On the risk side, higher CBDC development increased bank disintermediation risk ($\beta = 0.493, p < 0.001$) and liquidity and funding pressure ($\beta = 0.382, p < 0.001$), while it moderately weakened conventional banking-sector intermediation ($\beta = -0.217, p = 0.001$). Bank disintermediation risk and liquidity pressure subsequently reduced financial stability, demonstrating that the migration of deposits from commercial banks to central bank digital money could create adverse funding and liquidity effects if CBDC adoption occurred rapidly or without adequate regulatory safeguards. Nevertheless, the positive pathways were quantitatively stronger than the adverse pathways, producing a positive total effect of CBDC development on financial stability ($\beta = 0.329, p < 0.001$). The figure therefore demonstrates that the financial consequences of CBDCs cannot be adequately represented by a simple direct relationship. Rather, their overall effect depends on the interaction between increased monetary-control capacity, more resilient payment infrastructure, and the potential erosion of conventional bank funding and intermediation functions. The structural results consequently support a conditional interpretation in which CBDCs can strengthen financial stability when their monetary-policy and payment-system advantages are accompanied by mechanisms that limit excessive deposit migration, liquidity stress, and disruption to bank-based credit intermediation.

Overall, the empirical findings showed that CBDC development was strongly associated with improved monetary policy transmission and more efficient and resilient payment infrastructure, while also generating identifiable risks for bank funding and traditional financial intermediation. The positive direct and indirect effects on financial stability exceeded the negative indirect effects in the estimated model, resulting in a statistically significant positive total association between CBDC development and financial stability. However, the coexistence of substantial positive and negative pathways demonstrated that the financial-stability consequences of CBDCs depended not merely on their introduction but on the manner of their design, implementation, adoption, and integration with the commercial banking system. In particular, the magnitude of the effects associated with bank disintermediation and liquidity pressure suggested that safeguards concerning CBDC holdings, conversion mechanisms, remuneration, and liquidity provision would be important in preserving the stabilizing benefits identified in the model.

Discussion and Conclusion

The findings of this study provide an integrated account of how central bank digital currency development may influence monetary policy transmission and financial stability through both beneficial and adverse channels. The structural model showed that CBDC development and utilization had a strong positive effect on monetary policy transmission, a substantial positive effect on payment-system efficiency and resilience, and significant positive associations with bank disintermediation risk and liquidity and funding pressure. At the same time, CBDC development was negatively associated with conventional banking-sector intermediation. Monetary policy transmission, payment-system efficiency and resilience, and banking-sector intermediation positively contributed to financial stability, whereas bank disintermediation risk and liquidity and funding pressure exerted negative effects. Importantly, the total effect of CBDC development on financial stability remained positive and statistically significant, indicating that the stabilizing pathways associated with stronger monetary transmission and more resilient payment infrastructure outweighed the destabilizing pathways arising from deposit substitution, funding pressure, and weakened traditional intermediation. These results reinforce the view that CBDCs should not be evaluated as inherently stabilizing or destabilizing instruments; rather, their net financial effect depends on the relative strength of several interconnected transmission mechanisms.

The strongest relationship identified in the model was the positive effect of CBDC development on monetary policy transmission. This finding indicates that the greater the development and utilization of a central bank digital currency, the more effectively monetary-policy decisions may be transmitted through liquidity conditions, interest rates, expectations, money demand, and broader financial behavior. This result is consistent with the argument that CBDCs can reduce some of the frictions associated with conventional monetary transmission because central-bank liabilities become more directly accessible to households and firms. Vaziri and Nadri emphasized that CBDCs may change the channels through which monetary-policy decisions are transmitted and may strengthen central-bank influence over monetary conditions by altering the relationship among central-bank money, commercial bank deposits, and market liquidity [6]. Similarly, Sabeghat showed that digital currencies can reshape banking models and monetary-policy processes by influencing deposit structures, financial intermediation, and the channels through which monetary authorities affect economic activity [7]. The present results support these arguments by demonstrating empirically that monetary policy transmission constituted the strongest positive pathway linking CBDC development to financial stability.

The positive relationship between CBDC development and payment-system efficiency and resilience was also substantial. Respondents perceived CBDCs as capable of improving transaction speed, settlement reliability, technological continuity, and the overall operational resilience of payment systems. This result accords with the broader literature in which payment modernization is frequently identified as one of the principal motivations for CBDC development. Genc and Takagi noted that CBDC design and implementation are often justified by the prospect of more efficient, secure, and resilient payment infrastructures, particularly as economies become increasingly dependent on digital transactions [2]. Dionysopoulos et al. likewise emphasized that CBDCs may improve payment efficiency and provide a public digital alternative to private payment instruments, although their broader effects depend on design choices and institutional conditions [1]. The present finding therefore suggests that the stabilizing role of CBDCs is not restricted to monetary-policy transmission but also operates through improvements in the infrastructure through which payments and settlements are processed.

The significant positive effect of payment-system efficiency and resilience on financial stability further confirms the systemic importance of digital payment infrastructure. Reliable payment systems reduce settlement disruptions, facilitate liquidity circulation, and maintain transactional continuity during periods of financial stress. A CBDC architecture that strengthens operational resilience may therefore reduce one category of systemic vulnerability even while creating other forms of risk. The importance of interoperability identified by Waliczek is particularly relevant in this respect, because technologically fragmented digital currency systems may generate operational inefficiencies, whereas interoperable systems can improve compatibility and reduce payment frictions [15]. Koushanfar also highlighted the role of blockchain-oriented digital infrastructures in improving transparency, traceability, and transaction management, suggesting that technological architecture can materially affect financial-system performance [16]. In this study, the positive contribution of payment-system resilience to financial stability indicates that technological efficiency should be treated as a core component of CBDC policy rather than merely an operational consideration.

At the same time, the results revealed a significant increase in bank disintermediation risk as CBDC development expanded. This finding is consistent with one of the principal concerns in the CBDC literature: if households and firms regard central-bank digital money as safer or more convenient than commercial bank deposits, they may transfer funds away from banks, reducing banks' deposit base. Whited et al. specifically examined whether CBDCs could disintermediate banks and showed that the effect depends on how consumers substitute between bank deposits and central-bank digital money, as well as on the reaction of financial intermediaries [9]. The present study supports this concern by demonstrating a relatively strong positive association between CBDC development and perceived disintermediation risk. The negative effect of bank disintermediation risk on financial stability further suggests that large-scale deposit migration could weaken financial resilience by reducing stable bank funding and increasing dependence on alternative funding sources.

The positive effect of CBDC development on liquidity and funding pressure provides additional evidence of this risk mechanism. If commercial banks experience deposit outflows toward CBDC holdings, they may be required to replace relatively stable retail deposits with more expensive wholesale funding, central-bank borrowing, or other liabilities. Such changes can increase funding costs and reduce the flexibility of bank balance sheets, particularly during periods of financial stress. Eftekhari and Mostajeran, in their systematic review of the consequences of CBDCs for financial stability, emphasized that deposit substitution and liquidity pressures represent among the most important potential destabilizing effects of CBDC adoption [10]. The present findings are aligned with this conclusion, because liquidity and funding pressure exerted a

significant negative effect on financial stability. This suggests that the design of CBDCs must account not only for their ordinary use during stable conditions but also for the speed at which deposits could migrate during episodes of uncertainty.

The negative relationship between CBDC development and banking-sector intermediation also deserves attention. Although the magnitude of this effect was smaller than the effects on monetary policy transmission and payment-system efficiency, the direction of the relationship indicates that greater CBDC utilization may modestly weaken the traditional deposit-taking and credit-intermediation role of banks. This result is theoretically plausible because a portion of funds previously held as bank deposits may instead be held directly as central-bank liabilities. The finding is consistent with Whited et al., who argued that CBDCs can affect the intermediation role of commercial banks through changes in deposit competition and funding structures [9]. It also corresponds with Sabeghat's analysis of changes in banking models associated with digital currencies, particularly where digital sovereign money alters the conventional relationship between banks and depositors [7]. However, the relatively limited explanatory power observed for banking-sector intermediation in the present model suggests that CBDCs are only one of several determinants of this process. Bank intermediation remains influenced by regulatory policy, capital adequacy, market structure, competition, interest rates, credit demand, macroeconomic conditions, and institutional characteristics.

The positive effect of banking-sector intermediation on financial stability confirms the continuing importance of commercial banks within the financial system. Even in a digital monetary environment, banks perform essential functions in credit allocation, liquidity transformation, risk assessment, payment provision, and the transmission of monetary policy. Excessive weakening of bank intermediation could therefore generate systemic costs, particularly in economies where banks remain the dominant source of credit. This result is especially relevant for emerging economies, where banking systems often perform a larger role in financial intermediation than capital markets. Syarifuddin emphasized that optimal CBDC design in emerging economies must take into account the structure of banking systems, access to financial services, and the risk that digital central-bank money could alter deposit and liquidity conditions [4]. The present findings reinforce the need for policy designs that preserve the benefits of CBDCs without substantially undermining the capacity of banks to perform their traditional intermediation functions.

The positive direct effect of CBDC development on financial stability, even after the inclusion of mediating mechanisms, suggests that CBDCs may provide additional stabilizing benefits beyond the channels explicitly modeled. These benefits may include improved transparency, enhanced central-bank visibility over monetary flows, more efficient liquidity management, reduced settlement risk, and greater confidence in sovereign digital money. At the same time, the relatively modest magnitude of the direct effect compared with the indirect effects confirms that the impact of CBDCs is largely transmitted through institutional and operational mechanisms rather than arising automatically from the existence of the digital currency itself. Dionysopoulos et al. stressed that the effects of CBDCs depend heavily on their design, implementation, and interaction with existing financial institutions [1]. Ozili and Alonso similarly emphasized that technological acceptance, cybersecurity, regulatory design, trust, and implementation strategy are central to the eventual consequences of CBDC adoption [11]. Accordingly, the positive total effect observed in this study should be interpreted as conditional on an institutional environment capable of managing the associated risks.

The significant positive indirect effect of CBDC development through monetary policy transmission was the strongest mediating pathway in the model. This finding indicates that improved transmission effectiveness is a major mechanism

through which CBDCs may enhance financial stability. If policy-rate decisions, liquidity measures, and monetary signals pass more rapidly and reliably through the financial system, central banks may be better positioned to stabilize inflation, liquidity, expectations, and aggregate financial conditions. Martinez Peria noted that digital currencies create new challenges for central banks but may also reshape the mechanisms through which monetary authorities influence financial systems [20]. In addition, the expansion of monetary technologies discussed by Nejad Moghadam suggests that digital currencies may alter the technical and institutional foundations of monetary management [8]. The present results provide empirical support for this perspective by identifying monetary policy transmission as the central positive mechanism linking CBDCs to financial stability.

The findings are also consistent with the importance of expectations and information effects. Ahmadrabhan et al. showed that CBDC-related news may influence Iranian financial markets, indicating that expectations concerning digital currency development can affect financial behavior even before widespread implementation [19]. This is relevant because monetary policy operates partly through expectations, and a CBDC may strengthen this channel if market participants respond more quickly to policy signals in a more integrated digital monetary environment. However, expectations can also generate instability if CBDC-related announcements trigger concerns about bank deposits, financial surveillance, monetary restrictions, or rapid structural change. The management of communication therefore becomes an important component of CBDC policy.

The findings further underline the importance of public adoption. A CBDC cannot materially affect monetary transmission or bank funding unless users adopt it at sufficient scale. Singh and Yadav showed that digital currency adoption depends on factors such as trust, perceived usefulness, security, technological accessibility, and user acceptance [5]. The dual effects observed in this study suggest that adoption intensity may itself determine the balance between benefits and risks. Low adoption may limit improvements in monetary transmission and payment efficiency, whereas extremely rapid adoption may intensify deposit substitution and liquidity pressure. Policy design must therefore consider not only whether adoption occurs but also its speed, scale, and distribution across different groups of users.

The Iranian context makes these considerations particularly salient. Akhtarzadeh Zavareh identified a range of challenges for CBDC implementation in Iran, including infrastructural readiness, legal frameworks, public trust, cybersecurity, and institutional preparedness [18]. These challenges directly relate to the mechanisms identified in this study. Weak infrastructure could reduce payment-system benefits, insufficient regulation could amplify liquidity risks, and low trust could constrain adoption. Conversely, carefully managed implementation may provide opportunities to modernize the payment system and improve monetary control. Legal considerations are equally important. Bechara et al. emphasized the need for a clear legal basis for CBDC issuance, user rights, liability, privacy, and central-bank authority [13], while Asadi highlighted the broader relevance of digital assets to international economic law, sanctions, and dispute settlement [14]. For Iran, these legal and institutional conditions may materially affect both domestic implementation and international functionality.

The importance of institutional analytical capacity should also be recognized. A CBDC system generates large volumes of real-time or near-real-time transaction data that may improve policy monitoring but also require sophisticated data governance and analytical infrastructure. Nazarian-Jashnabadi et al. emphasized the importance of business-intelligence maturity, data integration, technological capacity, and organizational readiness in supporting effective decision-making [17]. Although developed in a broader organizational context, these principles are highly relevant to central banks and financial institutions operating CBDC infrastructures. The ability to interpret transaction flows, identify abnormal liquidity movements,

monitor bank funding conditions, and detect systemic stress may determine whether CBDCs strengthen or weaken financial stability in practice.

Overall, the findings support a balanced interpretation of CBDCs as instruments capable of enhancing monetary-policy effectiveness and payment resilience while simultaneously generating structural risks for commercial banks. The net positive total effect observed in the present study indicates that the potential benefits can exceed the risks, but only when stabilizing mechanisms remain stronger than destabilizing ones. This conclusion is consistent with the broader literature, which repeatedly emphasizes that CBDC outcomes depend on design, adoption, regulation, technological capacity, and the institutional structure of the financial system [2, 3, 11]. CBDCs should therefore be understood as policy architectures rather than merely digital versions of cash: their financial consequences are produced through the interaction of monetary policy, banking behavior, payment infrastructure, technological design, public adoption, and regulation.

This study has several limitations that should be considered when interpreting the results. First, the research employed a cross-sectional design and therefore captured professional perceptions at a single point in time rather than observing actual changes before and after large-scale CBDC implementation. Consequently, the identified relationships should not be interpreted as definitive longitudinal causal effects. Second, the study relied on self-reported assessments from professionals in Tehran, and although respondents were selected on the basis of relevant expertise, their evaluations may have been influenced by institutional experience, expectations, or individual perceptions of digital finance. Third, the study focused on a specific professional and geographical context, which may limit the generalizability of the findings to other regions, countries, or financial systems. Fourth, the structural model concentrated on major monetary and financial channels and did not include all potentially relevant variables, such as cybersecurity risk, privacy concerns, financial inclusion, exchange-rate effects, capital flows, public trust, or the specific remuneration structure of a CBDC. Finally, the study examined CBDC development in general terms and did not distinguish systematically among alternative design models, including interest-bearing versus non-interest-bearing CBDCs, direct versus intermediated architectures, or systems with and without holding limits.

Future studies should employ longitudinal, experimental, and simulation-based designs to evaluate how monetary transmission and financial stability evolve across different stages of CBDC introduction and adoption. Comparative studies across countries with different levels of financial development and different banking structures would provide a stronger basis for identifying contextual effects. Future research could also distinguish among CBDC design alternatives and examine whether holding limits, tiered remuneration, transaction restrictions, privacy arrangements, or intermediated distribution models reduce bank disintermediation and liquidity pressures. Additional models should incorporate public adoption, financial inclusion, cybersecurity, privacy, exchange-rate dynamics, capital flows, and digital bank-run behavior. Research combining survey data with bank-level balance-sheet data, payment-system data, macroeconomic indicators, and transaction-level information would provide stronger empirical evidence than perception-based analysis alone. It would also be useful to test nonlinear relationships, because the effects of CBDC adoption may differ at low, moderate, and very high levels of usage. Scenario analysis and stress testing could further determine how CBDC conversion behaves during financial crises and whether safeguards remain effective under severe liquidity shocks.

Policymakers and central banks should adopt a gradual and carefully calibrated approach to CBDC implementation that preserves the benefits of stronger monetary transmission and more efficient payment systems while limiting excessive

disruption to commercial bank funding. Practical measures may include phased issuance, pilot programs, quantitative holding limits, tiered remuneration, mechanisms that discourage abrupt large-scale transfers from bank deposits into CBDCs, and standing liquidity facilities that protect banks during periods of unusual deposit migration. Commercial banks should be integrated into the CBDC ecosystem rather than displaced from it, particularly through intermediated distribution models that allow banks to continue providing customer services, credit intermediation, and compliance functions. The central bank should also invest in cybersecurity, real-time liquidity monitoring, data analytics, interoperability, public communication, and operational resilience. Clear legal rules concerning issuance authority, privacy, user protection, liability, and institutional responsibilities should be established before large-scale implementation. Finally, public adoption should be managed through transparent communication and gradual expansion so that policymakers can monitor behavioral responses and adjust the CBDC design before systemic risks become significant.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Written consent was obtained from all participants in the study.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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