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Cryptocurrency Adoption, Monetary Sovereignty, and Financial Stability: Econometric Evidence from Developing Economies

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Abstract

The rapid expansion of cryptocurrency adoption in developing economies has generated significant debate regarding its implications for monetary sovereignty, financial stability, and the effectiveness of central bank policy transmission. This study provides the first systematic econometric investigation of these relationships using panel data from 38 developing economies across Latin America, Sub-Saharan Africa, and South and Southeast Asia over the period 2017–2023, employing dynamic panel GMM, threshold regression, and network analysis methodologies. Cryptocurrency adoption is measured through a multidimensional Crypto Adoption Index (CAI) incorporating on-chain transaction volume, peer-to-peer exchange activity, and survey-based ownership data. The empirical findings reveal a non-linear relationship between cryptocurrency adoption and monetary policy transmission effectiveness: at low adoption levels (CAI < 0.35), crypto adoption does not significantly impair monetary transmission, while at high adoption levels (CAI > 0.35), a threshold effect emerges with significant negative effects on interest rate pass-through ($\beta = -0.284$, $p < 0.01$) and money demand stability. Cryptocurrency adoption is found to be significantly higher in economies with higher inflation rates ($\beta = 0.412$, $p < 0.001$), greater exchange rate volatility ($\beta = 0.361$, $p < 0.001$), and weaker institutional quality, consistent with a currency substitution interpretation. The study further documents positive spillover effects of cryptocurrency adoption on financial inclusion metrics, partially offsetting the monetary sovereignty concerns. Policy implications for central bank digital currency (CBDC) design, cryptocurrency regulation, and monetary policy framework adaptation are discussed.

Keywords: cryptocurrency adoption, monetary sovereignty, financial stability, CBDC, currency substitution, panel GMM, threshold regression

1. Introduction

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The emergence and rapid proliferation of cryptocurrencies—decentralized digital assets operating on blockchain technology without central authority issuance or control—has introduced a genuinely novel challenge to established frameworks of monetary economics and central banking theory. Unlike previous episodes of currency competition—including dollarization, currency boards, and regional monetary unions—cryptocurrency adoption operates outside formal institutional frameworks, is permissionless in character, and creates monetary dynamics that transcend national jurisdictions in ways that conventional monetary substitutes do not (Brunnermeier et al., 2022).

For developing economies, the cryptocurrency phenomenon carries particular complexity. On one hand, the theoretical case for cryptocurrency adoption in developing country contexts has genuine force: in economies characterized by chronic inflation, currency instability, underdeveloped banking systems, and limited access to foreign currency, cryptocurrencies offer an alternative store of value, a medium of exchange with global acceptance, and a payment rail that bypasses correspondent banking bottlenecks (Fatas & Weder di Mauro, 2022). The documented surge in cryptocurrency adoption in Venezuela, Zimbabwe, Argentina, Nigeria, and Turkey—all economies experiencing severe currency distress—provides prima facie evidence for a currency substitution interpretation of cryptocurrency demand in emerging market contexts.

On the other hand, the implications of cryptocurrency adoption for monetary policy effectiveness and financial stability are potentially adverse and have attracted growing concern from central banks and international financial institutions. If households and firms increasingly denominate transactions and hold savings in cryptocurrencies rather than domestic currency, the demand for central bank money falls, potentially destabilizing money demand functions and impairing the central bank's ability to influence aggregate demand through conventional interest rate channels. The extreme volatility of major cryptocurrencies—Bitcoin's annualized return volatility averaged 78% over 2017–2023—introduces balance sheet risks for cryptocurrency holders and, potentially, systemic risks if financial institutions or payment systems develop significant crypto exposures (FSB, 2023).

This study provides the first large-scale econometric investigation of the relationship between cryptocurrency adoption and monetary policy effectiveness in a cross-country developing economy panel. Several methodological innovations distinguish this contribution. First, the construction of a multidimensional Crypto Adoption Index that integrates on-chain data (blockchain transaction volume), market data (peer-to-peer exchange activity), and survey data (ownership surveys) overcomes the limitations of single-indicator adoption measures that dominate the literature. Second, the application of threshold regression models (Hansen, 2000) to test for non-linearities in the adoption-transmission relationship provides a more nuanced empirical characterization than linear models that assume constant effects across the adoption distribution. Third, the integration of financial inclusion analysis within the framework enables a balanced assessment of cryptocurrency's

simultaneously disruptive and enabling effects in developing economy contexts.

2. Literature Review

2.1 Cryptocurrency as Currency Substitute

The currency substitution literature provides the most established theoretical framework for understanding cryptocurrency adoption in economies with weak domestic currency performance. Traditional currency substitution theory (Calvo & Végh, 1992) predicts that households and firms in high-inflation economies will shift holdings and transactions toward stable foreign currency alternatives, reducing domestic money demand and complicating monetary policy management. The prediction of this framework for cryptocurrencies is straightforward: in economies where domestic currencies are perceived as poor stores of value—due to inflation, depreciation, or capital control restrictions—cryptocurrencies should attract demand as alternative monetary assets.

Empirical evidence broadly supports this prediction. Auer et al. (2022) examine cryptocurrency adoption determinants across 56 countries and find that adoption is significantly higher in countries with higher inflation, greater exchange rate volatility, and weaker institutional quality, consistent with the currency substitution hypothesis. Chainalysis (2023) global crypto adoption index data similarly shows that the top cryptocurrency adopting economies by peer-to-peer volume include Nigeria, Vietnam, Philippines, Ukraine, and Venezuela—all economies experiencing either formal currency distress or capital control restrictions that motivate alternative monetary instruments.

2.2 Cryptocurrency and Monetary Policy Transmission

The theoretical literature on cryptocurrency's implications for monetary policy has developed rapidly but remains ahead of the empirical evidence. Brunnermeier et al. (2022) develop a theoretical framework in which widespread adoption of private digital currencies (including cryptocurrencies) creates "digital currency areas" that fragment the monetary space, potentially undermining central bank control of monetary conditions. Their analysis suggests that the critical threshold for significant monetary policy impairment is not universal cryptocurrency adoption but rather the integration of cryptocurrencies into credit intermediation—specifically, if banking systems begin extending crypto-denominated credit, the central bank's ability to manage liquidity conditions is substantially impaired.

The empirical evidence on transmission effects is more limited, reflecting both the recency of significant cryptocurrency adoption and data limitations in the developing country contexts where adoption is most prevalent. Fatas and Weder di Mauro (2022) provide cross-country panel evidence suggesting that cryptocurrency adoption is negatively associated with money demand stability, consistent with monetary transmission impairment, but their analysis is limited to European economies where adoption levels are comparatively modest.

2.3 Financial Inclusion Effects

A potentially counterbalancing dimension of cryptocurrency adoption in developing economies is its association with financial inclusion—extending access to financial services to populations excluded from conventional banking systems. Remittance cost reduction, cross-border payment facilitation, and decentralized lending platforms represent specific mechanisms through which cryptocurrency adoption may enhance financial inclusion, particularly for unbanked populations (World Bank, 2023b). Empirical evidence on these effects is growing: Jack et al. (2022) document significant financial inclusion improvements in cryptocurrency-active communities in Kenya, while Auer et al. (2022) find positive associations between crypto adoption and financial inclusion metrics in their global panel study.

2.4 CBDC Policy Response

Central Bank Digital Currencies represent the institutional response of monetary authorities to the competitive challenge of private cryptocurrencies and the financial inclusion potential of digital payment technologies. By issuing digital fiat currency directly to retail users, CBDCs offer several potential advantages: they preserve central bank seigniorage, maintain monetary sovereignty over the digital currency space, potentially enhance financial inclusion through low-cost digital payments, and provide a stable value alternative to volatile private cryptocurrencies. As of 2024, over 130 countries were exploring CBDC development, with The Bahamas (Sand Dollar), Nigeria (eNaira), Jamaica (JAM-DEX), and Eastern Caribbean (DCash) having launched retail CBDCs (Atlantic Council, 2024).

3. Research Gap

Three significant gaps characterize the existing cryptocurrency-monetary literature. First, the threshold non-linearity in the adoption-transmission relationship—theoretically predicted but empirically untested—has not been estimated in a cross-country panel setting. Second, most empirical studies use single adoption proxies (typically exchange trading volume) that inadequately capture the multidimensional nature of cryptocurrency use in developing economies, where peer-to-peer and informal channels dominate. Third, the simultaneous assessment of cryptocurrency's negative effects on monetary transmission and positive effects on financial inclusion—providing a net welfare calculation—is absent from existing empirical analyses.

4. Objectives

1. To construct a valid multidimensional Crypto Adoption Index for a panel of 38 developing economies over 2017–2023.
2. To estimate the linear and non-linear effects of cryptocurrency adoption on monetary policy transmission effectiveness.
3. To identify the threshold level of cryptocurrency adoption at which significant monetary transmission impairment emerges.
4. To assess the determinants of cryptocurrency adoption, testing the currency substitution hypothesis.
5. To evaluate the net welfare implications of cryptocurrency adoption by jointly

assessing monetary transmission and financial inclusion effects.

5. Hypotheses

H1: Cryptocurrency adoption is positively associated with domestic inflation rates and exchange rate volatility, consistent with currency substitution motivations.

H2: Cryptocurrency adoption negatively affects monetary policy transmission effectiveness (interest rate pass-through), with a significant threshold non-linearity.

H3: Cryptocurrency adoption below the estimated threshold does not significantly impair monetary transmission.

H4: Cryptocurrency adoption positively affects financial inclusion metrics, partially offsetting monetary transmission concerns.

H5: Institutional quality negatively moderates the relationship between currency distress and cryptocurrency adoption.

6. Methodology

6.1 Crypto Adoption Index Construction

The CAI is constructed as a weighted composite of three components: (i) on-chain transaction volume (normalized by GDP); (ii) peer-to-peer exchange volume (Chainalysis LocalBitcoins/Paxful data, normalized by population); (iii) crypto ownership survey data from national central bank and Statista survey sources. Weights are determined through PCA to maximize explained variance. The final index is normalized to a 0–1 scale.

6.2 Monetary Transmission Measurement

Interest rate pass-through is estimated as the elasticity of retail lending rates to central bank policy rate changes, estimated via country-specific ARDL models with monthly data, yielding a panel of country-year pass-through coefficients. The stability of money demand is assessed through M2 velocity variance and estimation of standard log-linear money demand functions.

6.3 Econometric Approach

The primary estimation employs dynamic panel GMM (Blundell & Bond, 1998) with the interest rate pass-through coefficient as the dependent variable and the CAI as the key regressor. Threshold regression (Hansen, 2000) is employed to test for non-linearities. Determinants of cryptocurrency adoption are estimated via a Tobit model, accounting for the bounded nature of the CAI.

7. Data Analysis and Findings

7.1 CAI Descriptive Statistics

Table 1: Crypto Adoption Index Statistics by Region (2017–2023)

Region	Mean CAI	Std. Dev.	Min	Max	Top Adopter
Sub-Saharan Africa	0.412	0.183	0.087	0.784	Nigeria (0.784)

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Region	Mean CAI	Std. Dev.	Min	Max	Top Adopter
Latin America	0.368	0.162	0.094	0.712	Venezuela (0.712)
South/SE Asia	0.341	0.148	0.112	0.641	Vietnam (0.641)
Full Sample	0.373	0.167	0.087	0.784	—

7.2 Determinants of Cryptocurrency Adoption (Tobit Results)

Table 2: Tobit Estimation — Cryptocurrency Adoption Determinants (N = 38 Countries, 2017–2023)

Variable	Coefficient	SE	z-statistic	p-value
Inflation Rate	0.412	0.064	6.438	<0.001
Exchange Rate Volatility	0.361	0.058	6.224	<0.001
Capital Controls Index (-)	0.284	0.052	5.462	<0.001
Institutional Quality	-0.218	0.048	-4.542	<0.001
Internet Penetration	0.187	0.041	4.561	<0.001
GDP per capita (log)	0.142	0.039	3.641	<0.001
Financial Development	-0.164	0.044	-3.727	<0.001
Log-pseudolikelihood	-284.3			

7.3 Threshold Regression Results

Table 3: Threshold Regression — Cryptocurrency Adoption and Monetary Transmission

	Below Threshold (CAI ≤ 0.35)	Above Threshold (CAI > 0.35)
	β (SE)	β (SE)
CAI → Pass-Through	-0.047 (0.038)	-0.284** (0.062)
Observations	156	110
Threshold Estimate (CAI)	0.347 (95% CI: 0.318–0.381)	
Bootstrap F-statistic	18.42***	

7.4 Financial Inclusion Effects

Table 4: Cryptocurrency Adoption and Financial Inclusion (GMM Panel)

	Account Ownership (%)	Mobile Payments (%)	Remittance Cost (%)
CAI	0.187*** (0.041)	0.312*** (0.052)	-0.241*** (0.048)

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	Account Ownership (%)	Mobile Payments (%)	Remittance Cost (%)
Controls	Yes	Yes	Yes
Observations	228	228	228
AR(2) p-value	0.318	0.284	0.347
Hansen p-value	0.412	0.388	0.421

7.5 Hypothesis Testing Summary

Table 5: Hypothesis Testing Results

Hypothesis	Finding	Decision
H1: Currency distress → Crypto adoption	Inflation β=0.412, ERV β=0.361, p<0.001	Supported
H2: Crypto adoption → Transmission impairment (non-linear)	Threshold at CAI=0.347, above-threshold β=-0.284	Supported
H3: Below-threshold effect non-significant	β=-0.047, p=0.218	Supported
H4: Crypto adoption → Financial inclusion	All inclusion metrics positive, p<0.001	Supported
H5: Institutions moderate currency distress → adoption	Inst. quality β=-0.218, p<0.001	Supported

8. Discussion

The threshold finding is this study's most consequential empirical contribution. The discovery that cryptocurrency adoption does not significantly impair monetary transmission at adoption levels below CAI = 0.35, but generates significant transmission impairment above this threshold, has direct implications for the urgency of regulatory and central bank policy responses. Currently, the majority of developing economies in the sample (58%) fall below the identified threshold, suggesting that immediate monetary sovereignty concerns are overstated in most contexts. However, the rapid growth trajectory of adoption in several high-vulnerability economies—Nigeria, Venezuela, and Argentina—places them above or near the threshold, warranting targeted policy attention.

The simultaneous finding that cryptocurrency adoption significantly improves financial inclusion metrics—account ownership, mobile payments, and remittance costs—underscores the genuine tension facing policymakers. Blanket prohibition of cryptocurrency activity, as implemented in several developing economies, forgoes these inclusion benefits without necessarily preventing informal adoption in economies with strong currency substitution motivations.

9. Theoretical Implications

This study advances monetary economics theory by providing the first empirical quantification of the adoption threshold at which cryptocurrency begins to impair monetary sovereignty, translating theoretical

concerns into an empirically measurable construct. The currency substitution interpretation of cryptocurrency demand in developing economies is rigorously confirmed, extending traditional currency substitution theory to the digital asset domain. The institutional quality moderation evidence—showing that strong institutions reduce the currency-distress-to-adoption pathway—connects the cryptocurrency literature to the broader institutional economics literature on the determinants of informal monetary instrument adoption.

10. Practical Implications

For central banks in developing economies, the threshold finding argues for proactive monitoring of cryptocurrency adoption levels against the identified CAI = 0.35 benchmark, with escalating policy responses calibrated to adoption intensity. Below-threshold environments warrant regulatory frameworks that accommodate beneficial adoption (particularly for financial inclusion) while building CBDC capacity. Above-threshold environments may require more active monetary policy adaptation, including CBDC acceleration, macroprudential cryptocurrency exposure limits, and potential capital flow management measures.

11. Conclusion

This study provides comprehensive econometric evidence on the determinants and monetary consequences of cryptocurrency adoption across 38 developing economies. The currency substitution interpretation of crypto demand is confirmed: adoption is driven primarily by currency distress indicators and constrained by institutional quality. A significant threshold non-linearity in the adoption-transmission relationship—with monetary transmission impairment emerging above a CAI threshold of 0.347—is the study's most novel finding. Simultaneously, cryptocurrency adoption generates positive financial inclusion effects that must be weighed against monetary sovereignty concerns in regulatory design. Future research should examine the monetary effects of CBDC introduction on cryptocurrency adoption dynamics and develop country-specific threshold estimates that account for economy-specific structural characteristics.

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