

A Model of Trust in Central Bank Digital Currency (CBDC) in Brazil: How Trust in a Two-Tier CBDC with Both the Central and Retail Banks Involved Changes Consumer Trust



Alex Zarifis and Xusen Cheng

1 Introduction

This research puts forward a model of consumer's trust in central bank digital currencies (CBDC) in Brazil. Three institutional, and three technological factors, are found to play a role. It is important to develop user-centred services in Brazil so that trust is built in the services themselves, and the government institutions that deliver them, sufficiently for broad adoption (OECD, 2023). Brazil, as one of the largest economies in Latin America has been seen as a leader in financial technology for some time in that part of the world, but more recently, as a member of BRICS it is starting to have an influential role globally. Brazil has taken initiatives to update its own internal central bank services, but has also been involved in several initiatives as part of BRICS. As part of this, Brazil is also leading in the implementation of CBDCs. This top-down innovation in financial technologies at national and international levels must also be supported by a bottom-up adoption by citizens. The citizen now has a variety of options for their financial services. Not all of the options that are popular and easily available to citizens are fully regulated or secure. Some of the easily available options such as meme coins can be quite risky (Huber & Sornette, 2022). Brazilian citizens can support, or push back, on a CBDC for a variety of reasons that are not necessarily easy to predict. A CBDC is a complex innovation, and it is not straightforward to predict which characteristic of the solution, or the general context, will have the most decisive influence. It

A. Zarifis (✉)

University of Southampton, Southampton, UK

Cambridge Centre for Alternative Finance, Cambridge, UK

e-mail: a.zarifis@soton.ac.uk

X. Cheng

Renmin University of China, Beijing, China

© The Author(s) 2025

A. Zarifis, X. Cheng (eds.), *Fintech and the Emerging Ecosystems*, Financial Innovation and Technology, https://doi.org/10.1007/978-3-031-83402-8_4

is therefore important to understand the citizens perspective in the adoption of the Brazilian CBDC. Consumer trust in their CBDC can make the adoption more effective and reduce the risk of a partial or complete failure.

1.1 Central Bank Digital Currencies (CBDC)

With various versions of CBDCs being implemented or explored, a general definition cannot go beyond its fundamental characteristics of being money that is digital, without a physical note or coin, and issued by a central bank. Unlike most cryptocurrencies that are decentralized, a CBDC is typically centralized. While being centralized may reduce some risks, it may inadvertently increase others. Furthermore, unlike most cryptocurrencies, blockchain is not necessarily always utilized in a CBDC.

There are wholesale and retail CBDCs (Auer et al., 2023; Auer & Böhme, 2020). The Brazilian consumer can use the retail version for their daily payments. A wholesale version can be used to move large amounts of money between banks efficiently. While most Latin American central banks are focusing mainly on the retail version (Proskalovich et al., 2023), Brazil, through its involvement in BRICS, is also moving forward with a wholesale version.

A retail CBDC can either be issued directly to individuals, or to commercial banks that then offer them to individual consumers. A CBDC using the two-tier system is closer to existing solutions while a one-tier solution is potentially more disruptive. Many countries exploring CBDCs are considering a hybrid implementation, with both one-tier and two-tiers offered. While this is a more complicated solution, offering some flexibility to consumers may be beneficial and reduce push-back.

Despite the first initiative to explore CBDCs in Latin America being in 2014 by Ecuador, most Latin American countries seem to be moving forward cautiously. However, more recently, Brazil along with Mexico seems to be moving forward more enthusiastically with CBDCs having pilots and putting some of the necessary regulations in place. At the same time, Latin America is also home to El Salvador which took a different approach to innovation in financial technology by adopting Bitcoin as a legal tender and supporting Bitcoin adoption enthusiastically (Alvarez et al., 2023).

The motivation to implement a CBDC can include wanting to increase efficiency, offer new services and encourage innovation, reduce tax evasion, reduce money laundering, de-dollarisation and fight off competition from new financial alternatives such as Bitcoin (Chen et al., 2022; Morales-Resendiz et al., 2021).

An innovation on this scale, and with something so sensitive, is not without challenges. Some of these challenges are typical for all CBDC implementations while others are specific to the region or the specific country. There is limited financial and digital knowledge and a lack of identity documents among some people. Cash is still popular and there is a large informal economy. The occasional

challenges in the economy such as inflation also cause people to move their wealth abroad (Proskalovich et al., 2023).

The large project of implementing a CBDC will not only affect the finances of the country but also many aspects of the citizens personal and professional lives. This change will influence the relationship between the government, the regulators, the central bank, retail banks and other financial institutions offering services to individuals and merchants. It also affects countries and people outside Brazil. Firstly, it is happening with some co-ordination with other countries that are members of BRICS building on previous efforts to link CBDCs of several countries (BIS Innovation Hub, 2023). Secondly, many Latin American countries are waiting for the regional leaders to move forward with CBDCs so they follow. It will be easier for other Latin American countries once there is a strong regional example of a CBDC so there is a model of the technology and the process to implement it (Proskalovich et al., 2023).

1.2 Consumer Trust in a CBDC

While there is a breadth of stakeholders that need to support this innovation, it is critical that consumers adopt it. In the current environment the consumer has many options, some that are fully regulated and supported by the government, others that are partially regulated, and others that are illegal but are still available and hard to shut down. In addition to the financial dimension of a currency such as it holds its value, being widely accepted and so on, it needs to be trusted to be used. Traditionally, the government institutions involved in delivering the currency build trust sufficiently, but government institutions are not trusted as much as they were in the past with around seven in ten Brazilians not trusting them (OECD, 2023). While it is likely that a citizen will use their country's currency, it is not inevitable that they will use their country's currency for all their needs. The consumer's trust is challenged by the risks that a new digital currency brings so it is important to build trust to mitigate this. Therefore, the research question is:

How can consumer trust be built in the Brazilian Central Bank Digital Currency (CBDC)?

Existing research that identified six ways to build trust in a different CBDC (Zarifis & Cheng, 2024a) was used as a basis. This research tested a model with seven ways to build trust in the Brazilian CBDC. The seventh hypothesized way to build trust that was added to the model is not supported by the analysis. It was hypothesized that the implementation process, including pilot implementations, was a seventh way to build trust, but that is not supported by the data. The data supported six out of the seven ways to build trust that came from the original model. Therefore, despite the differences in the Brazilian CBDC, the original model applies there also which suggests the model applies to both two-tier solutions, and mixed one and two-tier solutions. The six ways to build trust that are supported are: (a) trust in government and central bank offering the CBDC, (b) expressed guarantees for

those using it, (c) the favourable reputation of other active CBDCs, (d) the CBDC technology, the automation and limited human involvement necessary, (e) the trust building features of the CBDC wallet app, and (f) the privacy features of the CBDC wallet app and back-end processes.

The theoretical foundation that follows concludes with the initial research model. The methodology section explains the quantitative approach used to explore this model. The analysis section presents the many statistical tests that are implemented. Finally, the theoretical and practical implications of the findings are discussed.

2 Theoretical Foundation

The implementation of this new currency and the technology that supports it in Brazil is a very large project with far-reaching implications, for the various stakeholders, and the consumers using it in particular. This interdisciplinary topic is discussed extensively in the literature on Fintech but it is also covered by the broader literature on finance and information systems. The literature review here first covers the main forms of CBDCs, then it looks at the Brazilian implementation so far, and finally, the role trust has in similar contexts. These three sections of the literature, provide the foundation for the research model that will be tested.

2.1 *The Different Forms of Central Bank Digital Currencies (CBDC)*

A variety of reasons, including the reduced popularity of cash, and the increasing popularity of cryptocurrencies, have made CBDCs more appealing to governments and central banks (Auer et al., 2023). There are some existing implementations of CBDCs and there are many more planned. However, there isn't one solution in terms of the digital currency, or the technology that supports it. Beyond the fundamental principle that it is a currency issued by a central bank, and for which the central bank is liable, there are many differences. Firstly, there can be a CBDC that is only used between banks to transfer large amounts of money efficiently, which is sometimes referred to as a wholesale CBDC (BIS Innovation Hub, 2023). Then there is a retail CBDC that is used by regular citizens for all their purchases from a retailer, and to send money to each other, peer-to-peer (Auer & Böhme, 2020; León et al., 2024). Retail CBDCs can have two tiers like the current system with the central bank, retail banks and the consumers, or one tier, where the central bank interacts directly with the consumer. In a one-tier system, the central bank will typically have to offer consumers a digital wallet to use their CBDCs, so they do not need an account with a retail bank for this process.

In terms of technology, while CBDCs are seen as a government version of cryptocurrencies, the use of blockchain is not entirely necessary, as this is a centralised currency, and not decentralised. Nevertheless, some digital currencies use blockchain as it can, in some cases, support faster and more secure transactions.

The current implementations of CBDCs include China's digital Renminbi RMB, India's Digital Rupee, Russia's Digital Ruble, Bahamas Sand Dollar, the Eastern Caribbean Central Bank Dcash, the Nigerian e-Naira and the Jamaican JamDex (Flores Gálvez & Mata Hernández, 2023; Xu, 2022). These cases are sufficiently used to be considered a real live implementation, and not just a trial. At the same time, they have not reached the level of adoption to fully replace the traditional currency. In Latin America, the other large country to be moving forward is Mexico, but progress is not as fast as Brazil (Flores Gálvez & Mata Hernández, 2023; Zarifis & Cheng, 2024b).

2.2 The Brazilian Central Bank Digital Currency (CBDC) Drex

2.2.1 The Implementation Process and Pilots

Brazil is the largest, most populous country in Latin America, and it also has the largest economy. It is therefore no surprise that it is also expected to be one of the leaders in financial innovation, and CBDCs in particular (Proskalovich et al., 2023; Tombini, 2023). Leading in this complex financial innovation requires a long commitment to develop technologies, processes and people's skills. While it is unrealistic to expect such a large project to be completed without any setbacks, limiting the problems, and keeping the disruption as low as possible, reduces the financial cost to all the stakeholders.

Brazil started this process by successfully implementing a project for an instant payment system called PIX. This system uses a unique key to complete a transaction from one account to another instantly (Rodrigues et al., 2022). The adoption was helped by people's habit of using their phones, the perceived value, and the expected performance of this solution (Amboage et al., 2024). The successful implementation of the PIX project was an interim step that moved the technology and the people towards a CBDC.

Through a series of working groups and consultations, some priorities were identified for the CBDC in Brazil. These include (a) the need for better cross-border interoperability than current solutions, (b) encouraging financial innovation by supporting technologies such as smart contracts, and (c) encouraging financial innovation by supporting other organisations that want to provide integrated financial services (Brazilian Central Bank, 2024).

It is easy to see how the Brazilian CBDC fits into its national strategy, but also that of BRICS, which it is a member of. The scale of the project, and the high level of interconnectedness in finance, mean that even large countries like Brazil benefit

from international collaboration. Limiting currency substitution, typically with the dollar is another area where international collaboration with BRICS is beneficial.

2.2.2 The Specific Challenges Brazil Faces for Its CBDC

Brazilian citizens want user-centred designs, appreciate being involved in the creation of new services that affect them, and do not want to simply receive services planned by others passively (OECD, 2023). These beliefs are similar around the world, but it cannot be assumed that what works in one place, works in another, so it is important to evaluate new solutions in different contexts.

The large informal economy in Brazil is around 40% (Statista Research Department, 2023) and cash is still popular. On the one hand, those using cash may be more resistant to a CBDC, but on the other hand, if the CBDC is a superior payment system it might entice them more than previous options.

Millions of Brazilians do not have identity documents (Agencia Brazil, 2024). As with other challenges to a Brazilian CBDC identified here, this can be seen as an opportunity to make progress on several fronts. It is also important for the solution to show resilience to Internet and power losses. An offline capability through a wallet app would be helpful. If consumers do not know if they will have reliable access to the CBDC they will probably continue to use cash instead.

2.2.3 The Architecture of the Brazilian CBDC Drex

Drex has wholesale functionality that enables banks to move money between themselves efficiently, and retail functionality for individuals to use. The retail functionality is not provided directly by the central bank, but through retail banks, mirroring the current system (Brazilian Central Bank, 2024). This is an example of the importance that has been put on moving forward with all the stakeholders, and not causing unnecessary disruption to the financial ecosystem. Drex has been designed from the start to work with blockchain-based smart contracts. This means many automated financial services that execute contracts, based on some predefined criteria, can be provided. Smart contracts are particularly useful in enabling financial services from different organisations to be combined. Therefore, while Drex, like all CBDCs is centralised, it supports some decentralised financial services. Drex utilises a ‘permissioned’ Ethereum Hyperledger Besu (Brazilian Central Bank, 2024).

2.3 *Trust in Cryptocurrencies and CBDCs*

2.3.1 *Trust in Technology*

When using technology to make a payment there are several risks that challenge the consumer's trust in the process. There is the risk of losing the money being spent, the account details, or other personal information. Typically, if the consumer's trust is not enough they will not use the technology (McKnight et al., 2011). There may be some exceptions such as a scenario where the consumer has no choice but to use something they do not trust. However, typically there are alternatives, and the use of a specific financial technology is not compulsory. In most parts of the world, including Latin America, the alternative financial services available are increasing. One example of the increase in choice is the bank licence awarded to the purely online bank Revolut in Mexico. A second example of the increase in choice is the many leaders that state that they are positive towards cryptocurrencies.

2.3.2 *Trust in Financial Services and Currencies*

Trust in many government institutions around the world is considered to be lower than usual for a variety of reasons and this is also the case in Brazil, where seven out of ten do not trust their government institutions (OECD, 2023). A CBDC, particularly in the way Drex is being implemented, with a whole ecosystem of services being built around it, offers many new services that bring with them new risks. Therefore, the role of trust, may be even more critical for a wide-ranging CBDC ecosystem than a simpler financial innovation like an Internet-only bank.

2.4 *Research Model*

This research attempts to identify the factors that build trust in CBDCs in Brazil. An existing model with three variables covering trust in institutions, and three variables covering trust in technology, is used as a basis (Zarifis & Cheng, 2024a). A seventh variable covering trust in the implementation process is added to the existing model to capture the specific context of the Brazilian implementation of CBDCs more comprehensively. Two more changes are made to the original model so that it captures the Brazilian two-tier CBDC model better. Two variables from the existing model related to the wallet app that enables the use of the CBDC are adjusted to reflect that this functionality is provided by a retail bank in a two-tier system. The functionality to use the CBDC is provided by a central bank directly in a one-tier system, unlike the typical situation we have now where a retail bank provides it. Figure 1 illustrates the initial research model of how consumer trust is built in the Brazilian CBDC with seven methods.

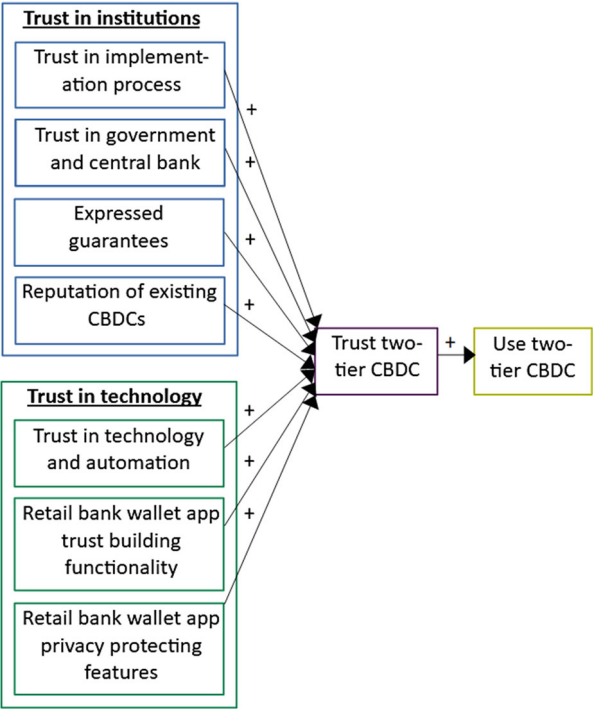


Fig. 1 Initial research model of trust in a two-tier CBDC in Brazil, adapted from (Zarifis & Cheng, 2024a)

2.4.1 Trust in Implementation Process

Citizens’ trust in Brazil’s government and the services it offers is believed to benefit from having a transparent, clear process, being involved extensively, and having the opportunity to give feedback (OECD, 2023). While a CBDC may be seen as a type of currency with standard characteristics this is not the case as the literature review shows. There is both a range of characteristics and a range of different implementation processes. The implementation process has been proven to influence the rate of adoption of a CBDC significantly (León et al., 2024). The Brazilian implementation process has been very gradual and built on previous successes. This gradual, confident and transparent implementation process was designed to make all the stakeholders comfortable moving forward and is expected to build trust. Therefore the first hypothesis is:

H1 Trust in CBDC implementation process will build a user’s trust in the CBDC.

2.4.2 Trust in the Institutions Supporting the CBDC

Trust in many government institutions around the world is lower than usual for a variety of reasons and this is also the case in Brazil (OECD, 2023). Trust in the related institution usually play a role in the adoption of a technology (Pavlou & Gefen, 2004). While it is clear that the institutions supporting the CBDC will influence trust in it, it is not so easy to identify in what way this will happen. Not everything a government or central bank will do will have an influence. Even actions that may seem influential may not play a decisive role in the end. Based on the literature, in addition, to trust in the government and central bank issuing the CBDC, trust will be built by expressed guarantees (Martínez-López et al., 2020), and the positive reputation of CBDCs already operating elsewhere (Dupont & Karpoff, 2020; Einwiller, 2003). These three dimensions of institutional trust are expected to play a significant role. Therefore the second, third and fourth hypotheses are:

H2 Trust in the Brazilian government and central bank issuing the CBDC will build a user's trust in their CBDC.

H3 Expressed guarantees for the user of a Brazilian CBDC will increase trust in that CBDC.

H4 A positive reputation of CBDCs already implemented in other countries increases a consumer's trust in the Brazilian CBDC.

2.4.3 Trust in Technology Used by the Central Bank and the Retail Banks to Operate a CBDC

As the name of a CBDC suggests, technology plays a central role in this digital currency. Many technologies spread across several organisations come together to support the CBDC, and ecosystem of financial services it provides. The consumer may be more comfortable with technologies and solutions they are familiar with, and find it challenging to trust something new like a CBDC that uses blockchain (Brazilian Central Bank, 2024). The Brazilian CBDC is a two-tier system with the central bank and retail banks playing their traditional roles. Therefore, the technology of both the central bank and retail banks plays a role. Based on the literature trust can be built by, (a) the automation and reduced human involvement achieved by a CBDC technology (Ahn & Chen, 2022), (b) the retail bank's wallet app trust-building functionality (Chang et al., 2013), and (c) the retail bank's wallet app privacy protecting features such as not sharing personal information with other organisations (Dinev et al., 2013; Pocher & Veneris, 2022). Therefore, the fifth, sixth and seventh hypotheses are:

H5 The automation and reduced human involvement achieved by a CBDC technology increases trust.

H6 The trust-building functionality of the retail bank's wallet app will increase trust in the CBDC.

H7 The retail bank's wallet app privacy-protecting features, and back-end processes such as anonymity, will increase trust in the CBDC.

2.4.4 Trust Increases Willingness to Use a CBDC

In addition to identifying the factors that build trust in the Brazilian context, it is important to confirm that trust does indeed influence the adoption of this technology in this context, as it does in similar contexts (Lankton et al., 2015; McKnight & Chervany, 2002). The seven factors listed above are expected to build trust in the Brazilian CBDC. The consumer's trust is expected to increase the use of the CBDC as there is extensive literature supporting the positive relationship between trust and the adoption of a technology. This positive relationship however needs to be tested and verified in this context. Furthermore, validating this relationship will complete a model from the ways to build trust in a CBDC, to using the CBDC. This is a sufficiently comprehensive way to frame these issues. Therefore, the eighth hypothesis is:

H8 Consumer trust in the Brazilian CBDC will increase their willingness to use it.

3 Methodology

3.1 Data Analysis

As this research attempts to explore and validate a model a quantitative method is chosen. In order to test the nine hypotheses and the whole model they create, Partial Least Squares-Structural Equation Modelling (PLS-SEM) is applied with the SmartPLS 4.1 software. PLS-SEM is considered to be more geared toward exploring a model than Covariance Based Structural Equation Modelling which is more focused on validating a model (Hair et al., 2021).

3.2 Data Collection

This study adapts an established model of trust in CBDCs to the particular context of Brazil which has some distinct characteristics (Zarifis & Cheng, 2024a). There are two main distinct characteristics this CBDC has. The first is the gradual and successful build-up to its implementation, and the second is the architecture with

two tiers, where consumers still interact with retail banks and not directly with the central bank.

Consequently, the research instrument must reflect four factors that build trust in a CBDC that remain the same as the established model (Zarifis & Cheng, 2024a), two factors that are adapted to reflect the two-tier model, and one new factor to reflect the significance of the journey to implementation. The seven variables that build trust, along with the variable of trust in a CBDC, and a variable of using a CBDC, are illustrated in Table 1. These nine variables are latent variables, as each of them is measured by three measured variables. This is done because beliefs such as trust and privacy often have several dimensions to them and are hard to measure directly. Using several measured variables ensures the latent variables are captured more accurately. The ninth variable willingness to use a CBDC is arguably a simpler concept and may have been captured sufficiently with two latent variables, as some other research does, but three were used for this also to ensure its accuracy.

For data collection, a self-administered questionnaire was made available via the SoSci Survey cloud service (www.soscisurvey.de) that meets privacy requirements such as GDPR. The study was promoted on social media in Brazil and participants could use a URL link directing them to where they could complete the questionnaire.

Participants could use a seven-step bipolar scale from one, representing strongly disagree, to seven, representing strongly agree. No incentive was given, firstly because it was not considered necessary to give extra motivation on this new and important issue, secondly to avoid biasing in some way, and thirdly to avoid collecting personal information. Established scales were used as the basis for the questions of this study as illustrated in Table 1.

Table 1 Latent variables and their measures

Latent variables	Measures	Source of construct measures adapted
Trust in CBDC implementation process	TP1, TP2, TP3	Lankton et al. (2015), McKnight and Chervany (2002)
Trust in government and central bank (TG)	TG1, TG2, TG3	Grimmelikhuijsen and Knies (2017)
Expressed guarantees (EG)	EG1, EG2, EG3	Dinev et al. (2013), Martínez-López et al. (2020), Yun et al. (2019)
Reputation of existing CBDCs (R)	R1, R2, R3	Einwiller (2003)
Trust in technology and automation (TA)	TA1, TA2, TA3	Lankton et al. (2015), McKnight and Chervany (2002)
Retail bank’s wallet app trust building functionality (AF)	AF1, AF2, AF3	Pavlou (2002)
Retail bank’s wallet app privacy protecting features (PF)	PF1, PF2, PF3	Dinev et al. (2013)
Trust in CBDC (TC)	TC1, TC2, TC3	Lankton et al. (2015), McKnight and Chervany (2002)
Intention to use CBDC (UC)	UC1, UC2, UC3	Venkatesh et al. (2003)

The minimum sample size necessary was estimated in three ways. Firstly, the G*Power software 3.1.9.7 estimated a minimum sample size of 263 for a predictive power of 95%. Based on the maximum number of arrows being seven, for a significance level of 1% and a minimum R^2 of 0.10, the minimum number required is 228 (Hair et al., 2021). Lastly, a rule of thumb that is popular is to ensure there are ten participants per measured variable, which suggests a minimum sample of 270.

Some quality checks were made on the 512 submissions and the final number of valid completed surveys is 453. The quality checks ruled out unreasonably fast submissions, submissions that chose the same number throughout, and incomplete submissions. The survey did not have any questions that could not be answered by someone that lived in Brazil (Table 2).

4 Analysis and Results

The analysis starts by evaluating the measurement model, which covers the relationship between each latent variable and its measured variables. This is followed by the analysis of the structural model, the relationship between the latent variables that form the model.

4.1 Measurement Model

The measurement model is evaluated in several ways to check if the measured variables are indeed strongly associated with their latent variable and not another latent variable. The results are presented in Tables 3 and 4. The convergent validity of the variables is evaluated with two methods. The lowest factor loading is 0.862 for PF3, above the minimum acceptable value of 0.7. For the Average Variance Extracted (AVE) the lowest value is 0.798 for R, above the minimum acceptable value of 0.5. Composite Reliability (CR) is used to test the reliability of the latent variables. The lowest value for CR is 0.868 for TC, above the recommended threshold of 0.7. The Fornell–Larcker criterion evaluated the discriminant validity as illustrated in Table 4. As the results in Table 4 show the latent variables are sufficiently distinct statistically. Overall, the tests carried out at this stage support the measurement model.

4.2 Structural Model

Several criteria must be met to support the structural model. In the initial model, TP had a weak negative effect on trust of 0.33 and was therefore removed from the model. The hypothesis related to TP, trust in the process is not supported. The model

Table 2 Participants demographic information

Measure	Variable	Participants	Percentage
Gender	Female	196	43%
	Male	257	57%
Age	18–24	182	40%
	25–39	147	33%
	40–59	84	19%
	60 or older	40	9%
Educational level (highest qualification)	No high school education	46	1%
	High school graduate	254	56%
	University bachelor's degree	135	30%
	University postgraduate degree	18	4%
Income (Brazilian Real per month)	No income	74	16%
	Up to 6000	62	14%
	6001–9000	143	32%
	9001–12,000	151	33%
	Over 12,001	23	5%
Brazilian nationality and Brazilian resident Without Brazilian nationality but a Brazilian resident		404	89%
		49	11%

Table 3 Measurement model results for convergent validity, consistency and reliability

Variables		Loadings	CR	AVE
TP	TP1	0.943	0.916	0.853
	TP2	0.918		
	TP3	0.910		
TG	TG1	0.943	0.947	0.904
	TG2	0.958		
	TG3	0.951		
EG	EG1	0.886	0.909	0.843
	EG2	0.960		
	EG3	0.907		
R	R1	0.934	0.878	0.798
	R2	0.897		
	R3	0.846		
TA	TA1	0.934	0.917	0.855
	TA2	0.911		
	TA3	0.929		
AF	AF1	0.906	0.900	0.832
	AF2	0.898		
	AF3	0.932		
PF	PF1	0.928	0.892	0.818
	PF2	0.922		
	PF3	0.862		
TC	TC1	0.916	0.868	0.789
	TC2	0.856		
	TC3	0.892		
UC	UC1	0.913	0.914	0.853
	UC2	0.938		
	UC3	0.938		

Table 4 Measurement model results for discriminant validity (Fornell–Larcker criterion)

	TP	TG	EG	R	TA	AF	PF	TC	UC
TP	0.924								
TG	0.813	0.951							
EG	0.745	0.900	0.918						
R	0.687	0.815	0.866	0.893					
TA	0.771	0.884	0.851	0.816	0.925				
AF	0.912	0.720	0.766	0.754	0.683	0.912			
PF	0.550	0.648	0.710	0.740	0.635	0.897	0.904		
TC	0.714	0.862	0.884	0.861	0.888	0.852	0.825	0.888	
UC	0.669	0.777	0.806	0.794	0.767	0.755	0.747	0.885	0.924

Table 5 Results of the final structural model

Path	Sample Mean	Standard Deviation	T Statistics
TG-TC	1.658	89.737	0.008**
EG-TC	2.001	118.657	0.007**
R-TC	0.860	67.784	0.004**
TA-TC	1.106	34.822	0.020**
AF-TC	0.437	31.447	0.027**
PF-TC	0.059	33.493	0.010**
TC-UC	0.994	0.014	70.972**

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

was therefore retested without TP. PLS-SEM and SmartPLS are designed to support exploring a model and generating a revised, stronger model (Hair et al., 2021).

The results of the evaluation of the structural model are presented in Table 5 which shows the path coefficients and the coefficient of determination R -square values. For the endogenous variable, ‘trust CBDC’, the coefficient of determination R -square is 0.905, and for the second endogenous variable ‘use CBDC’ it is 0.783 so they are both substantial as they are above 0.67 (Chin, 1998).

The effect size (f^2) for the paths TG-TC (0.022), EG-TC (0.035), R-TC (0.021), TA-TC (0.143), AF-TC (0.052), PF-TC (0.100) are weak but significant. TC-UC (3.604) is strong as it is above 0.35 (Chin, 1998).

Bootstrapping with 5500 resamples was utilised to evaluate the path significance levels. The results of the bootstrapping statistics are presented in Table 5. The bootstrapping results give further support to the relationship between TG, EG, R, TA, AF, PF and TC.

The priority of the PLS-SEM is not to evaluate model fit (Hair et al., 2021) but nevertheless, the Standardized Root-Mean Residual (SRMR) for the estimated model is 0.063 suggesting a good model fit as it is below 0.08 (Hu & Bentler, 1999).

5 Discussion

Trust is necessary for a CBDC to be widely adopted and used enthusiastically across all economic activity. As trust in the government institutions including those in Brazil, seem to be lower than usual it is important to identify and utilize all the ways that trust can be built (OECD, 2023).

5.1 Implications for Theory

This research extends an existing model of consumer trust in a CBDC (Zarifis & Cheng, 2024a) to cover the Brazilian CBDC and other two-tier CBDC implementations. In two-tier CBDC implementations the central bank and commercial banks

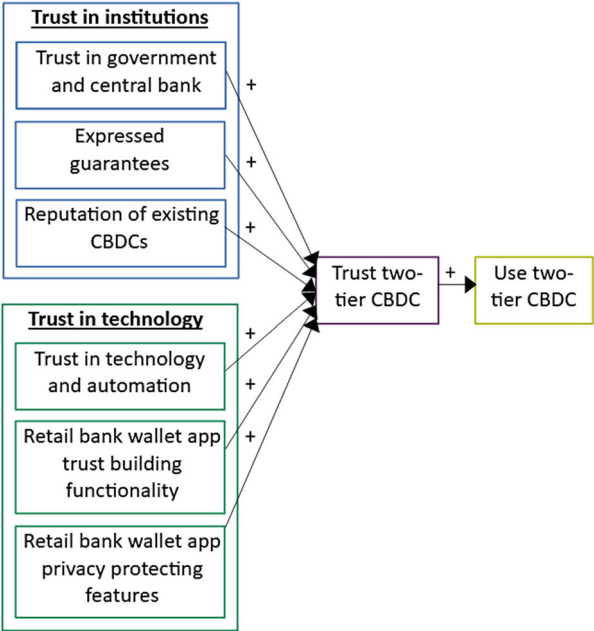


Fig. 2 Model of consumer trust in Brazil’s two-tier CBDC, adapted from (Zarifis & Cheng, 2024a)

retain similar roles to the ones they have today, unlike a one-tier system where the central bank interacts directly with the user. The supported model of trust in Brazil’s two-tier CBDC is illustrated in Fig. 2.

While it is obvious that a different country, in this case Brazil, may have some idiosyncrasies in how users perceive CBDCs, what might be less obvious is that the Brazilian CBDC is a different solution with a different implementation process. The implementation is a clear two-tier solution meaning that the current two-tier system with the central bank and the commercial banks is mirrored. The implementation process in Brazil is also distinctive due to its gradual, and successful, implementation that built on previous successes like the PIX instant payment platform.

This research first clarified what the key characteristics of the Brazilian CBDC are. It then proposed a model of consumer trust in a CBDC based on an existing model (Zarifis & Cheng, 2024a) with one addition. The addition made was that the implementation process in Brazil, because of its cautious, gradual and successful nature would build trust. The analysis supports the original model but does not support the addition made. One possible explanation is that the successful implementation process avoided problems that would reduce trust but did not necessarily build trust. A second possible explanation is that many people were not aware, or did not think about the implementation process.

An additional adjustment to the model used as a starting point is that the wording of the two variables related to the wallet app is changed to reflect that in a two-tier CBDC the wallet app used, will be that of the retail bank.

As the implementation process does not have a significant influence, it is three institutional factors and three features of the technology that influence trust. Therefore this model finds that trust in the Brazilian CBDC is built in the following ways: (a) trust in government and central bank offering the CBDC, (b) expressed guarantees for those using it, (c) the favourable reputation of other active CBDCs, (d) the CBDC technology, the automation and limited human involvement necessary, (e) the trust building features of the retail bank's CBDC wallet app, and (f) the privacy features of the retail bank's CBDC wallet app and back-end processes.

It is an important theoretical contribution to show that the model of consumer trust in a CBDC is valid in at least two countries and that it is valid for both a mixed implementation, and a clear two-tier implementation. The two countries where this model has now been tested have distinct cultures, and the two solutions and implementation processes are also quite different, so it is useful to show that the same model is useful in these two cases. This is a strong indication that the model will be valid in many countries, although it cannot be assumed it would be valid for a strict one-tier implementation.

Lastly, this research informs the broader literature on trust illustrating the influence on consumer trust by the institutions involved in the service, and the technology characteristics (Ratnasingham et al., 2005; Stouthuysen et al., 2018). While the institutions and the technology characteristics often influence trust, this is not always the case, and there is therefore an ongoing debate on the relationship between institutions and trust.

5.2 Implications for Practice

This research has practical implications for several stakeholders in a CBDC and can inform action to build consumer trust. It is widely believed that on the topic of CBDCs, as with other financial innovations Brazil is a regional leader with some countries in Latin America waiting to see what CBDC will be offered, how it will be implemented, and received by the public, before moving forward (Proskalovich et al., 2023). Therefore, clearly framing the Brazilian CBDC model makes it easier for the countries in Latin America primarily, but also elsewhere, to learn lessons. The first two important implications for practise from the Brazilian model are the choice of a two-tier CBDC which is close to the existing system people are familiar with, and the gradual implementation that is transparent to the public without surprises, and also enables expertise to be built up. While these do not build trust directly they may stop trust being reduced.

The final implication for practice is the model of how to build trust in a CBDC that shows what to focus on. While one person or a focus group could come up

with a long list of possible issues affecting trust, this model identifies the six issues that do indeed influence trust. This is a manageable number for stakeholders such as the government, regulators, commercial banks or other financial institutions. A stakeholder that is affected by CBDCs may try to influence as many of the six factors shaping trust as possible, or they may focus on some of the six.

A government may be able to influence five of the six either directly or indirectly. It is unlikely that a government can influence (c) the reputation of existing CBDCs. A government can probably influence (a) trust in the government and central bank, and (b) expressed guarantees directly. A government should also be able to have some indirect influence over (d) trust in the technology and automation, (e) retail bank wallet app trust-building functionality and (f) retail bank wallet app privacy features.

Other stakeholders such as retail banks, depending on their role will probably have to focus on the last three trust-building methods. As the two-tier system is close to the current system, the role of banks and other financial institutions offering services to private individuals, in building trust is also similar. Nevertheless, given that in a typical banking app, a customer has several currencies to choose from, the retail banks will have to think about how trust in the CBDC can be built sufficiently so that it is preferred to the alternatives that have been available for longer and are more familiar.

5.3 Limitations and Future Research

This research hypothesised that the gradual and successful implementation of the Brazilian CBDC positively influenced consumer trust in it. Despite this being a logical hypothesis, supported by some literature, this was not supported by the data. This does not mean this gradual cautious implementation was not beneficial. It may have avoided failures that would have damaged trust and it may have built trust in other stakeholders, other than the consumers.

If the implementation was not so cautious with several pilots, there may have been problems that weakened trust. Future research can explore this further, although it is not easy to measure the potential effect of an event that did not happen. An experiment may be suitable.

Future research can also explore whether the gradual implementation built trust in the other stakeholders such as regulators, retail banks, other financial institutions and technology providers. These stakeholders may have followed the developments more closely and may have been more positively influenced by the gradual implementation process.

While the model is supported in two countries and two different implementations of CBDCs, it would be useful to validate it in additional countries especially if they have very different implementations such as a strict one-tier implementation.

6 Conclusion

This research extends an existing model of consumer trust in a CBDC (Zarifis & Cheng, 2024a) to cover the Brazilian CBDC, and other two-tier CBDC implementations where the central bank and commercial banks retain similar roles to the ones they have today. The model was explored with survey data.

The implementation process does not have a significant influence on trust, so it is three institutional factors, and three features of the technology that influence trust. Therefore trust in the Brazilian CBDC is built in the following ways: (a) Trust in government and central bank offering the CBDC, (b) expressed guarantees for those using it, (c) the favourable reputation of other active CBDCs, (d) the CBDC technology, the automation and limited human involvement necessary, (e) the trust building features of the CBDC wallet app, and (f) the privacy features of the CBDC wallet app and back-end processes.

References

- Agencia Brazil. (2024) *CNJ Counts 100,000 Attendances in the Civil Registration Week*.
- Ahn, M. J., & Chen, Y. C. (2022). Digital transformation toward AI-augmented public administration: The perception of government employees and the willingness to use AI in government. *Government Information Quarterly*, Elsevier Inc., 39(2), 101664. <https://doi.org/10.1016/j.giq.2021.101664>.
- Alvarez, F., Argente, D., & Van Patten, D. (2023). Are cryptocurrencies currencies? Bitcoin as legal tender in El Salvador. *Science*, 382(6677). <https://doi.org/10.1126/science.add2844>
- Amboage, G. B., Monteiro, G. F. d. A., & Bortoluzzo, A. B. (2024). Technological adoption: the case of PIX in Brazil. *Innovation and Management Review*. <https://doi.org/10.1108/INMR-10-2022-0133>
- Auer, R., & Böhme, R. (2020). The technology of Retail Central Bank Digital Currency. *BIS Quarterly Review*.
- Auer, R., Cornelli, G., & Frost, J. (2023). Rise of the Central Bank Digital Currencies. *International Journal of Central Banking*, 19(4), 185–214.
- BIS Innovation Hub. (2023). *Project MBridge Update: Experimenting with a Multi-CBDC Platform for Cross-Border Payments*.
- Brazilian Central Bank. (2024). *Drex – Digital Brazilian Real*.
- Chang, M. K., Cheung, W., & Tang, M. (2013). Building trust online: Interactions among trust building mechanisms. *Information and Management, Elsevier B.V.*, 50(7), 439–445. <https://doi.org/10.1016/j.im.2013.06.003>
- Chen, S., Goel, T., Qiu, H., & Shim, I. (2022). CBDCs in emerging market economies. *BIS Papers*, <https://doi.org/10.2139/ssrn.4085690>.
- Chin, W. W. (1998). The partial least squares approach to structural equation modelling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295–336). Lawrence Erlbaum Associates.
- Dinev, T., Xu, H., Smith, J. H., & Hart, P. (2013). Information privacy and correlates: An empirical attempt to bridge and distinguish privacy-related concepts. *European Journal of Information Systems, Nature Publishing Group*, 22(3), 295–316. <https://doi.org/10.1057/ejis.2012.23>
- Dupont, Q., & Karpoff, J. M. (2020). The trust triangle: Laws, reputation, and culture in empirical finance research. *Journal of Business Ethics, Springer*, 163(2), 217–238. <https://doi.org/10.1007/s10551-019-04229-1>

- Einwiller, S. (2003). When reputation engenders trust: An empirical investigation in business-to-consumer electronic commerce. *Electronic Markets*, 13(3), 196–209. <https://doi.org/10.1080/1019678032000092246>
- Flores Gálvez, J. N., & Mata Hernández, J. M. (2023). CBDC-MXN: Challenges and perspectives in the implementation as a Mexican digital currency. *Mercados y Negocios*, 2023(49), 3–20. <https://doi.org/10.32870/myn.vi49.7689>
- Grimmelikhuijsen, S., & Knies, E. (2017). Validating a scale for citizen trust in government organizations. *International Review of Administrative Sciences*, 83(3), 583–601. <https://doi.org/10.1177/0020852315585950>
- Hair, J., Hult, T., Ringle, C., & Sarstedt, M. (2021). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.). Sage Publishing.
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Huber, T. A., & Sornette, D. (2022). Boom, bust, and Bitcoin: Bitcoin-bubbles as innovation accelerators. *Journal of Economic Issues, Informa UK Limited*, 56(1), 113–136. <https://doi.org/10.1080/00213624.2022.2020023>
- Lankton, N., McKnight, H., & Tripp, J. (2015). Technology, humanness, and trust: Rethinking trust in technology. *Journal of the Association for Information Technology*, 16(10), 880–918.
- León, C., Moreno, J. F., & Soramäki, K. (2024). Simulating the adoption of a retail CBDC. *Journal of Economics and Statistics*, 1–33. <https://doi.org/10.1515/jbnst-2024-0002>
- Martínez-López, F. J., Li, Y., Feng, C., & Esteban-Millat, I. (2020). Purchasing through social platforms with buy buttons: A basic hierarchical sequence. *Journal of Organizational Computing and Electronic Commerce, Taylor & Francis*, 30(1), 67–87. <https://doi.org/10.1080/10919392.2020.1713698>
- McKnight, H., Carter, M., Thatcher, J. B., & Clay, P. (2011). Trust in a specific technology: An investigation of its components and measures. *ACM Transactions on Management Information Systems*, 2(2). <https://doi.org/10.1145/1985347.1985353>
- McKnight, H., & Chervany, N. L. (2002). What trust means in E-commerce customer relationships: An interdisciplinary conceptual typology. *International Journal of Electronic Commerce*, 6(2), 35–59.
- Morales-Resendiz, R., Ponce, J., Picardo, P., Velasco, A., Chen, B., Sanz, L., Guiborg, G., et al. (2021). Implementing a retail CBDC: Lessons learned and key insights. *Latin American Journal of Central Banking*, 2(1), 1–10. <https://doi.org/10.1016/j.latcb.2021.100022>
- OECD. (2023). Drivers of trust in public institutions in Brazil. *OECD Publishing*. <https://doi.org/10.1787/fb0e1896-en>
- Pavlou, P. A. (2002). Institution-based trust in interorganizational exchange relationships: The role of online B2B marketplaces on trust formation. *The Journal of Strategic Information Systems*, 11(3–4), 215–243. [https://doi.org/10.1016/S0963-8687\(02\)00017-3](https://doi.org/10.1016/S0963-8687(02)00017-3)
- Pavlou, P., & Gefen, D. (2004). Building effective online marketplaces with institution-based trust. *Information Systems Research*, 15(1), 667–675. <https://doi.org/10.1287/isre.1040.0015>
- Pocher, N., & Veneris, A. (2022). Privacy and transparency in CBDCs: A regulation-by-design AML/CFT scheme. *IEEE Transactions on Network and Service Management, IEEE*, 19(2), 1776–1788. <https://doi.org/10.1109/TNSM.2021.3136984>
- Proskalovich, R., Jack, C., Zarifis, A., Serralde, D. M., Vershinina, P., Naidoo, S., Njoki, D., et al. (2023). *Cryptoasset ecosystem in Latin America and the Caribbean*. Cambridge Centre for Alternative Finance.
- Ratnasingham, P., Gefen, D., & Pavlou, P. A. (2005). The role of facilitating conditions and institutional trust in electronic markets. *Journal of Electronic Commerce in Organizations*, 14(5), 69–82.

- Rodrigues, V. F., Policarpo, L. M., da Silveira, D. E., da Rosa Righi, R., da Costa, C. A., Barbosa, J. L. V., Antunes, R. S., et al. (2022). Fraud detection and prevention in e-commerce: A systematic literature review. *Electronic Commerce Research and Applications, Elsevier B.V.*, 56. August 2021. <https://doi.org/10.1016/j.elerap.2022.101207>
- Statista Research Department. (2023). *Informal Employment as Percentage of Total Employment in Brazil from 2011 to 2022*.
- Stouthuysen, K., Teunis, I., Reusen, E., & Slabbinck, H. (2018). Initial trust and intentions to buy: The effect of vendor-specific guarantees, customer reviews and the role of online shopping experience☆. *Electronic Commerce Research and Applications, Elsevier B.V.*, 27, 23–38. <https://doi.org/10.1016/j.elerap.2017.11.002>
- Tombini, A. (2023). The future of money: A possible role for central bank digital currencies and their implications digitalisation and benefits for society. *BIS Speeches*, 1–14.
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: *Toward a unified view*. *MIS Quarterly*, 27(3), 425–478
- Xu, J. (2022). Developments and implications of Central Bank Digital Currency: The case of China e-CNY. *Asian Economic Policy Review*, John Wiley and Sons Inc, 1 July, <https://doi.org/10.1111/aepr.12396>.
- Yun, H., Lee, G., & Kim, D. J. (2019). A chronological review of empirical research on personal information privacy concerns: An analysis of contexts and research constructs. *Information and Management, Elsevier B.V.*, 56(4), 570–601. <https://doi.org/10.1016/j.im.2018.10.001>
- Zarifis, A., & Cheng, X. (2024a). *The six ways to build trust and reduce privacy concern in a Central Bank Digital Currency (CBDC)* (pp. 115–138). Business Digital Transformation, Springer International Publishing. https://doi.org/10.1007/978-3-031-33665-2_6
- Zarifis, A., & Cheng, X. (2024b). *Trust in Central Bank Digital Currency (CBDC) in Mexico* (pp. 1–3). European Conference on Information Systems (ECIS).

Alex Zarifis's research and teaching are on the practical applications of technology in business. Before the University of Southampton, he worked at several academic institutions including the University of Cambridge, the University of Manchester and the University of Mannheim. He is currently a research affiliate of the Cambridge Center for Alternative Finance (CCAF).

He has explored cryptoassets such as cryptocurrencies since 2012. As part of this research, he published the first peer-reviewed research on trust in digital currencies in the world in 2014. He also participated in creating the first government recognised, university degree on blockchain technologies in the world.

Dr Alex has published extensively on trust in different technologies and business models. His research has explored the role of trust in AI, blockchain, financial technology (Fintech) and insurance technology (Insurtech).

Xusen Cheng is a Full Professor of Information Systems in the School of Information at Renmin University of China. He is also a research fellow in the Metaverse Research Center and School of Interdisciplinary Studies at the Renmin University of China. He obtained his PhD degree from the University of Manchester, UK. His research interests include trust and information systems, design and behaviour issues of digital business, digital economy and Metaverse. His research has been published in leading journals such as *MIS Quarterly* and *Journal of Management Information Systems*.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

