6-20-2022

CENTRAL BANK DIGITAL CURRENCY: WHAT FACTORS DETERMINE ITS ADOPTION?

Novi Maryaningsih
Bank Indonesia, Indonesia, nmaryaningsih@bi.go.id

Suahasil Nazara
University of Indonesia, Indonesia, suahasilnazara@gmail.com

Febrio N. Kacaribu
University of Indonesia, Indonesia, febrio.nathan@ui.ac.id

Solikin M. Juhro
Bank Indonesia, Indonesia, solikin@bi.go.id

Follow this and additional works at: https://bulletin.bmeb-bi.org/bmeb

CENTRAL BANK DIGITAL CURRENCY: WHAT FACTORS DETERMINE ITS ADOPTION?

Novi Maryaningsih*,[1], Suahasil Nazara**, Febrio N. Kacaribu***, and
Solikin M. Juhro****

*Corresponding author. Department of Economics, University of Indonesia, Bank Indonesia,
Indonesia. Email: nmaryaningsih@bi.go.id
** Department of Economics, University of Indonesia, Indonesia. Email: suahasilnazara@gmail.com
*** Department of Economics, University of Indonesia, Indonesia. Email: febrio.nathan@ui.ac.id
**** Bank Indonesia. Email: solikin@bi.go.id

ABSTRACT

This paper attempts to explain the differences in Central Bank Digital Currency (CBDC) adoption across emerging and advanced countries using an ordered probit model. Based on a cross-country dataset, we show that wholesale CBDC is more advanced in countries with developed financial markets and greater cross-border transactions. Retail CBDC is more advanced in countries with lower financial inclusion and a large informal economy. We further show that different factors affect retail CBDC adoption across emerging and advanced countries. However, cross-border transactions are the most crucial factor influencing wholesale CBDC adoption across emerging and advanced countries.

Keywords: Central bank digital currency; Financial development; Financial inclusion; Technology adoption.
JEL Classifications: E42; E58; O33.

---

[1] The authors' opinions in this study are their own and do not necessarily reflect the opinions of Bank Indonesia.

I. INTRODUCTION

This paper attempts to explain the differences in Central Bank Digital Currency (CBDC) adoption across emerging and advanced countries. Digitization of the payment system has reshaped the monetary and financial systems' landscape. Digital transactions have experienced more accelerated growth over the last decade and more so during the COVID-19 pandemic, since they do not require direct contact, thus reducing the risk of transmitting the virus (Alfonso *et al.*, 2021). However, the payment system's innovation poses challenges for policymakers. The increase in digital transactions causes the demand for money to decrease, impacting the effectiveness of monetary policy and the central bank's independence (Prabheesh and Rahman, 2019). The emergence of cryptocurrencies also pressures policymakers because these currencies may have a negative impact on financial system stability (Liu and Serletis, 2019). Such challenges have prompted the central bank to consider issuing CBDCs. The central bank could use CBDC's interest rate as a secondary monetary policy tool to affect liquidity in the economy, and hence enhance monetary policy transmission.[2] Furthermore, the CBDC might potentially be utilized as a tool for financial inclusion (Zams *et al.*, 2020), allowing for easier access to the financial system. In addition, the CBDC could provide real-time economic activity data, shifting the economy from informal[3] to formal, and boosting fiscal resilience through greater tax collection (Shirai, 2019).

Although authorities agree on the feasibility of CBDC adoption, the pace of its adoption varies by country. Such a difference raises the question of what factors influence the adoption. Drawn on this background, our study evaluates various concerns related to CBDC adoption progress across countries. More specifically, this study investigates what the economic and institutional factors influence the adoption of CBDCs. This study also examines whether the determinants of CBDC adoption vary between advanced and emerging countries. Our investigation is motivated by the following reasons. First, emerging countries are more motivated to adopt retail CBDC as a complement or replacement for cash to address financial inclusion and informal economy issues (Barontini and Holden, 2019; Shirai, 2019). On the other hand, advanced countries tend to be more interested in adopting wholesale CBDC.[4] In countries with developed financial systems, the advantages of wholesale CBDC will be increasingly apparent. Wholesale CBDC will improve payment system services to the financial sector. The higher the financial development of a country, the greater the financial transactions that occur (Folkerts-Landau and Garber, 1997), thus requiring innovative wholesale payment solutions. Meanwhile, countries that have implemented real-time settlements for large-value payments are less interested in implementing wholesale CBDC because Real-Time Gross Settlement (RTGS) is considered to have met the needs of their domestic payment systems (Lee *et al.*, 2021).

---

[2] The central bank might issue a CBDC with an interest rate as a complement to the existing policy rate. See Barrdear and Kumhof (2021) for further discussion.

[3] The literature also refers to this as the shadow economy.

[4] The Bahamas, China, Ecuador, Cambodia, Ukraine, and Uruguay have carried out retail CBDC pilot projects. Canada, France, the United Kingdom, Hong Kong, Japan, and Singapore have already carried out the wholesale CBDC pilot project (Boar *et al.*, 2020).

Second, the limitation of the existing payment system also forces the central bank to look at the possibility of CBDC as a solution. The wholesale payment system technology, RTGS, has operational limitations such as the operational of RTGS system is limited to office hours since officer operates it. The Distributed Ledger Technology (DLT)[5] in a wholesale CBDC has advantages over RTGS because it enables the system to synchronize transaction data automatically, allows for data traceability, and does not require third party transaction verification (Bank for International Settlements, 2018), making the settlement faster. In addition, DLT allows the financial institution to own access to its network's information, reducing asymmetric information (Parlour *et al.*, 2020a). The retail payment system has a complex hierarchy, including involving various payment system service providers and technologies, which makes it difficult for the central bank to supervise. The adoption of the retail CBDC is expected to lessen the central bank's regulatory and supervisory burden over existing complex retail payment systems (Qian, 2019).

Furthermore, CBDC is the money issued by the central bank in electronic format; it is peer-to-peer, and universally accessible, i.e., all agents in the economy could use it to buy goods and services (Davoodalhosseini, 2021). In addition, CBDC is available 24 hours a day, seven days a week, uses the national currency, and could have an interest rate (Barrdear and Kumhof, 2021). The CBDC implementation plans may differ between countries in approach and technology, depending on the goals and needs of each country (Soderberg, 2022). The CBDC could employ either centralized or decentralized technology, with the distinction in the authorization of transaction data.[6]

Presently, there are two types of CBDC based on its users. The first is the wholesale CBDC, which is used for transactions between the central bank and financial institutions or between financial institutions and the second is the retail CBDC, which could be accessed and used for public transactions (Meaning *et al.*, 2021). Economic-wide CBDC is applied when a country adopts both wholesale and retail CBDC. From a survey conducted on 169 countries, no country has implemented CBDC (Auer *et al.*, 2020a).[7] The data showed that most countries are still in the early stages of CBDC adoption. Only 10% of countries have carried out economic-wide CBDC pilot projects, and 5% have carried out retail CBDC and wholesale CBDC pilot projects (Figure 1).

---

[5] A mechanism for recording transactions given a set of rules for network participants that elicits decentralized consensus on the unique, actual history without the need for an appeal to a trusted authority.

[6] Centralized technology allows only the trusted authority to update transaction data, whereas decentralization, such as DLT (i.e., blockchain in bitcoin), allows all participants to update transaction data at the same time. See Kiff et al. (2020) for further discussion.

[7] China has expanded the scope of the pilot project to include the use of E-CNY at the Winter Olympics in February 2022 (www.finextra.com). For recent development of E-CNY, see People's Bank of China (2021).

Figure 1.
CBDC's Progress

The figure shows the proportion of CBDC's adoption progress from 169 countries. The data come from the Bank for International Settlement.
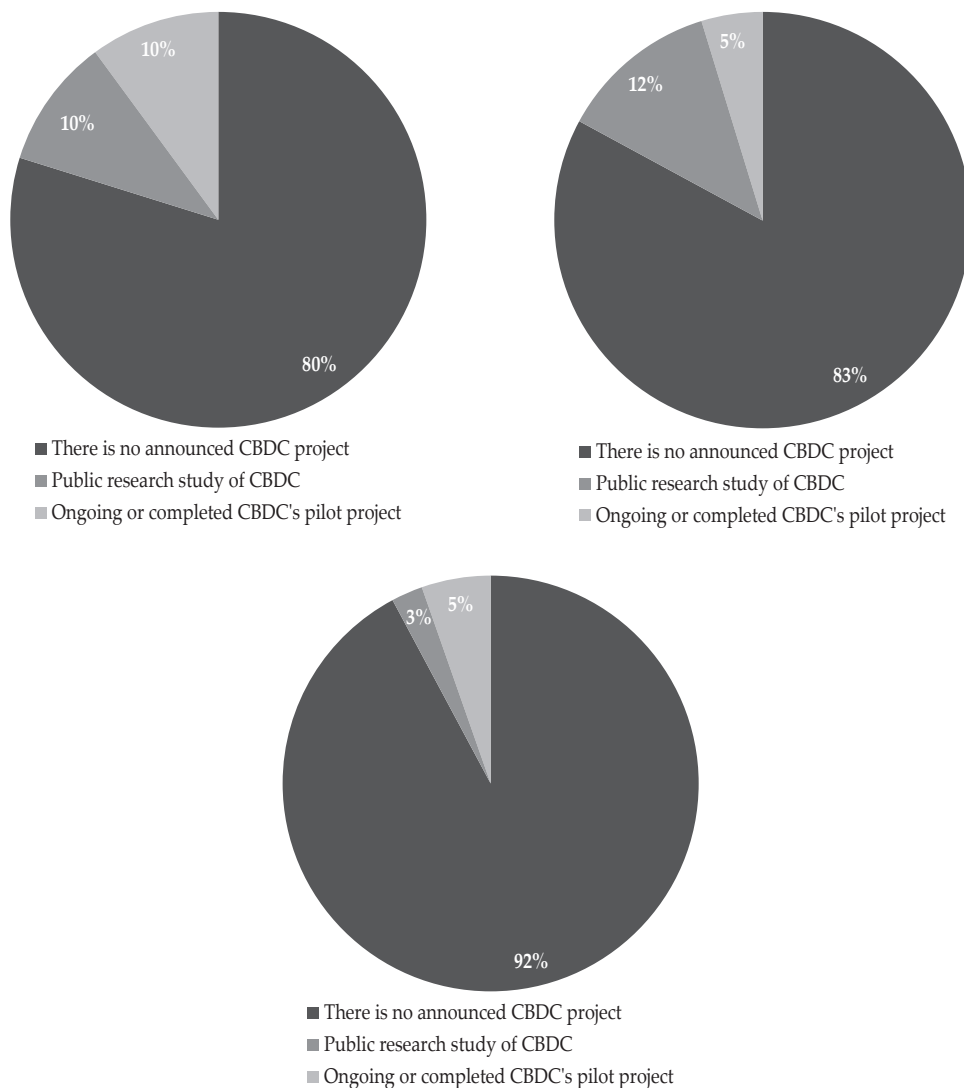
One possible explanation for countries being careful in the CBDC's adoption is to avoid financial instability. The most considerable risk of CBDC is that it could disrupt the intermediation system by crowding out bank deposits, increasing credit interest rates , and in turn contracting commercial banking credit to the real sector (Agur *et al*., 2021). The CBDC may increase the role of central bank in allocating economic resources, resulting in broad economic losses if the central bank is less efficient in allocating resources than the private sector (Bindseil, 2020). Furthermore, the central bank's issuance of CBDC could disrupt the money

creation by commercial banks. Bank financing sources are reduced because of the public's ability to shift from deposits to CBDC, leading to lower loan disbursement (Agur *et al*., 2021; Kim and Kwon, 2019; Keister and Sanches, 2019).

The limited studies that have attempted to investigate the factors that influence CBDC adoption across countries are purely descriptive (see, for example, Lee *et al*., 2021; Meaning *et al*., 2021; Bindseil, 2020; and Qian, 2019). We depart from prior studies by using regression analysis and thus add to the literature in the following ways. First, when compared to previous studies, our study considers a much broader set of potential determinants of CBDC adoption, such as financial development, financial inclusion, cross border transaction, infrastructure, innovation, macroeconomics, and institutional factors. Second, our paper addresses the issue of differences in the determinants of CBDC adoption between advanced and emerging countries. To our knowledge, this is the first study addressing this issue.

Our analysis regresses the CBDC index from the Bank International Settlements, which tracks cross-country CBDC adoption in 169 countries on macroeconomic factors, infrastructure, financial development, and institutional factors averaged over ten years from 2010 to 2019. Based on an ordered probit model, we revealed that countries with better developed financial development and higher innovation capacity are more likely to engage in CBDC projects. In countries with a lower level of financial inclusion and a larger informal economy, retail CBDC projects are more advanced. Meanwhile, wholesale CBDC initiatives are farther in countries with a more open economy. We found that different factors affect the progress of retail CBDC projects across emerging and advanced countries.[8] Retail CBDC projects are more progressed in emerging countries with higher openness, innovation capacity, and informal economy. Meanwhile, financial markets and high non-cash payment behavior significantly impact retail CBDC projects in advanced countries. However, cross-border transaction is the most crucial factor influencing wholesale CBDC adoption. Our model passes robustness tests such as using last observations of the dataset, several indicators for each variable category, and alternative methods for controlling the skewness of dependent variables.

The rest of the paper is organized as follows. Section II reviews the literature review, while Section III describes the data and the research methods. Section IV reports and discusses the empirical results. Section V reports the robustness checks, and finally, Section VI presents the conclusion and implications.

II. LITERATURE REVIEW
A. Current Payment System and Challenges for Monetary Policy
The payment instrument developed rapidly. In the early development, the barter system was standard in the pre-modern era. Payment instruments continue to grow from cash-based to non-cash, digital payment instruments[9] through commercial

---

[8] We grouped the countries into advanced and emerging based on International Monetary Fund (IMF) classifications (see International Monetary Fund, 2022).
[9] Digital payment instruments range from paper-based payment instruments like check and card-based payment instruments like debit cards, credit cards, and e-money.

banks' money and digital currency.[10] The dual currency regime model shows that digital currency will not completely replace fiat currency (Hong *et al.*, 2018). The high costs of using fiat currency, due to the high inflation rates, will increase demand for digital currency. Similarly, the high costs of using digital currency will increase the demand for fiat currency.

The use of digital transactions as a substitute for money causes the demand for money in the economy to fall, making the money multiplier unstable (Wang and Wolman, 2016). As a result, monetary policy based on base money becomes ineffective, especially in countries where monetary aggregates have been difficult to control (Cohen, 2001). The decline in demand for cash could reduce the central bank's income from seigniorage, forcing the central bank to rely on the government for operational funding (Woodford, 2000). This condition undermines the central bank's monetary policy independence since the government must authorize the cost of policies. This means that the central bank policies must be approved by the government.

Although the use of cash in advanced countries has decreased, its use has significantly increased in most emerging countries (Foster *et al.*, 2020). These changes in cash usage across advanced and emerging countries might reflect the size of the existing informal economies across these countries. Empirical research has demonstrated that once the informal sector emerges it is not easy to eradicate (Eilat and Zinnes, 2002), thus it requires a breakthrough to capture this economic activity. The increase in digital transactions also increases the financial inclusion gap for people who do not have formal access to banking, especially the poor and the elderly (Fabris, 2019).

The latest challenge faced by the central bank is the emergence of cryptocurrencies, i.e. the digital money issued by private entities. These currencies have significant price differences across countries and their volatility substantially impact other financial markets (Liu and Serletis, 2019). Moreover, because they could be used for domestic and cross-country payments, cryptocurrencies (e.g. Facebook's Libra) might have a systemic impact on the financial system and monetary sovereignty (Auer *et al.*, 2020b).

The COVID-19 outbreak has increased the demand for digital transactions (Allen, *et al.*, 2022). People are forced to shop online due to various rules restricting social and economic activities. To illustrate, during a lockdown, contactless transactions contribute to running the economy; countries with a digital economy and high discipline have more negligible effects and recover faster from each wave of COVID-19 (Lee *et al.*, 2021). In addition, the United States began taking the retail CBDC implementation plan seriously in response to the deteriorating economic conditions of the COVID-19 pandemic, which is thought to be more effective for distributing social assistance (Brainard, 2021).

It is becoming increasingly feasible to issue CBDCs to address monetary policy and payment system constraints. The CBDC could be used as a secondary monetary policy tool, allowing the central bank to control the money supply more effectively through interest rates and quantity of CBDC (Barrdear and Kumhof, 2021). Furthermore, increasing the accessibility of CBDCs by the public will improve

---

[10] This refers to cryptocurrency issuing (e.g., Bitcoin, Ethereum, Litecoin, etc.) by private entities.

financial inclusion (Chorzempa, 2021). The CBDC could be accessed via devices that do not require an internet connection, making it more accessible to the elderly and to those with restricted internet access. This will cause the informal economy's share to decrease since the CBDC would record data on economic activities in real-time. In addition, the CBDC will strengthen fiscal resilience through tax collection from previously unrecorded transactions. The documentation of such an economic activity will support anti-money laundering and help combat the financing of terrorism (Engert and Fung, 2017).

B. Determinants of CBDC's Adoption

Despite the authorities agreeing on the future use of CBDCs, their adoption has varied across countries. This disparity raises the question of what factors influence CBDC adoption across countries. Auer *et al*. (2020a) identify CBDC adoption determinants and find that CBDC projects are primarily found in countries with a substantial informal economy. Retail CBDC initiatives are found mainly in countries with high innovation capacity. Furthermore, they found that CBDC adoption is motivated by increased financial access.

We also review the literature on the factors influencing technology and financial innovation adoption to identify potential determinants of the adoption of CBDCs (e.g., Zhou *et al*., 2019 and Lashitew *et al*., 2019). In general, the factors that influence the CBDC adoption are indicators related to financial development, financial inclusion, cross-border transactions, infrastructures, innovation, macroeconomic, and institutional conditions.

III. DATA AND RESEARCH METHODS

We included 169 countries in our dataset (see Appendix Table A.1). The CBDC index, which is the dependent variable, is constructed from a survey performed by the Bank for International Settlements (Auer *et al*., 2020a). Independent variables are the average for 2010 to 2019.[11] There are four possibilities for CBDC adoption represented by the CBDC index: 0 if a country has not announced a CBDC project; 1 if there is research on CBDC; 2 if there is a CBDC pilot project; and 3 if the country implemented CBDC. However, from the survey, no countries have implemented CBDC. Thus, there are only three categories in the current progress of the CBDC adoption: 0, 1, and 2.

We utilized an ordered probit technique estimated by maximum likelihood, since standard ordinary least squares would produce inconsistent estimates.[12] Our empirical model resembles the following:

$$CBDC_i = \beta_0 + \beta_1 FD_i + \beta_2 FI_i + \beta_3 CB_i + + \beta_4 INFRA_i + \beta_5 INOV_i + \beta_6 MACRO_i + \beta_7 INST_i + \varepsilon_i \tag{1}$$

---

[11] Central bank independence index is based on average of 2012 and 2016 data, for the remaining variables, averages are taken over the years 2010–2019 to smooth out potential year-to-year variations. See Lashitew *et al*. (2019) for the discussion.

[12] For more on the use of ordered probit, see Kawamura *et al*. (2021).

where $CBDC_i$ is the CBDC index that represents the progress of CBDC's adoption; $\beta_1, \cdots, \beta_7$ are the coefficients to be estimated; β_0 is the intercept and ε_i denotes the error term. Similarly, *FD* stands for financial development, indicators of financial institutions, financial markets, and financial instruments development. The *FI* variable is an indicator of financial inclusion, a measurement of individuals' and businesses' access to valuable and affordable financial products and services that meet their needs. The *CB* variable is the cross-border transaction indicator, a proxy for the capital account or trade openness. The *INFRA* variable is an indicator of infrastructure and measures the access or quality of infrastructure. Furthermore, *INOV* represents innovation variables that measure a country's innovation capabilities. The *MACRO* variable denotes macroeconomic variables, and *INST* stands for the institutional variable that includes government quality and central bank independence.

As far as the explanatory variables are concerned, Table 1 shows their description and descriptive statistics.[13] On average, the share of domestic credit for advanced countries reached 111.11% of GDP compared to emerging countries, which was only 44.23% of GDP. Furthermore, there is a significant difference in financial inclusion between advanced and emerging countries. Advanced countries additionally have higher cross-border transaction sizes and capital account openness. The ratio of exports to GDP of advanced countries reached 66.89%, while emerging countries was only 38.87%, on average.

---

[13] Details of descriptive statistics are available on request.

Table 1.
Descriptive Statistics

This table reports selected descriptive statistics for the variables considered in this study. The capital account openness is measured by the Chinn Ito index, ranging from 0 to 1; a higher index means higher capital account openness (Chinn and Ito, 2020). Innovation data were derived from Global Innovation Index from World Intellectual Property Organization (WIPO), ranging between 0 to 100, a higher index means higher innovation capability. Informal economy data are obtained from Medina and Schneider (2019) (www.cesifo.org). Data of central bank independence are from Institutional Profile Database (IPD) and Garriga and Rodriguez (2020), range between 0=no independence to 4=strong independence (IPD) and 0=no independence to 1=strong independence (Garriga Index). The rest of the data comes from the World Bank (https://data.worldbank.org).

Variables	Description	All Samples		Advanced Countries		Emerging Countries	
		No. of obs.	Mean	No. of obs.	Mean	No. of obs.	Mean
FD - Financial Development							
DOMCR	Domestic credit (% GDP)	150	60.050	34	111.108	113	44.233
PRCR	Private credit (% GDP)	149	58.396	33	101.946	113	45.710
FI - Financial Inclusion							
COMBANK	Commercial bank (per 100,000 adults)	153	18.205	35	29.887	115	14.720
CC	Credit card (% age 15+)	138	19.157	34	46.846	102	9.598
IPAY	Internet payment (% age 15+)	132	24.046	34	58.107	97	11.692
ATM	ATM access (per 100,000 adults)	153	51.011	34	94.174	116	36.656
CB - Cross border transaction							
CAO	CA openness (index)	146	0.589	33	0.947	110	0.489
TRADE	Trade openness (% GDP)	188	0.946	36	1.306	116	0.872
INFRA - Infrastructures							
ELAC	Electricity access (% population)	164	86.318	36	98.301	120	82.148
ELQUAL	Electricity quality (% of output)	126	12.838	35	6.773	89	15.297
MCEL	Mobile cellular (per 100 adult people)	163	106.778	36	127.638	120	101.220
FBROAD	Fix broadband (per 100 adult people)	162	13.020	35	31.810	119	7.046
INOV - Innovation							
INOV	Innovation (index)	132	37.055	33	52.930	98	31.521
PATENT	Patent applications (thousand)	135	12.975	36	18.641	98	9.642
MACRO - Macroeconomics							
GDP	GDP per capita (constant thousand 2010 US$)	162	16.255	35	43.422	119	7.039
HHCONS	HH final consumption (% GDP)	151	62.740	35	53.302	110	66.138
SHADOW	Informal economy (% GDP)	138	26.346	35	14.229	101	30.468
POP	Population (million people)	165	42.187	36	27.793	121	48.733
INST - Institution							
REG	Regulatory quality (index)	169	0.079	37	1.306	121	-0.327
GOVT	Government effectiveness (index)	169	0.101	37	1.330	121	-0.317
CBIIPD	CBI IPD (index)	131	2.752	35	3.700	94	2.420
CBIGAR	CBI Garriga (index)	149	0.060	33	0.714	113	0.575

Advanced and emerging countries have almost the same access to electricity infrastructure, but the quality of electricity in emerging countries is lower. The mobile subscription gap in advanced countries and emerging markets is negligible. Still, the number of internet users and the quality of network infrastructure in advanced countries are much higher. A striking difference is also observed in innovation capacity. Emerging countries have a much larger informal economy share than advanced countries. In contrast, the difference in the percentage of private consumption to GDP is insignificant. Advanced countries also have better institutions than emerging countries.

IV. EMPIRICAL RESULTS

Table 2 shows that financial development is positively related to CBDC adoption. The finding is consistent with the finding of previous studies (Auer *et al.*, 2020a; Carstens, 2021; Parlour, *et al.*, 2020b). The results suggest that the higher the level of financial development, the more likely a country will adopt a CBDC. The results show that financial inclusion is negatively correlated with retail CBDC adoption. That is, countries with lower financial inclusion are likely to be more advanced in retail CBDC adoption.

Cross-border transactions are positively correlated with the progress of wholesale CBDC adoption, suggesting that the more prominent the cross-border transactions in a country are, the higher the need for alternative wholesale cross-border payment solutions that are more efficient than those currently available (Bank for International Settlement *et al.*, 2021). The finding highlights the possibility that wholesale CBDC could be developed as an alternative solution for cross-border transactions (Auer *et al.*, 2021a). Surprisingly, we found that electricity does not influence CBDC adoption. Although we use different indicators of electricity (i.e. electrification ratio and electricity quality), none of them significantly influenced CBDC adoption. This result is most likely because the countries included in our analysis have adequate electricity access and hence access to electricity may not be a relevant determining factor for CBDC adoption.

Furthermore, we find that digital infrastructure has only a marginally significant impact on economic-wide CBDC adoption. As such, this suggests that digital infrastructure may have a more negligible effect on CBDC adoption than previously thought. Furthermore, we found a strong positive relationship between innovation and retail CBDC adoption. That is, the higher the innovation capacity, the higher the likelihood of retail CBDC adoption. Meanwhile, the relation between innovation and wholesale CBDC adoption is not significant. This result implies that the implementation of retail CBDC would be more challenging than wholesale CBDC and would necessitate more innovation. Since the existing retail payment system has a complex hierarchy and the retail CBDC is used for broader public transactions, the public will be involved in the implementation.

Table 2.
Results for the Full Sample

This table reports the coefficient of the ordered probit regression. The dependent variable is the CBDC index, and the independent variables are listed in Table 1. The asterisks *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. /cut1 is the estimated cut point on the latent variable used to differentiate low CBDC index from middle and high CBDC index, meanwhile /cut2 to differentiate middle CBDC index from high CBDC index, when values of the predictor variables are evaluated at zero. The likelihood ratio *chi*-square with a *p*-value of 0.000 tells that our model is statistically significant.

Variables	Economic wide CBDC Project		Retail CBDC Project		Wholesale CBDC Project	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
DOMCR	0.012*	0.006	0.011**	0.005		
PRVCR					0.025*	0.018
COMBANK	-0.026*	0.015	-0.024*	0.014		
CC			0.009	0.017		
IPAY					-0.069**	0.032
ATM					0.008	0.007
CAOPEN	1.949**	0.781			4.266*	2.375
TRADE			-1.249**	0.572		
ELACCESS	0.012	0.018				
ELQUAL			0.066	0.041		
MOBCELL	0.017*	0.009	0.014	0.009		
FIXBROAD					-0.023	0.067
INOV	0.127**	0.054	0.149***	0.054	-0.079	0.103
HHCONS	-0.031*	0.019	-0.004	0.017	-0.160**	0.067
SHADOW	0.088***	0.027	0.068***	0.024	0.013	0.046
POP	0.438***	0.137	0.137	0.148	1.118***	0.424
REG	-0.852*	0.500	-0.469	0.510	2.362**	1.106
CBIGAR	-1.676	1.044				
CBIIPD			-0.397*	0.229	0.405	0.440
/cut1	16.720***	4.047	11.050***	3.736	38.680	33.860
/cut2	17.710***	4.100	12.38***	3.796	39.080	33.870
Observations	109		103		102	
Log likelihood	48.131		-45.779		-20.304	
LR chi2	70.190		52.250		37.040	
Prob > chi2	0.000		0.000		0.000	
Pseudo R2	0.422		0.363		0.477	

We found mixed results regarding the relation between household consumption and CBDC adoption. The share of household consumption has a negative and significant correlation with wholesale CBDC adoption, but an insignificant correlation with retail CBDC adoption. This finding is consistent with previous research indicating that the ability to consume is influenced by financial development (see Liu *et al.,* 2021; Wang *et al.,* 2018). The higher the level of financial development, the greater the capacity for consumption (Li *et al.*, 2020). This means that countries with high consumption tend to have high financial development, necessitating the need for financial institutions to have an alternative to wholesale

payments. We found strong evidence that the informal economy is highly correlated with the progress of retail CBDC adoption. Our model shows that countries with a larger informal economy have a higher probability of adopting retail CBDC. The finding supports previous research, which found that authorities use retail CBDCs as an alternative solution for tracking informal economic financial transaction data (Auer *et al.*, 2020a). Furthermore, policymakers could utilize granular, high-frequency retail CBDC transaction data to improve forecasting accuracy or other real sector policies. Finally, the population size significantly impacts economic and wholesale CBDC adoption progress, but the impact on retail CBDC adoption progress is weak, suggesting that population size has little effect on retail CBDC adoption. This latter finding corroborates existing research, which found that other factors, such as education, community networks, and geographic variations, have a greater influence on the decision to adopt and use financial innovation than population size (Lee *et al.*, 2022; An *et al.*, 2022).

We were also surprised by the results for the institutional control variables. Regulatory quality is detrimental to economic-wide CBDC projects but beneficial to wholesale CBDC projects. The authority's role is more dominant or involves developing wholesale CBDC projects, which emphasizes the critical role of coordination and harmonization between countries when implementing wholesale CBDCs, given that each country's wholesale payment system has its own set of systems and rules. Furthermore, central bank independence harms retail CBDC projects. This possibility stems from concerns about diminishing seigniorage from printing money if the central bank issues retail CBDC forcing it to rely on government financing, perhaps jeopardizing its independence (Ferré, *et al.*, 2018; Nolivos and Vuletin, 2014). Wholesale CBDC, on the other hand, is positively associated with central bank independence. As a result, wholesale CBDC projects are more likely to be conducted by central banks with strong independence, but not retail CBDC projects. Our estimations have an excellent prediction value, deviations of 1% to 5% from the actual predictions.[14]

To understand the differences in the determinants of CBDC adoption across emerging and advanced countries, we performed the estimations by subdividing the samples into emerging and advanced countries. The intuition is that the effect of some variables, such as financial inclusion and informal economy, are thought to have a greater impact on CBDC adoption in emerging countries (see Boar, *et al.*, 2021; Lee *et al.*, 2021). In contrast, since advanced countries have high financial inclusion rates and smaller shadow economies, their CBDC adoption decisions should not be influenced by these factors. Table 3 shows empirical results on the factors affecting economic-wide CBDC projects in emerging and advanced countries. The development of financial markets has a strong influence on the progress of economic-wide CBDC projects in advanced countries, but the influence is weak in emerging markets.

---

[14] The model predictions are available upon request.

Table 3.
Results for Emerging vs. Advanced Countries: Economic-Wide CBDC

This table reports the coefficient of the ordered probit regression. The dependent variable is the CBDC index, and the independent variables are listed in Table 1. The asterisks *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. /cut1 is the estimated cut point on the latent variable used to differentiate low CBDC index from middle and high CBDC index, meanwhile /cut2 to differentiate middle CBDC index from high CBDC index, when values of the predictor variables are evaluated at zero. The likelihood ratio *chi*-square with a *p*-value of 0.000 tells that our model is statistically significant.

Variables	Emerging Countries		Advanced Countries	
	Coefficient	Standard Error	Coefficient	Standard Error
DOMCR	0.013	0.010	0.019**	0.010
COMBANK	-0.057*	0.030	0.001	0.028
CC	-0.055	0.054	-0.045	0.030
CAOPEN	2.657**	1.042	1.375	5.177
MOBCELL	0.034**	0.015	-0.031	0.036
INOV	0.257*	0.134	0.109	0.114
HHCONS	-0.031	0.025	-0.085	0.054
SHADOW	0.083**	0.032	0.179	0.144
POP	0.311	0.200	0.921**	0.361
REG	-1.856**	0.815	3.176	2.516
/cut1	20.280***	6.297	20.400*	11.510
/cut2	21.030***	6.351	22.190*	11.620
Observations	78		30	
Log likelihood	-24.577		-15.587	
LR chi2	43.38		28.53	
Prob > chi2	0.000		0.002	
Pseudo R2	0.469		0.478	

The results show that financial inclusion and informal economy affect the progress of economic-wide CBDC adoption in the emerging countries. In contrast, we find no significant effect of financial inclusion and informal economy on economic-wide CBDC adoption in the advanced countries. These findings are consistent with the hypothesis that financial inclusion and the informal economy have a greater impact on economic-wide CBDC adoption in emerging countries, but not in advanced countries. In addition, emerging countries with higher proportions of mobile phone users, innovation, economic openness, and less stringent regulations are more likely to adopt economic-wide CBDC projects. On the contrary, advanced countries with large populations are more likely to be more distinguished in economic-wide CBDC projects.

Table 4.
Results for Emerging vs. Advanced Countries: Retail CBDC

This table reports the coefficient of the ordered probit regression. The dependent variable is the CBDC index, and the independent variables are listed in Table 1. The asterisks *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. /cut1 is the estimated cut point on the latent variable used to differentiate low CBDC index from middle and high CBDC index, meanwhile /cut2 to differentiate middle CBDC index from high CBDC index, when values of the predictor variables are evaluated at zero. The likelihood ratio *chi*-square with a *p*-value of 0.000 tells that our model is statistically significant.

Variables	Emerging Countries		Advanced Countries	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
DOMCR	0.013	0.009	0.031**	0.016
COMBANK	-0.035	0.026	0.025	0.066
CC	0.025	0.066	0.075*	0.044
CAOPEN	1.691*	0.931	-0.863	9.292
ELQUAL	0.046	0.050	-0.069	0.551
MOBCELL	0.016	0.011	-0.103	0.090
INOV	0.144*	0.087	0.419*	0.232
HHCONS	0.017	0.022	-0.099	0.082
SHADOW	0.053**	0.027	0.524	0.335
POP	0.377**	0.186	0.961	0.644
REG	-1.348**	0.590	3.553	4.541
/cut1	58.450**	26.800	9.655	18.750
/cut2	22.190*	11.620	10.080	18.760
Observations	86		32	
Log likelihood	-8.961		-13.076	
LR chi2	18.93		15.85	
Prob > chi2	0.008		0.026	
Pseudo R2	0.514		0.377	

Table 4 shows the differences in the factors that affect the progress of retail CBDC projects in emerging and advanced countries. Our results show that the informal economy, population, and regulatory quality are the most critical variables that affect retail CBDC projects in emerging countries. Meanwhile, the degree of openness and innovation capacity weakly affect retail CBDC projects in emerging countries. On the other hand, retail CBDC projects in advanced countries are strongly influenced by the level of development of financial markets. Non-cash payment behavior and innovation capacity only weakly affect advanced countries' retail CBDC projects. Therefore, emerging countries with larger informal economies, larger populations, and a more prominent role of authorities are more likely to carry out retail CBDC projects.

Table 5.
Results for Emerging vs. Advanced Countries: Wholesale CBDC

This table reports the coefficient of the ordered probit regression. The dependent variable is the CBDC index, and the independent variables are listed in Table 1. The asterisks *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. /cut1 is the estimated cut point on the latent variable used to differentiate low CBDC index from middle and high CBDC index, meanwhile /cut2 to differentiate middle CBDC index from high CBDC index, when values of the predictor variables are evaluated at zero. The likelihood ratio *chi*-square with a *p*-value of 0.000 tells that our model is statistically significant.

Variables	Emerging Countries		Advanced Countries	
	Coefficient	Standard Error	Coefficient	Standard Error
DOMCR	-0.004	0.012	0.010	0.010
COMBANK	-0.074	0.067	-0.005	0.021
CC	-0.165*	0.097	0.019	0.035
TRADE	2.398*	1.404	0.886*	0.473
GDP	3.681**	1.687	-0.364	1.530
SHADOW	0.050	0.047	-0.057	0.120
POP	1.343*	0.733	0.629**	0.309
/cut1	19.110***	6.001	40.202	26.100
/cut2	19.820***	6.049	44.080	26.850
Observations	72		30	
Log likelihood	-26.664		-8.632	
LR chi2	23.39		30.84	
Prob > chi2	0.016		0.001	
Pseudo R2	0.305		0.641	

In contrast to retail CBDCs, the factors that influence the progress of wholesale CBDCs tend to be the same between emerging and advanced countries. These factors are cross-border transactions and population. Meanwhile, the income per capita variable only affects the development of wholesale CBDC projects in emerging countries (Table 5). Our model for emerging and advanced countries demonstrates good prediction model values, with deviation of 1% to 5% from the actual predictions.

Policymakers should consider that there are fundamental differences in the motivations of emerging and advanced countries in developing retail CBDCs. The development of financial markets and non-cash behavior are the dominant factors influencing retail CBDC adoption in advanced countries. The CBDC is considered one of the tools for strengthening the current payment infrastructure to respond to the increasing need for connectivity due to communication innovations and the disintegration of financial sector services (Bank for International Settlement *et al.*, 2021; *Auer et al., 2021b*). The nature of retail CBDC in advanced countries is an alternative to current retail payments. For emerging countries, there is a need to use retail CBDC to enhance financial inclusion and to capture transaction data from the sizable informal economy.

Meanwhile, wholesale CBDC projects in both emerging and advanced countries are influenced by the need for solutions to cross-border transactions, which are currently considered inefficient (Boar, *et al.*, 2020; Soderberg, 2022). This cross-border transaction solution is vital for emerging countries with high cross-border transaction costs and low speeds (Obstfeld, 2021). Furthermore,

considering that these cross-border transactions involve the country of origin and destination, coordination between countries is needed to implement the cross-border CBDC project.

V. ROBUSTNESS CHECKS

We conducted robustness tests by using the last point data and used several indicators for each variable category. In addition, we present a robustness test based on the ordered logit and zero-inflated ordered probit (i.e., Cour-Thimann & Jung, 2021; Dong *et al.*, 2021) to tackle potential skewness of the dependent variable**.** The robustness test results are consistent with our estimation results.[15] Financial development strongly influences the progress of wholesale CBDC adoption in advanced countries. However, this is not the case in emerging countries. The progress of retail CBDC projects is more advanced in emerging countries with lower levels of financial inclusion.

VI. CONCLUSION AND IMPLICATIONS

This paper attempts to explain the differences in CBDC adoption across emerging and advanced countries using an ordered probit model. The results showed that wholesale CBDC projects are more advanced in countries with more developed financial markets and greater cross-border transactions. Conversely, countries with lower levels of financial inclusion, larger informal economies, and higher innovation are more advanced in CBDC retail projects. Moreover, there are differences in the factors that affect the progress of retail CBDC projects for advanced and emerging countries. Retail CBDC projects are more accelerated in emerging countries with a higher degree of openness, innovation capacity, informal economy, and a more significant role of authorities. Meanwhile, retail CBDC projects in advanced countries are more influenced by the development of financial markets and high non-cash payment behavior. However, cross-border transactions are the most dominant factor influencing wholesale CBDC projects in advanced and emerging countries.

Our study provides guidance to policymakers in exploring the opportunities and challenges involved in CBDC adoption and has important policy implications. Our results may suggest that financial development, financial inclusion, innovation, and institutional characteristics are more critical determinants of CBDC adoption across countries than other factors. The development of financial markets has led to more significant financial transactions. Thus, alternative payment solutions, both wholesale and retail, are required. There is also a need to improve innovation capacity for countries to engage in CBDC projects. The heightened role of coordinating and harmonization is required for the development and adoption of CBDCs, especially wholesale CBDC projects.

Another finding from our research is that retail CBDC is most likely to be used as an alternative solution for financial inclusion in emerging countries. Wholesale CBDC, on the other hand, is found to be a viable alternative to the current inefficient

---

[15] The estimates are available on request.

cross-border payment systems. As a result, authority is critical when engaging in CBDC projects, particularly wholesale CBDC projects.

This study has limitations that could be explored further in future research. For instance, the number of variables collected and analyzed is limited. Future studies should expand the number of variables to complement our study. The second limitation of our study is that sudden and rapid changes in central bank decisions could affect the conclusions and hence future studies should consider this.

REFERENCES

An, J., Hou, W., & Lin, C. (2022). Epidemic Disease and Financial Development. *Journal of Financial Economics*, 143, 332–358.

Agur, I., Ari, A., & Dell'Ariccia, G. (2021). Designing Central Bank Digital Currencies. *Journal of Monetary Economics*.

Alfonso, V., Boar, C., Frost, J., Gambacorta, L., & Liu, J. (2021). E-commerce in the Pandemic and Beyond. *BIS Bulletin*, No 36.

Allen, F., Gu, X., & Jagtiani, J. (2022). Fintech, Cryptocurrencies, and CBDC: Financial Structural Transformation in China. *Journal of International Money and Finance*, 124, 102625.

Auer, R., Cornelli, G., & Frost, J. (2020a). Rise of the Central Bank Digital Currencies: Drivers, Approaches and Technologies. *BIS Working Paper*.

Auer, R., Cornelli, G., & Frost, J. (2020b). COVID-19, Cash, and the Future of Payments. *BIS Bulletin*, 3, 1–7.

Auer, R., Monnet, C., & Shin, H. S. (2021a). Distributed Ledgers and the Governance of Money. Monetary and Economic Department. *BIS Working Papers No 924*.

Auer, R., Haene, P, & Holden,H. (2021b). Multi-CBDC Arrangements and the Future of Cross-border Payments. *BIS Paper*, March.

Bank for International Settlements. (2018). Central Bank Digital Currencies. *Committee on Payments and Market Infrastructures, Markets Committee.*

Bank for International Settlement, CPMI, Innovation Hub, International Monetary Fund, & WorldBank. (2021). *Central Bank Digital Currencies for Cross-border Payments Report to the G20.*

Barontini & Holden. (2019). *Proceeding with Caution - a Survey on Central Bank Digital Currency*. Bank for International Settlements, 101(January), 1–15.

Barrdear, J., & Kumhof, M. (2021). The Macroeconomics of Central Bank Digital Currencies. *Journal of Economic Dynamics and Control*.

Bindseil, U. (2020). Tiered CBDC and the Financial System. *SSRN Electronic Journal.*

Boar, C., Holden, H., & Wadsworth, A. (2020). Impending Arrival - a Sequel to the Survey on Central Bank Digital Currency. *BIS Papers*, 107, 19.

Boar, Codruta & Wehrli, A. (2021). Ready, Steady, Go? - Results of the Third BIS Survey on Central Bank Digital Currency. *BIS Paper*, 114.

Brainard, L. (2021). *Private Money and Central Bank Money as Payments Go Digital: An Update on CBDCs*. Speech Board Governors of the Federal Reserve at the Consensus by CoinDesk 2021 Conference.

Carstens, A. (2021). Central Bank Digital Currencies: *Putting a Big Idea into Practice*.

Chinn, M and Ito, H (2020). Notes on The Chinn-Ito Financial Openness Index 2018 Update. The dataset is available at http://web.pdx.edu/~ito/Chinn-Ito_website.htm

Chorzempa, M. (2021). China, the United States, and Central Bank Digital Currencies: How Important is it to be First? *China Economic Journal*, 14, 102–115.

Cohen, B. J. (2001). Electronic Money: New Day or False Dawn? *Review of International Political Economy*, 8, 197–225.

Cour-Thimann, P., & Jung, A. (2021). Interest-rate Setting and Communication at the ECB in its First Twenty Years. *European Journal of Political Economy*, 70, 1–24.

Davoodalhosseini, S. M. (2021). Central Bank Digital Currency and Monetary Policy. *Journal of Economic Dynamics and Control*, 104150.

Dong, Y., Hou, Q., & Ni, C. (2021). Implicit Government Guarantees and Credit Ratings. *Journal of Corporate Finance*, 69, 102046.

Eilat, Y., & Zinnes, C. (2002). The Shadow Economy in Transition Countries: Friend or Foe? A Policy Perspective. *World Development*, 30, 1233–1254.

Engert, W., & Fung, B. S. C. (2017). Central Bank Digital Currency: Motivations and Implications. *Bank of Canada Staff Discussion Paper* 2017-16.

Fabris, N. (2019). Cashless Society - the Future of Money or a Utopia? *Journal of Central Banking Theory and Practice*, 8, 53-66.

Ferré, M., Garcia, J., & Manzano, C. (2018). Tax Efficiency, Seigniorage and Central Bank Conservativeness. *Journal of Macroeconomics*, 56, 218–230.

Finextra. (2022). *China's Digital Yuan Wallet Arrives in Android and Apple App Stores*. https://www.finextra.com/newsarticle/39461/chinas-digital-yuan-wallet-arrives-on-the-android-and-apple-app-stores?utm_medium=newsflash&utm_source=2022-1-5&member=86413

Folkerts-Landau, D., & Garber, P. (1997). The Reform of Wholesale Payment Systems. *Finance & Development*, 34, 25.

Foster, K., Greene, C., & Stavins, J. (2020). The 2019 Survey of Consumer Payment Choice: Summary Results. *Federal Reserve Bank of Atlanta.*

Garriga, A. C., & Rodriguez, C. M. (2020). More Effective than We thought: Central bank Independence and Inflation in Developing Countries. *Economic Modelling*, 85, 87-105.

Hong, K. H., Park, K., & Yu, J. (2018). Crowding Out in a Dual Currency Regime? Digital Versus Fiat Currency. *Emerging Markets Finance and Trade*, 54, 2495–2515.

International Monetary Fund. (2022). World Economic Outlook April 2022: War Sets Back the Global Recovery.

Kawamura, T., Mori, T., Motonishi, T., & Ogawa, K. (2021). Is Financial Literacy Dangerous? Financial Literacy, Behavioral Factors, and Financial Choices of Households. *Journal of the Japanese and International Economies*, 60, 101131.

Keister, T., & Sanches, D. (2019). Should Central Banks Issue Digital Currency? *Working Papers 19-26*, Federal Reserve Bank of Philadelphia.

Kiff, J., Alwazir, J., Davidovic, S., Farias, A., Khan, A., Khiaonarong, T., & Malaika. M. (2020). A Survey of Research on Retail Central Bank Digital Currency. *IMF Working Paper 20/104*, International Monetary Fund.

Kim, Y. S., & Kwon, O. (2019). Central Bank Digital Currency and Financial Stability. *SSRN Electronic Journal*.

Lashitew, A. A., van Tulder, R., & Liasse, Y. (2019). Mobile Phones for Financial Inclusion: What Explains the Diffusion of Mobile Money Innovations? *Research Policy*, 48, 1201–1215.

Lee, D. K. C., Yan, L., & Wang, Y. (2021). A Global Perspective on Central Bank Digital Currency. *China Economic Journal*, 14, 52–66.

Lee, J. N., Morduch, J., Ravindran, S., & Shonchoy, A. S. (2022). Narrowing the Gender Gap in Mobile Banking. *Journal of Economic Behavior and Organization*, 193, 276–293.

Li, J., Wu, Y., & Xiao, J. J. (2020). The Impact of Digital Finance on Household Consumption: Evidence from China. *Economic Modelling*, 86, 317-326.

Liu, Jinan, & Serletis, A. (2019). Volatility in the Cryptocurrency Market. *Open Economies Review*, 30, 779–811.

Liu, Y., Luan, L., Wu, W., Zhang, Z., & Hsu, Y. (2021). Can Digital Financial Inclusion Promote China's Economic Growth? *International Review of Financial Analysis*, 78 (September).

Meaning, J., Dyson, B., Barker, J., & Clayton, E. (2021). Broadening Narrow Money: Monetary Policy with a Central Bank Digital Currency. *International Journal of Central Banking*, 17, 1–42.

Medina, L., & Schneider, F. (2019). Shedding Light on the Shadow Economy: A Global Database and the Interaction with the Official One.

Nolivos, R. D., & Vuletin, G. (2014). The Role of Central Bank Independence on Optimal Taxation and Seigniorage. *European Journal of Political Economy*, 34, 440–458.

Obstfeld, M. (2021). Two Challenges from Globalization. *Journal of International Money and Finance*, 110, 102301.

Parlour, C. A., Rajan, U., & Zhu, H. (2020a). When FinTech Competes for Payment Flows. *SSRN Electronic Journal*.

Parlour, C. A., Walden, J., & Rajan, U. (2020b). Payment System Externalities and the Role of Central Bank Digital Currency. *Ross School of Business Paper*, 1337.

People's Bank of China. (2021). *Progress of Research and Development of E-CNY in China*.

Prabheesh, K. P., & Eki Rahman, R. (2019). Monetary Policy Transmission and Credit Cards: Evidence from Indonesia. *Bulletin of Monetary Economics and Banking*, 22, 137–162.

Qian, Y. (2019). Central Bank Digital Currency: Optimization of the Currency System and its Issuance Design. *China Economic Journal*, 12, 1–15.

Shirai, S. (2019). *Money and Central Bank Digital Currency*. ADBI Working Paper, 922.

Soderberg, G. (2022). *Behind the Scenes of Central Bank Digital Currency, Emerging Trends, Insights, and Policy Lessons*. Note/2022/004, International Monetary Fund.

Wang, Z., & Wolman, A. L. (2016). Payment Choice and Currency Use: Insights from Two Billion Retail Transactions. *Journal of Monetary Economics*, 84, 94–115.

Wang, P., Wen, Y., & Xu, Z. (2018). Financial Development and Long-run Volatility Trends. *Review of Economic Dynamics*, 28, 221–251.

Woodford, M. (2000). Monetary Policy in a World without Money. *International Finance*, 3, 229–260.

Zams, B. M., Indrastuti, R., Pangersa, A. G., Hasniawati, N. A., Zahra, F. A., & Fauziah, I. A. (2020). Designing Central Bank Digital Currency for Indonesia: The Delphi-analytic Network Process. *Bulletin of Monetary Economics and Banking*, 23, 411–438.

Zhou, X. B., Wei, W., Jang, C. L., & Chang, C. P. (2019). The Impacts of Government R&D Expenditure on Innovation in Chinese Provinces: What's the Role of Corruption. *Bulletin of Monetary Economics and Banking*, 21, 409–430.

APPENDIX

Table A.1
Variable Description

This table reports variable descriptions and sources of the data used in this study

Abbreviations	Full Form	Data Description	Sources
ECOWIDE	Economic wide CBDC index	0: There is no announced CBDC *project*	Auer et al., 2020a
RETAIL	Retail CBDC index	1: Public research study of CBDC	
WHOLESALE	Wholesale CBDC index	2: Ongoing or completed CBDC's pilot project	
		3: Live CBDC	
DOMCR	Domestic credit	Domestic credit to the private sector by banks, calculated as the percentage of GDP	World Development Indicator (WDI), processed
PRCR	Private credit	Private credit by deposit money banks, calculated as the percentage of GDP	Global Financial Development (GFD), processed
COMBANK	Commercial bank	Number of commercial bank branches per 100,000 adults	WDI
CC	Credit card	Percentage of adults who own a credit card	Global Financial Inclusion (GFI)
IPAY	Internet payment	Percentage of adults who used the internet to pay bills or to buy something online in the past 12 months	GFI
ATM	ATM access	Number of Automated teller machines (ATMs) per 100,000 adults	GFD
CAO	Capital account openness	Chinn Ito Index, is an index that measures a country's capital account openness. Index normalized from 0 to 1; a higher index means higher capital account openness	Chinn and Ito (2020)
TRADE	Trade openness	The sum of imports and exports over GDP	WDI, processed
ELAC	Electricity access	Percentage of population who have access to electricity	WDI
ELQUAL	Electricity quality	Percentage of electric power transmission and distribution losses from its output	WDI
MCEL	Mobile cellular subscription	Gross mobile cellular subscriptions rates refer to the percentage of adults in a country with a subscription to mobile phones	WDI
FBROAD	Fix broadband	Fixed broadband subscriptions rates refer to the percentage of adults in a country with a subscription to fix broadband access	WDI

Table A.1
Variable Description

Abbreviations	Full Form	Data Description	Sources
INOV	Innovation index	Global Innovation Index (GII) ranks world economies according to their innovation capabilities. The range between 0 to 100, a higher index means higher innovation capability.	World Intellectual Property Organization (WIPO)
PATENT	Patent applications	Number of residents' patent applications (ln)	WDI, processed
GDP	GDP per capita	GDP per capita in constant 2010 US\$ (ln)	WDI, processed
HHCONS	Household final consumption	Households' and NPISHs' final consumption expenditure, calculated as the percentage of GDP	WDI, processed
SHADOW	Shadow economy	Size of the shadow economy, calculated as the percentage of GDP	Medina, L & Schneider, F (2019)
POP	Population	Population size, which reflects the size of the market (ln)	WDI, processed
REG	Regulatory quality	Regulatory quality, capturing perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Index from -2,5 to 2,5, the higher the index, the better regulatory quality.	Worldwide Governance Indicators (WGI)
GOVT	Government effectiveness	Government effectiveness, capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Index from -2,5 to 2,5, the higher the index, the better government effectiveness.	WGI
CBIIPD	CBI IPD	Central bank independence index, 0=no independence, 4=strong independence	Institutional Profile Database
CBIGAR	CBI Garriga	Central bank independence index, 0=no independence, 1=strong independence	Garriga and Rodriguez (2020)

Table A.2.
List of Countries

This table reports 169 sample countries used in this study

Afghanistan	El Salvador	Liberia	
Albania	Estonia	Libya	
Algeria	Eswatini	Lithuania	Serbia
American Samoa	Ethiopia	Luxembourg	Seychelles
Argentina	Fiji	Macao SAR, China	Sierra Leone
Armenia	Finland	Madagascar	Singapore
Aruba	France	Malawi	Slovak Republic
Australia	French Guiana	Malaysia	Slovenia
Austria	Gambia, The	Maldives	Solomon Islands
Azerbaijan	Georgia	Malta	Somalia
Bahamas, The	Germany	Mauritania	South Africa
Bahrain	Ghana	Mauritius	Spain
Bangladesh	Greece	Mexico	Sri Lanka
Barbados	Greenland	Moldova	Sudan
Belarus	Guatemala	Mongolia	Suriname
Belgium	Guinea	Morocco	Sweden
Belize	Guyana	Mozambique	Switzerland
Bermuda	Haiti	Myanmar	Syrian Arab Republic
Bhutan	Honduras	Namibia	Taiwan, China
Bolivia	Hong Kong SAR, China	Nauru	Tajikistan
Bosnia and	Hungary	Nepal	Tanzania
Herzegovina	Iceland	Netherlands	Thailand
Botswana	India	New Zealand	Tonga
Brazil	Indonesia	Nicaragua	Trinidad and Tobago
Brunei Darussalam	Iran, Islamic Rep	Nigeria	Tunisia
Bulgaria	Iraq	Niue	Turkey
Cabo Verde	Ireland	North Macedonia	Turkmenistan
Cambodia	Israel	Norway	Tuvalu
Canada	Italy	Oman	Uganda
Cayman Islands	Jamaica	Pakistan	Ukraine
Chile	Japan	Panama	United Arab Emirates
China	Jordan	Papua New Guinea	United Kingdom
Colombia	Kazakhstan	Paraguay	United States
Comoros	Kenya	Peru	Uruguay
Costa Rica	Kiribati	Philippines	Uzbekistan
Croatia	Korea, Dem People's Rep	Poland	Vanuatu
Cuba	Korea, Rep	Portugal	Venezuela, RB
Cyprus	Kuwait	Qatar	Vietnam
Czech Republic	Kyrgyz Republic	Reunion	Virgin Islands (US)
Denmark	Lao PDR	Romania	Yemen, Rep
Djibouti	Latvia	Russian Federation	Zambia
Dominican Republic	Lebanon	Samoa	Zimbabwe
Ecuador	Lesotho	Saudi Arabia	
Egypt, Arab Rep			

This page is intentionally left blank