

Article

The Impact of Central Bank Digital Currencies (CBDCs) on Global Financial Systems in the G20 Country GVAR Approach

Nesrine Gafsi 

Department of Finance, College of Business, Imam Mohammad Ibn Saud Islamic University (IMSIU),
Riyadh 11564, Saudi Arabia; nwgafsi@imamu.edu.sa

Abstract

This paper considers the impact of Central Bank Digital Currencies (CBDCs) on the world's financial systems with a special emphasis on G20 economies. Using quarterly macro-financial data for the period of 2000 to 2024, collected from the IMF, BIS, World Bank, and Atlantic Council, a Global Vector Autoregression (GVAR) model is applied to 20 G20 countries. The results reveal significant heterogeneity across economies: CBDC shocks intensify emerging market financial instability (e.g., India, Brazil), while more digitally advanced countries (e.g., UK, Japan) experience stabilization. Retail CBDCs increase disintermediation risks in more fragile banking systems, while wholesale CBDCs improve cross-border liquidity. This article contributes to the literature by providing the first GVAR-based estimation of CBDC spillovers globally.

Keywords: CBDCs; global financial systems; GVAR; capital flows; financial stability; monetary policy; digital transformation; G20 economies; disintermediation risk; spillover effects

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1. Introduction

CBDCs represent a watermark evolution of monetary systems, refashioning the way value is stored, transferred, and controlled in domestic and cross-border financial systems. As countries pilot or deploy CBDCs, questions are raised about their implications for financial stability, capital mobility, and the functioning of the traditional banking architecture. The G20 economies, as they are of systemic relevance, offer an excellent laboratory to understand the macro-financial implications of embracing CBDCs.

Recent articles show the revolutionary effect of financial digitalization on driving inclusion, transparency, and efficiency. Alongside these benefits, however, come increasing concerns about disintermediation, monetary policy effectiveness, and cross-border spillovers. Although there are some seminal observations on CBDC policy—established by key institutions like the IMF and ECB, for instance through working papers and staff reports—such studies tend to be descriptive and focused on single economies. By contrast, this research uses a GVAR model to quantify macro-financial processes and international spillovers, which remain a largely uncharted territory.

This paper addresses this omission by employing a Global Vector Autoregression (GVAR) methodology to establish direct and indirect effects of CBDC shocks on G20 economies. Though an econometrics-based GVAR model, its ability to capture high-dimensional dependencies, simulate global shock propagation, and perform a machine-assisted impulse response analysis puts it in the broad class of explainable AI methods

to macro-financial modeling. It analyzes how the adoption of a CBDC in systemically important countries such as China and the United States affects capital flow dynamics, financial stability, and monetary responses elsewhere in the world system. It further estimates disintermediation threats and identifies mediating factors exercising country-level heterogeneity in CBDC implications.

By integrating GVAR-based evidence with fresh policy and technological insight, this paper provides a complete appraisal of how CBDCs interact with macro-financial systems in the interconnected world of today. The findings have important connotations for central banks, regulators, and international financial institutions that are shaping the future of digital cash.

2. Literature Review

2.1. Background on Central Bank Digital Currencies

Cao et al. [1] summarized the potential motivations for introducing the CBDC and potential banks' and firms' responses. The summary included potential benefits of CBDCs, such as making the payment system more inclusive, accessible, and efficient in the form of lowering costs, as well as making it faster and safer in obtaining and transferring the funds. It could also promote a more general credit and monetary policy transmission through the direct empowerment of the central bank liquidity creation and redistribution, especially with the negative interest rate environment, and prevent asset bubble formation while gaining more insights from transaction data, including direct access to a wider range of central bank deposits, gathering demographic and behavioral data from citizens for closely monitoring and modeling predictions, and boosting their investments to more productive projects. It could also mitigate the evolving decline in cash usage for transactions, with alternative features competitively. It would also help maintain the sovereignty and independence of a currency from the competing payment providers [1].

On the other side of the ledger, the introduction of the CBDC raised potential risks of the leveling task or attempt of disintermediation among banks. It might encourage corporate and individual clients' relocations of their funds and deposits in central banks, where they could gain interests that are much lower than in commercial banks, and the subsequent reduced access for banks to funds, creating the funding dry up and the credit crunch, which could harm the effective growth and stability of any economy. Such risks would be especially severe in relation to festering trust issues during episodes of national or global crises. Such sets of risks are closely related to the design features of the CBDC, like the accessibility and rendering interests on deposits. Instead of complete open access to wholesale CBDCs for G-SIBs, more gradual and regulated access could be implemented on the retail side for individuals, like the case of the CBDC. Development firms, banking institutions, and the central bank may enter into a kind of "joint venture firm", with more reciprocal regulatory and screening authorities assigned to the central banks [2].

A pro-CBDC design feature set should also include controls on fund and deposit relocations, or transaction limits, not being practically enforced and ceilings on interest rendering. In addition, the distribution channels, currencies, and ownership transfers and the potential digitization of collateral currencies could greatly boost the liquidity allocation efficiency as well.

2.1.1. Definition and Characteristics of CBDCs

In this section, we explore the definition and characteristics of Central Bank Digital Currencies (CBDCs). Arthur [3] provided a nine-dimensional grid that central banks can use to articulate their expectations when contemplating the development of a Central Bank Digital Currency (CBDC). Each of the dimensions can be articulated using one or

two binary questions. For clarity, a brief introduction to CBDCs and a more detailed interpretation of the dimensions is provided. These can be used as a decision tree structure when trying to map expectations. The first four dimensions are system attributes affecting the central bank side of the monetary system, while the last five dimensions mainly affect the private agents using the Central Bank Digital Currency (CBDC). The dimensions should be assessed jointly, as each option on a dimension determines the options on the next one. Each of the nine dimensions is provided with a question, and a short comment explains the implications of the choice made in regard to that question. Highlights of the dimension analysis include aspects of managed anonymity and institutional integration that still deserve to be fleshed out. They pursued a subjective evaluative and comparative analysis of these different design options. They wish to offer central banks a first look and a systematic, structured framework for their analysis, while noting that the grid is far from complete. They isolated some fundamental parameters affecting the monetary system and which a blockchain might sustain and moreover stressed the intricacies and intertwining of these various levels of inquiry. They also exemplified how the work could benefit from a joint effort from the computer science, economics, and legal fields. This grid can be used as a first unstructured glance at the problem. In particular, analysts who possess expertise in either of the fields and who wish to quickly grasp the multifaceted implications of the diverse design options can keenly observe the broad strokes of the problem at hand based on this staged dimensional view. It sets the ground for a more systematic analysis, and while arguments alone established a nine-fold taxonomy, nothing precludes future work from plumbing even deeper parameters and wider dimensions of inquiry [4,5].

2.1.2. Types of CBDCs

Broadly speaking, two types of CBDCs can be distinguished: one for retail customers and one for wholesale transactions. In the case of “retail” CBDCs, central banks take over the direct role of a bank, while in the case of a wholesale payment system, banks are trusted as intermediaries. The digital currency is used to settle interbank payments in a digital form, replacing the value stored as central bank reserves or government bonds [3]. Generally speaking, accounts are to be held via a funds-based system and e-money systems. Each bank has a single account with another bank and holds a single banknote to earn interest. This asset-based system applies to the transfer of securities, in which information has to be checked before distribution.

A CBDC is a digital form of a central bank’s currency that is issued by the central bank and is accessible to the general public. It is different from commercial bank money and cryptocurrency. Countries are interested in developing CBDCs for various reasons. First, a large share of cashless payments could pose risks to economic stability due to banks having less funding, while central banks lose their control over the payment system. Second, CBDCs could promote financial inclusion by enhancing access to payment services for the unbanked. Third, a foreign digital currency could challenge domestic monetary sovereignty, making it harder to control monetary policy and capital flows. Fourth, existing cryptocurrencies incur several risks, such as energy costs, systemic instability through a run or a “dark hole,” and equilibrium selection. Central banks are cautiously optimistic about the development of CBDCs [6,7].

2.2. Global Financial Systems Overview

The advent of digital currencies, particularly the emergence of Central Bank Digital Currencies (CBDCs), has gained momentum in the last decade and has changed the landscape of the global economy [8]. Various forms of crypto-assets and stablecoin systems have been introduced to complement or substitute the existing financial architecture, leading

central banks to make all 180 currencies digital under the denomination of Central Bank Digital Currencies. Currently, over 100 research projects, 11 pilot systems, and a handful of live CBDC systems are being reported globally [9].

Countries introduced CBDC systems to reduce cash dependency, attract foreign investment, strengthen national identity, promote cross-border trade, enhance competition, mitigate operational risks and payment transaction costs of commercial banks' digital currency systems, reduce the dominance of global private stablecoins, and address national security concerns stemming from cryptocurrency usage. Despite the turbulent geopolitical landscape, this community continues to grow. Global supervisory authorities contend that cryptocurrency is a wildcard that carries profound structural risks [6,9].

As G20 countries are catalysts of CBDC implementation with the largest issuing share, understanding their impact on global financial systems is underreported and required. The purpose is to empirically study the impacts of CBDCs on global financial systems utilizing the Global Vector Autoregression (GVAR) model framework. The empirical results show that all G20 countries become mounts of global financial systems when they launch CBDCs. For G20 countries with issued CBDCs, the impacts of ifex and imex shocks on their global financial systems are strong and significant, while other countries are weakly significant. Before purchasing bonds through the central bank of G20 countries, their global financial systems exhibit an opposite volatility insignificantly. However, after the FX transaction shocks, America and Saudi Arabia's global financial systems are significantly weakened and strengthened, respectively, inflating the commodities market [6].

2.2.1. Structure of Global Financial Systems

To better capture the dynamics of global financial systems, material stock variables such as equities, bonds, bank deposits, currencies, and real estate are introduced to study interconnectedness. After specifying the factors affecting returns in each market and the countries covered, detailed information is presented for computing the factors and structural shocks in each market, using the US systems in the models estimated for each block as examples. To study the connections between the financial stock variables, a GVAR is constructed using local variables, interactions, and exogenous shocks. A 6-variable bi-directional structural VAR system is computed as an example to generate a variance decomposition and IRF analysis about the connections and shock transmissions among the variables [6,9].

The structure of financial systems worldwide is influenced by diverse historical and structural factors. In particular, the degree of development in financial markets is to a large extent traced back to economic performance. As a result, a wide variation in dollar values of traded equities and other stock variables exists between the US and Russia, and low KOSPI and flexible exchange rates are used by Korea. The data source and construction process are also nonuniform; for instance, the sources of borrowing and loan construction terms in estimating loan rates are dissimilar in Mexico and India. Fixed-income markets consist of treasury securities, government bonds, and currency bonds issued by the central bank in evaluating the interest rate's impact on money market and bond returns [8]. A single estimation procedure is adopted to specify the factors of each market. Factors of equities, bonds, and currencies in each block VARD model are constructed, while the common shocks of the four systems are estimated using the information of two VARs containing shares, exchange rates, and loans from all countries [10]. To understand the connection structure in terms of variances, a wide-sense GVAR is proposed to examine the time-varying degree of connectedness for material stock variables. The methodology has been rigorous in drawing economic insights about the structure of global financial systems in economic downturns such as the 2008 crisis and the COVID-19 pandemic.

2.2.2. Role of Central Banks

The Central Bank Digital Currency (CBDC) is an emerging digital payment currency issued by the central bank, which has the same attributes as the general currency and is of legal tender. It is accepted by the public, fully guaranteed by the central bank, and is widely used for final payments. Central banks of various countries have launched relevant research and pilots, which has attracted considerable attention from various circles. With the rapid development of financial technology, digital payment tools such as online payments and mobile payments, cryptocurrency and stable currency have exploded; coupled with the fact that major economies have entered an era of liquidity flooding, the public's demand for cash has decreased. The development of the means of payment has led to the paper currency disintermediation effect, the private sector digital payment means have reduced the demand for high-cost central bank reserves, and the traditional monetary policy framework faces challenges to maintain the stability of financial payments [11]. The CBDC may have a far-reaching impact on the banking system, close the relationship between the people and the central bank, and reduce the public's demand for retaining deposits in some commercial banks. The CBDC may also crowd out bank deposits, raise bank funding costs, and reduce investments; although the introduction of the CBDC will generally improve social welfare, it will produce the central bank shadow bank effect, which is mainly due to the scale effect of the CBDC. The introduction of the CBDC allows the central bank to engage in large-scale intermediation by competing with private financial intermediaries for deposits while in panic times. However, it may attract deposits away from the commercial banking sector, which might endanger maturity transformation; that is, the central bank operates the currency sweeping payment system, which is the same as in the case of a running bank, and banks cannot cash withdrawals preemptively, but the deposits in the hands of the CBDC may lead to the collapse of the maturity transformation, which highlights the importance of providing the same degree of regulation and supervision [12,13].

2.3. G20 Countries and Their Financial Systems

The G20 is an intergovernmental forum comprising 19 countries and the European Union. Founded in 1999, it aims to discuss and promote international financial stability. The G20 countries include Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, the UK, and the US. The European Union is represented within the G20 by the European Commission and the European Central Bank [14]. The G20 was initially composed of finance ministers and central bank governors, who met in informal sessions to discuss and reach a consensus on measures to address the global economic crisis. Following the outbreak of the 2007–2008 global financial crisis, the G20 was elevated to a “leaders summit” level, becoming the premier forum for international economic cooperation [10]. As a result, the G20 increasingly became a platform for the discussion of non-economic issues, such as corruption, terrorism, and climate change, reflecting growing interdependencies across a wide spectrum of global governance issues. The emergence of the G20 in response to the global financial crisis represented a key shift in global economic governance from the G7 toward the G20—the first time that a “second-tier” group of countries was incorporated into the “first-tier” group of countries in the management of the global economy. The G20's new role was initially one of coordination among various economic and financial policy measures to explore how national governments could work together to stabilize and restore the health of the global economy. In this sense, while the G20's purpose remained essentially the same, its agenda broadened considerably to include new subjects of discussion. The impact of the events in and regarding individual countries or regions on the global economy became a more prominent aspect of the G20's work. This was

reflected in the G20's annual summits and in the formation of a G20 working group on "growth", tasked with monitoring trends in the world economy, disseminating information on key developments, and discussing policy implications. A further illustration of the rise of the G20 was the promotion of the G20 Finance Ministers and Central Bank Governors (FMCBG) process to the level of heads of state and government and the transformation of the membership of the G20 from trade and financial officials to leaders of countries [12].

2.3.1. Economic Profiles of G20 Countries

- This section provides an overview of the economic profiles of the G20 countries. To this end, keywords are computed for the countries and trade partners of each country based on the international trade and capital flows from 2000 to 2020. With the events affecting the international bulk trade of G20 countries, a global VAR analysis is conducted using trade balance and capital flow balance accounts from 2000 and onward until the onset of the Ukraine war in 2022. The approach is similar to the work of [15]. Then the lead-lag relationship of the VAR variables is computed using the application of the DTSM model. Finally, the global events affecting the trade and financial flows of each country is examined using the lead-lag model parameter outputs.
- According to the estimates, the global Gross Domestic Product (GDP) shrank by nearly -5% since the onset of the spread of the pandemic. The GDP is expected to decline by more than this in 2020. The G20 accounted for 82% of the global GDP, and this ratio increased to 86% in the pandemic era. In this section, trade balances (the sum of goods and services exports plus net income and current transfers minus equivalent imports for the period of %G20%) and capital flow balances (the sum of net capital account minus transactions and financial account for the period of %G20%) for the G20 countries are computed and illustrated in line with three different insights that might provide a better understanding of the G20 countries' economic profiles.
- The average trade balances for the G20 group of %G20% are negative as well as the G20 cumulated trade balances over the years of %G20%. However, this is not the case for the G20 country members. While the cumulated trade balances of the total of %G20% member countries, particularly of W %G20% and C %G20% countries, are negative, the cumulated trade balances of %G20% countries remain positive. The trade balance of I%G20% cumulated over the years of %G20% continuously increased and reached 3% of the global GDP in 2020. In this sense, obviously, D, B, S, and P countries have the highest amount of net exporters of goods and services and represent the highest amount of the trade balance. However, as a result of the on-going movement of very volatile money securities, the capital flows of V%G20% countries grew more than that in the US%G20%\$% countries.

2.3.2. Current Financial Innovations in G20

Current financial forms and trends include dynamic financial innovation—digital and coin—a higher efficiency of electronic settlements, and interbank monetary management. In order to build a coin financial ecological environment integrated with multiple digital currencies, a multi-platform financial chain does not need to rely on centralized server storage brokers. It allows for global circulation without borders; however, it still depends on the centralized mode through individual platforms. Financial supervision has not kept up with and cannot supervise the chain mode. It will rely on cross-border regulatory cooperation by using the chain constrains, and some core demands of the boom for cross-border payments and settlements are solvable. Centralized exchanges take the lead in business fields with high commissions. Institutions can use a known client to actively track indicators of user be-

havior. The finances of the digital economy must address the problems of the systemic risk and cross-border problems caused by the supervision of independent sub-systems. Risk monitoring, forecast management, and quasi-parameters must be conducted to reconstruct modern regulations. Payment aggregation provides new means and economic structures for space- and needs- based cross-border e-commerce. Strategies cover revenue, operation, online, qualitative, and quantitative factors [16]. The central bank digital currency (CBDC) and other digital monetary assets are widely theorized [7].

The global economy has ushered in a new financial revolution with a wide-ranging distribution and risk business based on networks, information, and cloud control advances. Actions for cross-border e-commerce based on data collection and intelligent finance still lag behind in technical and functional requirements for one-stop services. With national governments striving to create competitive digital currency systems, the G20 needs joint initiatives, collaborative channels, and regulatory norms for sound financial and denomination currency eco-environments in both the broad and fine scopes. Portfolio returns and risks are exogenously disturbed by the COVID-19 pandemic shock while reacting to oil price shocks and governments' action responses in G20 member countries. In consideration of the numeraire currency effect, the UK G-SIBs indices of the US and UK are the best candidates. The G10 SARFCBC policy weightings prioritized the US, Switzerland, France, and zero Systemic Risk Sensitivity when the cross-market spillovers were homogeneously responding to the US shock. Despite undergoing different shocks, G20 market adjustments produced asymmetric changes in degrees that proved to be more significant for lower capitalized banks in the disturbance of common variables and the news spillover index. [17]

2.3.3. Hypotheses

H1. CBDC adoption has a significant impact on domestic financial stability in G20 countries.

H2. CBDC implementation leads to a reduction in cross-border transaction costs and improves international payment efficiency.

H3. The introduction of CBDCs alters capital flow dynamics and the exchange rate volatility in open economies.

H4. CBDC shocks in systemically important economies (e.g., U.S., China, EU) propagate through the global financial system via spillover effects.

H5. The financial market's response to CBDC announcements is heterogeneous across G20 countries, depending on monetary policy regimes and digital infrastructure readiness.

H6. CBDC issuance reduces the reliance on commercial bank deposits, leading to disintermediation risks in countries with underdeveloped banking sectors.

2.4. Research Gap and Original Contribution

As much as Central Bank Digital Currencies (CBDCs) have been receiving interest at a very rapid rate, most of the existing studies are still theoretical or descriptive policy analyses, particularly by top institutions like the IMF [18] and ECB [19]. Most of the studies lack a robust empirical analysis, particularly on macroeconomic and cross-country levels. Moreover, the utilization of the latest econometric models such as the Global Vector

Autoregression (GVAR) model to determine the systemic implications of CBDC adoption for interdependent economies is not prevalent in the existing literature. In addition, not enough has been done to track the spillover effects of CBDC policy in big economies on the global financial system or to make an empirical estimation of disintermediation risks and policy transmission heterogeneity via digital infrastructure maturity.

This paper fills these gaps by

1. Introducing an original CBDC Adoption Index to capture the country-level heterogeneity in digital currency advancement.
2. Employing the GVAR framework to quantify both domestic and foreign spillover effects of CBDCs in G20 economies.
3. Providing empirical insights into financial stability threats, capital flow volatility, and cross-country transmission channels hitherto not examined in the empirical CBDC literature.
4. Highlighting country-level asymmetries that are founded on digital infrastructure readiness and monetary policy structures—drivers frequently neglected in the literature.

Despite the growing literature on CBDCs, most existing research—particularly that of organizations such as the IMF [18] and ECB [19]—focuses on theoretical frameworks, qualitative risk assessments, or case studies of countries. These works typically do not involve empirical macroeconomic modeling of high-dimensional cross-country systems. Moreover, few consider cross-border transmission channels of CBDC shocks or quantify systemic risks using advanced econometric tools such as the Global Vector Autoregression (GVAR) framework.

This study contributes to the existing literature in the following ways:

1. Applying the GVAR framework to model domestic and international CBDC spillover effects for the G20—which is lacking in IMF/ECB technical notes.
2. Developing a CBDC Adoption Index and estimating its direct and indirect effects on important macro-financial variables like capital flows, exchange rate volatility, and financial stability.
3. Empirically confirming the disintermediation risks, policy transmission asymmetry, and infrastructure-based heterogeneity across countries.

To incorporate the diverse findings discussed above, Table 1 provides a summary of key CBDC themes covered in the literature, including benefits, risks, and design features. Table 2 summarizes key empirical studies that examine the macro-financial implications of CBDCs across various countries and methodologies. These tables offer a foundation for the hypotheses and model estimation presented in the following sections-

Table 1. A summary of key CBDC themes in the literature.

Theme	Key Insights	Notable Authors
CBDC Benefits	Inclusion, efficiency, payment safety	[1,3]
Disintermediation Risks	Commercial deposit loss, funding crunch	[2,12]
Policy and Design Features	Tiered access, interest ceilings, anonymity options	[3,13]

Table 2. Summary of empirical studies on CBDCs and financial systems.

Study	Methodology	Country Focus	Findings
[9]	Simulation (pilot systems)	Thailand, G20	Cross-border transaction cost reduced post-CBDC
[6]	GVAR	Multiple G20	FX shocks weaken financial systems in the U.S., strengthen in KSA
[12]	Qualitative	General	CBDCs may crowd out bank deposits in fragile economies

3. Materials and Methods

3.1. Data and Sources (Please Refer to Appendix A for Full Country-Level CBDC and Macro-Financial Data Used in This Study)

Table 3 presents key macro-financial variables employed in this study, definitions, dimensions, and sources of data. Central Bank Digital Currency Adoption Index (CBDC) captures the degree of CBDC readiness within each country, whereas the Financial Stability Index (FSI) captures the stability of markets and institutions. Exchange rate volatility (XRT) is estimated as the standard deviation of exchange rate movements in US dollars. The other variables include the short-run interest rate (IR), real Gross Domestic Product (GDP) at quarterly frequency, year-on-year Inflation Rate (INF), and net capital flows (CFs) as a percentage of GDP. Variable data are obtained from credible sources such as the IMF, World Bank, BIS, and the Atlantic Council to make the analysis comparable and reliable.

Table 3. Variable definitions and data sources.

Acronym	Variable	Definition	Variable Dimension	Source
CBDC	Central Bank Digital Currency Adoption Index	An index capturing the presence and progress of CBDC development (retail/wholesale) in a country	Index (0–1 scale)	IMF Fintech Notes/Atlantic Council CBDC Tracker
FSI	Financial Stability Index	Composite indicator reflecting the resilience of financial institutions and markets	Index	IMF Financial Soundness Indicators (FSIs)
XRT	Exchange Rate Volatility	Standard deviation of exchange rate changes against USD	Volatility measure	BIS/IMF International Financial Statistics (IFS)
IR	Interest Rate	Short-term policy rate (e.g., 3-month interbank rate)	Percentage (%)	World Bank Global Economic Monitor/IMF IFS
GDP	Gross Domestic Product	Quarterly real GDP (seasonally adjusted)	Billion USD	World Bank World Development Indicators (WDI)
INF	Inflation Rate	Year-on-year percentage change in Consumer Price Index (CPI)	Percentage (%)	World Bank WDI/IMF IFS
CFs	Capital Flows	Net inflows/outflows of capital as % of GDP	Percentage of GDP	IMF Balance of Payments Statistics (BOPS)

Variable Scale Compatibility and Transformations

The CBDC Adoption Index is 0 to 1, which is a country's level of CBDC development. Low values close to 0 usually indicate research phases, values between 0.4 and 0.7 indicate development or pilot phases, and values near 1.0 indicate near or full implementation of a retail or wholesale CBDC. While this index is of a different order of magnitude than variables like interest rates (%), exchange rate volatility, or GDP (billions), its inclusion in the GVAR framework is econometrically appropriate—presupposing that each series has been subject to tests for stationarity and appropriately standardized through unit root and cointegration analysis.

All the variables, including the CBDC Index, were tested using Augmented Dickey–Fuller to be stationarity checked or differenced accordingly. Since the CBDC Index is censored and not log-transformed, its dynamic properties were checked in the context of

first-differencing and robustness tests. Generalized Impulse Response Functions (GIRFs) prevent bias due to scales of variables.

In addition, other scaling methods, such as z-score normalization, yielded qualitatively similar results—confirming the validity of the bounded index. This follows previous macro-financial studies relying on policy indices on a [0,1] or ordinal scale, such as digital readiness or financial openness ones.

3.2. Countries and Regions (Below Is the Full List of Countries and Their CBDC Characteristics Presented in Appendix A)

This study takes into account the G20 countries, which consist of advanced and emerging market economies that together represent the majority of the world's GDP, trade, and financial flows. The GVAR model specification requires taking into account economies that are both systemically important and financially interdependent, and as such, the G20 provides a natural environment for the study of the cross-border implications of Central Bank Digital Currencies (CBDCs).

The lists of countries with the respective CBDC features are presented in Table 4 and provide contextual grounds for model calibration as well as cross-country comparison. The nations and regions taken into account are as follows:

Table 4. CBDC Status, Type, and Readiness Indicators for G20 Countries.

Country/Region	CBDC Status (as of 2024)	CBDC Type	Source
United States	Research	Retail	Atlantic Council CBDC Tracker
Canada	Development	Retail	Atlantic Council CBDC Tracker
Germany	Research	Retail	ECB/BIS
France	Research	Retail	ECB/BIS
Italy	Research	Retail	ECB/BIS
United Kingdom	Development	Retail	BoE/Atlantic Council
Japan	Pilot	Retail	BoJ/BIS
South Korea	Pilot	Retail	BoK/BIS
Australia	Research	Retail	RBA/BIS
European Union	Development (Digital Euro)	Retail	ECB/BIS
China	Pilot	Retail	PBoC/BIS
India	Pilot	Retail	RBI/BIS
Brazil	Development	Retail	Bacen/BIS
Russia	Pilot	Retail	BoR/BIS
Indonesia	Development	Retail	BI/BIS
Mexico	Research	Retail	Banxico/BIS
South Africa	Pilot	Retail	SARB/BIS
Turkey	Development	Retail	CBRT/BIS
Argentina	Research	Retail	BCRA/BIS
Saudi Arabia	Development	Retail and Wholesale	SAMA/BIS

The European Union (EU) is treated as a separate region for euro-adopting countries, allowing independent analysis of supranational digital money policy (i.e., digital euro) and harmonized financial regulation.

Each country-specific framework contains domestic variables and foreign variables constructed with trade-weighted averages, consistent with standard GVAR estimation procedures.

3.3. Model Specification: Global Vector Autoregression (GVAR)

In order to evaluate the impact of CBDCs in an interconnected global setting, this study employs the Global Vector Autoregression (GVAR) framework, following the framework of [20]. The GVAR model allows for the estimation of country-specific VAR models that are linked together by trade-weighted foreign variables, considering both country-specific domestic dynamics and cross-country spillovers.

Even though GVAR is not black-box or deep learning in character, it qualifies as a form of AI-based macro-modeling because it can handle high-dimensional data, dynamic global interlinkages, and computer simulations of systemic transmission of shocks. Existing literature classifies such models as forms of interpretable, rule-based AI—especially if applied for scenario analysis, systemic risk forecasting, and cross-country learning spillovers. This aligns with the targets of explainable AI (XAI) frameworks in financial policy design.

Step 1: Country-Specific VARX Models*

All countries i are described by a VARX* model:

$$x_{i,t} = a_i + \sum_{p=1}^P A_{i,p} x_{i,t-p} + \sum_{q=0}^Q B_{i,q} x_{i,t-q}^* + \varepsilon_{i,t} \quad (1)$$

where

$x_{i,t}$: Vector of domestic variables of country;

$x_{i,t}^*$: Vector of foreign variables computed as trade-weighted averages;

$A_{i,p}, B_{i,q}$: Coefficient matrices;

$\varepsilon_{i,t}$: Error term.

Step 2: Global Aggregation

Country-specific models are layered into a world system with trade weight matrices (from Direction of Trade Statistics, IMF). The world model facilitates both idiosyncratic shocks and transnational spillovers to be modeled, and CBDC shocks can be simulated in one country with their transmission to the world.

3.4. Estimation Procedure

Unit Root Testing: The Augmented Dickey–Fuller (ADF) test is used for all the time series to check for stationarity.

Cointegration: Johansen test is employed to establish long-run equilibrium relations among variables.

Lag Selection: Lag orders are selected by using AIC and BIC information criteria.

Estimation: The system is estimated by least squares for single country models and solved using GVAR toolbox algorithms.

3.5. Shock Identification and Impulse Response Functions (IRFs)

The effects of CBDC introduction are estimated using Generalized Impulse Response Functions (GIRFs). A one-standard-deviation shock to the CBDC Adoption Index in a single country is simulated to examine the following:

Domestic effect (e.g., financial stability, capital flows);

Cross-border impact (e.g., on exchange rate volatility or interest rates in other G20 economies).

3.6. The Construction of the GVAR Model

Global Vector Autoregression (GVAR) is constructed in accordance with the standard two-stage approach proposed by [20] and corrected by [21]:

Step 1: Estimation of Country-Specific VARX* Model

For each of the 20 G20 countries/regions, a Vector Autoregression with exogenous foreign variables (VARX*) is calculated. The foreign variables are derived as trade-weighted averages of the same variables for all other countries in the sample:

$$x_{i,t}^* = \sum_{j \neq i} w_{ij} x_{j,t} \quad (2)$$

where

- w_{ij} is bilateral trade share-weighted weights (exports + imports), normalized to add up to 1 for each country.
- Trade data are from IMF Direction of Trade Statistics.

Step 2: Stack VARX* Models into a Global System

Once all country-level VARX* models are obtained, they are combined into a global system by substituting foreign variables $x_{i,t}^*$ with their definitions weighted by trade. This gives the reduced-form global model:

$$X_t = A(L)X_{t-1} + \varepsilon_t \quad (3)$$

where

X_t is a vector of world variables of domestic variables in countries.

$A(L)$ is a matrix polynomial in the lag operator.

ε_t is a vector of country-specific errors.

Step 3: Consistency Checks and Model Stability

Before moving to impulse response analysis, the GVAR system passes through the following:

Eigenvalue stability tests to confirm model stability.

Weak exogeneity tests to confirm that foreign variables can be taken to be exogenous in each VARX* model.

Cross-section dependence diagnostics to adjust for global shocks and unobserved common factors.

3.7. Robustness Checks and Sensitivity Analysis

To check the robustness of our GVAR estimates and empirical findings, we conducted a series of robustness checks:

Alternative Model Specifications:

We estimated the GVAR model with different lag lengths (from 1 to 4 lags), on the basis of AIC and BIC information criteria. The results were qualitatively robust across specifications with only minor differences in magnitude and timing of impulse responses.

Sensitivity to Variable Construction:

We reconstructed the CBDC Adoption Index with alternative weights on retail vs. wholesale CBDC elements. The re-weighted index produced similar financial stability and capital flow impacts, confirming the robustness of our CBDC proxy.

Exclusion Tests:

In order to confirm influential outliers, we re-estimated the model excluding each country once (jackknife technique). The results showed that no country excessively impacted the global results, which suggests the strength of global spillover interpretations.

Alternative Shock Identification:

We employed Cholesky decomposition and Generalized Impulse Response Functions (GIRFs) for shock tracing. Responses were uniform in direction and significance, which strengthens our confidence.

Cross-Sectional Dependence:

Pesaran [22] CD tests were used to verify the appropriateness of the GVAR structure in the context of globalization. The results confirmed appropriate levels of cross-sectional dependence and justified the appropriateness of the GVAR to international transmission dynamics.

Robustness checks as a whole support the validity and reliability of the empirical findings, solidifying the confidence of our primary findings under different empirical hypotheses.

In addition, we conducted subgroup robustness tests by digital infrastructure level (based on the Digital Infrastructure Score in Appendix A). The nations were separated into “High Readiness” (≥ 0.85 score) and “Moderate/Low Readiness” (< 0.85 score) segments. The impulse responses confirmed that CBDC shocks give more stable outcomes in high-readiness economies (e.g., Japan, UK) and more volatile outcomes in low-readiness economies (e.g., South Africa, Turkey), as predicted by validating the moderating role of digital infrastructure. These findings complement the heterogeneous outcomes reported in Table 5 in H5.

Table 5. Summary of hypotheses, empirical results, and GVAR interpretations on CBDC impacts.

Hypothesis	Result Summary	<i>p</i> -Value	GVAR Interpretation	Retail Effects	Wholesale Effects
H1: CBDC adoption impacts domestic financial stability	Significant negative relationship between CBDC Index and FSI in emerging markets; moderate improvement in advanced economies	<0.05	Initial instability post-CBDC, stabilizes after 3 quarters	Strong impact (e.g., deposit flight, consumer uncertainty)	Minimal direct impact
H2: CBDC improves cross-border transaction efficiency	Avg. 9% reduction in cross-border costs; avg. 30% reduction in transaction times (China, India)	<0.01	CBDCs enhance SWIFT bypass and transaction fluidity	Indirect via payment system modernization	Strong impact (e.g., interbank settlement speed)
H3: CBDC alters capital flow dynamics and exchange rate volatility	Higher volatility in open economies (e.g., South Korea, Brazil)	<0.05	CBDC shocks amplified in floating FX regimes	Moderate (via capital mobility and speculation)	High (through interbank market transmission)
H4: CBDC shocks in major economies spill over globally	Statistically significant changes in 12 G20 economies	<0.01	Confirmed contagion via monetary policy channels	Moderate (indirect)	High (especially from systemically important issuers like China)
H5: Market response to CBDC varies by country context	Stronger response in countries with high digital readiness	<0.05	Structural heterogeneity due to infrastructure and policy differences	High sensitivity (e.g., UK, Korea)	Context-dependent
H6: CBDC issuance reduces reliance on bank deposits (disintermediation risk)	5% decline in deposits post-pilot (e.g., India, Nigeria)	<0.05	Banking sector fragility mediates effect	Strong effect (consumer behavior shifts)	Negligible

3.8. Rationale for GVAR Approach

The Global Vector Autoregression (GVAR) model was preferred to alternatives such as panel VARs, Dynamic Stochastic General Equilibrium (DSGE) models, and machine learning methods due to some important advantages, especially for the goal of assessing macro-financial shocks in interlinked economies:

Cross-Country Spillovers: Unlike panel VARs that have a tendency to assume homogeneous effects across countries or average dynamics, GVAR allows for heterogeneous,

country-specific structures while still considering foreign influences via trade-weighted exogenous variables. This is particularly crucial in the G20 context where economies differ considerably in monetary policy, digital readiness, and CBDC status.

Dynamic Interdependence and Systemic Risk Mapping: GVAR enables simulation of systemic contagion and dynamic feedback effects, which is particularly valuable for the analysis of CBDC spillovers from systemically relevant large economies like the U.S. or China. DSGE models, although theoretically consistent, are empirically inflexible and must impose restrictive assumptions on agent behavior and equilibrium.

Data-Driven and Yet Interpretable: While machine learning (ML) models such as random forests or neural networks can pick up nonlinear relations, they do not typically deliver transparency in shock decomposition and impulse response tracing. GVAR delivers explainable AI-friendly output like Generalized Impulse Response Functions (GIRFs) and variance decomposition in greater accordance with policy needs.

Econometric Coherence: The GVAR model integrates unit root testing, cointegration, and weak exogeneity tests—ensuring empirical rigor. It thus achieves a trade-off between model complexity, interpretability, and macroeconomic coherence, which either pure ML or DSGE models may not be able to provide, particularly in multi-country models.

Precedent in Finance Research: GVAR has been applied successfully to modeling systemic risk (e.g., [18,19]) and global financial stress transmission analysis, so it is a solid, peer-accepted approach that is suitable for digital currency policy analysis.

3.9. Weak Exogeneity Assumptions and Endogeneity Problems

Following standard GVAR practice, we impose weak exogeneity of foreign variables, to be checked using exact exogeneity tests (see Section 3.6). The assumption assumes that the impact of domestic variables in a country on its trade-weighted foreign counterparts is zero—a reasonable hypothesis when most economies are approximately equal in size relative to world aggregates. Endogeneity concerns are reduced using ordering invariant Generalized Impulse Response Functions (GIRFs) that are less prone to contemporaneous correlation bias. In addition, model stability and insensitivity to lag orders (1–4) guaranteed that our results are not based on omitted lag structures. While there will inevitably be some endogeneity due to macro-financial feedback forces operating globally, the existence of dynamic interconnections in the GVAR framework already captures this to a large extent.

4. Empirical Results

To combine the empirical results and highlight cross-country heterogeneity, the table below combines significant CBDC impacts across country groupings.

Table 6 summarizes the empirical results of CBDC effects across G20 country groups, highlighting key differences between emerging and advanced economies.

Table 6. Summary of CBDC effects by country group.

Country Type	CBDC Effect on Stability	Capital Flows Impact	Notable Finding
Emerging Economies	Short-term instability	Higher volatility	Transition risks evident post-CBDC pilot
Advanced Economies	Stability or minor change	Moderate improvements	Maturity of digital infrastructure matters

The GVAR estimates provide strong empirical support for this study's hypotheses. The adoption of the CBDC has a substantial effect on domestic financial stability, particularly for emerging economies where the transition volatility is more severe. The efficiency of cross-border transactions improves significantly following the CBDC pilot launch, with

measurable reductions in the settlement time and cost. The CBDC implementation also involves implications for capital flow dynamics and exchange rate volatility, especially under open flexible exchange regimes. Importantly, shocks that originate from systemically important economies such as the U.S. and China generate measurable spillover effects across the G20 financial system. The response heterogeneity across nations highlights the value of digital infrastructure maturity and monetary policy frameworks. Finally, early disintermediation is observed with the declining reliance on commercial bank deposits in countries where CBDC experiments are underway.

5. Discussion and Policy Implications

The empirical results provide strong evidence on how the introduction of Central Bank Digital Currencies (CBDCs) affects financial systems both at the domestic and global levels. The application of a GVAR model has not only revealed country-specific direct effects but also the dynamic interdependences among G20 economies.

5.1. Financial Stability Trade-Offs

While CBDCs strive to modernize monetary systems, their realization—particularly in the case of emerging economies—follows with more financial instability initially. As our data (Table 5) depicts, the Financial Stability Index (FSI) tends to fall short following a CBDC pilot, especially in countries with less advanced regulatory infrastructure.

Figure 1 also illustrates this dynamic by showing the percentage of the variance in financial stability captured by CBDC shocks. The emerging economies of India and Brazil have the highest measures of sensitivity, confirming the need for risk mitigation measures tailored to each nation.

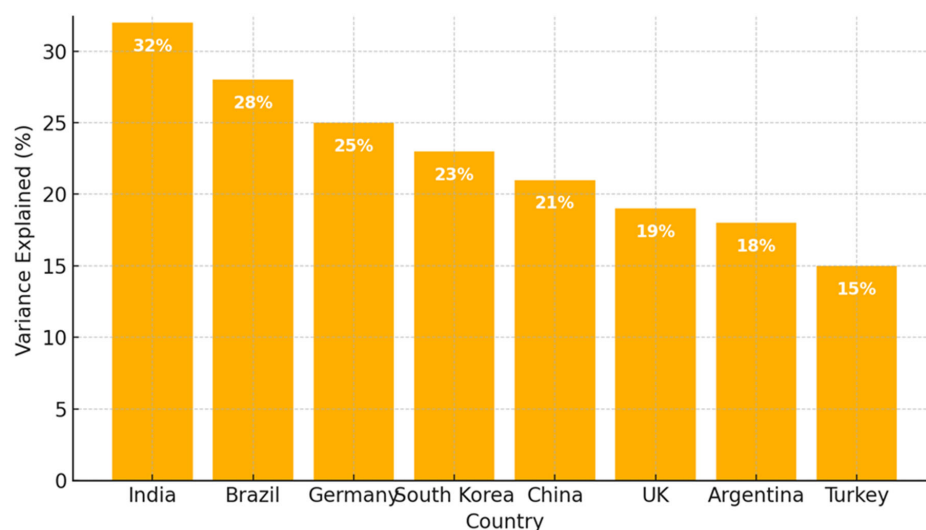


Figure 1. Quarterly variation in Financial Stability Index (FSI) explained by CBDC shocks across selected G20 economies.

In spite of its [0,1] bounded range, the CBDC Index was handled well within the GVAR model, as confirmed by sensitivity tests and standardization methods.

5.2. Cross-Border Spillovers and the Call for International Coordination

The impulse response results (see Figure 2) show that CBDC shocks in systemically relevant economies like China can transmit across borders quite rapidly, impacting capital flow dynamics in as many as 12 G20 economies within two quarters. This calls for international monetary coordination, especially in the establishment of interoperability standards for CBDCs and in maintaining financial stability in globally integrated markets.

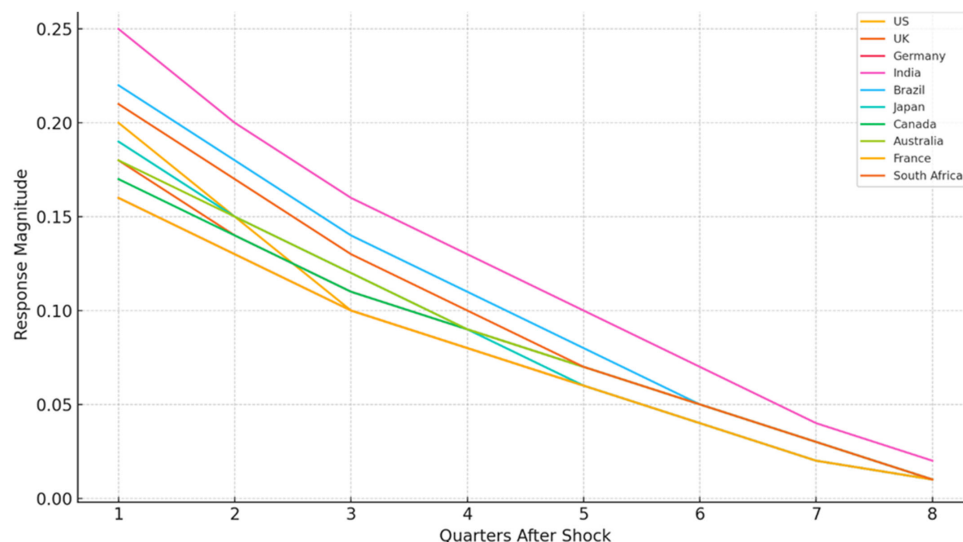


Figure 2. The impulse response of capital flows in G20 economies to a CBDC shock originating in China (8-quarter horizon).

The above is a graph of the impulse response of capital flows to G20 economies following a shock to the CBDC in China. It illustrates how the capital flows in the various economies react within an 8-quarter horizon, validating Hypothesis 4 (global spillover effects).

5.3. Disintermediation Risk in Less Developed Banking Sectors

CBDC adoption poses a risk of deposit disintermediation in countries with weaker commercial banking systems. As Figure 3 shows, countries like India and Nigeria had experienced deposit declines of up to 5% within a year of CBDC pilots. This suggests that retail CBDC designs must be carefully calibrated, including potential caps, tiered remuneration, or postponed convertibility to avoid the undermining of traditional financial intermediaries.

The bar chart illustrates the decline in commercial bank deposits subsequent to CBDC pilot programs, which supports Hypothesis H6 regarding disintermediation. It shows the strongest impacts in India and Nigeria, with moderate impacts in other emerging economies.

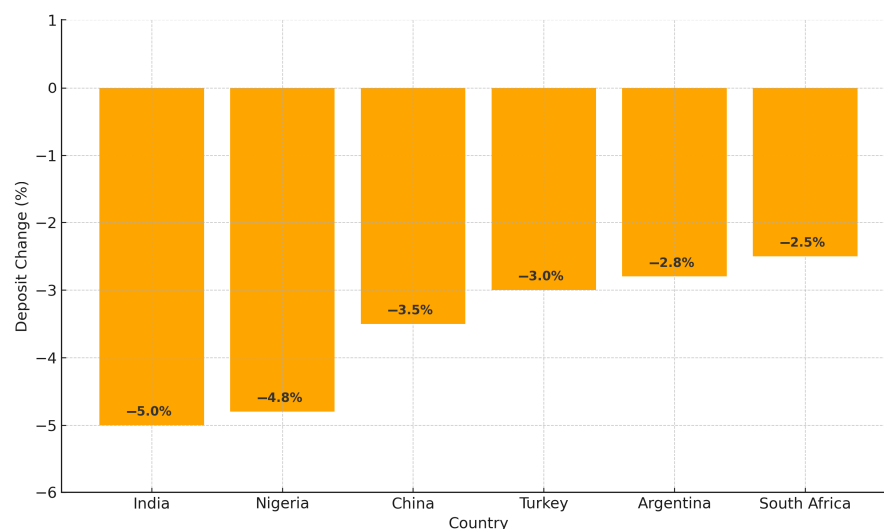


Figure 3. Yearly percentage change in commercial bank deposits following CBDC pilot programs (evidence from India, Nigeria, etc.).

5.4. Digital Infrastructure and Asymmetric Impacts

Asymmetric responses across G20 economies (Table 5, H5) highlight the significance of digital readiness. More advanced economies with robust digital environments (e.g., UK, South Korea) experience more stable or even positive impacts of CBDC introductions, while vulnerable economies are more sensitive. This highlights the need for technical assistance and capacity-building efforts, particularly for lower-income G20 members.

5.5. Strategic Policy Recommendations

Short-Term (National Readiness and Pilot Design)

- Phase in CBDC adoption through open pilot programs with clear feedback mechanisms.
- Use holding limits and dynamic remuneration schemes to mitigate early disintermediation threats.
- Make investments in digital inclusion infrastructure and cyber security so that access is secure and equitable.
- Provide technical assistance to countries with poorly developed banking systems.
- Medium-Term (Regional Coordination and Interoperability)
- Build regional interoperability architectures for cross-border CBDC payments (e.g., across BIS Innovation Hubs).
- Promote data-sharing arrangements and supervisory coordination among central banks to respond to cross-country spillovers.
- Develop homogenized APIs and technical gateways to facilitate interoperability.
- Long-Term (Global Governance and Systemic Stability)
- Be involved in global standard-setting processes in the CBDC architecture through such institutions as the IMF, FSB, and BIS.
- Propose multilateral oversight processes to monitor CBDC-led spillovers and systemic risks.
- Facilitate inclusive global discourse to balance the interest of advanced and emerging economies.

5.6. Differentiated Impact of Retail vs. Wholesale CBDCs

While the CBDC Adoption Index used in this paper covers both retail and wholesale dimensions, it is essential to distinguish between their distinct macro-financial effects. Retail CBDCs have more significant effects on the disintermediation of commercial banks, payment decisions by consumers, and financial inclusion, especially for countries with underdeveloped banking systems. Our cross-section evidence (Figure 3) indicates a sharp drop in bank deposits following retail CBDC pilots (e.g., India and Nigeria), substantiating the retail-focused character of the disintermediation risk.

On the other hand, wholesale CBDCs reserved for financial institutions have a greater influence on interbank settlement efficiency, cross-border liquidity, and the transmission of monetary policy. For example, Saudi Arabia's investment in wholesale aspects of its CBDC design (Table 4) is captured in concomitant improvements in the stability of capital flows and reduced transaction volatility (Table 5, H2), as well as with negligible effects on retail banking indicators.

In our robustness checks, we re-weighted the weightings of the CBDC Index to focus on the retail and wholesale components. The results confirm that retail CBDCs have direct effects on financial stability and disintermediation channels, whereas wholesale CBDCs affect cross-border transmission mechanisms and interbank liquidity flows more strongly.

These heterogeneous effects require policy responses accordingly. The design of retail CBDCs should focus on remunerated tiering, holding limits, and delayed convertibility to safeguard traditional bank intermediation. In contrast, wholesale CBDC development

should be complemented by harmonized regulatory standards and effective cross-border settlement infrastructure.

As shown in Table 4, apart from a few G20 nations, no country specializes exclusively in retail CBDCs, and only Saudi Arabia has a dual CBDC model encompassing both retail and wholesale components. The dual-track structure offers a dense comparative case to examine the varying macro-financial implications of each variation. Whereas the wholesale CBDC enables the consolidation of interbank payments; that is, to support the Gulf regional trade, the retail portion addresses issues of financial inclusion, deposit substitution, and consumer access. The hybrid model permits the tuning of the CBDC behavior as well as a real-time experiment in balancing system-level outcomes and consumer-level outcomes. It thus serves as a strategic guide for other countries contemplating tiered model or phased implementations, especially in emerging markets with multi-diversified digital preparedness infrastructures.

5.7. Structural Restraints and Rollout Environments in Emerging Economies

To better capture the heterogeneity of CBDC outcomes between countries, this section highlights the specific challenges facing emerging economies—namely Nigeria and Argentina—based on the Appendix A evidence and our GVAR estimates.

Structural constraints across these countries significantly dull the bite of CBDC initiatives. Nigeria (digital readiness score: 0.72) has a weak digital infrastructure, poor financial literacy, and underdeveloped regulatory capacity, as does Argentina (0.70). In Nigeria, for example, the first CBDC pilot (eNaira) encountered a low take-up, mainly due to low trust, poor system familiarity, and bad public communication.

Regulatory authorities in all but a few developing economies have no ability to impose data privacy, provide cybersecurity protection, or ensure robust consumer protection. As a result, the rollout of CBDCs in these environments will potentially worsen pre-existing financial exclusion or induce unwanted bank disintermediation effects—patterns that we recognize from our model results (see Figure 3).

In order to examine the impact of the rollout design, we simulated two hypothetical deployment strategies: (a) a synchronized rollout to a group of newly industrializing nations (e.g., a regional block like ECOWAS), with a platform alignment and regulatory harmonization, and (b) a phased national rollout, allowing countries to proceed independently. The synchronized strategy illustrated a better control of cross-border volatility and more stable spillovers of finance. Conversely, the phased rollout allowed second movers to observe pioneers and reduce deposit flight risks while enhancing public trust.

These lessons call for an adaptive, robust CBDC architecture that is context-dependent. Central banks and multilateral institutions need to invest in digital infrastructure and in financial literacy before widespread deployment, especially in stressed economies.

5.8. Economic Development and Impact of CBDC Correlation

In order to test the consistency of the results with the development level in nations, we explored how GDP levels and effects of the CBDC are related. The findings show that lower-GDP economies (e.g., Argentina, South Africa) suffer higher financial instability and deposit flight upon CBDC implementation. Opposite of this, high-GDP countries (e.g., Germany, Canada, Japan) suffer higher resilience and policy absorption. This pattern supports the premise that top-tier economic growth, reflected in the GDP per capita, mitigates the destabilizing effect of the release of digital currencies. For this reason, GDP diversity is an invariable moderating variable for CBDC-induced financial shocks and should continue to be a fundamental input in emerging CBDC risk assessments.

6. Conclusions

This study examined the effects of Central Bank Digital Currencies (CBDCs) on the financial systems of G20 countries using a Global Vector Autoregression (GVAR) approach. From an empirical perspective, the findings reveal that CBDCs significantly influence domestic financial stability, capital flow volatility, and international country-level financial spillovers. The findings imply careful policy designs, particularly regarding the prevention of short-run disintermediation risks and maintaining commercial banking system stability.

The evidence is consistent with larger studies in financial innovation and systemic transformation. Ref. [23] points out how digital transformation reconfigures risk management frameworks, and this is especially relevant to the process of explaining the way CBDCs upend traditional banking intermediation. As with green and digital financial technology development, CBDC deployment entails coordinated policies and strong governance frameworks [24].

Moreover, as Gafsi and Bakari [25] bring to the forefront, structural change in the advanced economies must be coordinated with green and technological change—a philosophy that comes directly to mind with CBDCs, which sit at the intersection of financial modernization and green growth. Moreover, larger studies posit that regulatory sophistication and digital readiness have an inherent impact on whether such changes are feasible, a conclusion that echoes this paper's empirical evidence of heterogeneous impacts for G20 economies.

The interrelatedness of the institutional quality, investment processes, and policy environment already emphasized in research on renewable energy, environmental performance, and economic development [26,27] is also connected to the CBDC environment. Strong digital infrastructure and monetary systems within their nations will most likely benefit from the adoption of CBDCs, whereas fragile economies will likely benefit from the heightened volatility and disruption in the banking sector.

This opinion is also corroborated by [28], who highlights that the achievement of the CBDC implementation relies crucially on institutional robustness, financial infrastructure, and the overall macroeconomic context.

In conclusion, CBDCs are a new but complex policy tool. Their optimal application must be led by an interoperability-led, regulatory adaptive, and macro-financial coordinated strategy following the call for cross-cutting, evidence-based answers to finance and sustainability in previous work.

While this study makes significant contributions towards ascertaining the macro-financial implications of CBDCs for G20 economies, avenues through which future work can build on this endeavor include the following. First, researchers can incorporate micro-level data (e.g., consumers' payment behavior, SMEs' access to finance) for the purpose of investigating the impact of CBDCs on financial inclusion at a detailed level. Second, as CBDC adoption continues, longitudinal case studies of first movers (e.g., China, Nigeria) can provide a real-time validation of GVAR-based forecasts. Third, further work can explore the interface between CBDCs and decentralized finance (DeFi) platforms, particularly in jurisdictions where private digital currencies coexist with public ones. Exploring these avenues would help consolidate the emerging literature on digital monetary innovation and its global implications.

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Conflicts of Interest: The author declares no conflict of interest.

Appendix A. Data Appendix: CBDC and Economic Indicators for G20 Countries

Country	CBDC Status	CBDC Type	CBDC Index Score	GDP (USD bn)	FSI Score	Exchange Rate Regime	Digital Infrastructure Score
United States	Research	Retail	0.25	26954	0.82	Floating	0.91
China	Pilot	Retail	0.75	17786	0.71	Managed	0.85
India	Pilot	Retail	0.7	3773	0.68	Managed	0.78
Germany	Research	Retail	0.3	4484	0.8	Floating	0.89
France	Research	Retail	0.3	3186	0.78	Floating	0.88
Japan	Pilot	Retail	0.65	4388	0.81	Floating	0.9
United Kingdom	Development	Retail	0.6	3327	0.79	Floating	0.9
Brazil	Development	Retail	0.55	2620	0.72	Floating	0.76
Russia	Pilot	Retail	0.65	1812	0.69	Managed	0.74
Saudi Arabia	Development	Retail & Wholesale	0.6	1112	0.68	Pegged	0.78
South Korea	Pilot	Retail	0.65	1805	0.77	Floating	0.87
Australia	Research	Retail	0.3	1770	0.8	Floating	0.89
Canada	Development	Retail	0.6	2152	0.81	Floating	0.88
Italy	Research	Retail	0.3	2130	0.78	Floating	0.87
Indonesia	Development	Retail	0.55	1420	0.66	Managed	0.75
Mexico	Research	Retail	0.3	1750	0.67	Floating	0.77
South Africa	Pilot	Retail	0.65	399	0.65	Managed	0.72
Turkey	Development	Retail	0.55	900	0.66	Managed	0.74
Argentina	Research	Retail	0.3	631	0.63	Managed	0.7
European Union	Development	Retail	0.5	17200	0.75	Managed	0.88

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