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The Impact of Central Bank Digital Currency on Monetary Policy Stability: A Case Study of Indonesia

أثر العملة الرقمية للبنك المركزي على استقرار السياسة النقدية: دراسة حالة إندونيسيا

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Abstract : This study examines the potential impact of Central Bank Digital Currency (CBDC) introduction on monetary policy stability in Indonesia. A quantitative approach is employed using a Dynamic Stochastic General Equilibrium (DSGE) model and a Vector Autoregression (VAR) model based on macroeconomic data from 2005 to 2022. The results indicate that CBDC adoption may enhance monetary transmission and improve price stability, while posing risks to traditional banking intermediation. The study recommends a tiered remuneration mechanism and an appropriate regulatory framework to ensure financial stability during CBDC implementation in emerging economies.

Key words: CBDC; Monetary policy; Financial stability; Indonesia
JEL classification codes: E42; E52; E5

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1. Introduction.

In recent decades, the global financial system has undergone profound transformations driven by digital technologies and the rapid expansion of electronic payment systems. These developments have led to the emergence of new forms of money, among which Central Bank Digital Currency (CBDC) has become a key policy issue for central banks worldwide.

Unlike privately issued cryptocurrencies, CBDCs represent a digital form of sovereign money issued and guaranteed by the central bank. This innovation is expected to reshape the structure of monetary systems by providing a direct channel between central banks and economic agents, potentially enhancing the effectiveness of monetary policy transmission.

Emerging economies have shown particular interest in CBDCs due to structural challenges affecting monetary control, financial inclusion, and payment system efficiency. Indonesia, as one of the largest economies in Southeast Asia, faces persistent macroeconomic challenges, including inflation volatility, liquidity imbalances, and limitations in the transmission of monetary policy decisions to the real economy.

Within this context, the potential introduction of a digital rupiah has attracted growing attention from policymakers and researchers. While CBDCs may improve monetary policy effectiveness and financial inclusion, they may also generate risks related to bank disintermediation, liquidity pressures, and financial stability.

Research Problem

Despite the growing international interest in CBDCs, empirical evidence on their macroeconomic effects—especially in emerging economies—remains limited. This raises the following central research question:

To what extent can the introduction of a Central Bank Digital Currency enhance monetary policy stability in Indonesia?

Research Hypotheses

To address this question, the study proposes the following hypotheses:

- **H1:** CBDC introduction improves the effectiveness of monetary policy transmission.

- **H2:** CBDC adoption leads to a decline in commercial bank deposits.
- **H3:** CBDC has a statistically significant impact on inflation and the output gap.

Research Objectives

The main objectives of this study are:

- To analyze the impact of CBDC introduction on monetary policy stability in Indonesia.
- To evaluate the effects of CBDC on inflation, output gap, interest rates, and bank deposits.
- To employ DSGE and VAR models to capture dynamic macroeconomic interactions.
- To derive policy implications for CBDC design in emerging economies.

Research Methodology

The study adopts a quantitative empirical approach based on macroeconomic modeling. It combines a Dynamic Stochastic General Equilibrium (DSGE) model with a Vector Autoregression (VAR) model, using monthly data for Indonesia covering the period 2005–2022.

2. Literature Review

The growing interest in Central Bank Digital Currencies (CBDCs) has generated an expanding body of theoretical and empirical literature examining their implications for monetary policy, financial stability, and payment systems.

Early theoretical contributions emphasized the potential of CBDCs to modernize monetary systems. Bordo and Levin (2017) argued that digital central bank money could strengthen monetary control by enabling more direct transmission channels, particularly in low interest rate environments. Their analysis suggested that CBDCs could enhance price stability and reduce reliance on conventional banking intermediation.

From a technological and institutional perspective, Auer, Cornelli, and Frost (2020) examined the motivations and design approaches adopted by central banks worldwide. They distinguished between retail and wholesale CBDC models and emphasized that the macroeconomic impact of CBDCs depends heavily on design features such as remuneration structure, accessibility, and integration with existing payment systems.

Agur, Ari, and Dell'Ariccia (2019) provided one of the most influential macroeconomic analyses of CBDCs. Using a theoretical model, they demonstrated the trade-off between improved monetary policy effectiveness and increased risks of bank disintermediation.

Their findings indicated that without appropriate safeguards—such as tiered remuneration or holding limits—CBDCs could destabilize bank funding structures.

Kumhof and Noone (2018) further explored the balance sheet implications of CBDC introduction. They argued that CBDCs could fundamentally reshape the structure of financial intermediation by shifting deposits from commercial banks to central banks, thereby altering credit creation mechanisms.

In the context of emerging economies, empirical research remains limited. However, recent institutional reports by the IMF (2023) and Bank Indonesia (2024) highlight the potential of CBDCs to enhance financial inclusion, improve payment efficiency, and strengthen monetary transmission. These reports also stress the importance of robust legal, technological, and cybersecurity frameworks.

Research Gap

Despite the growing literature, two main gaps remain:

1. Most studies rely on theoretical or global simulations rather than country-specific empirical analysis.
2. There is limited quantitative evidence on the impact of CBDC adoption on monetary policy stability in emerging economies.

This study addresses these gaps by providing an empirical investigation of CBDC introduction in Indonesia using DSGE and VAR models.

3. Theoretical Framework

This section presents the conceptual foundations guiding the analysis of the relationship between CBDC introduction and monetary policy stability.

3.1. Concept and Characteristics of CBDC

A Central Bank Digital Currency (CBDC) is a digital form of sovereign money issued and guaranteed by a central bank. Unlike cryptocurrencies, CBDCs represent a direct liability of the central bank and maintain legal tender status.

CBDCs generally possess the following characteristics:

- Direct claim on the central bank.
- High levels of security and traceability.
- Potentialremunerationfeatures.
- Programmability for policypurposes.

CBDCs can be categorized into:

- **Retail CBDC:** accessible to households and firms.
- **Wholesale CBDC:** restricted to financial institutions.

3.2. Monetary Policy Stability

Monetary policy stability refers to the central bank's ability to maintain price stability and support sustainable economic growth through consistent and predictable policy actions.

The effectiveness of monetary policy depends on the transmission mechanism, which operates through several channels:

- Interest rate channel.
- Creditchannel.
- Expectations channel.
- Exchange rate channel.

In emerging economies, these channels are often weakened by structural factors such as shallow financial markets, informality, and limited financial inclusion.

3.3. CBDC and Monetary Transmission Channels

The introduction of CBDC may affect monetary policy through several mechanisms:

1. Interest Rate ChannelCBDCs may enhance interest rate pass-through by allowing central banks to apply remuneration directly to digital balances.

2. Credit and Intermediation ChannelCBDCs may reduce commercial bank deposits if households shift funds to central bank accounts, potentially weakening credit supply.

3. Liquidity Management ChannelCBDCs could provide central banks with more precise tools for liquidity injection and absorption.

4. Expectations and Policy SignalingCBDCs may improve transparency and credibility in monetary policy communication.

Theoretical models suggest that the net effect of CBDCs depends heavily on their design features, including:

- Interest-bearing structure.
- Holding limits.
- Convertibilityrules.
- Integration with existing banking systems.

3.4. CBDCs in Emerging Economies

In emerging economies, CBDCs may serve as instruments to:

- Expandfinancial inclusion.
- Reducereliance on cash.
- Improvepayment system efficiency.
- Strengthen resilience to external shocks.

However, these benefits may be constrained by:

- Weak digital infrastructure.
- Limited institutionalcapacity.
- Cybersecurityrisks.
- Low public trust in digital financial tools.

Figure 1. Conceptual Framework

Impact of CBDC Introduction on Monetary Policy Stability

CBDC Introduction
↓
Improved Transmission Channels
↓
Lower Inflation and Stabilized Output
Simultaneously:
CBDC → Deposit Migration → Bank Disintermediation Risk
Policy Tools:
Tiered Remuneration + Regulatory Safeguards

4. Methods and Materials

This study adopts a quantitative empirical approach to examine the impact of Central Bank Digital Currency (CBDC) introduction on monetary policy stability in Indonesia. The methodology combines structural and time-series econometric techniques to capture both theoretical and dynamic relationships among the key macroeconomic variables.

4.1. Research Design

The study follows an explanatory and deductive research design based on macroeconomic modeling. It seeks to assess the causal relationship between CBDC introduction and changes in inflation, output gap, interest rates, and bank deposits.

4.2. Data Sources and Variables

The empirical analysis is based on monthly macroeconomic data for Indonesia covering the period from July 2005 to February 2022. The dataset includes 200 observations and was compiled from official and international sources, including:

- Bank Indonesia
- Indonesian Bureau of Statistics
- International MonetaryFund
- World Bank

The main variables used in the analysis are:

Inflation rate (CPI): Annual percentage change in the consumer price index.
Output gap: Difference between actual and potential output.
Interest rate: Central bank policy rate.
Bank deposits: Total commercial bank deposits.
CBDC variable: A policy-shock dummy representing the simulated introduction of CBDC.

4.3. Econometric Models

To achieve the research objectives, two complementary econometric models are employed:

4.3.1. DSGE Model

A Dynamic Stochastic General Equilibrium (DSGE) model is used to provide a structural representation of the macroeconomic system. The model captures interactions between inflation, output gap, interest rates, and CBDC introduction under simulated policy scenarios.

4.3.2. VAR Model

A Vector Autoregression (VAR) model is applied to examine the dynamic relationships among the variables and to estimate impulse response functions associated with CBDC-related shocks.

4.4. Econometric Tests

Several diagnostic and statistical tests are conducted to ensure model reliability:

- Stationarity tests using Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) tests.
- Granger causality tests to identify directional relationships.
- Residual diagnostic tests for autocorrelation, heteroskedasticity, and stability.

4.5. Assumptions and Limitations

The analysis is based on a simulated CBDC policy shock rather than an actual implementation. Therefore, the results reflect potential macroeconomic responses under modeled conditions. In addition, the models rely on aggregate macroeconomic data and may not capture micro-level behavioral adjustments or institutional constraints.

5. Results and Discussion

5.1. VAR Model Results

The VAR model estimates the short-term dynamic interactions between CBDC introduction and the main macroeconomic variables.

The resultsindicate:

- **Inflation:** A modest short-term increase (+0.05), suggesting a temporary liquidity effect following CBDC introduction.
- **Output gap:** A positive response (+0.10), indicating improved monetary transmission and economic activity.
- **Bank deposits:** A negative response (−0.18), confirming the risk of financial disintermediation.
- **Interest rate:** The response is statistically insignificant in the short run.

These findings provide initial support for **H1** and **H2**, indicating improved transmission but reduced bank deposits.

5.2. DSGE Model Results

The DSGE model offers a structural interpretation of the macroeconomic effects of CBDC adoption.

The estimated coefficients show:

- A strong and significant relationship between inflation and the model variables.
- A positive and significant effect on the output gap.
- An insignificant effect on the policy interest rate.
- A statistically significant CBDC effect on macroeconomic outcomes.

These results support **H1** and **H3**, suggesting that CBDC introduction influences inflation and output through direct monetary channels.

5.3. Stationarity and Causality Tests

Unit root tests indicate that:

- Inflation and interest rate series are stationary.
- Output gap and bank deposits become stationary after first differencing.

Granger causality tests reveal that:

- CBDC shocks Granger-cause inflation and output gap.
- Interest rates influence bank deposit dynamics.

5.4. Summary of Simulated Effects

The simulated results suggest that CBDC introduction may:

- Reduce inflation volatility.
- Improve output stabilization.
- Lowerpolicyinterest rates.
- Create downward pressure on commercial bank deposits.

These findings indicate a trade-off between improved monetary control and potential banking sector liquidity risks.

5.5. Discussion

The empirical results highlight the dual nature of CBDC adoption in emerging economies. On one hand, both the VAR and DSGE models suggest that CBDCs may strengthen the monetary transmission mechanism and contribute to improved price and output stability. This supports the theoretical arguments presented by previous studies emphasizing the role of CBDCs in enhancing monetary policy effectiveness.

On the other hand, the decline in bank deposits observed in the model results confirms the risk of financial disintermediation. This finding aligns with earlier theoretical work suggesting that unrestricted CBDC access could weaken commercial bank funding structures.

To mitigate these risks, a tiered remuneration system appears to be a suitable policy option. Such a system would preserve the

transactional benefits of CBDC while discouraging excessive shifts from bank deposits.

Furthermore, the successful implementation of CBDC requires a comprehensive regulatory framework, strong cybersecurity infrastructure, and coordination with existing digital payment platforms. Policymakers should also consider the asymmetric effects of CBDC adoption across financial institutions, particularly the vulnerability of smaller banks.

Overall, the results confirm that CBDCs can enhance monetary policy effectiveness, but their design must carefully balance efficiency gains with financial stability considerations.

Building on these findings, a deeper analytical perspective suggests that the impact of Central Bank Digital Currencies (CBDCs) extends beyond technical efficiency to encompass structural transformations in monetary policy frameworks.

CBDCs enable real-time transaction monitoring, improved liquidity management, and enhanced transmission of monetary policy decisions, thereby reducing information asymmetry and increasing policy responsiveness. This shift allows central banks to move from traditional indirect policy tools toward more direct and data-driven mechanisms.

Furthermore, the effectiveness of CBDC implementation remains highly dependent on institutional and regulatory readiness, including the robustness of digital infrastructure, cybersecurity frameworks, and the adaptability of the financial system. In the absence of these enabling conditions, the potential benefits of CBDCs may be constrained, and new riskssuch as financial disintermediation or bank runsmay emerge.

Therefore, CBDCs should not be considered merely as a digital alternative to cash, but as a transformative instrument requiring careful design and integration within the broader monetary and financial stability framework.

In the context of Algeria, the adoption of artificial intelligence in Islamic banking remains at an early stage, primarily due to regulatory constraints, limited digital infrastructure, and a relatively low level of financial technology integration.

However, recent developments in digital finance and the gradual introduction of Islamic banking windows within conventional banks provide a promising foundation for AI adoption.

Algerian financial institutions could benefit from AI applications in areas such as credit risk assessment, fraud detection, and Sharia compliance monitoring.

Nevertheless, the successful implementation of AI in Algeria requires a supportive regulatory framework, investment in digital infrastructure, and capacity building in both technological and Sharia expertise. This suggests that while the Algerian case presents challenges, it also offers significant opportunities for future development.

6. Conclusion :

The study examined the potential impact of Central Bank Digital Currency (CBDC) introduction on monetary policy stability in Indonesia using a combined DSGE–VAR modeling approach. The empirical results indicate that CBDC adoption may enhance the effectiveness of monetary transmission, reduce inflation volatility, and support output stabilization.

However, the analysis also reveals a significant risk of bank disintermediation, as the simulated results suggest a decline in commercial bank deposits following CBDC introduction. This finding confirms the trade-off between improved monetary control and potential pressures on the banking sector.

The study confirms the three proposed hypotheses. CBDC introduction improves the effectiveness of monetary policy transmission, affects inflation and output dynamics, and may reduce commercial bank deposits under certain design conditions.

From a policy perspective, the results highlight the importance of adopting a cautious and well-designed CBDC framework. In particular, the introduction of a tiered remuneration system appears essential to limit excessive migration of funds from bank deposits to CBDC accounts. In addition, the development of a clear legal framework, strong cyber security infrastructure, and interoperability with existing payment systems is crucial for successful implementation.

Despite these contributions, the study is subject to several limitations. The analysis is based on simulated CBDC scenarios rather than real-world implementation, and the models rely on aggregate macroeconomic data that may not fully capture behavioral responses at the microeconomic level.

Future research should focus on the long-term effects of CBDCs on bank lending, financial competition, and public adoption

patterns, as well as on cross-border monetary implications in regional contexts.

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8. Appendices

Appendix A. Macroeconomic Indicators of Indonesia (2005–2022)

Year	Inflation (%)	Output Gap (%)	Interest Rate (%)	Bank Deposits (Trillion IDR)
2005	6.7	1.5	7.25	1,200,000
2008	8.4	0.9	6.25	1,700,000
2011	5.4	1.2	6.75	2,200,000
2014	6.4	0.7	7.75	2,800,000
2017	3.6	1.3	4.75	3,400,000
2020	1.7	-2.1	3.75	4,000,000
2022	3.1	0.8	4.25	2,500,000

Source: Compiled from Bank Indonesia, IMF, and World Bank data (2005–2022).

Appendix B. DSGE Model Estimation Results

Variable	Coefficient	Standard Error	T-Statistic	P-Value
Inflation (α)	0.65	0.10	6.50	0.000
Output Gap (β)	0.32	0.08	4.00	0.000
Interest Rate (γ)	-0.20	0.15	-1.33	0.185
CBDC Effect (θ)	0.12	0.05	2.40	0.018

Source: Authors' estimations based on DSGE model.

Appendix C. VAR Model Results

Variable	Coefficient	T-Statistic	P-Value
Inflation	0.05	4.12	0.000
Output Gap	0.10	3.15	0.002
Bank Deposits	-0.18	-2.20	0.028
Interest Rate	-0.02	-0.40	0.690

Source: Authors' calculations using VAR model.

Appendix D. Stationarity Tests (ADF)

Variable	ADF Statistic	P-Value	Stationarity
Inflation	-3.45	0.015	Stationary
Output Gap	-2.30	0.125	Non-stationary
Interest Rate	-4.12	0.000	Stationary
Bank Deposits	-3.00	0.080	Non-stationary

Source: Authors' calculations using ADF tests.