FINANCIAL INFRASTRUCTURE REPORT

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FINANCIAL **INFRASTRUCTURE REPORT**

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This version adjusts the Per Capita conventions to thousands of 2020 dollars in Graph A2.20, pages 107 to 109.

Additionally, it contains orthotypographic corrections that do not alter the information presented previously.

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FINANCIAL
INFRASTRUCTURE REPORT

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Glossary

ACH: Automated Clearing House
ACH-Cenit: National Interbank Electronic Settlement System, managed by *Banco de la República*
ACH-Colombia: Automated Clearing House of Colombia
ATH: A Toda Hora S.A. ATM network
BIS: Bank for International Settlements
BVC: Colombian Stock Exchange
CCDC: Foreign Exchange Clearing House of Colombia
CDT: Term deposit certificate
CEDEC: Electronic clearing system for checks and other payment instruments, managed by *Banco de la República*
CRCC: Central Counterparty Risk of Colombia S.A.
CR5: Concentration index constructed as the sum of the five largest participations
CUD: Deposit Accounts System, managed by *Banco de la República* and used to settle large-value money transfers. It is also known as the large-value payment system.
DANE: National Administrative Department of Statistics
DCV: Central Securities Depository, managed by *Banco de la República*
Deceval: Centralized Securities Depository of Colombia
DGCPTN: General Directorate of Public Credit and the National Treasury - Ministry of Finance and Public Credit
DvP: Delivery versus payment method applicable to securities settlement
FIC: Collective Investment Fund (CIF)
FINAGRO: Fund for the Financing of the Agricultural Sector
IBR: Benchmark Reference Index
BDBR: *Banco de la República's* Board of Directors
MEC: Colombian Electronic Market, owned by the Colombian Stock Exchange
NDF: Non-deliverable forwards
PIB: Gross domestic product (GDP)
PSE: Secure online payments (SOP)
SEN: Electronic trading system, managed by *Banco de la República*
SET-ICAP-FX: Foreign exchange electronic transaction system, managed by Servicios Integrados en Mercado Cambiario S.A. and backed by the Colombian Stock Exchange and SIF-ICAP of Mexico
SET-ICAP Securities: Electronic and voice system for trading and registering financial instruments; is also a financial information provider
TES: Bonds issued by the Colombian government and managed by *Banco de la República*
TRM: Representative market exchange rate
TTS: Temporary transfer of securities

Introduction

Banco de la República's monitoring of the local financial market infrastructure is an additional contribution to the country's financial stability. One of the products of that monitoring has been the Payment Systems Report, which is now known as the *Financial Infrastructure Report*. The change in name, as of this edition, is intended to reflect in a broader way the issues that are addressed in the report.

The 2022 edition includes several changes that are the result of a comparative study of financial infrastructure reports prepared by other central banks. These changes seek to make the report more fluid and easier to read, including main points and selected key figures for the different interest groups to which it is addressed.

The report shows the financial infrastructure continued to render its services without interruption, with general evidence of good performance in 2021. Additionally, the resilience of the Central Counterparty Risk of Colombia (CRCC) and the Large-value Payments System (CUD) to extreme events was validated, based on stress tests conducted according to international standards (focused on liquidity and credit risk).

As for retail payments, transactional information indicates the use of electronic instruments increased in terms of value during 2021 compared to 2020 (credit and debit cards, checks and electronic funds transfers). The use of debit and credit cards in payments rose to levels similar to those reached in the pre-pandemic year. Meanwhile, electronic funds transfers continued to grow.

Although the results of the BR 2022 survey show cash continues to be the instrument most used by the public for regular payments (like the situation in other countries), the perception of its use decreased significantly to 75 % (87 % in 2019). Also, in commerce, cash was the preferred instrument for customers. However, in this measurement, several retail channels such as hairdressers, drugstores and restaurants joined the group that has traditionally received electronic payments for a value greater than 10% of their sales (hypermarkets and gas stations). Likewise, for nearly 50% of the population, cash payments are lower than before the pandemic. This is consistent with the transactional increase in electronic payment instruments that was observed in 2021.

Banco de la República continues to monitor the technological developments that have expanded and modernized the supply in the international and local payments market, as these are issues of interest to the industry that provides clearing and settlement services. This report outlines the Pix case for instant payments in Brazil, the projects that are underway regarding the possible issue of digital currency by central banks (CBDC) for cross-border payments, as well as an approach to the Fintech ecosystem in Colombia, with an emphasis on companies that provide payment services.

Leonardo Villar
Governor

Main points: 2022

The local financial infrastructure was safe and efficient throughout the year.
The services of the financial infrastructure were proved on a continuous basis, showing good performance overall.

Less momentum in the large-value payment system
CUD activity declined versus the previous year because of fewer government deposits with BanRep. This was offset partially by growth in repos to increase money supply and in retail-value payments (electronic funds transfers, checks and cards).

Increased momentum in financial market infrastructures.
Larger amounts were cleared and settled through the Central Securities Depository (DCV) due to an increase in the market for sovereign debt. Operations managed by the Central Counterparty Risk of Colombia (CRCC) increased due to inclusion of the foreign exchange segment and the positive evolution in non-delivery forward peso/dollar contracts.

Added confidence in the peso/dollar spot foreign exchange market due to CRCC interposition.
Number and value of trades grew, mainly due to the adjustment of the risk management model for the FX segment and the increase in the limit on net selling positions in dollars.

Stress testing with international standards to validate CRCC and CUD resilience
Stress tests conducted independently by the SFC, BanRep and the CRCC, like those done in England and the United States, concluded that the CRCC's risk management model allows it to withstand extreme market events and simultaneous defaults by its main members.
Based on the experience of other central banks, BanRep strengthened its intraday liquidity risk stress exercises in the CUD by incorporating temporary payment delays. It calculated that a two-hour delay by a key participant increases the system's liquidity needs by 0.5%.

Main points: 2022

Electronic payments increased during 2021
According to transactional information, all electronic payment instruments increased in value versus 2020 (electronic funds transfers, checks and debit and credit cards). Electronic funds transfers continued to grow (80% from legal entities), with the participation of closed schemes driven particularly by the use of mobile wallets (35% of the number of intra-transfer transactions). The use of debit and credit cards for payments climbed to levels similar to those witnessed in the pre-pandemic year.

Cash continues to be the instrument most used by the public for regular payments.
The results of the BanRep survey in 2022 show that the perception of the use of cash declined significantly to 75% (87% in 2019), and about 50% of the population perceive their cash payments as being lower than those they made before the pandemic. Electronic funds transfers were second most used instrument, having increased to 15% (3% in 2019). Also, in commerce, cash was the preferred instrument of payment for its customers; however, several commerce channels received more than 10% of the value of their sales in electronic payments (hypermarkets 35%, gas stations 25%, hairdressers 15%, drugstores 14% and restaurants 12%).

Continuous technological developments have broadened, and modernized services offered in the payments market.

pix
powered by Banco Central

Pix (instant payments in Brazil). The high level of adoption of instant transfers in Brazil motivated a review of its strengths; namely, the possibility of different use cases between individuals, businesses, and government; high participation by financial and payment institutions; free of charge for individuals and the possibility of charging legal entities, and simple user experience.

CBDC

Digital currencies in central banking. Several groups of countries have joined forces to conduct pilot projects with wholesale CBDCs for cross-border payments. Flows generated by international trade, foreign investment and remittances between individuals can be processed more efficiently, transparently, and securely by reducing their cost and increasing their speed. Due to the constant progress being made on this issue, BanRep will continue to monitor all CBDC-related matters.

The fintech ecosystem for payments in Colombia. A high percentage of existing FinTech companies in the country are dedicated to offering digital payment services: wallets, payment gateways, mobile devices (point-of-sale terminals) and acquisition. These have driven innovation in payment services.

Selected key figures, 2022

(In terms of daily average for 2021 and annual change, percentage)

By infrastructure

Transactions settled in the CUD		Payments in financial markets		Retail payments	
		+ DCV COP 34.4 b (28%) CRCC COP 15.7 b (264%) Deceval COP 2.6 b (-20%)	2,150 (3%) 5,814 (186%) 6,853 (-1%)	ACH Colombia COP 5.6 b (23%) ACH Cenit COP 1.1 b (14%) + Cedec COP 0.6 b (27%) Redes TyC COP 0.6 b (20%)	1.2 m (15%) 66,225 (186%) 22,819 (-1%) 5.5 m (36%)
Value	Number	Value	Number	Valor	Number
COP 53.3 b (-4%)	6,188 (-5%)	COP 52.7 b (45%)	14,817 (34%)	COP 8 b (22%)	6.8 m (31%)

By instrument

Electronic funds transfers		Card transactions		Check transactions	
+ Intra COP 13.5 b (2%) Inter COP 6.7 b (21%)	3.3 m (62%) 1.3 m (16%)	+ Debit COP 845 mm (18%) Credit COP 198 mm (26%)	3.2 m (19%) 0.8 m (21%)	+ Intra COP 230 mm (18%) Inter COP 621 mm (27%)	13,070 (-21%) 22,819 (3%)
Value	Number	Value	Number	Value	Number
COP 20.3 b (7%)	4.6 m (46%)	COP 1 b (19%)	4 m (20%)	COP 851 mm (25%)	35,888 (-7%)

1. General Overview of Colombia's Financial Infrastructure

The Bank for International Settlements (BIS) defines financial market infrastructures as multilateral systems in which the participating institutions clear, settle, and record payments, securities, derivatives, and other financial assets.[1] These infrastructures include payments systems (PS), securities depositories (SDs), central counterparties (CCPs) and systems for recording operations,[2] as well as the other clearing and settlement infrastructures that exist.

Diagram 1.1 shows the infrastructures that participate in the clearing and settlement of securities and other financial assets in Colombia. It also illustrates the main platforms for trading and recording these assets, so as to provide an overview of the entire value chain. The core role of the large-value payment system managed by *Banco de la República*, known as the Deposit Account System (CUD), is unmistakable. It is the central axis and foundation of the entire infrastructure and is where the cash legs of operations with local financial assets and bank payment instruments are settled.

Band A at the top of Diagram 1.1 shows the trading and recording systems for securities as well as currencies. The former include the Electronic Trading System (SEN), managed by *Banco de la República*, where transactions with sovereign debt securities are traded and recorded, and the Colombian Electronic Market (MEC), managed by the Colombian Stock Exchange (BVC), which is where government and private debt is traded and recorded. The BVC also manages the market for equities and standardized financial derivatives with underlying assets other than energy-related commodities.

There is the Derivex system, which manages the market for standardized derivatives where the underlying assets are energy-related commodities, and other trading and recording systems [3] that allow for trading and recording transactions between participants through the use of hybrid mechanisms (voice and data).

With respect to foreign currency, the Forex Market Electronic Transaction and Information System (SET-FX), managed by SET-ICAP FX S.A.,[4] and the platforms for some trading and recording systems,[5] provide trading and recording infrastructure.

Band B in Diagram 1.1 shows the systems for clearing and settling operations. Institutions use these infrastructures to settle security, foreign currency, and derivative legs resulting from the obligations they contract on those markets. Among the sys-

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1 The Committee on Payment and Settlement Systems and the Technical Committee of the International Organization of Securities Commissions (2012). "Principles for Financial Market Infrastructures," July; available at: https://www.bis.org/cpmi/publ/d94_es.pdf

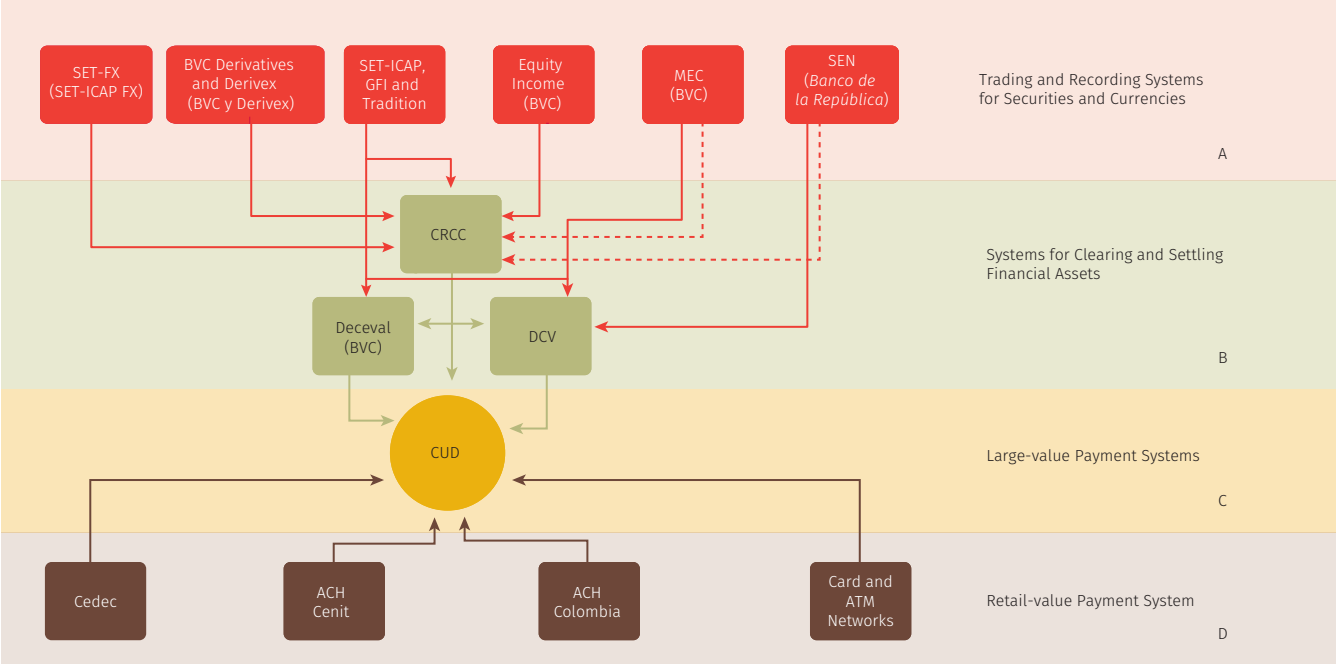
2 The recording systems report information on over-the-counter market operations that are conducted by affiliated financial intermediaries in their own name and on behalf of third parties.

3 These are ICAP Securities Colombia, GFI Securities Colombia and Tradition Securities Colombia.

4 In 2012, SET-ICAP FX S.A. replaced Integrated FX as the manager of the SET-FX system. This change was the result of a corporate agreement between ICAP Colombia Holdings SAS, ICAP Latin America Holdings B.V. and the BVC. The intention was to jointly supply Colombia's capital markets with mixed system management services for forex and securities trading and recording.

5 GFI Exchange Colombia and Tradition Colombia.

Diagram 1.1
Overview of Financial Market Infrastructures (FMI) and Other Participants [a/] (2021)



a/ The dotted lines refer to the fact that the CRCC manages the risks in sell/buy backs with sovereign debt (TES) coming from SEN and MEC, at the same time gross settlement in the DCV-CUD takes place.
Source: *Banco de la República* (DSIF).

tems concerned with securities, Diagram 1.1 includes the Central Securities Depository (DCV), managed by *Banco de la República* and used solely for sovereign debt securities; the Centralized Securities Depository of Colombia (Deceval), which is for all types of securities, both government and private; and the Central Counterparty Risk of Colombia (CRCC), which handles term operations, standardized derivatives (both financial and energy derivatives) and non-standardized derivatives, such as interest rate forwards and swaps (IRF and IRS), as well as equity securities on the spot market. In relation to foreign exchange, the CRCC clears and settles both spot transactions and standardized derivates at the representative market rate of exchange (TRM) and non-standardized (COP/USD) non-deliverable forwards (NDF).

Band C shows the large-value payment system (CUD), which is the core of the country's financial infrastructure. It is where the cash legs of operations converge to be settled, including those of operations in financial asset clearing and settlement systems, as well as the cash legs of operations in retail-value payment systems.

The retail-value payment systems are grouped into Band D. They include the clearing and settlement of multilateral positions generated by the use of debit and credit cards, checks and electronic funds transfers.

Annex 1 offers a description that helps to identify and understand the role financial infrastructures play, according to the markets they support.

Table 1.1 contains a detailed description of the type of operations channeled through each system, and the daily average value and quantity of operations conducted over the last two years. These figures reflect the magnitude of the resources mobilized on a gross basis. However, the amount, in value, does not necessarily coincide with the flow of money used to settle the obligations contracted there by agents, either because

Table 1.1
Financial Market Infrastructures in Colombia
(Main operations in number and value)

	Daily Averages [a/]				Main Operations
	Number of Operations		Value (Billions of Pesos)		
	2020	2021	2020	2021	
Large-value Payment System					
Large Value					
CUD	6,537	6,188	55,527	53,253	– Settlement of the cash leg of operations cleared by the DCV, Deceval, the BVC, the CCDC, the CRCC, and the retail-value payment systems. – Payment of the cash leg of monetary operations; monetary policy operations: repos and remunerative deposits – Transfers of funds ordered directly by the participants. – Debit to accounts for items such as interbank clearing, VAT, GMF, and commissions, among others
Systems for Clearing and Settling Financial Assets					
Securities Depositories					
DCV[b/]	2,090	2,150	26,903	34,403	– Pertains to transactions with government securities on the primary market (trusteeship), the secondary market, and monetary operations by *Banco de la República*. – Comprised of transactions with government securities, corporate debt, and shares of stock on the primary and secondary markets. Includes cash collateral.
Deceval[c/]	6,941	4,514	3,278	2,577	
Central Counterparty Clearing Houses					
CRCC S.A.	2,034	5,814	4,306	15,690	– Clearing and settlement of standardized financial and energy derivatives. – Clearing and settlement of non-standardized foreign exchange and interest rate derivatives. – Clearing and settlement of repos, cash, and temporary transfer of securities (TTS) on equities. – Purchase and sale transactions in dollars between exchange market intermediaries in the spot market (t + 0, t + 1, t + 2 and t + 3). – Term operations (TES sell/buy backs) are sent by the SEN and MEC systems to the Central Counterparty Risk of Colombia (CRCC) for respective risk management, while gross clearing and settlement are done in the DCV-CUD. An average of 655 operations daily were handled in 2021 for COP 11.05 trillion.
Retail-value payment systems					
ACH Colombia	1,048,593	1,201,214	4,577	5,616	– Recurring payments such as payroll, pensions, suppliers, social security, dividends and, in general, invoicing for the purchase of all types of goods and services, as well as automatic collections for these same items.
ACH: Cenit	41,327	66,225	987	1,130	– Mainly drafts and payments from the National Treasury to territorial entities.
Cedec	22,097	22,819	488	621	– Checks for the purchase and sale of goods, services and to discharge obligations, among others.
Cards and ATM Networks	4,051,773	5,492,969	494	593	– Transactions with debit and credit cards, as well as clearing operations between ATMs.

a/ Averages calculated based on the days each infrastructure was operating.
b/ Corresponds to the settled value of operations cleared and settled through the DCV and originated in the primary, secondary and money markets. Includes operations settled with delivery versus payment and free of payment. In the case of sell/buy backs, repos, and TTS, it includes initial agreements and its reverse operations.
c/ Pertains to the settled value sent by the investor in the acquisition of a security.
Sources: *Banco de la República*, Deceval, BVC, ACH Colombia, and the CRCC.

those obligations do not imply the movement of money or because the systems use net settlement mechanisms.

As mentioned earlier, the settlement of obligations from the other external system[6] for operations conducted by financial intermediaries and all other agents in the securities, forex, derivatives and domestic currency markets, both in large and retail values, converges in the large-value payment system (CUD). The average daily value of the transactions settled there in 2021 came to COP53.3 trillion (t), which is equivalent to 4.53% of the country's annual gross domestic product (GDP), followed by operations in the equities market (COP37 t), which include the DCV (COP34.4 t) and Deceval (COP2.6 t). Next in order of importance is the value of operations with derivatives and repos, spot transactions and temporary transfers of securities and spot foreign exchange cleared and settled by the CRCC (COP 15.7 t); the sum of the two ACH (Cenit and Colombia) (COP 6.74 t); the value of interbank clearing of checks settled in the Cedec system (COP 0.62 t); and, finally, the value of card and ATM clearing (COP 0.59 t).

6 External Resolution 5, issued in 2009 by the Board of Directors of *Banco de la República* (BDBR), defines an "external system" as any payment system other than a determined large-value payment system, as well as any securities clearing and settlement system, currency clearing and settlement system, or a system that clears and settles futures, options and other financial assets, including central counterparty risk clearing houses, provided they are duly authorized by the competent authority to operate in Colombia.

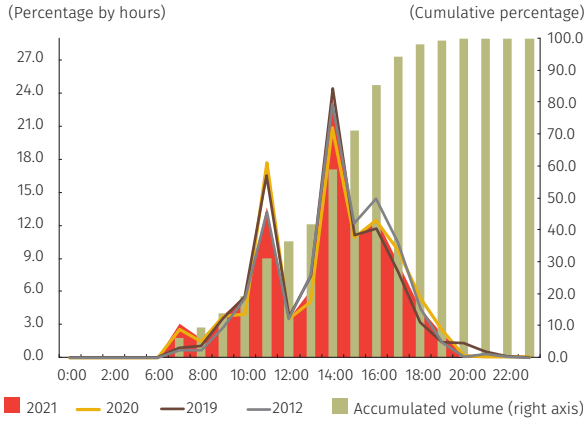
2. Executive Summary of the Financial Infrastructure

2.1 The Financial Infrastructure in Colombia

The local financial infrastructure was safe and efficient throughout the year.

The services of the financial infrastructure were proved on a continuous basis, showing good performance overall.

Graph 2.1
Distribution of Transactions in the CUD System by Hourly Range in Value



Source: *Banco de la República* (CUD).

The operational availability of the entire infrastructure in the local market exceeded 98% of the total time established for service during the year. Specifically, the CUD offered continuous service during 98.7% of its normal business hours (with occasional suspensions affecting 1.3% of the time). The DCV was available 99.9% of the time, while CRCC services for participants were available 99.8% of the time, on average, for all segments.

Over 80% of the transactions handled through the country's financial market infrastructure were cleared and settled before 5:00 in the afternoon,[7] indicating the risk of unsettled transactions after the systems close was mitigated. During 2021 the CUD was 2.3 % more timely than in 2020, having gone from 82% to 84% of transactions settled before 5:00 p.m. (Graph 2.1). DCV and Deceval were 0.5% and 27% more timely, going from 95.9% to 96.4% and from 71.8% to 91%, respectively.[8]

Pronounced settlement peaks in transactions are observed at certain times of the day (Graph 2.1), thanks to the DCV's simulated netting settlement mechanisms. In particular, the 24%, 21% and 24% peaks in payments observed at around 14:00 hours in 2019, 2020 and 2021, respectively, were generated as a result of the liquidity saving mechanisms (simulated netting) in the securities and cash legs offered by the DCV and retrocession of the Bank's repos to increase money supply. The 3.0% increase in settlement at around 14:00 hours between 2020 and 2021 is mainly due to a higher number of these repos, as they generate more chains of collateral reuse.

7 It is important to point out that the CUD, in line with what has been implemented by other large-value payment system managers, has a fee schedule that generates incentives for participants not to leave the settlement of pending transactions until the end of the day. The charge before 5:00 p.m. is per transaction settled (i.e.: the amount does not matter), while settlement after that time is made according to the amount of the transaction (COP 2.5 per million). On average, a transaction settled between one hour and another can range from COP 3,170 to COP 40,000.

8 The closing time for the CUD and DCV is 8 p.m. but infrastructure participants may request an extension of these hours until 11:59 p.m. by paying $3,083,800 for each hour or fraction thereof.

With respect to the CRCC, it maintained the counterparty risk management scheme throughout the year and strengthened the security mechanisms for foreign exchange segment, by incorporating a collective collateral fund. Thus, the structure of these mechanisms and the order in which they are used is transversal for all the segments this infrastructure is responsible for clearing and settling. During 2021, the CRCC experienced 77 events involving a delay; however, none of them had an impact on the provision of service nor was it necessary to execute collateral.

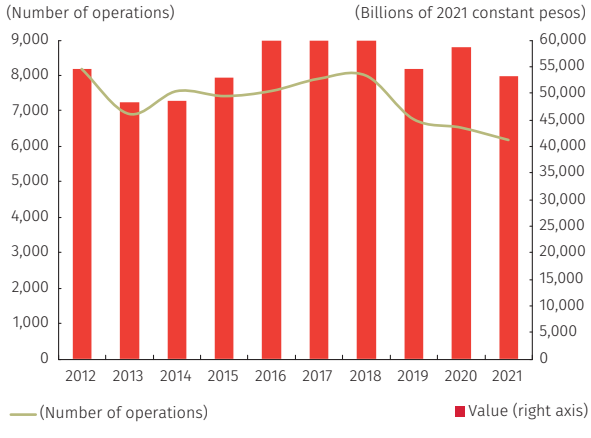
Several of the highlights and boxes presented in this report consider some of the fundamental considerations suggested in the principles applicable to CPSS-Iosco financial market infrastructures (2012).

2.2 Payments in Financial Markets

Less momentum in the large-value payment system

CUD activity declined versus the previous year because of fewer government deposits with BanRep. This was offset partially by the growth in repos to increase money supply and in retail-value payments (electronic funds transfers, checks and cards).

Graph 2.2
Statistics on the Number and Value of Operations in the CUD Large-value Payment System



Source: *Banco de la República* (CUD).

A decline in the value and number of CUD operations was observed (Graph 2.2 and Table 2.1). The daily average number of operations (6,188) fell by 5.34% in 2021 compared to the previous year; likewise, the nominal value (COP 53.2 t) was down by 4.10% with respect to that same year. In real terms, the average daily value declined by 9.2%. In the annual total, the value paid represented 11.1 times Colombia's gross domestic product (GDP) in 2021; that is, a daily average on the order of 4.53% of GDP, which is less than the performance in 2020, which accounted for 5.56%.

The decline in the value of transactions settled through the CUD is explained by the behavior of interest-bearing government deposits with *Banco de la República* (which were down by COP 9.7 t) and by sell/buy backs and purchases and sales with government securities (COP 1.6 t). This drop was offset mainly by an added COP 3.3 t in BanRep repos to increase money supply (excluding intraday repo) and by an increase of COP 0.46 t in retail-value payments, among other factors.

The decline in the amount of transactions is explained largely by the activity in financial markets coming from other FMIs, such as the DCV and Deceval, which finalize settlement of the cash leg of their operations in the CUD. Specifically, while 2,248 operations were handled daily through these systems in 2020, on average (DCV 1,509; Deceval 739), a decline of 6.7% was observed in 2021, closing at 2,096 (DCV 1,480; Deceval 616).

Of the all the transactions handled through the CUD, 44.5% were carried out with government securities held in custody

Table 2.1
Number and Value of Operations in the CUD System

Year	Daily Average					Annual Value			
	Number of Operations	Value		Value Average Transaction		Number of Operations	(Billions of pesos)	Annual value (Billions of 2021 constant pesos)	(Number of times GDP)
		(Billions of pesos)	(Billions of 2021 pesos)	(Billions of pesos)	(Billions of 2021 constant pesos)				
2012	8,196	38,132	54,432	4.7	6.6	2,016,269	9,380,456	13,390,308	14.1
2013	6,925	34,543	48,372	5.0	7.0	1,689,588	8,428,598	11,802,844	11.8
2014	7,570	35,925	48,531	4.7	6.4	1,847,039	8,765,618	11,841,654	11.5
2015	7,430	41,767	52,847	5.6	7.1	1,805,454	10,149,449	12,841,824	12.6
2016	7,574	52,083	62,318	6.9	8.2	1,863,090	12,812,358	15,330,051	14.8
2017	7,921	55,305	63,573	7.0	8.0	1,932,687	13,494,365	15,511,854	14.7
2018	8,007	54,977	61,250	6.9	7.6	1,969,837	13,524,386	15,067,518	13.7
2019	6,774	50,752	54,473	7.5	8.0	1,652,880	12,383,453	13,291,334	11.7
2020	6,537	55,527	58,649	8.5	9.0	1,589,352	13,516,504	14,276,391	13.5
2021	6,188	53,253	53,253	8.6	8.6	1,516,294	13,047,093	13,047,093	11.1

Source: *Banco de la República* (CUD).

Table 2.2
Origin and Item of Operations for which Deposit Accounts in the CUD System are Debited, Number and Value of Transactions (Daily Averages in Billions of Pesos)

Operations with Sovereign Debt in the DVC [a/]	Year 2020		Year 2021		Year 2020		Year 2021	
	Number of Operations	Value	Number of Operations	Value	Number of Operations	Value	Number of Operations	Value
					(Percentage)			
Primary Market								
Placements[b/]	16	273.61	20	270.09	0.2	0.5	0.3	0.5
Payment of principal and yield[c/]	34	174.26	24	199.72	0.5	0.3	0.4	0.4
Secondary Market [d/]								
Purchase/sales	778	3,571.47	746	3,409.77	11.9	6.4	12.0	6.4
Money Market[d/]								
Sell/buy backs	337	6,400.84	341	5,676.27	5.2	11.5	5.5	10.7
Reverse sell/buy backs	338	6,405.49	340	5,647.12	5.2	11.5	5.5	10.6
TTS	2	47.831	5	189.79	0.0	0.1	0.1	0.4
Reverse TTS	2	47.573	5	190.00	0.0	0.1	0.1	0.4
Repos between financial institutions	1	15.49	0	0.00	0.0	0.0	0.0	0.0
Reverse repos between financial institutions	1	15.58	0	0.00	0.0	0.0	0.0	0.0
Total operations with sovereign debt in the DCV (1)	1,509	16,952	1,480	15,583	23.1	30.5	23.9	29.3
Others DCV [e/]	25	132.67	27	160.91	0.4	0.2	0.4	0.3
Total (1) + (2)	1,534	17,085	1,508	15,744	23.5	30.8	24.4	29.6

Table 2.2 (continuation)
Origin and Item of Operations for which Deposit Accounts in the CUD System are Debited, Number and Value of Transactions
(Daily Averages in Billions of Pesos)

Monetary Policy	Number of operations	Value	Number of operations	Value	Number of operations	Value	Number of operations	Value
Repos to increase money supply[f/]	34	2,937.42	58	6,325.38	0.5	5.3	0.9	11.9
Reverse repos[g/]	0	0.00	0	0.00	0.0	0.0	0.0	0.0
Definitive TES purchases	3	19.90	7	44.90	0.1	0.0	0.1	0.1
Definitive private debt purchases	1	35.67	0	0.00	0.0	0.1	0.0	0.0
Repos with private debt securities	1	8.51	0	0.00	0.0	0.0	0.0	0.0
Repos with promissory notes	1	5.25	0	3.11	0.0	0.0	0.0	0.0
Remunerated Deposits[h/]	97	16,379.39	38	4,896.61	1.5	29.5	0.6	9.2
Total Monetary Policy Operations	138	19,390	103	11,270	2.1	34.9	1.7	21.2
Provision of Liquidity in the Payment System (*Banco de la República*)	**Number of Operations**	**Value**	**Number of Operations**	**Value**	**Number of Operations**	**Value**	**Number of Operations**	**Value**
Intraday repos[i/]	54	1,451.41	62	1,721.27	0.8	2.6	1.0	3.2
Total Operations to Provide Liquidity	54	1,451.41	62	1,721.27	0.8	2.6	1.0	3.2
Direct Funds Transfers in the CUD[j/]	**Number of Operations**	**Value**	**Number of Operations**	**Value**	**Number of Operations**	**Value**	**Number of Operations**	**Value**
Securities (Money uploads and downloads)[k/]	654	6,107.23	638	6,187.45	10.0	11.0	10.3	11.6
Intraday interbank loans	20	247.41	24	276.85	0.3	0.4	0.4	0.5
Direct Funds Transfers in the CUD[j/]	**Number of Operations**	**Value**	**Number of Operations**	**Value**	**Number of Operations**	**Value**	**Number of Operations**	**Value**
					(Percentage)			
Reverse intraday interbank loans	12	148.37	15	143.02	0.2	0.3	0.2	0.3
Interbank loans to one or more days	15	400.11	16	489.15	0.2	0.7	0.3	0.9
Reverse interbank loans to one or more days	16	382.49	17	468.12	0.2	0.7	0.3	0.9
Interbank loans in the IBR	16	320.00	16	320.00	0.2	0.6	0.3	0.6
Reverse interbank loans in the IBR	16	320.04	16	320.02	0.2	0.6	0.3	0.6
Currencies settled outside the clearing house	38	220.93	41	265.95	0.6	0.4	0.7	0.5
Taxes	135	572.31	143	687.17	2.1	1.0	2.3	1.3
Transfers from managers to custodians: CIF operations	124	2,318.06	123	2,422.27	1.9	4.2	2.0	4.5
Custodian transfers to managers: CIF operations	155	1,350.03	143	1,408.94	2.4	2.4	2.3	2.6
Other transfers[l/]	2014	565.67	1,873	6,389.49	30.8	1.0	30.3	12.0

Table 2.2 (continuation)
Origin and Item of Operations for which Deposit Accounts in the CUD System are Debited, Number and Value of Transactions
(Daily Averages in Billions of Pesos)

Direct Funds Transfers in the CUD[j/]	Number of Operations	Value	Number of Operations	Value	Number of Operations	Value	Number of Operations	Value
					(Percentage)			
Deceval[m/]								
Placements	45	213.89	42	171.08	0.7	0.4	0.7	0.3
Payment of principal and yield	211	289.12	192	275.92	3.2	0.5	3.1	0.5
Purchase/sales	124	399.56	93	299.93	1.9	0.7	1.5	0.6
Sell/buy backs	52	66.95	44	56.59	0.8	0.1	0.7	0.1
Reverse sell/buy backs	53	67.22	44	56.55	0.8	0.1	0.7	0.1
Repos	7	5.74	4	2.77	0.1	0.0	0.1	0.0
Reverse repos	7	5.88	4	2.77	0.1	0.0	0.1	0.0
Temporary transfers of securities	4	0.005	0	0.000	0.1	0.0	0.0	0.0
Change of depositor	227	177.25	176	143.77	3.5	0.3	2.8	0.3
Term transactions	5	0.52	5	0.59	0.1	0.0	0.1	0.0
CRCC cash operations – Deceval	5	11.25	13	26.18	0.1	0.0	0.2	0.0
Total Deceval operations	739	1,237.37	616	1,036.15	11.3	2.2	10.0	1.9
Colombian Stock Exchange (BVC)[n/]	30	29.41	0	0.00	0.5	0.1	0.0	0.0
Central Counterparty Risk of Colombia (CRCC)[o/]	19	45.16	20	42.09	0.3	0.1	0.3	0.1
Central Counterparty Risk of Colombia (CRCC)[p/]	17	900.47	17	1,128.30	0.3	1.6	0.3	2.1
Retail-value payment systems[q/]								
ACH	147	1,989.81	155	2,230.58	2.2	3.6	2.5	4.2
Card and ATM networks	49	186.11	53	321.82	0.8	0.3	0.9	0.6
Checks (Cedec and delegated clearing houses)	28	100.87	37	192.23	0.4	0.2	0.6	0.4
Total retail-value payment systems	224	2,276.79	245	2,744.63	3.4	4.1	4.0	5.2
Total direct transfers of funds in the CUD	4,244	17,438	3,964	24,329	64.9	31.4	64.1	45.7

Table 2.2 (continuation)
Origin and Item of Operations for which Deposit Accounts in the CUD System are Debited, Number and Value of Transactions (Daily Averages in Billions of Pesos)

Other operations	Number of operations	Value	Number of operations	Value	Number of operations	Value	Number of operations	Value
Total other transactions[r/]	566	163.09	552	188.44	8.7	0.3	8.9	0.4
Total debit transactions in the CUD	6,537	55,527	6,188	53,253	100	100	100	100

a/ Transfers of funds in the CUD system, originating with securities transactions in the DCV.
b/ Placement of securities that effectively implied an outlay of resources. Does not include reinvestments in agricultural development titles (TDA), tax refund certificates (CERT), sovereign debt securities (TES) to pay court rulings, and agricultural and constant-value bonds, among others.
c/ Pertains to money effectively transferred in the CUD for payment of principal and yield on securities deposited with the DCV, excluding payments for *Banco de la República*'s investments.
d/ Does not include cross trades; that is, operations where a financial entity is both the originator and recipient of the cash leg., it is the same financial institution.
e/ Deposit account debits originating with the collection of fees, penalties, and commissions in the DCV.
f/ Pertains to reverse repos. In the case of repo chains, it includes only the net value and interest.
g/ Reverse repos.
h/ Remunerated deposits. This includes the DGCPTN.
i/ Pertains to reverse intraday repos. In the case of repo chains, it includes only the net value and interest.
j/ Clearing and settlement of operations from external systems or operations processed by deposit account entities directly in their CUD stations.
k/ Transfer of funds (money uploads) from leading banks to brokerage firms, trust companies and pension funds (known as customers), so they have enough liquidity in their deposit accounts to cover the cash leg of their securities operations. The banks debit this money from the customer's current account, in advance.
l/ Transfers of funds from Deceval to the creditor in securities transactions (through delivery-versus-payment), with the initial transfer from the debtor to Deceval broken down according to the elements in item m/; transfers of funds from the ACH account and from the networks' clearing systems to institutions with a multilateral creditor position in each clearing cycle; initial transfers from debtors to the ACH and networks are in item q/; Operations – Section No. 10 in Article 879 of the tax law; transfers between accounts belonging to the same institution; transfers of funds from the Central Counterparty Risk account to foreign exchange market intermediaries with a multilateral creditor position in pesos (payment-versus- payment mode); initial transfers from foreign exchange market intermediaries with a debtor position to the Central Counterparty Risk are in item p/; credit disbursements; payment by issuers of securities; transfers of funds from the account of the Central Counterparty Risk Clearing House to institutions with a multilateral creditor position in pesos; initial transfers from institutions in a debtor position with the CRCC are shown in item o/; and constitution-return of collateral.
m/ Payment of principal and yield, and transfers of funds from debtor institutions to Deceval, so it can guarantee the settlement of operations through delivery versus payment; includes, among others: purchase-sale transactions, sell/buy backs, repos and change of depositor of securities deposited in Deceval.
n/ Multilateral net clearing and settlement of the cash leg in stock trades.
o/ Transfers of funds from institutions with a debtor position in pesos to the Central Counterparty Risk of Colombia, so it can guarantee the settlement of derivatives clearing (daily settlement and at contract maturity). Does not include the cash Forex segment.
p/ Transfers of funds from foreign exchange market intermediaries with a debtor position in pesos to the CRCC so it can guarantee settlement through payment-versus-payment.
q/ Transfers of funds from institutions with a multilateral debtor position to the ACH and the Credibanco, Redeban, Servibanca, and ATH networks, so they can guarantee the settlement of clearing for electronic fund transfers and operations with debit and credit cards, and ATMs. It also includes check clearing and settlement.
r/ Provision of cash from *Banco de la República*'s treasury to financial institutions with deposit accounts, payment of services, commissions and fees, liens, and financial transaction tax collection by the government.
Source: *Banco de la República* (CUD).

by the DCV. Settlement of the cash leg of sell/buy backs, repos and TTSs by agents at the DCV (excluding BanRep) accounted for 29.26% of the total value of the CUD in 2021 (Table 2.2). BanRep repos to increase money supply accounted for 15.2%, with 3.2% corresponding to intraday repos for payment systems. Interest-bearing deposits with BanRep represented 9.2%, of which 7.73% were from the Ministry of Finance and Public Credit (MHCP).

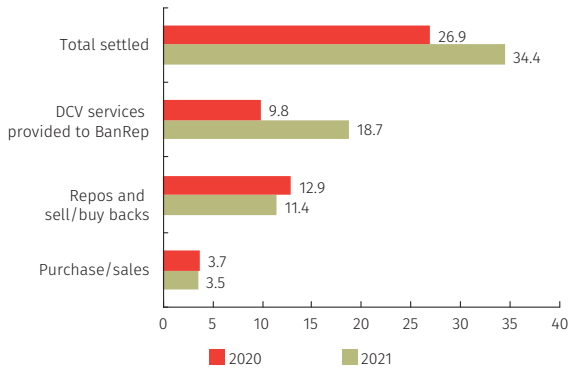
Direct transfers of funds in the CUD accounted for 45.69% of the transactions. It is important to emphasize that 11.6% involve transfers (money "uploads") from lending establishments to other institutions holding deposit accounts, so the latter have the necessary liquidity to meet the cash leg of their operations with securities. On the other hand, 5.15% account for net multilateral clearing in the retail-value payment systems (4.19% ACH, 0.60% card and ATM networks and 0.36% checks), while 4.5% are transfers of resources from collective investment fund (CIF) managers to the custodians of those funds, so the latter may settle purchase and/or sell/buy back operations with securities from the DCV.

Increased momentum in financial market infrastructures

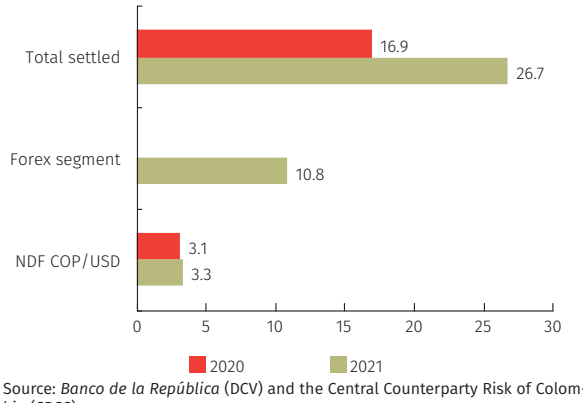
Larger amounts were cleared and settled through the Central Securities Depository (DCV) due to a rise in BanRep repos to increase money supply (excluding intraday repos). Operations managed by the Central Counterparty Risk of Colombia (CRCC) increased due to inclusion of the foreign exchange segment and the positive evolution in non-delivery forward peso/dollar contracts.

Graph 2.3
Daily Average Transactions Conducted through Financial Market Infrastructures
(In trillions of Colombian pesos)

A. DCV

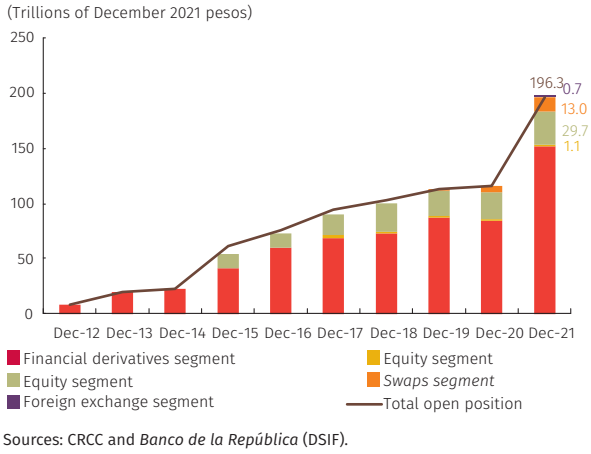


B. CRCC



Source: *Banco de la República* (DCV) and the Central Counterparty Risk of Colombia (CRCC).

Graph 2.4
Evolution in the Open Position, by Segment and at the Close of Each Year
(Gross open position, both ends)



Sources: CRCC and *Banco de la República* (DSIF).

In the DCV, the average daily value of settled transactions rose by 28%[9] from COP 27 t to COP 34 t (Graph 2.3), mainly due to added momentum (90%) in the services provided by the DCV to *Banco de la República* (OMO and provision of liquidity to the large-value payment system). Sell/buy backs declined (-11%), as did purchase/sales (-5%). The number of operations increased by 2.9%, from 2,090 in 2020 to 2,150 in 2021. The balance in custody rose by 13.9 %, in current pesos, from COP 372 t to COP 424 t by the end of the year (94% TES).

At Deceval, the average daily value of operations fell by 21% from COP 3.3 t to COP 2.6 t. Regarding its function as a depository, the balance in custody in current pesos showed a decline of 1.8 % from COP 545 t to COP 536 t. As for this last amount, 57% of the balance in current pesos declined from COP 545 t to COP 536 t, with 57% of the latter pertaining to equities; 21% to CDTs; 15% to bonds, and the remaining 7.0% to other securities.

The value of operations through the CRCC increased (by 58%)[10] since it settled peso/dollar spot transactions in 2021. On a daily average, it cleared and settled COP 26.7 t, including COP 10.8 t in peso/dollar spot transactions (Graph 2.3). On the other hand, the products with the most growth were peso/dollar NDF forwards, having increased by COP 0.2 t., with a daily average value of COP 3.3 t.

The gross valued open positions with which the CRCC closed out 2021 came to COP 196 t in total. This amount represents an increase of 70% with respect to the open position at the end of 2020, due to the increase in positions in interest rate swaps[11] (COP 38.5 t), peso/dollar NDF forwards (COP 32.8 t), sovereign debt sell/buy backs (COP 5.4 t) and TRM futures (COP4.5 t). Regarding the participation of segments and values of the gross open position, the financial derivatives segment had an open position of COP 152 t (77%), the fixed income segment, COP 30 t (15%), the interest rate swaps segment, COP 13 t (7%), the equity income segment, COP 1.1 t (0.5%), and the foreign exchange segment, COP 0.7 t (0.4%) (Graph 2.4).

On a daily average, margin requirements for offsetting between buy and sell positions with the same underlying asset were reduced during 2021 for the more representative products; namely, 74% for futures contracts on TRM and on peso/dollar NDF forwards; 68% for interest rate futures and swaps,

9 In settlement or market value, defined as the value that is actually paid in the transaction. It represents what will move out of the deposit account.

10 This began to be done in December 2020.

11 The CRCC clears and settles two types of interest rate swaps. The first is related to swaps used to form the IBR rate where the flows of a fixed rate equivalent to the IBR (1, 3, and 6 months) and a variable rate corresponding to the compound interest rate of the overnight IBR during the term of the swap are exchanged. The second is a swap with similar characteristics to the previous one, with remaining terms of up to 18 months.

and 12% for futures contracts on TES of specific references. The lower collateral requirements are produced by offsetting the risks generated for the CRCC by the members' open position: specifically, offsetting between open buy and sell positions for the same product with different maturities, or offsetting between open buy and sell positions for different products with the same underlying asset.

In addition, multilateral netting of peso/dollar spot transactions generated liquidity savings of 82% for CRCC members. The average daily gross value traded was USD 1,292 million and the average daily net value settled was USD 236 million.[12]

In Focus 1: **Intraday Repos in Large-value Payment Systems (LVPS)**

Large-value payment systems operating on the basis of real-time gross settlement (RTGS) are characterized by the fact that transfers of funds are made one by one and continuously throughout the day. For example, institution A has a payment commitment with institution B for COP 100. At the same time, institution B must pay participant A COP 90 today, under another contractual agreement. Although in net terms, institution A owes COP 10 (COP 100-COP 90) to institution B, both obligations are settled separately and usually at different times of the day.

This results in elevated liquidity needs by participants in the system. To mitigate them, RTGS systems have mechanisms that help to reduce such needs. One of these is to provide participants with liquidity through the central bank by means of intraday repo operations. This contributes to the normal and smooth functioning of the payment system.

In Colombia, the intraday repo for payment systems offered by *Banco de la República* (BanRep) to participants in the large-value payment system (LVPS) has the following characteristics, among others (Table A).

If the institution that carried out the initial transaction does not deliver the funds to BanRep before the deadline, the obligation is automatically converted to an overnight repo with a cost equivalent to the monetary policy rate + 100 bp to be completed before 9:00 a.m. the following day. This is an important point to bear in mind.

In recognizing the importance of intraday repos to proper functioning of the payment system and the mitigation of intraday liquidity risk, there are international standards, such as those proposed by the Bank for International Settlements (BIS), known as "principles applicable to market infrastructures," which highlight the need to identify and monitor the use of intraday liquidity in a financial market infrastructure. Accordingly, some general statistics on intraday repos and their recent use are presented below.

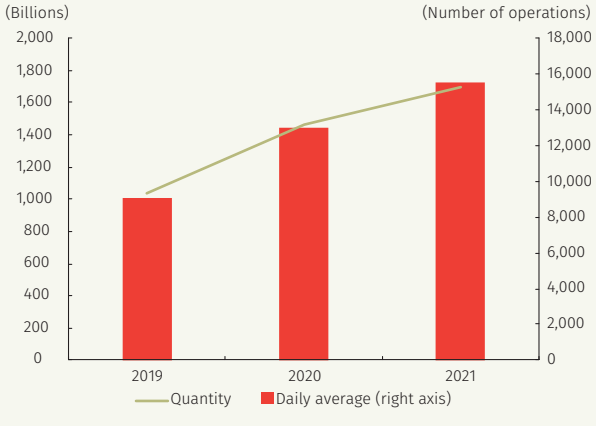
12 Variations and details concerning the behavior of operations, open positions and changes introduced by the CRCC in 2021 are outlined in Annex 1.

Table A
Characteristics of Intraday Repos offered by *Banco de la República*

Authorized participants	Credit institutions, brokerage firms, investment management companies, trust companies, insurance companies, securitization companies, pension and severance fund managers, Fogafin, SEDPES, SICFES, capitalization companies, CRCC, Bancóldex, FDN, FNA, Finagro and Findeter.
Operational availability	Initial operation: between 7:00 a.m. and 8:00 p.m. Return operation: before 8:00 p.m.
Limit amount	From one hundred million pesos in multiples of one hundred thousand pesos up to the limit per operation in *Banco de la República's* global policy on banking.
Eligible collateral	Security Bonds, Peace Bonds, Agricultural Development Securities (TDA), Class B TES, Solidarity Securities (TDS), sovereign debt securities, securities issued by Fogafin, and securities issued by *Banco de la República*.
Limit on number of transactions per participant	Authorized participants may access the operation more than once in the same day and for the resources required, provided they have sufficient collateral.
Cost of operation	The CRCC cost is equal to the expansion window (monetary policy rate plus one hundred basis points). For other participants: 0.1% effective annual.

Source: DEFI and DFV.

Graph A
Intraday Repos



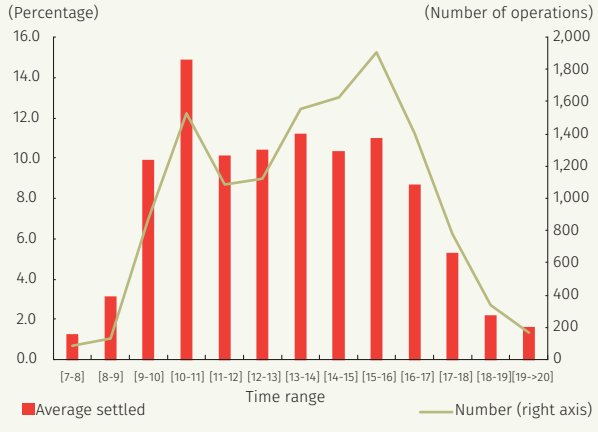
Source: *Banco de la República* (DSIF).

The growth in intraday repos was at around 20% between 2019 and 2021, with approximately COP 1.4 trillion mobilized daily, on average (Graph A). This amount is close to 3.0% of the total value of transfers made in the LVPS.

As to the time of the day when the greatest demand for resources occurs (Graph B), one sees uniform behavior between 9:00 a.m. and 4:00 p.m., during which time COP 110 billion are required per hour (on average). Additionally, there is a peak within this period between 10:00 and 11:00 in the morning. This suggests that participating institutions try to have an initial supply of intraday liquidity to meet their obligations, which is adjusted during the day but, in any case, is not sharply concentrated within a particular hour.

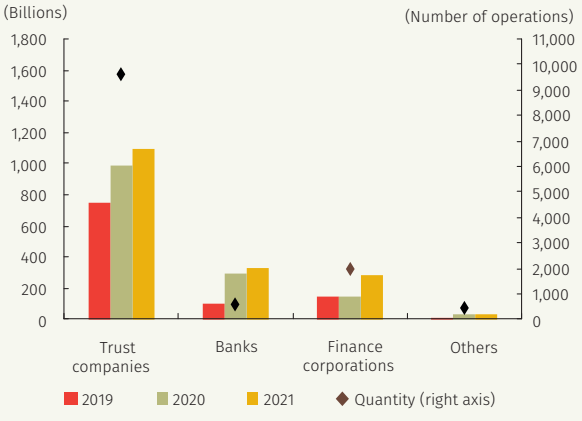
Finally, with respect to the type of institution using intraday repos, trust companies and banking establishments stand out, both in terms of the number and value needed, with close to 70% (Graph C). However, it is important to point out that while this source of payment represents 1.0% and 7.0% of all available resources for banks and financial corporations, it represents 16% for trust companies (Graph D). This reflects the importance of intraday repos as a source of payment for these institutions in the LVPS, since, in simple terms, for every COP 100 that trust companies pay in the LVPS, COP 16 are paid thanks to the funding obtained through intraday repo operations.

Graph B
Distribution of Intraday Repos by hours (2019-2021)



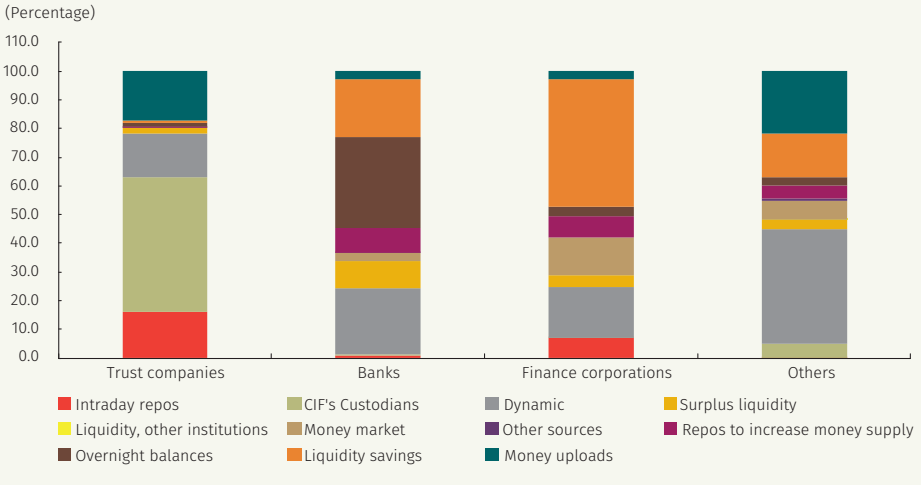
Source: *Banco de la República* (DSIF).

Graph C
Primary Users of Intraday Repos



Source: *Banco de la República* (DSIF).

Graph D
Sources of Liquidity Used for Payments (2019-2021)



Source: *Banco de la República* (DSIF).

References

Banco de la República (2022). Circular Reglamentaria Externa DEFI-354 y sus modificaciones, available at: https://www.banrep.gov.co/es/reglamentacion-expansion-y-contraccion-monetaria

Banco de la República (2019). Circular Externa Operativa y de Servicios DFV-120 Asunto 61, available at: https://www.banrep.gov.co/es/temas-filtro-a/2347/Otras%20disposiciones

CPSS-Iosco (2011). Principios para las infraestructuras del mercado financiero, available at: https://www.bis.org/cpmi/publ/d101_es.pdf

In Focus 2: **Regulatory Changes in Application of the Principle of Finality**

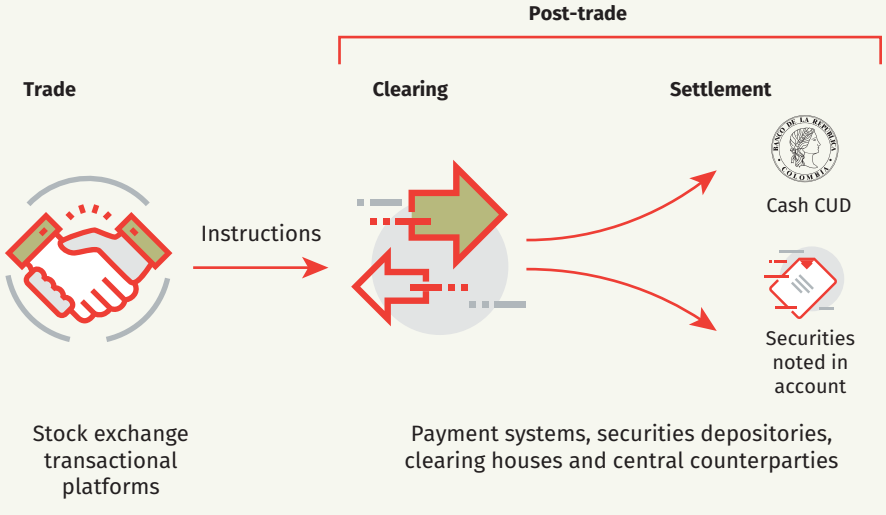
This section offers a formal definition of the principle of finality and details its application in international markets and in the local market. It is a continuation of a publication on the subject released in 2018,[1] and includes the regulatory updates made in Colombia due to modification of the principle.

Finality is framed by the context of the definition of the life cycle of a transaction, which starts with trade or negotiation (instruction or order to buy or sell), continues with clearing (calculation of the obligations of each of the participants) and ends with settlement (receipt or delivery of the traded asset).

Specifically, this cycle begins with the trading or recording of securities on stock exchanges and transactional platforms [2] and then continues in financial market infrastructures (FMIs): clearing and settlement (post-trade) in payment systems, securities depositories, clearing houses and central counterparties (Diagram A).

To ensure post-trade operations are normal and safe, FMIs have several tools to manage risks. The principle of finality is one of them. It defines the moment as of which orders for the transfer of securities and cash may not be revoked.

Diagram A
Cycle of Operations and Financial Market Infrastructures



Source: *Banco de la República.*

1 See "The Concept of Finality and It's Application in an International Example," in the 2018 edition of the Payment Systems Report.

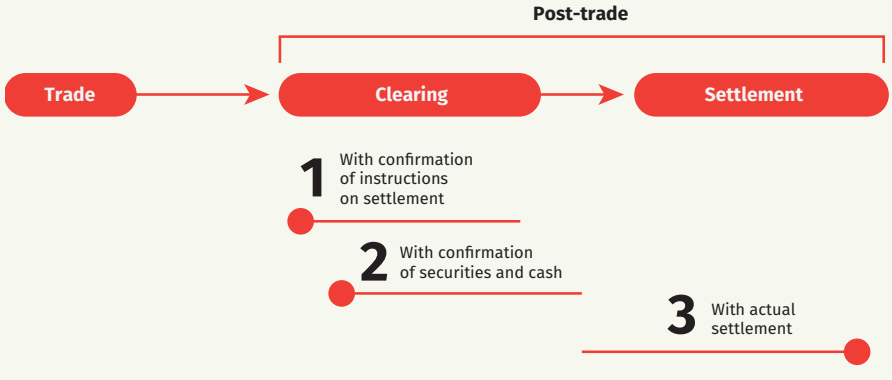
2 This refers to systems authorized by the Office of the Superintendent of Financial Institutions in Colombia that offer their participants securities trading and recording of transactions.

This tool provides protection for orders on the purchase and sale of securities from the moment they are considered firm and binding up to the time they are settled. Should judicial or administrative action be taken against a participant, using this tool does not prejudice or prevent completion of the transactions the participant may have pending in the system.

The finality principle provides a legal basis for protecting trades (i.e., those arising from judicial decisions against a participant) and mitigating systemic risk. Revoking a participant's trades between the start and the end of post-trading could pose significant credit and liquidity risks to participants and the FMI and would have detrimental consequences for the markets served by the infrastructure and, thus, for the economy as a whole.[3]

There are several points in time during the course of a transaction when finality can be set: 1) when settlement instructions on the trade are received and confirmed, 2) when clearing or settlement is initiated (securities and cash adequacy is checked) or 3) when an actual settlement is made (change ownership of assets in the securities depository and transfer of money in the large-value payment system) (Diagram B).

Diagram B
Times When the Principle of Finality is Applied



Source: *Banco de la República.*

In international markets, there is no universal rule on the timing of the application of the finality principle during the post-trade cycle. In general, the timing of finality depends on the functioning of the markets in each jurisdiction, the settlement cycle, the liquidity-saving mechanisms of the systems, and the rules institutions have on intervention and settlement, among other factors.

When reviewing the post-trading process for securities in central securities depositories in some countries, it was found that finality is set when a transaction is settled. This largely responds to the need jurisdictions have for a moment of irrevocability for intraday transactions in the system (without other legal protection). However, if finality is fixed at the time of actual settlement, the benefit of protection will be reduced if the orders are irrevocable only until they are settled completely, leaving pending transactions entered into the system possibly subject to the effects of court decisions.

3 See "Principle 8: Settlement Finality," in CPSS-Iosco (2012). Principles Applicable to Financial Market Infrastructures, April.

For example, if an institution participating in the clearing and settlement system is taken over to be liquidated, it will be subject to the decisions of a settlement agent, which could decide not to meet the institution's pending obligations in the system. This could generate a cascade of defaults in the operations of the other participating institutions and would consequently generate a system risk (as mentioned above).

Therefore, the conclusion is that the moment of finality that offers the most protection against systemic risk is finality upon confirmation of instructions received from the trading systems on the settlement of transactions.

In Colombia, the principle of finality is regulated in the Securities Act (Law 964 of 2005) and in a unitary financial decree (Decree 2555 of 2010). Article 10 of the law states that securities transactions shall be final (firm, irrevocable, enforceable, and liable to third parties) upon acceptance in clearing and settlement systems. Moreover, in an accepted operation, the securities and the respective funds involved may not be subject to judicial or administrative measures that seek to prohibit, suspend or in any way limit the payments to be made in the system.

Therefore, in Colombia, acceptance in clearing and settlement systems is regarded as the moment a transaction comes to be protected under the principle of finality.

The unitary financial decree, in this sense, initially defined[4] a transaction as accepted after having complied with the requirements and risk controls established in the regulations on the clearing and settlement system. It also differentiated the moment of acceptance in gross and net settlement systems. For the former, acceptance was given after verifying the existence of balances and making the respective accounting entries (up to settlement). For net settlement systems, the moment of acceptance occurred after verification of securities and cash (moment of finality prior to settlement).

Accordingly, acceptance after verification of collateral and compliance with transaction limits (prior to settlement) was recognized in the regulations of the Central Counterparty Risk of Colombia (CRCC).

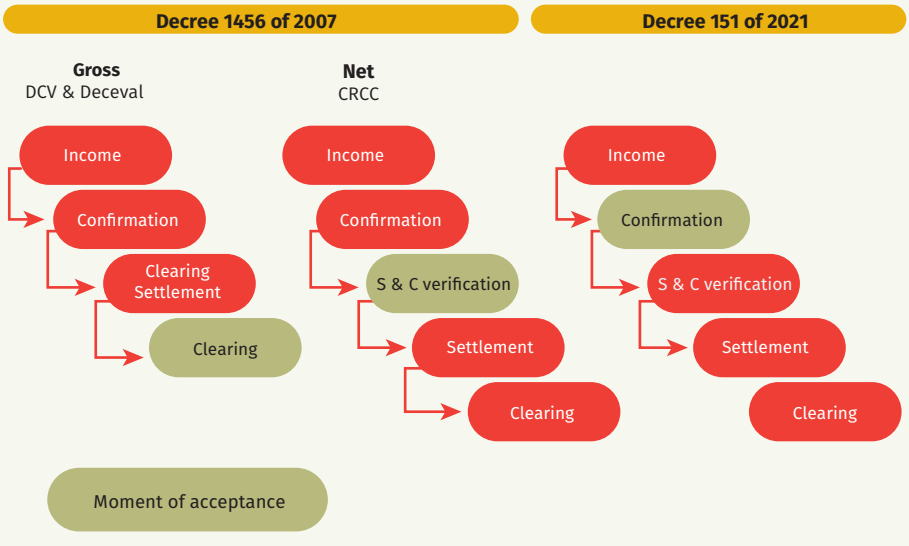
The decree maintained this differentiation between gross and net settlement systems until 2021, when it was eliminated by Decree 151, and the moment of acceptance of transactions was modified from "when they have complied with the requirements and risk controls established in the system's regulations" to "when they have been entered into the system and confirmed by the participants". This change in the moment of acceptance, as also mentioned in the decree, must be incorporated into the regulations and operating manuals of the infrastructures (Diagram C).

It represents recognition of the importance of establishing the moment of acceptance (finality) of transactions at the beginning of the post-trade cycle, minimizing the possibility of settlement risk and reflecting the main objective of the recommendations regarding the purpose of the principles for FMIs: "One of the key risks an FMI faces is settlement risk, which is the risk that settlement will not occur as planned" (see CPSS-Iosco, 2012: op. cit.).

4 Incorporating the provisions of Decree 1456 of 2007.

Therefore, according to the provisions in Decree 151 of 2021, it is now up to the local securities depositories (systems that use clearing and gross settlement) to modify their regulations and to the Office of the Superintendent of Financial Institutions in Colombia to accept them, so as to maintain the spirit of the moment of acceptance indicated in the regulation.

Diagram C
Principle of Finality in Colombia



Source: *Banco de la República.*

In Focus 3: **Changes in the Local Peso/Dollar Spot Market**

Some of the components to mitigate risk in the clearing and settlement of transactions on the peso/dollar spot market [1] have changed. First, the limit on the maximum net short position[2] (or net dollar selling position) a participant may have during the day has changed over the last two years. On the other hand, because of the merger between the Cámara de Compensación y Liquidación de Divisas de Colombia S.A. (CCDC) and the Cámara de Riesgo Central de Contraparte de Colombia S.A. (CRCC), these transactions went from being cleared through a foreign exchange clearing and settlement system to being cleared by a central counterparty risk clearing house, an entity that interposes itself between the original counterparties through the novation mechanism.[3]

Described and analyzed in this section are the changes in the dollar values cleared, in the number of transactions and in the number of participants. These changes were caused by three events that occurred during the last two years. The first is the decline in the short position limit (SPL), the second involves substitution of the type of financial infrastructure that clears and settles transactions in this market, and the third pertains to an increase in the SPL.

Tables A and B show separately the values corresponding to the transactions that were traded with compliance the same day (97.5 % of the market) and those where compliance occurred within three days of the trading date (2.5 % of the market). It shows the daily average gross and net dollar values, the number of transactions and the number of market participants with same-day and next-day compliance (t + 1 to t + 3), for the first two months of 2020. Additionally, the percentage differences are included for the periods in which the changes occurred, considering that the variations correspond to the comparisons between the period of each row and the immediately preceding period.

At the beginning of 2020, peso/dollar spot market transactions were cleared through the CCDC (without interposition between the parties), and the SPL was set at USD 80 million (m). The gross and net multilateral settled values on an average daily basis came to USD 1,515.97 m and USD 164.18 m, respectively, and the number of transactions and the number of active participants were 1963 and 33, in that order.

In March 2020, the CCDC lowered the SPL by USD 15 m through an adjustment in one of the parameters for calculating the SPL.[4] This change remained effective until February 2021. During that period, there were variations in transactions with t + 0 complian-

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1 In accordance with External Resolution 1 of 2018, the periods covered by the foreign exchange spot market are from t + 0 to t + 3.

2 If a participant is required to sell more than this limit, it would be necessary to prepay the multilateral obligations for at least the value that exceeded the limit.

3 Novation is understood as the mechanism whereby a central counterparty clearing house becomes the buyer of every seller and the seller of every buyer. Therefore, the original relationship between the parties is eliminated.

4 To mitigate liquidity risk stemming from default by its two main liquidity providers that are simultaneously active participants in dollar sales, the CCDC established the SPL as the total of pre-agreed credit lines minus the two largest credit lines in dollars. By March 2020, the sum of the lines was USD 120 m and the two largest lines totaled USD 55 m.

Table A
Behavior of Volumes and Amounts in Response to Changes in the Short Position Limit and with Novation of Transactions with Same-day Completion

Settlement t + 0 (daily average)					
Period	Gross value (millions of dollars)	Net value (millions of dollars)	Number of transactions	Number of clearing members	Type of clearing and value of short position limit
20201 - 20202	1,515,971,659.21	164,178,850.00	1963	33	Clearing without interposition SPL USD80 m
20203 - 20211	-20.6%	27.5%	-26.2%	-1	Clearing without interposition SPL USD65 m
20212 - 20219	4.2%	6.2%	13.3%	-1	Clearing with interposition SPL USD 65 m
202110 - 202112	9.4%	24.8%	7.2%	-0	Clearing with interposition SPL USD 80 m

B. Behavior of Volumes and Amounts in Response to Changes in the Short Position Limit and with Novation of Transactions with Completion between One and Three Days

Settlement Next day (daily average)					
Period	Gross value (millions of dollars)	Net value (millions of dollars)	Number of transactions	Number of clearing members	Type of clearing and value of short position limit
20201 - 20202	210,419,927.87	162,112,238.14	68	24	Clearing without interposition SPL USD80 m
20203 - 20211	-48.0%	-48.3%	-48.8%	-10	Clearing without interposition SPL USD65 m
20212 - 20219	-11.2%	3.7%	-11.8%	-1	Clearing with interposition SPL USD 65 m
202110 - 202112	16.9%	14.1%	40.3%	1	Clearing with interposition SPL USD 80 m

Source: CRCC. Calculations by *Banco de la República*.

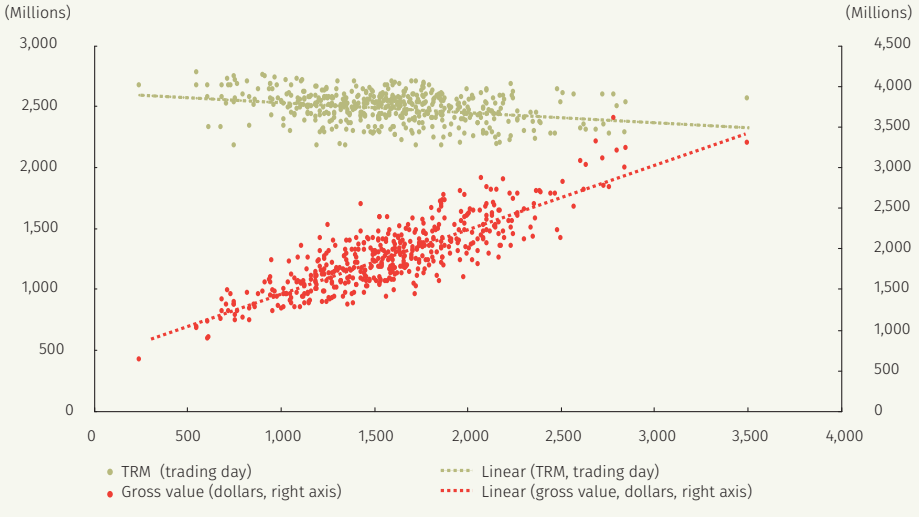
ce; namely, reductions in the gross value of cleared transactions and in the number of transactions (20.6% and 26.2%, respectively), one less active participant, and an increase of 27.5% in multilateral net values. This last variation coincides with the increase in the National Treasury Department's participation in the foreign exchange spot market.

On the other hand, with respect to operations completed in more than one day and in t + 3 (Table B), there was a decline in gross and net values, and in the number of ope-

rations cleared: 48%, 48.3% and 48.8%, respectively. Similarly, the number of active participants went from 24 to 14.

In summary, the reduction in the SPL might have negatively affected the values of the variables analyzed. Although there are other factors that could also explain this situation, such as the behavior of the peso/dollar exchange rate (TRM: representative market rate),[5] it was found that the correlation coefficient of the current TRM value and the gross value traded was -0.29 (Graph A). This reinforces the likelihood that changes in the parameters of the clearing mechanisms explain the variations in the quantity and value of market operations.

Graph A
Behavior of the TRM and Forex Spot Market Transactions
(Peso/Dollar)



Source: CRCC. Calculations by *Banco de la República*.

Clearing and settlement has been done by the CRCC since December 2020. However, as of February 2021, the CRCC began to use the novation mechanism to carry out these processes. The SPL remained at USD 65 m. These two conditions were left unchanged until September 2021. When comparing the previous period, evaluated on the basis of performance between February and September 2021, it was found that gross values, net values and the number of operations in the case of operations with t + 0 compliance had increased by 4.2%, 6.2% and 13.3%, respectively. The number of participants declined by one.

On the other hand, operations with compliance from t + 1 to t + 3 showed an increase of 3.7% in net value and a decline of 11.2% in gross value and 11.8 % in the number of operations. The number of participants also declined by one.

5 The TRM is the weighted average of the buy and sell foreign exchange rate for transactions to exchange United States dollars for Colombian pesos, agreed by exchange market intermediaries for completion in both currencies on the same trading day. The TRM in effect for any day is calculated with the operations of the previous business day.

The results were as expected. Elimination of the restriction that implied the establishment of bilateral quotas between the parties to transactions produced an increase in the analyzed variables. Likewise, participants may have had incentives to clear and settle their trades with CRCC intervention due, for example, to a substantial change in the risk management model, from one based on individual collateral requirements to one that also contemplates tools for mutualizing losses and replenishing financial resources.

Finally, in October 2021, the CRCC made an adjustment in terms of the liquidity providers by reducing the concentration of the two main credit lines and, thus, increasing the SPL by USD 15 m to UDS 80 m. A look at the period between October and December 2021 shows operations with t + 0 compliance rose in gross value, net value and number of operations by 9.4%, 24.8% and 7.2%, respectively. The number of participants remained at 31.

Operations completed in more than one day increased in gross value, in net value and in the number of operations by 16.9%, 14.1% and 40.3%, in that order. The number of participants increased by one to fourteen.

Generally speaking, it was found that the values and the number of transactions cleared and settled in the peso/dollar spot market are sensitive to changes in the SPL and to intervention in transactions through the CRCC. On the one hand, declines or increases in the SPL could affect, in the same sense, the values and volumes of trades, with a greater impact on the clearing of trades settled in more than one day. On the other hand, interposition by the CRCC could have increased the values and quantity of transactions cleared and settled for those with same-day compliance. This increase could be explained by the change in the credit and liquidity risk management model, which went from a scheme based on the management of individual collateral to a more robust one that implies a security-ring structure and the management of delays and defaults in a transversal way for all the products handled by the CRCC. However, the number of active members in this market did not increase with the change in the risk management model nor with the increase in the SPL. CRCC interposition implied the elimination of bilateral quotas in negotiation; consequently, the participation of a greater number of entities was not unexpected.

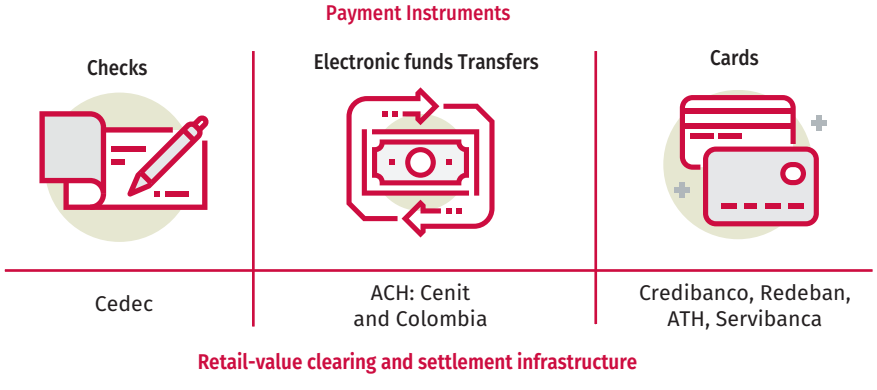
2.3 Retail Payments[13]

Electronic payments increased during 2021

According to transactional information, all electronic payment instruments increased in value versus 2020 (electronic funds transfers, checks and debit and credit cards). Electronic funds transfers continued to grow (80% from legal entities), with the participation of closed schemes driven particularly by the use of mobile wallets (35% of the number of intra-transfer transactions). The use of debit and credit cards for payments climbed to levels similar to those witnessed in the pre-pandemic year.

Some of the financial infrastructures are associated with each of the retail payment instruments in the economy:[14] the Electronic Clearing House for Checks (Cedec), managed by *Banco de la República*; the automated clearing houses for electronic payments (ACH): ACH-Cenit (also managed by the Central Bank) and ACH Colombia, which receive electronic payment orders for transferring funds; and the Credibanco networks, Redeban, ATH, Servibanca, among others, which process debit and credit card transactions made at commercial establishments and at ATMs (Diagram 2.1, Table 2.3 and Annex 2).

Diagram 2.1
Retail-value Infrastructures Operating with Payment Instruments in Colombia



Source: *Banco de la República* (DSIF).

An international comparison is provided in Annex 2 to look at the behavior of these payment instruments compared to how they are used in other countries.

13 When referring to retail payments, it is customary to frame them as payments made in the market for goods and services, with a particular characteristic of their own: at least one of the parties to the transaction, the payer or payee, is not a financial institution (BIS, 2016). This makes them thus different from payments made in the market for financial assets.

Retail payments are frequently used in different types of transactions between persons, companies and national or local governments (legal entities). They are involved on a daily basis in trade and business activity in general, in the distribution and collection of payments made by government entities and in payments between individuals, among others (BIS, 2016).

14 These instruments are used to transmit orders for the transfer of funds from a payer's account at a financial institution to a payee, for reasons such as compensation for goods and services or to transfer resources in themselves. They are characterized by having an electronic process or by incorporating an electronic format (for example, a check) at some point.

Table 2.3
Main Payment Instruments in the Colombian Economy, 2021

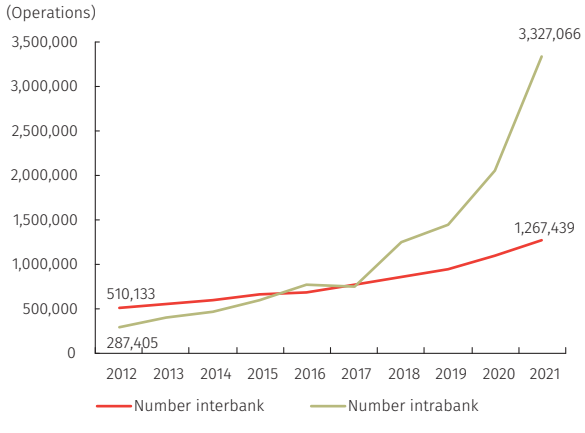
Market	Instrument	Use in Value by Originator (Percentage)	
		Individual	Legal entity
Goods and Services	Debit card	94	6
	Credit card	91	9
	Checks	21	79
	Electronic funds Transfers[a/]	5	95

a/ Pertains to the percentages of interbank transfers.
Sources: *Banco de la República*, Office of the Financial Superintendent of Colombia, commercial banks, and ACH Colombia.

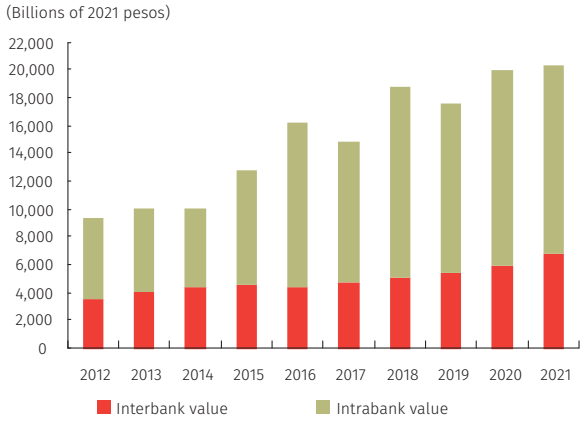
2.3.1 Electronic Funds Transfers

Graph 2.5
Electronic Funds Transfers
Daily average

A. Number



B. Value



Source: *Banco de la República*, ACH Colombia, and commercial banks.

The use of electronic funds transfers has increased in recent years, and they continue to be the most widely used electronic instrument of payment in the market for goods and services in Colombia (Graph 2.5). In 2021, these transfers (inter and intrabank) reached an average daily gross payment value of COP 20.3 t and 4.6 m transactions. Intrabank transfers in 2021 accounted for a high percentage in terms of both the number and value of total electronic funds transfers: 72% and 67%, respectively.

By source, 50% of all transfers originated with persons and 50%, with legal entities. In terms of value, 80% were made by legal entities and the remaining 20%, by individuals (Graph 2.6).

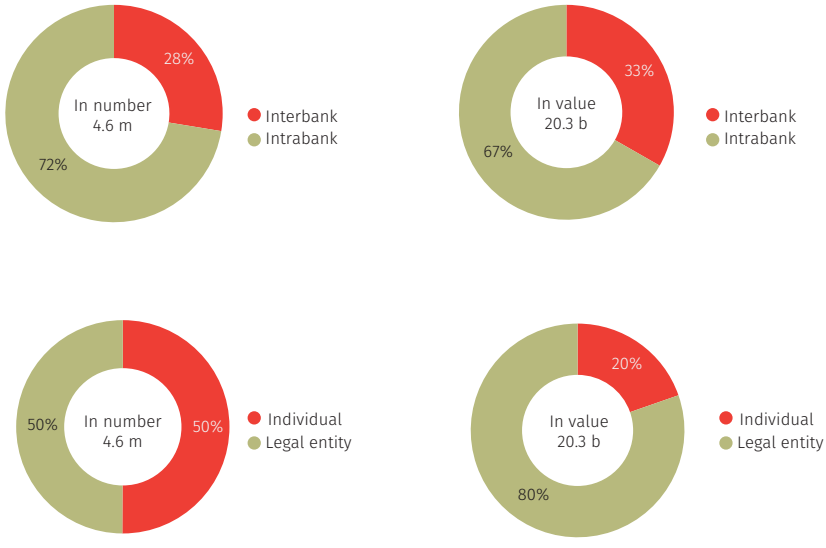
Electronic funds transfers have been the most widely used instrument in the development of new payment schemes, such as the payment button (initiator), instant payments and mobile wallets.

In 2021, the payment button and Transfiya (an instant person-to-person payment system), which are part of ACH Colombia, rose in value 34% and 217% , respectively. The value of PSE transactions in 2021 accounted for 19% of interbank transfers, while the value of Transfiya transactions represented 0.04%.

The transactionality of mobile wallets rose[15] 224% in value. This instrument accounted for 0.72% of value and 35% of the number of intrabank transfers, having been used mainly by individuals (99%).

15 The figures refer to electronic deposits.

Graph 2.6
Electronic Funds Transfers, 2021



Source: *Banco de la República*, ACH Colombia, and commercial banks.

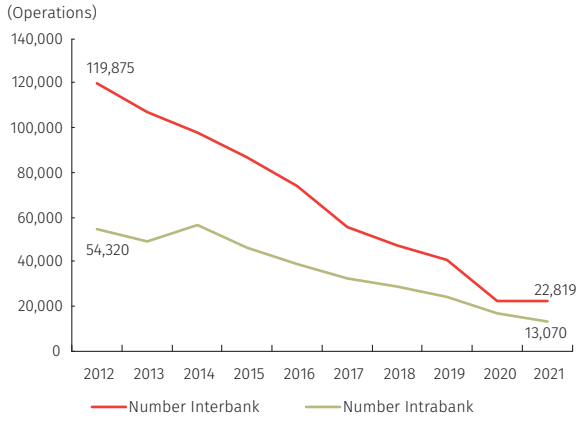
2.3.2 Checks

There has been a downward trend in the use of checks (inter and intrabank) during the last ten years. However, there was an increase of 25% between 2020 and 2021, when the gross daily average went from COP 682 b to COP 851 b. The number declined from 38.7 thousand (2020) to 35.9 thousand daily transactions, on average (2021) (Graph 2.7).

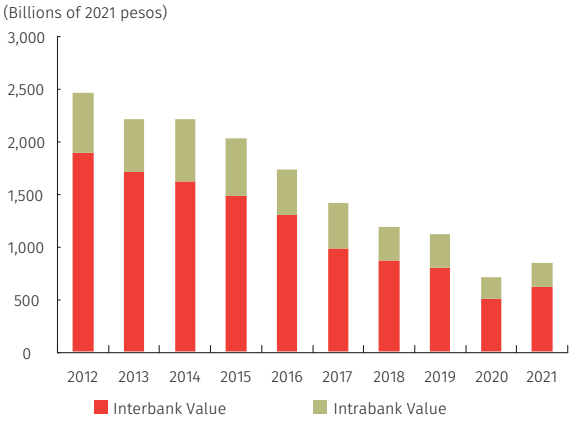
Seventy-nine percent (79%) of the value of checks cleared in 2021 came from legal entities and the remainder from individuals. Most of the checks drawn by companies (37%) are for an amount above COP 200 m.

Graph 2.7
Checks
Average daily number and value

A. Number



B. Value



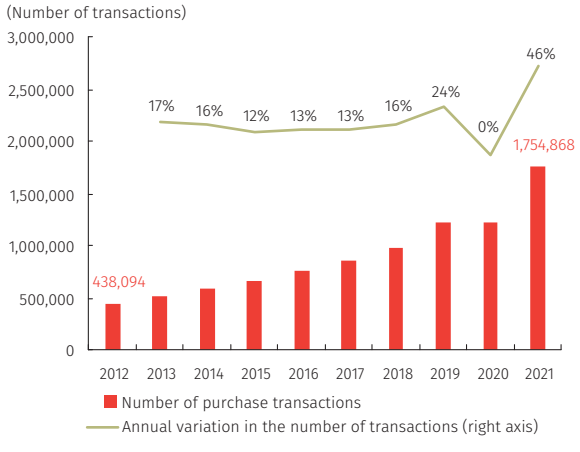
Source: *Banco de la República.*

2.3.3 Cards

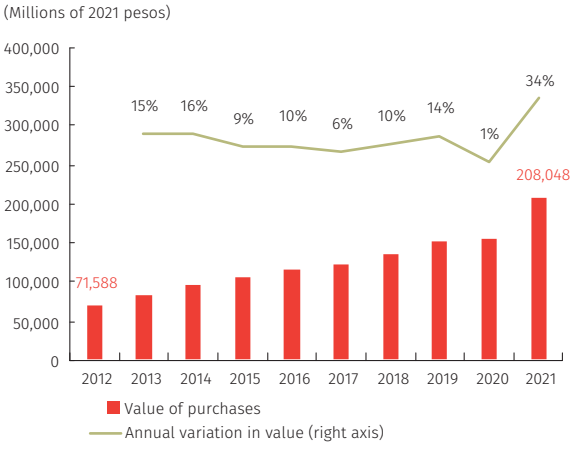
The use of debit and credit cards for purchases increased by 35% in 2021 compared to 2020. Purchases with debit and credit cards have trended upward in the last few years. However, they did decline during 2020, both in value and in the number of transactions. For 2021, the average daily value of debit card purchases came to COP 208 b and the number of transactions totaled 1.8 m, with positive respective variations of 42% and 46% versus the previous year (Graph 2.8). In the case of credit card purchases, the average daily value in 2021 was COP 153.2 b and the number came to 760,080 transactions, with positive respective variations 27% and 21% compared to the year before (Graph 2.9).

Graph 2.8
Debit Card
(Number and value of purchase transactions, daily average)

A. Number



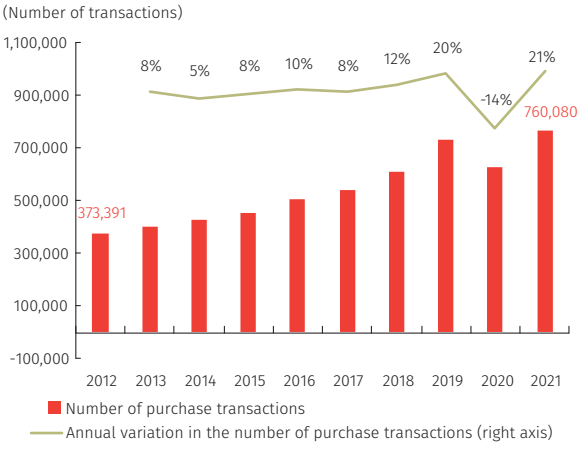
B. Value of transactions



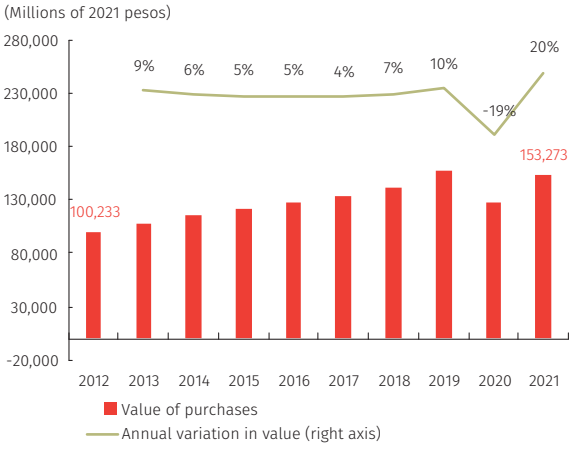
Source: Office of the Financial Superintendent of Colombia, calculations by *Banco de la República*.

Graph 2.9
Credit Card
(Number and value of purchase transactions, daily average)

A. Number



B. Value of transactions



Source: Office of the Financial Superintendent of Colombia, calculations by *Banco de la República*.

In terms of purchases, 94% of those made with debit cards and 91% of those with credit cards were made by individuals. Most transactions by individuals are for amounts up to COP 1 m (71% of debit card purchases and 55% of those with credit cards).

Cash continues to be the instrument most used by the public for routine payments.

According to the BR survey for the first half of 2022, most routine payments for food, beverages, clothing, transportation, housing, and utilities, among other items, are made in cash (78.4% according to the number of transactions and 74.6% in cash, by value). Similarly, commerce ratifies the public's response and indicates that cash is the preferred instrument for customer payments. The main results of this survey can be found in the infographic: *How do Colombians make their routine payments*? and in a separate, more detailed document to be published on *Banco de la República's* website.[16]

16 Every two years, *Banco de la República* conducts a national survey on the provision of banknotes and coins and payment instruments (Epbmip). In terms of payment instruments, the survey measures aspects concerning the population's preferences for the use of different payment instruments (cash, cards, checks and electronic funds transfers) when making routine monthly payments in the market for goods and services, i.e., payments limited to the purchase of food, beverages, clothing and payments for public utilities, as well as those related to transportation and housing. Therefore, this metric does not include payments for luxury or durable goods and services or those generated in the market for financial assets (e.g., payments for household appliances, vehicle purchases, financial obligations other than mortgage loans or the purchase of equities or government securities). Because cash is the instrument used the most in this niche of "routine payments" for goods and services, and considering that cash is not traceable, as opposed to payments made by the different electronic payment instruments (debit and credit cards, checks and electronic funds transfers), which leave a record of each transaction, the perception survey has been necessary in order to identify how the use of cash has evolved in the last nine years.

How do Colombians make their routine payments?

The Public

75% pay with cash

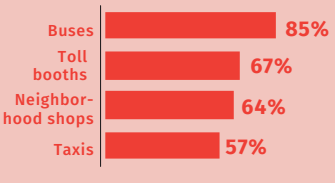
15% pay through an electronic funds transfer

8% pay with a debit card

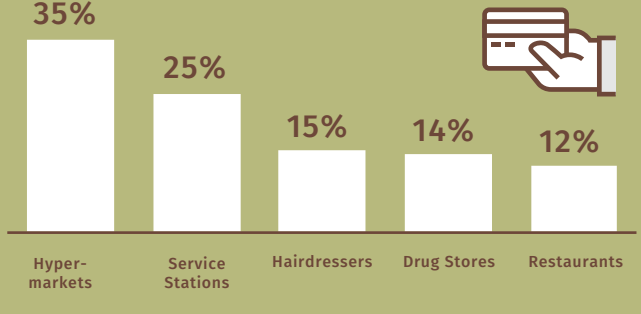
Commerce

More than **95%** of neighborhood shops, bakeries, small restaurants or cafeterias, stationary stores, buses, and taxes report that most of their sales are paid for in cash.

Percentage of channels that only take cash



Several **trade channels** report that more than **10%** of their sales are paid electronically (through Electronic funds transfers and cards).

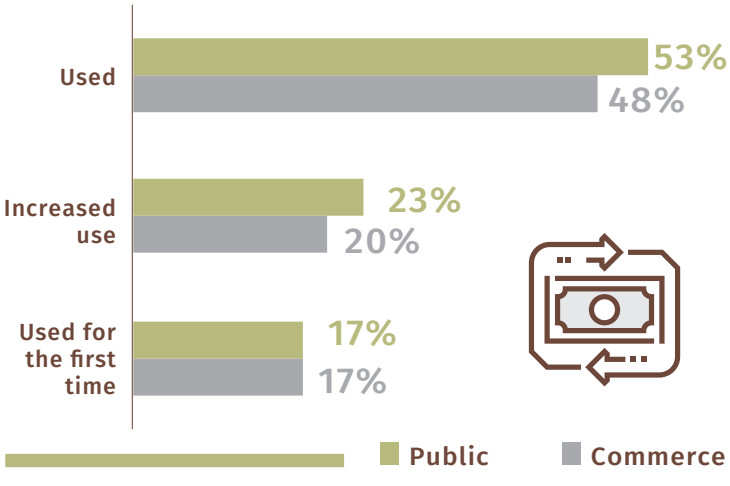


Payments during the Pandemic

About half of the population reports that their cash payments are less than they were before the pandemic.

However, for this group, the most used instrument is cash **(68%)** followed by electronic funds transfers **(21%)**.

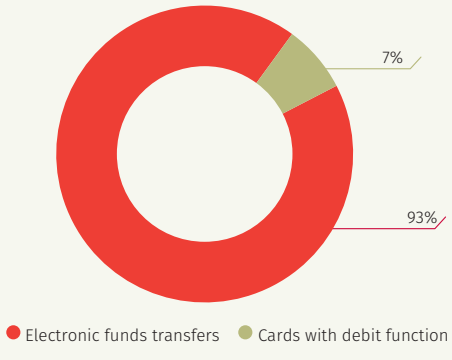
Electronic Payments Made during the Pandemic



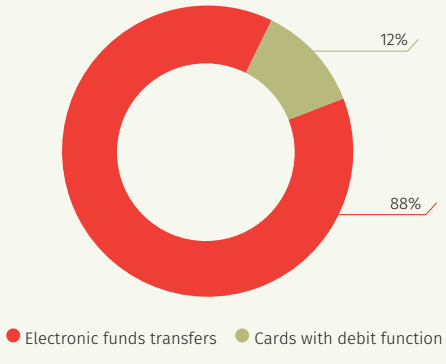
In Focus 4: **Transactional Use of Electronic Deposits**

Graph A
Payment Instruments, Electronic Deposit

1. Value



2. Number



Source: Commercial banks and Sedpes.

At the end of 2011, the national government recognized electronic deposits offered by credit institutions as demand deposits in the name of individuals or legal entities,[1] different from checking and savings accounts. This was done to encourage electronic payments, transactions and collections. Later, and to strengthen access to transactional financial services, in 2014 the law recognized companies specialized in electronic deposits and payments (Sedpes) as new financial entities.[2]

A description of the transactional use of this means of payment, which has been implemented mainly through mobile wallets, is included in this report every two years, as is customary. These replicate physical wallets on a mobile device, allowing users to employ instruments such as electronic funds transfers and debit cards for their payments. Mobile wallets are used through the Internet and mobile phone payment channels.

According to commercial banks and Sedpes, payments (purchases) made in 2021 via electronic deposits, using the aforementioned payment instruments, amounted to COP 35.4 t and to 423.3 m transactions (the daily average is COP 96.4 b and 1,159,614 transactions). Electronic deposit transactions accounted for 0.72% of the value and 35% of the number of intrabank transfers.

In terms of origin, 99% of the value and the number of transactions pertained to individuals and 1.0% to legal entities.

Transactions with transfers accounted for around 93% in terms of value and those with debit cards (debit or prepaid), 7%. As for the number of transactions, electronic funds transfers represented 88% and cards, 12% (Graph A).

Electronic funds transfers were the most widely used instrument and, by type, intrabank transfers accounted for 79% of the value and interbank transfers, 21%. In terms of number, intrabank transfers represented 82% and interbank transfers, the remaining 18%. This make-

1 Electronic deposits create the need to take advantage of technological advances for electronic transactions. Special conditions are established such as simplified opening procedures, limits on amounts, rules for the use of channels, means of handling and risk management.

2 Decree 4687 of 2011 and Law 1375 of 2014.

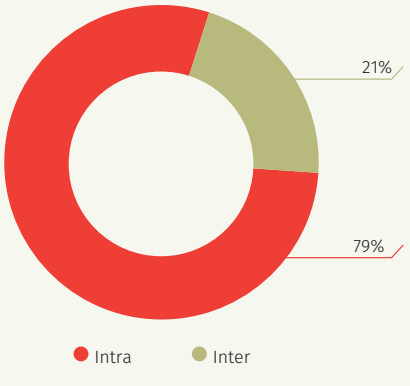
up of transfers indicates the transactional use of mobile wallets has developed within closed schemes (Graph B).

Regarding transactions in Colombian pesos, by range, those up to COP 500 thousand accounted for 73% of the value, followed by the range between COP 500,001 and COP 1,000,000, with 16%. By number of operations, 98% were in the range up to COP 500,000 (Graph C).

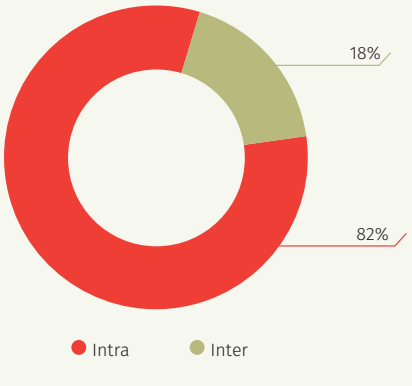
Accordingly, it is possible to conclude that electronic deposits in Colombia are used more by individuals than by legal entities. Likewise, in terms of payment instruments, transfers are used in the majority of their purchase transactions (mainly intrabank, which indicates that mobile wallets have been developed in closed schemes) for a high percentage of payments that under COP 500,000.

Graph B
Payment Instrument, Electronic funds transfer

1. Value



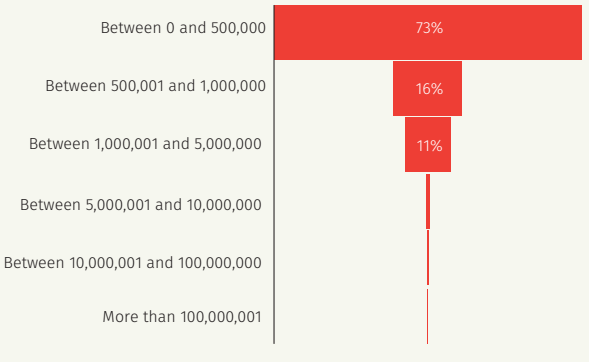
2. Number of transactions



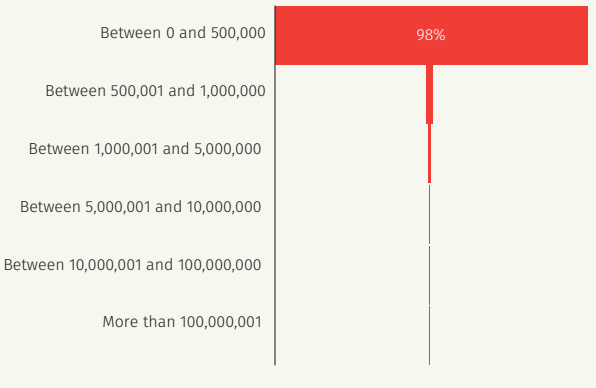
Source: Commercial banks and Sedpes.

Graph C
Payment by Range in Pesos, Electronic Deposit

1. Value



2. Number of transactions



Source: Commercial banks and Sedpes.

Box 1: The Impact of Arrears on the Large-Value Payment System (LVPS): An Initial Approximation through Simulations

1. Introduction

The large-value payment system (LVPS) is a network of participants who exchange payments during the day. Therefore, its proper functioning is based on the individual dynamics of each participant and not on the leadership of a particular institution or even on a general agreement among the participants. In other words, each institution organizes its payments individually, seeking to satisfy its own interests; however, such behavior does not necessarily create benefits for the rest of the participants in the system.

There are a variety of reasons why an institution may be unable to make payments on time. These can range from structural situations related to the institution's financial capacity to make its payments (i.e., bankruptcy) to momentary circumstances, such as a breakdown in its communications network or the impossibility of physically accessing the institution's facilities due to difficulties that affect law and order. In fact, problems with law and order can impact normal operation of the LVPS during the rest of the day.

Based on the foregoing, this section represents an attempt to quantify the possible impact on liquidity that may occur in the LVPS due to a temporary delay (i. e.: during the day) in the normal flow of an institution's operations, but in a situation where the affected institution would, in any case, comply with all its payments before the end of the day.

2. Necessary Minimum Liquidity (*Upper Bound*)

The Colombian LVPS, known as the Deposit Account System (CUD), provides a service for authorized participating institutions to transfer funds and record fund transactions between deposit accounts, in their own name or in the name of their clients, in order to settle obligations agreed on in financial markets, as well as clearing for other financial market infrastructures (FMIs).

Real time gross settlement (RTGS), which is the modus operandi of the CUD, allows money to be transferred and transactions to be settled one by one for their gross value and to be completed immediately (in real time), provided the originating institution has a sufficient balance in its deposit account. Thus, the CUD eliminates settlement risk by debiting the originator and crediting the payee immediately for each individual transaction.

The CUD has ways and means to expedite the settlement of transfer orders and to reduce the liquidity required for this purpose.[1] In addition, BanRep offers intraday repos to minimize obstacles to transactions and to help payments to be made on time.[2]

Although the system has mechanisms to optimize the settlement of transactions, it is the participants who, based on the liquidity sources available to them, manage the sequence in which they settle their payments during the day and, thus, their minimum liquidity needs.

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1 These mechanisms are described in Section 2 of Chapter III in the Payment Systems Manual, External Operating and Service Circular DSP-158 dated 17 January 2022.

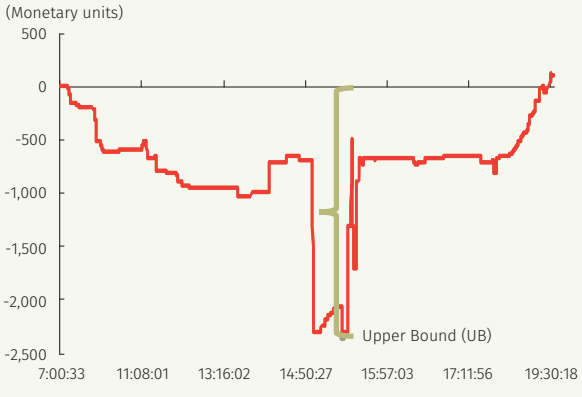
2 As per the provisions In External Regulatory Circular DFV-120, Issue 61 "Intraday Repo," in the Fiduciary and Securities Department Manual.

In RTGS systems, such as the CUD, a participant's minimum daily liquidity needs for a set of liquid transactions can be estimated, as suggested by Koponen and Soramäki (1998), via the upper bound (UB) concept, which represents the minimum balance the institution should have had at the start of the day to successfully settle all its payment obligations in the sequence in which they were recorded. This daily UB for an institution can be calculated as follows:

$$UB_t = |\ min\ [0; min \Sigma^{t}_{j=0}(P^{I}_{j} - P^{O}_{j});\ \forall t \in [0,T]]|$$

Where P^{I}_{j} y P^{O}_{j} are, respectively, the incoming and outgoing payments at time j, and T is the time when the system closes its operations for the day. Therefore, during an operating day between (0,T), if an institution had the following sequence of payments {(j=0,0),(j=1,+20(incoming payment)),(j=2,-40(outgoing payment)),(j=3,-60(outgoing payment)),(j=4,+10(incoming payment))}, then the value of its UB at different times during the day would be {(t=0,0),(t=1,0),(t=2,20),(t=3,80),(t=4,80)} and, for the entire day T=4, the minimum balance needed at the start of the day to meet the full sequence of payments (UB_T) would be 80.

Graph B1.1
Determining Mininum Liquidity Needs



Source: *Banco de la República* (DSIF).

It is important to note that the Basel Committee on Banking Supervision has now included this approach in its comprehensive supervisory framework, particularly with respect to the tools available to establish metrics to assess liquidity risk.[3]

As illustrated in Graph B1.1, the UB is the lowest point in an intraday balance path that starts with a balance of zero and is updated with each transaction that credits (debits) incoming (outgoing) resources at the time they are recorded (actual payments). Changes in the sequence or timing of an institution's payments, either to bring them forward or to delay them, may cause the liquidity needs or the UB to change. For example, if the value of payments received by an institution in one day is equal to or greater than the value of those it delivers, it could first wait to be paid and then make its payments with the liquidity it receives, strategically adopting a free-rider stance on intraday liquidity and, thus, reducing its UB to zero.

Accordingly, for an institution that postpones it payments and relies more on the resources it receives from its counterparties as a source of intraday liquidity to comply with its obligations, the balance at the start of the day becomes less important. On the other hand, the situation of the counterparties receiving payments from the postponing entity could be the opposite, since the delay in the resources they receive during the day reduces the importance of this source of liquidity to fund their payments and forces them to strengthen other alternative sources such as the start-of-day balance, to the extent determined by their UB.

When the path of an institution's intraday balance is located entirely above the horizontal axis (i.e., it is greater than zero), this means it has met all its payment obligations on time by funding itself with the liquidity it received from its counterparties.

In a LVPS such as the CUD (which does not grant overdrafts), an institution needs a balance at the start of the day that is at least

3 For more information, see "Liquidity Monitoring Metrics "(SRP050), a chapter that is part of Pillar II in the supervisory review process, available at: https://www.bis.org/basel_framework/standard/SRP.htm.

equal to the UB, if it is to settle all its transactions on time. Otherwise, part of its obligations might not be met in the observed sequence.

2. Delaying Payments and their Measurement

Delaying payments could favor the institution that does so, insofar as it allows it to fund a larger fraction of its payments with the liquidity it receives from its counterparties. However, an institution might not necessarily postpone payments during the day because of a strategic decision aimed at reducing its UB, but due to some operational failure, as mentioned in the introduction, such as the one associated with its computer infrastructure that prevents it from sending payments to its counterparties for a few minutes or hours.

To measure the impact of payment deferral on the minimum liquidity needs of CUD participants, a simulation exercise was done using the Bank of Finland's payment system simulator (BoF-PSS2). It is important to recognize, as an assumption in the exercise, that the institutions, except for the one that postpones its payments, assume a passive attitude, and send their payments in the "normal" sequence, despite the delay.

The exercise has multiple objectives. The first is to quantify the positive (negative) effects a temporary (i. e.: hours) postponement of payments would have on the postponing institution (the counterparties of the postponing institution). The second is to gauge if the counterparties of the postponing institution have enough additional liquidity (namely, the liquidity they can obtain through intraday repos with BanRep) to meet the increased liquidity needs (UB) resulting from the postponement; and the third is to quantify, at an aggregate level, the resulting net effect on liquidity needs (while the postponing institution may reduce its UB, its counterparties may increase theirs).

The ten days with the largest payments settled in the CUD were selected for this purpose (between 02 January 2020 and January 19, 2020), and the institutions' UBs were calculated for the payment sequences that were observed. The two-hour time slot when the largest payments in the day originated was identified for each of these days, and the financial institution that sent the largest payments was identified for each of these slots.

To gauge the impact payment deferral has on the individual liquidity needs (UB) of the deferrer and its counterparties, a scenario was developed in which the institution that most sends payments during the period with the largest payments on the selected days fails to do so and, only when that time period is over, does it recover the momentum in its payments by sending the payments that were not settled during that period, respecting the order in which they occurred originally.

Simulated payment sequences were constructed for this purpose for each of the selected days. This was done by changing the original schedule observed for the transactions sent by the most active institution within the two-hour period with the largest payment value for a schedule in which the institution maintains the actual order of its late payments but sends them consecutively with an interval of fifteen seconds between each deferred transaction, once the two-hour period is over.[4]

To evaluate how much the liquidity needs would vary at an individual and aggregate level because of an institution's payment deferral, the minimum liquidity needs (UB) were calculated for these new simulated payment sequences.

4 A two-hour deferral is the standard time considered in international best practices for the recovery and resumption of critical functions after an outage occurs. See "Federal Reserve System. Interagency Paper on Sound Practices to Strengthen the Resilience of the U.S. Financial System". April 2003 and the "European Central Bank – Issues Paper on Payment Systems Continuity. May 2005, at: https://www.newyorkfed.org/medialibrary/media/banking/circulars/11522.pdf and https://www.ecb.europa.eu/paym/pdf/cons/paysysbusinesscontinuity/paysysbusinesscontinuity.pdf

By way of illustration, Graph B1.2 shows the differential effects of two-day payment deferrals on the observed and simulated intraday balance paths and their respective UBs, for both the deferring institution and its main receiving counterparty.

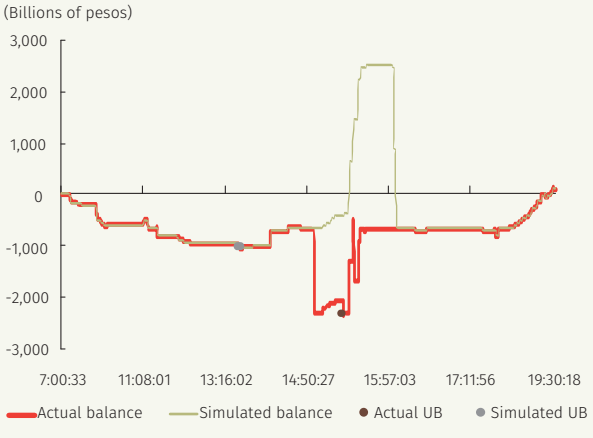
As shown in Graph B1.2, for day five (5), the institution that stops sending payments in the 14:00:00-15:59:59 time frame would reduce its minimum liquidity needs (UB) by approximately COP 1.3 trillion (t), because the liquidity it receives during that time frame allows it to fund its delayed payments later, thereby reducing the need to fund its payments with its initial liquidity. On the other hand, its main counterparty receiving payments would experience a slight increase in its UB, on the order of COP 300 million (m), which corresponds to 0.2% of the observed scenario.

For day one (1), the institution that postpones payments in the same time slot would not obtain the benefit of reducing its UB but would cause its main counterparty to increase its UB by COP 49 billion, a figure that is equivalent to more than 1.8 times the minimum liquidity required in its observed sequence of payments (actual UB).

Graph B1.2
Effect of Payment Delay on the Intraday Balance and Minimum Liquidity Requirements

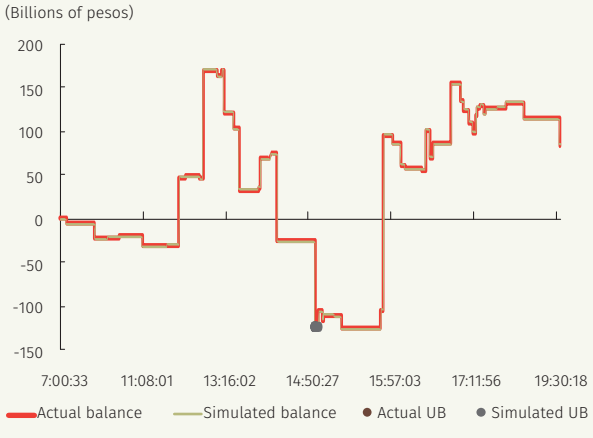
A. Institution delaying payment

i. Day 5 (10/01/2021)

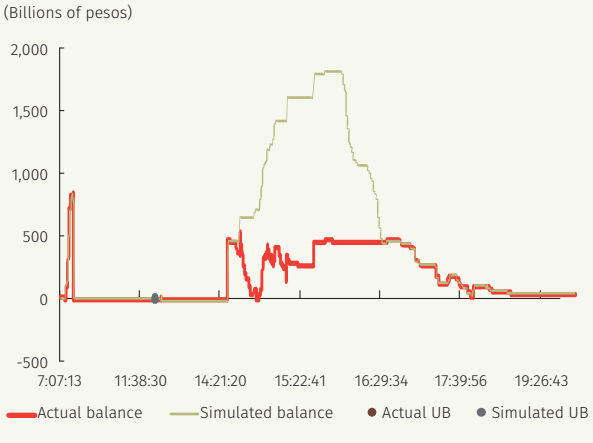


B. Main counterparty receiving payments

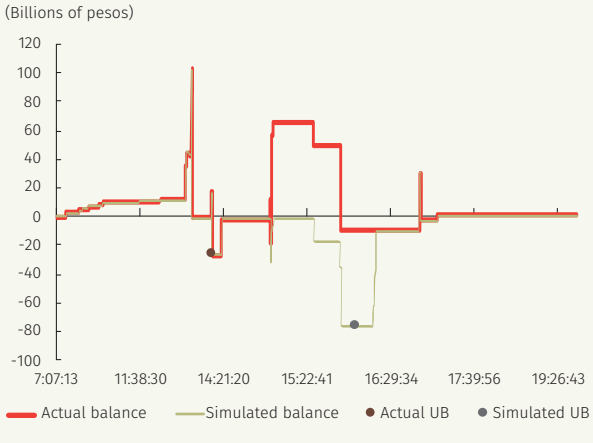
i. Day 5 (10/01/2021)



ii. Day 1 (03/12/2020)



ii. Day 1 (03/12/2020)



Source: *Banco de la República* (DSIF).

3. Initial Results

Summarized in Table B1.1 are the results of the simulation exercise for the ten days with the largest payment values settled in the CUD during the period under consideration. The two-hour window with the largest payment value, the value of settled payments and the minimum liquidity requirements (UB) for the observed and simulated payment sequences are shown for each of the days.

Table B1.1 is interpreted as follows. For day 2, the sum of all UBs of the institutions participating in the LVPS was COP 14,445.7 billion (b). As a result of the delay in payments by the institution with the largest payment value during the 14:00 to 15:59 time frame, the new value of the UB for the participants was COP 14,406.3 billion; in other words, it declined by COP 39.4 billion, net. This reduction is explained by three institutions that increased their UBs by a total of COP 28.6 billion and one institution (the one that delayed payments) that reduced its UB by COP 68 billion. Therefore, the following can be inferred from Table B1.1:

- The two-hour window in which the largest value of payments is settled is not always the same in the sample, but the most recurrent one is between 14:00:00:00 and 15:59:59:59.
- In the face of changes in payment sequences due to deferral, the minimum initial liquidity requirements (UB), in the aggregate, may increase or decline (i. e.: B – A).
- Increases in the UB in the system occur when:
  - The UB of the institution deferring payments remains the same, but that of its counterparties increases. This is observed on days 1 and 4, when the number of institutions that reduced their UB was zero, while 2 entities, for day 1, and 6 entities for day 4, increased theirs.
  - The reduction in UB experienced by the institution in arrears is more than offset by the increases in the UB of its counterparties. This occurs on day 6, when the decline in the UB of the institution in arrears was COP 55.1 (b), but the increase in UB experienced by 4 affected institutions was COP 143.8 (b).

Table B1.1
Minimum Liquidity Needs in a Scenario of Delayed Payments
(Billions of pesos)[a/]

Day	Date	Settled Value	Two-hour Time Slot with Highest Settled Value	Minimum required liquidity (UB)			Increases in UB		Reductions in UB	
				(A) Actual sequence	(B) Simulated sequence with two-hour payment delays	(B)-(A)	Number of institutions	Total value	Number of institutions	Total value
1	3/12/2020	56,644.3	14:00:00-15:59:59	8,597.8	8,647.7	49.9	2	49.9	0	0.0
2	3/16/2020	49,847.6	14:00:00-15:59:59	14,445.7	14,406.3	-39.4	3	28.6	1	-68.0
3	3/17/2020	47,863.0	17:00:00-18:59:59	14,398.8	14,352.6	-46.3	4	132.8	1	-179.1
4	9/14/2020	55,965.5	14:00:00-15:59:59	9,165.1	9,209.7	44.7	6	44.7	0	0.0
5	10/1/2021	50,374.0	14:00:00-15:59:59	13,817.5	12,500.2	-1,317.3	1	0.3	1	-1,317.6
6	11/2/2021	53,852.6	15:00:00-16:59:59	14,113.8	14,202.6	88.7	4	143.8	1	-55.1
7	11/22/2021	55,415.1	14:00:00-15:59:59	10,940.4	9,700.9	-1,239.5	4	22.0	1	-1,261.5
8	1/3/2022	39,604.6	13:00:00-14:59:59	14,591.8	13,641.1	-950.6	1	7.9	1	-958.6
9	1/14/2022	55,306.7	14:00:00-15:59:59	13,907.2	13,783.6	-123.7	4	91.7	1	-215.4
10	1/19/2022	52,678.9	13:00:00-14:59:59	14,255.9	14,221.0	-34.8	1	4.5	1	-39.4

a/ Payments settled in the CUD with the exception of those settled by BR, the DCV and retail-value FMIs.
Source: *Banco de la República* (DSIF).

- The reductions in the aggregate UB for the system are because the benefit in the reduction of the UB for the institution that postpones payments is stronger than the increases in UB experienced by its counterparts (days 5, 7, 8, 9, and 10).
- Payment deferrals on eight of the ten days would have benefited the deferring institution by reducing the requirement for larger opening balances to fund the value of its payments during the day.

4. The Capacity of Affected Participants to React

In view of these findings, it is helpful to determine if the counterparties, given the increased liquidity needs resulting from the delay by the main payment originator in the two most active hours, have sufficient resources to make their payments autonomously and without having to depend on outside sources of liquidity. Accordingly, an assessment is made as to whether the CUD balances of the counterparties observed at the beginning of the day would be sufficient to cover the increased liquidity needs resulting from the simulated scenario (UB estimated for the simulated sequence of payments). Moreover, recognizing that, besides their balance in the CUD, the institutions have a portfolio that can be used in intraday repo operations with BanRep, it will also be determined whether the addition of this liquidity would be sufficient to fund all their payments in the known sequence.

In general, Table B1.2 shows the increases in minimum liquidity requirements resulting from the simulated backlog scenario (simulated UB) could not be covered on most of the days in question by the actual CUD balances of the institutions that are counterparties on days 1 to 9 (except for day 5). However, when adding the possible liquidity to be obtained through repos with BanRep, these shortfalls are fully covered on days 1, 7 and 8, and partially covered on days 3, 4, 6, and 9.

5. Closing Comments

The simulation exercise outlined in this section is an initial approximation that makes it possible to quantify the liquidity effects a delay in payments by a relevant LVPS institution could have on the system. The methodology proposed by Koponen and Soramäki (1998), known as UB, was applied for this purpose. It involves estimating the maximum negative net positions the institutions can experience in one operating day. The sum of these positions is equivalent to the combined requirements of the system.

Table B1.2
Coverage of Minimum Liquidity Needs in a Scenario of Payment Arrears
(Billions of pesos)

Day	Date	Increases in UB Due to Payment Arrears		Insufficient CUD balance		Insufficient CUD Balance Plus liquidity backed by TES insufficient DCV	
		Number of institutions	Total increase	Number of institutions	Total balance lacking	Number of institutions	Total balance lacking
1	3/12/2020	2	49.9	1	42.7	0	0.0
2	3/16/2020	3	28.6	2	27.1	2	27.1
3	3/17/2020	4	132.8	4	129.5	3	102.1
4	9/14/2020	6	44.7	4	44.3	3	30.4
5	10/1/2021	1	0.3	0	0.0	0	-1,317.6
6	11/2/2021	4	143.8	4	143.7	2	4.0
7	11/22/2021	4	22.0	1	20.6	0	0.0
8	1/3/2022	1	7.9	1	7.6	0	0.0
9	1/14/2022	4	91.7	3	3.7	1	2.6
10	1/19/2022	1	4.5	0	0.0	0	0.0

Source: *Banco de la República* (DSIF)

The results were interesting in several respects. Initially, it was found that on only three of the ten busiest days of LVPS activity (days 1, 4 and 6 in Table B1.1) did the delay in payments by a relevant participant result in an increase in the aggregate needs of the system. This is because the increase in the liquidity needs of participants affected by the delay in payments was not fully offset by the decline in UB experienced by the participant delaying payments. Likewise, it was found that on days 1 and 4 the participant who delayed payments did not experience changes in its UB.

Another effect deals with determining whether those participants who experienced an increase in their UB had the capacity to absorb it; in other words, if the observed balances were greater than the new UB. In this case, on five of the ten days analyzed, the affected participants had sufficient liquidity (in cash and/or securities) to meet their increased liquidity needs autonomously and without having to depend on outside sources.

Although the sample analyzed is intended to illustrate the methodology used for the exercise, the latter turns out to be a starting point for knowing how sensitive the system's liquidity needs are to the impact a participant's delay of x hours. Initially, the expectation is that the more hours of delay, the greater the effect will be, although not in a liner sense. Gauging this will necessitate increasing the window of days analyzed, as well as the number of hours of delay in payments, which will be done with a computing tool that allows for processing the large amounts of data these types of simulation exercises require.

References

Koponen, R. and Soramäki, K. "Intraday Liquidity Needs in a Modern Interbank Payment System -A Simulation Approach," BANK OF FINLAND STUDIES E:14 • 1998.

Comité de Sistemas de Pago y Liquidación, y Comité Técnico de la Organización Internacional de Comisiones de Valores (2012). "Principios para las infraestructuras del mercado financiero," July; available at: https://www.bis.org/cpmi/publ/d94_es.pdf

Box 2: Stress Testing to Confirm the Resilience of Central Counterparties

Some central banks, financial authorities and international bodies consider central counterparties (CCPs) to be systemically important, and continuity in the provision of their services is regarded as critical to the stability of the financial system. Given their nature, CCPs are counterparties to all their clearing members. The possibility that CCPs do not adequately mitigate the risks they face and those that arise from their role as central counterparties could have a direct impact on their financial health, that of their members and the markets they serve, which could have potential systemic effects. Moreover, in some cases CCPs are highly interconnected through common participants. This can propagate the failures at one CCP throughout the system.

CCPs can increase the resilience of the financial system by simplifying financial interconnections and by ensuring that transactions are safer and more transparent than if they were conducted bilaterally (see Mariño et al., 2020). At the same time, due to their increasingly central role in the financial system and the reliance that members have on them, disruptions in CCPs now have more potential to cause stress in the financial system (Wenqian and Takáts, 2020; Wilkes, 2020; BIS, 2014; Wendt, 2015). A key tool for approximating the resilience of CCPs is the application of stress tests to gauge their ability to withstand extreme market scenarios and multiple member defaults.

According to the Bank of England (2021), while daily stress tests performed by CCPs focus on their own risk management, market clearing and cleared products, supervisory stress tests of CCPs can be used to achieve a system-wide view. Therefore, supervisory stress tests are better suited to capture and assess the connections, dependencies, and shared risk factors between CCPs, their members and their service providers.

In this regard, some financial authorities use stress tests as tools to assess the resilience of CCPs. The purpose of these tests is to measure the individual CCP's ability to withstand stress events caused by its members and the markets, and the resilience of the clearing network and its interaction with the rest of the financial system. Moreover, stress tests promote transparency and help to establish public confidence in the financial system. They also provide information to market participants, and act as a mechanism whereby the authorities can strengthen their tools to ensure financial stability.

This section offers some examples of recommendations issued by international organizations on the subject and summarizes several stress test exercises conducted by the financial authorities in the European Union (EU), the United States of America and England. Stress tests performed by the Central Counterparty of Colombia S. A. (CRCC), the Office of the Superintendent of Financial Institutions in Colombia (SFC) and *Banco de la República* (BanRep) are described for the Colombian case.

1. Payments and Market Infrastructure Committees and the Board of the International Organization of Securities Commissions (CPMI and Iosco).

The CPMI and Iosco published the Principles for Financial Market Infrastructures (PFMIs) in 2012, which strengthened and harmonized the three pre-existing sets of international standards for financial market infrastructures (FMIs) by increasing minimum standards, providing more detailed guidance, and expanding the scope of the standards to cover new areas of risk management. Among other aspects, the PFMIs note that CCPs should have enough financial resources to cover simultaneous default by their two largest clearing members and their subsidiaries, in addition to the need to ensure that these resources are available.

In April 2015, the G20 finance ministers and central bank governors asked the Financial Stability Board (FSB) to work jointly with the CPMI, Iosco and the Basel Committee on Banking Supervision to develop and present reports on a work plan to identify and address the CCP-related weaknesses and potential financial stability risks that are systemic across multiple jurisdictions. Thus, joint plans were put in place to address the priorities related to CCP resilience, recovery, and resolution.

The committees also were asked to assess CCPs' stress testing policies and practices, and to consider the need to establish a consistent and comparable framework for stress testing that seeks to measure the efficiency of CCPs' financial resources (including capital) and liquidity arrangements. In addition, they were asked to explore how stress tests are conducted by supervisory authorities.

As a result, CPMI-Iosco issued a document entitled "Framework for Supervisory Stress Testing of Central Counterparties (CCPs)" in April 2018. It defines a framework for supervisory stress testing (SST), which refers to exercises designed and executed by financial authorities, with or without the direct involvement of CCPs. SST can be designed to achieve specific objectives; for example, to assess the resilience of a given CCP in a specific stress scenario; that is, to assess effects at the micro level. At the macro level, the objective is to assess the potential systemic effects associated with a stress event that impacts multiple CCPs.

Because different authorities with different responsibilities, legal frameworks, expertise, and resources may be involved in each stress test exercise, the framework establishes a flexible, high-level approach to designing and conducting the tests. Given the number of variables at play, this guidance is intended to help authorities consider various approaches and decision points, while recognizing that each option may not be uniformly applicable across all authorities or jurisdictions. Authorities will need to consider each of these situations in view of their particular mandates and must design their tests accordingly.

The general framework for testing sets out the following six components that describe the steps authorities would likely follow in designing and executing these tests: 1) define the objective of each exercise; 2) establish institutional arrangements; 3) develop stress scenarios; 4) collect and protect information; 5) combine results and develop analytical metrics; and 6) determine how the results will be used and circulated.

In November 2020, the chairs of the FSB, CPMI, Iosco and the FSB Resolution Steering Group publicly agreed to collaborate and continue the effort to review CCP financial resources in terms of recovery and resolution. This work will examine the need for international policy on the use, composition and volume of financial resources for recovery and resolution, and develop relevant policy to further strengthen the resilience and resolution of CCPs in scenarios of losses generated by defaults or any other event. The results of this first exercise are expected to be published by the end of the first half of 2022.

Table B2.1
Stress Tests according to risk in several jurisdictions

Jurisdiction	Credit risk	Liquidity risk	Concentration risk	Operational risk
European Union	X	X	X	X
United States	X	X		
England	X	X	X	
Colombia	X	X		

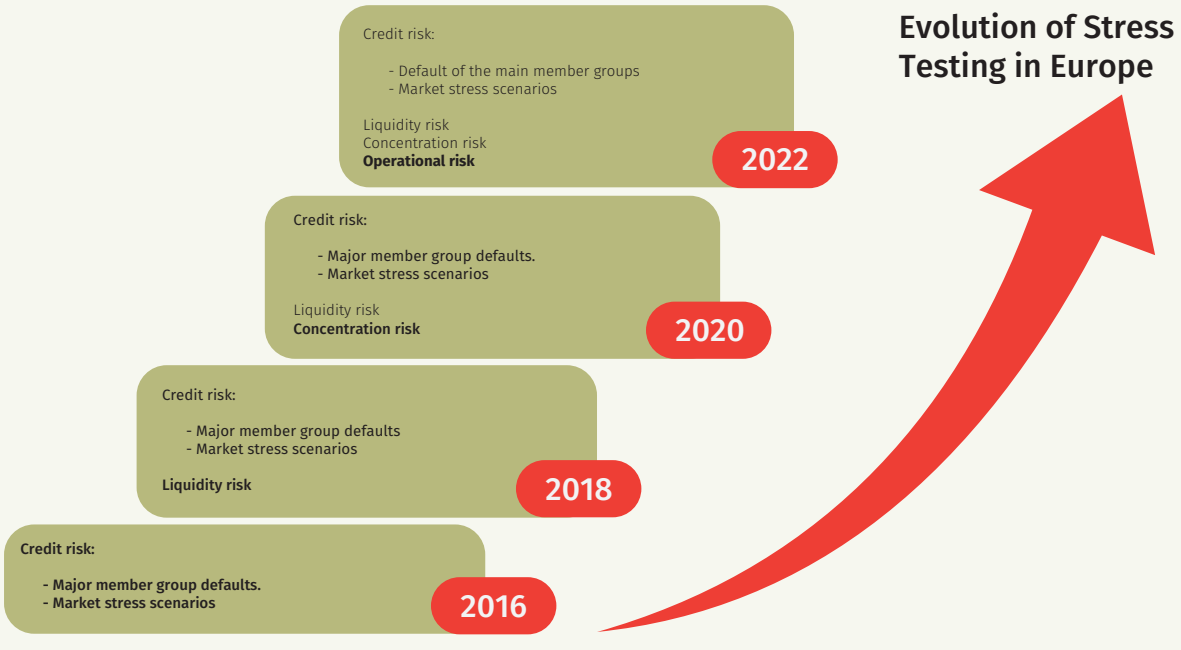
Source: Own calculations based on the sources described in section 2.

In addition to these multilateral initiatives, supervisory authorities in some jurisdictions have conducted stress tests of CCPs. Table B2.1 shows the types of risks assessed through stress tests in the selected jurisdictions.

2. Developments in Stress Testing in the European Union

Regulation EU-No 648/2012 of the European Parliament and Council establishes guidelines on OTC derivatives, central counterparties, and trade repositories. It specifies that each member state shall designate a competent authority to perform the functions required to apply the regulation when it comes to authorization and supervision of the CCPs established in its territory and to report to the European Securities and Markets Authority (ESMA). The latter will play a coordinating role in creating a common supervisory culture and ensuring uniform procedures and consistent approaches. Building on this legal and institutional structure, ESMA has conducted four stress testing exercises for CCPs operating in the EU. Each exercise involved a new test element with respect to the previous one, representing a constant evolution. Diagram B2.1 shows the risks assessed in each exercise.

Diagram B2.1
Evolution of Stress Testing in Europe



Sources: Reports of the ESMA stress test results; diagram prepared by *Banco de la República*.

The first exercise began in 2014 and the final report was published in April 2016.[1] It assessed the resilience of 17 CCPs and focused on the counterparty credit risk that EU CCPs would face because of multiple defaults by major clearing members[2] and simultaneous market price shocks. The exercise was supplemented with an analysis of the concentration of CCP exposure and potential spillover effects on non-defaulting clearing members, assessing the likelihood of additional defaults triggered by the CCP loss absorption mechanism.

1 This stress test on CCPs was the first exercise. There is no evidence of a similar exercise in any other jurisdiction (ESMA, 2016).

2 The financial significance of major groups is determined by the largest exposure they represent for CCPs, including exposure weighted by the probability of default.

The second exercise was launched in 2017 and the report on the results was published in February 2018 (ESMA, 2018). Compared to the first exercise, ESMA broadened the scope to include tests to measure CCPs' resilience to liquidity risk and strengthened the framework for defining scenarios and validating the test results set out in the first exercise. From a liquidity risk perspective, it examined whether CCPs had sufficient tools or sources of liquidity to cover default by their two largest members. The exercise tested the resilience of 16 European CCPs with approximately 900 clearing members across the EU.

The third exercise was begun in 2019 and the report on the results was published in July 2020 (ESMA, 2020). It covered credit and liquidity risks, with specific improvements in the methodology compared to the previous two exercises.[3] In addition, a stress test to assess the impact of the cost of liquidating concentrated positions (concentration risk) was included for the first time.

Concentration risk was assessed on the share of members' contributions to default funds and on the value of credit lines with liquidity providers. The larger the contributions or credit lines provided by a smaller number of members/suppliers, the greater the likelihood that stress at one institution will affect one or more CCPs, which could have systemic consequences.

The fourth exercise was launched in 2021, and the report outlining its methodology and scope was published in June of the same year (ESMA, 2021). According to the work plan, the report on the results is expected to be available by the second quarter of 2022. Klaus Löber, Chairman of the EU CCP Supervisory Committee, noted that the year 2020 showed financial systems are constantly evolving and subject to disruptions, such as those caused by Covid-19 or Brexit. Therefore, CCP stress testing becomes an essential supervisory tool that can contribute to financial stability and supervisory convergence in the EU.

In the fourth reiteration of stress testing, thirteen CCPs approved in Europe and two in the UK will be assessed, the credit and exposure concentration components [4] will be developed in an aggregate way, and an operational risk analysis will be introduced as well. With respect to the latter, CCPs will be provided with a common methodology to identify service providers that support critical activities. Once the common providers have been identified among the CCPs, potential risks will be assessed, and mitigation and monitoring tools will be defined.

In summary, the results of the three completed stress tests in terms of validating the adequacy of prefunded resources to withstand simultaneous default by the two most representative members and extreme market scenarios, show the European CCPs can be considered resilient because their prefunded resources would be sufficient to cover the losses resulting from most of the scenarios evaluated. However, in extreme scenarios where the two largest members are in default in all CCPs where they participate, combined with extreme market scenarios, it would be necessary to call on unfunded resources. Particularly, in the second exercise, one CCP was identified for which it would be necessary to request additional resources, without systemic implications.

On the other hand, the results of those tests measuring the adequacy of liquid resources show that, in most scenarios of extreme market movements, CCPs would have sufficient capacity to meet their liquidity needs. However, one of the CCPs assessed in the second exercise would require unrestricted access to markets and the ability to settle immediately, some CCPs would require access to short-term foreign exchange markets to hedge obligations in several major currencies, and other CCPs would use repo lines provided by central banks. In addition, some CCPs would need to be required to restructure the amounts required of members in each currency to meet their obligations on time.

Finally, the results of the concentration risk tests showed that concentrated positions pose a significant risk for two of the 16 CCPs, for which 80% of the default fund contributions are

3 One of the main changes was the use of information for two specific dates. Previous exercises were limited to one day of information.

4 An additional change in this fourth exercise refers to the granularity of the information. Accordingly, the exercises were applied not only to the clearing members but also to the account structures.

provided by three members. With respect to the concentration of liquid resources, three CCPs were found to be highly concentrated in their main liquidity provider.

3. Experience with Stress Testing the CCPs in England

In recent years, the Bank of England (BE) has been very much involved in the development of an international framework for SST of UK CCPs. Accordingly, it issued a discussion paper to gather the necessary information to develop a public framework for doing supervisory stress testing (BE, 2021). In October 2021, the Bank of England launched its first public supervisory stress test of CCPs.

The 2021-2022 stress test will explore the credit and liquidity resilience of the entire CCP system in the UK. The findings of the stress test will be used, together with comments on the discussion paper, to help develop and refine the SST regime. On the one hand, it will test whether CCP resources withstand a combination of market stress scenarios and clearing member defaults. On the other hand, it will validate the ability of CCPs to meet all liquidity requirements in the face of scenarios involving simultaneous market stress and default by its major clearing members and several service providers.

Both components will include an assessment of the additional costs associated with liquidating concentrated positions in stressed markets and for short periods. In addition, reverse stress tests [5] will be used to analyze the impact of severe scenarios with respect to market stress, concentration costs, and the number of defaulters CCPs would be able to withstand, and to determine under what circumstance CCPs' resources would be depleted.

The Bank of England expects to publish the results of the stress test in mid-2022.

4. The Stress Testing Experience for CCPs in the United States

The Commodity Futures Trading Commission (CFTC) is the financial authority in charge of overseeing CCPs in the United States that clear and settle commodity derivatives. The CFTC has conducted three CCP stress testing exercises to validate the adequacy of prefunded resources available to cover closing out positions in the event of member defaults and market stress scenarios that exceed the CCP's estimates.

The first report was published in November 2016, with results and an analysis of the impact to the system resulting from stressed market conditions and default by some clearing members in several CCPs. The tests focused on simulating default by those members with positions in more than one CCP, and the market stress conditions were based on extreme, but plausible, hypothetical scenarios. Overall, the CCPs were found to have the financial resources to withstand extreme market price movements across a wide range of products for the selected date.

In October 2017, the second stress test was conducted with an additional component to the first; that is, it also tested the capacity of available liquid financial resources. Specifically, it assessed how CCPs would obtain the necessary funds in time to honor obligations resulting from the settlement of positions in the face of simultaneous default by the two largest clearing members, and whether the need would arise for multiple CCPs to generate a demand for the same sources of liquidity, which could have systemic implications. It was found that CCPs used a wide variety of sources to fund their liquidity needs, and that there was no significant concentration in these sources. This mitigates systemic risk concerns.

The report on the results of the third test was released in April 2019. The test included two additional sections to those mentioned in the previous tests. The first involved the addition of a reverse stress test of CCP resources and an analysis of stressed costs because of settling positions. The reverse stress test identified potentially extreme scenarios for exhausting all prefunded resources available to the CCPs. The analysis of costs in settlement was structured to assess whether the CCPs had sufficient resources to meet both the obligations of

5 The process of identifying the point at which a CCP's risk management model or security-ring scheme becomes vulnerable; e.g., identifying the scenario in which available financial resources are exhausted.

a member default and an extreme shift in the market. Additionally, it was assumed that costs in the sale or auction of defaulted members' positions would be higher than the CCPs expected.

The results of the reverse stress tests showed the two CCPs included in the exercise had enough prefunded resources to cover losses in the selected scenarios. In other words, the sum of the shortfalls of all clearing members with exposure arising from these price shifts did not exceed the prefunded resources, including those that are mutualized. Additional resources would be required only in the scenario where price changes were more than 200% of the changes estimated by the CCPs. The results of the stressed settlement cost test showed the CCPs had sufficient liquid prefunded resources to cover the aggregate market and settlement costs for each defaulted member account.

5. Stress Tests Done by the Authorities in Colombia

In Colombia there is a central counterparty, the Cámara de Riesgo Central de Contraparte de Colombia S. A. (CRCC), which is supervised by the SFC. The latter has conducted periodic exercises to measure the CRCC's resilience in terms of credit and liquidity risks. The SFC assesses the capacity of the risk management model to address potential defaults by clearing members in the event of market stress. To do so, it provides the CRCC with six simulated stress scenarios from which the entity estimates the amount of the margin calls for each clearing member. Subsequently, the SFC incorporates these results in the regulatory liquidity metrics of each entity, as a cash flow to assess the sufficiency of the members' liquid resources. Finally, in the event of a hypothetical short-term liquidity mismatch in any member, the CRCC quantifies the impact on its risk model and evaluates its sufficiency to respond to severe market stress scenarios.

On the other hand, *Banco de la República* monitors the financial risks associated with the clearing and settlement of transactions managed by the CRCC, with a focus on identifying events with systemic implications. Accordingly, it conducts bimonthly reverse stress testing exercises to validate the adequacy of the CRCC's prefunded resources in the event of simultaneous default by its two main clearing members. Additionally, using extreme market scenarios superior to those employed by the CRCC, it determines in what situation or circumstance the prefunded resources and the recovery mechanisms available to the CRCC would be depleted. The last exercises done in 2021 showed the CRCC has sufficient prefunded resources to contend with simultaneous default by its two main clearing members, and that additional resources would be necessary only in the scenario where price variations were greater than 150% of the variations estimated by the CRCC.

For its part, the CRCC directly performs stress testing exercises on credit and liquidity risks. On the one hand, it validates the adequacy of prefunded resources in the face of multiple scenarios of market price volatility for each group of cleared products (segments). It also does reverse stress tests to determine the number of members that would have to default simultaneously for the prefunded financial resources to be exhausted. These tests are intended to validate the coverage of the two main members. Moreover, the CRCC assesses its liquidity needs daily by stressing the value of daily movements of cash by the two largest members and contrasting them with available liquid resources and credit lines.

6. Closing Comments

In conclusion, the preponderant role CCPs play in the post-trade activities of financial market operations and their contribution to risk mitigation oblige multilateral organizations that promote initiatives and tools to strengthen the financial stability of countries, as well as the authorities charged with supervising and monitoring financial infrastructures, to validate the resilience of CCPs in the face of extreme market scenarios and default by their main clearing members. Given the experience described above, the design, structure and scope of stress tests will depend largely on factors such as the complexity of the relationships these infrastructures have with each other, the concentration of risks in a few members, and the coincident participation of the same clearing members and related service providers.

Generally speaking, the stress tests done by the authorities emphasize evaluating the structure of the security-ring scheme, the adequacy of prefunded financial resources and the existence of mechanisms for recovering these resources. They also center on the existence of multiple sources of liquidity that allow CCPs to cover potential extreme liquidity needs. Finally, in their most recent tests, the authorities have focused their efforts on assessing the risks associated with exposure being concentrated in a few members and lines of credit being concentrated in a few liquidity providers, in addition to analyzing the potential operational effects of failure on the part of critical service providers. Due to the momentum in the markets and the products that CCPs clear and settle, it is important to regularly adjust the scenarios being assessed and to consider stress tests on additional risks.

References

Bank of England (2021). *"Supervisory Stress Testing of Central Counterparties,"* June, available at: https://www.bankofengland.co.uk/paper/2021/supervisory-stress-testing-of-central-counterparties

Commodity Futures Trading Commission (CFTC) (2019). "CCP Supervisory Stress Tests: Stress Test and Liquidation Stress Test," April.

Committee on Payments and Market Infrastructures (CPMI); Board of the International Organization of Securities Commissions (IOSCO) (2018). "Framework for Supervisory Stress Testing of Central Counterparties (CCPs)," BIS, April.

Committee on Payments and Market Infrastructures (CPMI); Board of the International Organization of Securities Commissions (IOSCO) (2014). *"Recovery of Financial Market Infrastructures,"* BIS, October.

European Securities and Markets Authority (ESMA) (2016). "Report- EU-wide CCP Stress Test 2015," April.

European Securities and Markets Authority (ESMA) (2018). "Report- EU-wide CCP Stress Test 2017," February.

European Securities and Markets Authority (ESMA) (2020). "Report- 3rd EU-wide CCP Stress Test," July.

European Securities and Markets Authority (ESMA) (2021). "Framework for the 2021 ESMA Stress Test Exercise for Central Counterparties," June.

Wendt, F. (2015). "Central Counterparties: Addressing their Too Important to Fail Nature," Working Paper, no. WP/15/21, International Monetary Fund.

Wenqian Huang, W.; Takáts, E. (2020). "Model Risk at Central Counterparties: Is skin-in-the-game a game changer?," BIS, Working Paper, no. 866, May.

Wilkes, S. (2020). "EU hands CCP Members a Narrow Win on Skin in the Game," Central Banking, August.

3. Payment Trends and Innovations

In recent years, the private sector has provided the public and businesses with a number of technological developments that have expanded and modernized the supply of services in the payments market. These services are focused largely on the provision of digital currencies and cryptoassets for payments and investments. One of the best-known types of digital currency is e-money, which is issued by companies in the private sector that offer financial technology services (e.g., Safaricom issues M-pesa). Its closest alternative is b-money, which generally takes the form of deposits with commercial banks and is accessed through accounts. B-money is a debt instrument that is denominated in the national unit of account (i.e., national currency) and accrues interest.[17] E-money can be denominated in either domestic or foreign currency and may or may not bear interest. B-money is the only form of digital currency that is backed by the central bank, i.e., it is redeemable at par for its nominal equivalent in central bank currency (cash). This means any depositor can make withdrawals from his or her commercial bank account (b-money) and receive that same value in local currency (see Adrian and Mancini-Griffoli, 2021).[18]

Cryptoassets, commonly known as cryptos, are another kind of technological solution offered by the private sector. They are tokenized assets that rely on decentralized (DLT or distributed ledger) systems for their record keeping (IMF, 2021).[19] Transactions using cryptos are authenticated through consensus on the part of the participants, because they have no issuers and, therefore, no intrinsic value. Although it is not possible to identify the counterparties to these transactions, since they are totally anonymous, it is possible to verify the value for which they were made. For this reason, they are regarded as an alternative that is designed not to be used by the financial system nor to be subject to the controls of supervisory bodies, since they do not allow traceability and their balances cannot be confiscated or frozen by the government. Cryptos have been much more widely used as a store of value (in the form of investments) than as a payment instrument, due to the high potential returns they offers to those who use them. However, the volatile behavior of the returns on cryptos makes a very risky investment (Sankar, 2022).[20]

Stable digital currencies (hereafter, stablecoins) issued by BigTech companies are another form of non-remunerated e-money. Their value is fixed to the sovereign currency of some country or to a basket of assets, which means the stability of their value is derived from the fiat currency of the issuing bank or the underlying

17 Adrian, T.; Mancini-Griffoli, T. (2021). "The Rise of Digital Money", Annual Review of Financial Economics, vol. 13.

18 Commercial banks are regulated entities and, therefore, are committed to maintaining ample liquidity and avoiding excessive risk-taking. However, should they run out of liquid assets to meet customer withdrawals, the central bank can provide liquidity through liquidity facilities. Generally, commercial banks have access to central bank liquidity, while e-money providers do not (Adrian and Mancini-Griffoli, 2021).

19 IMF (2021). Global Financial Stability Report, Annex 2.1, October.

20 The most well-known cryptoassest are bitcoin, ethereum, cardano, dogecoin and stellar (Sankar, R. (2022). "Cryptocurrencies: An Assessment", Keynote at the Indian Banks Association 17th Annual Banking Technology Conference and Awards, February).

assets to which stablecoins are linked (see IMF, 2021).[21, 22] A stablecoin can become a global stablecoin (i. e.: global stable digital currency) if it enters multiple jurisdictions and manages to achieve a substantial share as a payment instrument and/or as a store of value. This could pose far greater risks to financial stability than stablecoins would generate and could test the effectiveness of regulations and supervision, as well as existing oversight (see FSB, 2021).[23, 24]

The lack of regulation governing these new forms of currency and assets, and the opacity evident in their use, have motivated some central banks to consider technological solutions to modernize payment systems. As for retail payment systems, some central banks have opted to develop instant payment systems, the purpose being to facilitate the settlement of transactions in real time and at a low cost for their users. Examples of such technological solutions in the Latin American region include Mexico's CoDi and Brazil's Pix systems. This section briefly reviews the Brazilian case. According to Brazil's central bank, the Pix system was set up primarily in response to the growing use of cryptoassets as an investment vehicle and as a payment instrument in cross-border retail transactions. The success of Pix, as will be seen in this section, is related to the incentives the system provides to both incumbent and incoming participants.

Along the same lines as retail payments, some central banks have ventured into the study of central bank digital currency (CBDC) to be able to determine the convenience of issuing it. Like the other forms of money offered by central banks, CBDC would be denominated in the national unit of account and offered to individuals, businesses, and companies (retail CBDC) or to financial institutions for their local and external transactions (wholesale CBDC). Other central bank innovations have focused on improving services in wholesale payment systems, particularly those related to cross-border payments. In most countries, cross-border payments are slow, costly, and not very transparent, which is why, since the end of 2020, the Financial Stability Board (FSB) and the G20 defined their improvement as a priority. This section briefly mentions the frictions that limit the normal development of cross-border payments and describes the main wholesale CBDC models that have been proposed for this purpose, as well as the projects that are currently being piloted or implemented.

Finally, given that part of innovation in the provision of payment services has been driven by technology companies, better known as FinTechs, this section of the report also presents an overview of the private technology companies in Colombia

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21 BigTech, or technology giants (e.g., Facebook, Amazon, Google), are companies engaged in businesses such as e-commerce and social media. Some of these companies have ventured into retail payments markets, loans to individuals and small businesses, and insurance services, among others (see Cornelli, G.; Frost, J.; Gambacorta, L.; Rau, R.; Wardrop, R.; Ziegler, T. (2020). "Fintech and Big Tech Credit: A New Database," BIS Working Paper, no. 887). Many of the companies involved in the payments market have experienced exorbitant growth in recent years. In China, for example, the BigTech companies Alipay and WeChat Pay account for 94% of mobile payments (Carstens, A.; Claessens, S.; Restoy, F.; Shin, H. (2021). "Regulating Big Techs in Finance", BIS Bulletin, no. 45, August).

22 Most stablecoins are denominated in United States dollars, with USD Tether, USD coin and PAX dollar being among the most well-known.

23 FSB (2021). "Regulation, Supervision and Oversight of Global Stablecoin," Arrangements: Progress Report, October.

24 A rapid adoption of stablecoins and/or e-money may pose risks to financial stability if there is a run on e-money. Also, a rapid substitution of local fiat currency by stablecoins or other forms of foreign e-money may pose risks to monetary policy transmission, especially in countries with weak institutions and high levels of inflation (Adrian and Mancini-Griffoli, 2021).

that offer their services in the payments market, identifying the type of services they provide in the payments value chain.

3.1 Instant Payments in Brazil: Pix and Its Success

Fast payments systems have been implemented at an increasingly rapid pace in more than sixty countries. Central banks tend to play an important role in facilitating them and, occasionally, in operating the infrastructure directly. The rates at which these payments are adopted have generally been low in the early stages of implementation, although some recent systems, such as the Pix system in Brazil, have been adopted extensively and quite quickly (BIS, 2021).

Brazil is a country with a population of more than 200 million people. It has a banking penetration rate of 88% (number of people with a bank account), and cash payments account for 77% of the value of purchases made by the public. On the connectivity side, approximately eight out of ten Brazilians over the age of 10 have a mobile phone, and 73.9% of the population use the Internet (BIS, 2020a; BCB, 2019; Riquelme, 2021; Gutierrez, 2021; World Bank, 2020).

Given these conditions, the Central Bank of Brazil (BCB) created Pix as an instant electronic transfer system (24/7), thereby offering an additional option to electronic funds transfers in the retail payments market. In terms of its objectives, Pix is intended to increase the speed at which payments are made and received, improve efficiency, competitiveness and digitalization, increase financial inclusion and security in transactions, reduce costs, and improve the customer experience (BCB, 2020: Pix (https://www.bcb.gov.br/estabilidadefinanceira/pix)).

The BCB, which is the regulator of the retail-value payment ecosystem, established the rules under which Pix functions. Also, it put into operation the technological infrastructure that is required to enable transactions to be settled between different institutions (the payment service providers of both the payer and the payee[25]) and to make a payment in seconds (account-to-account transfer) (Diagram 3.1).

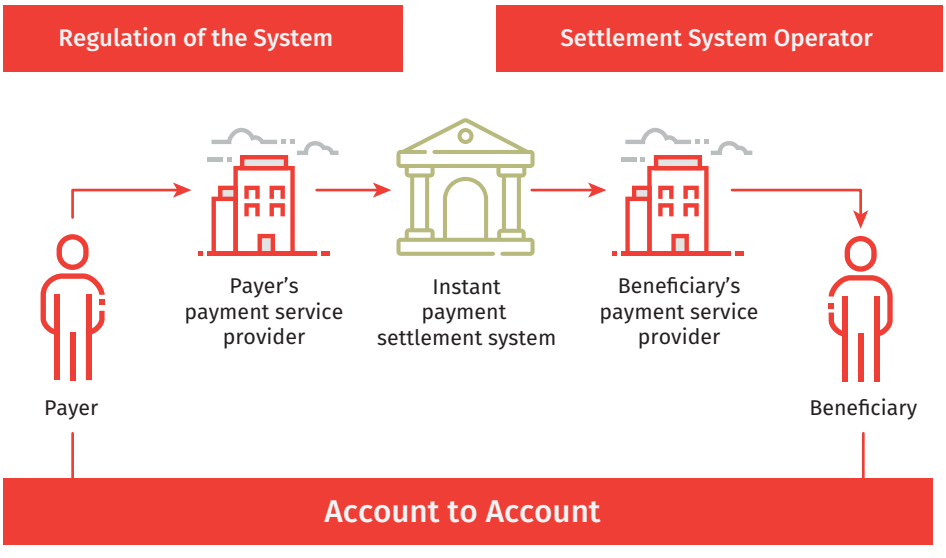
With the creation of Pix, an instant payment ecosystem was built. In its first year of operation (it began to be implemented in November 2020), Pix had a faster adoption rate than that of countries such as Denmark, Sweden, or Australia.[26] During that period, it surpassed other payment instruments, such as inter- and intra-bank credit transfers,[27] checks, prepaid cards and direct debit, in terms of the number of transactions and has reached the level of credit and debit cards. By the end of February 2022, Pix was being used by 114.4 million people from all income brackets (67% of the adult population and by 9.1 million companies in Brazil, i.e., about 60%

25 These providers are financial or payment institutions that offer an account to the end user.

26 The adoption indicator used corresponds to the number of instant payment transactions per capita. In the aforementioned countries, the first year these payments were offered showed lower levels than those of Pix but, in the years after implementation, these countries have high adoption rates. Denmark had an adoption rate close to 50% within five years, Sweden had an adoption rate of nearly 40% in seven years, and Australia reached a rate of 10% within two years. In these countries, adoption rates in the aforementioned years of implementation were higher than those of countries such as Singapore, Mexico, Chile, India, the United Kingdom and Nigeria.

27 Credit transfers are payment instruments used to transfer funds to the beneficiary by means of a payment order. Both the payment orders and the funds pass from the payer's institution to the beneficiary's institution (BIS, 2017). An example of this type of transfer is the purchase of airline tickets: the payer chooses the service to be purchased and makes the payment from his account to the merchant's account.

Diagram 3.1
Dual Role of the Central Bank of Brazil in Pix: Regulator and Operator



Source: Central Bank of Brazil.

of the firms that have a relationship with the financial system in that country (BCB, 2020; Pinho, 2021; Duarte et al., 2022).

The high Pix adoption rate is supported by the conditions that existed before the system began to operate, such as extensive use of the Internet and mobile phones, and also by the role played by the BCB as the regulator and operator of fast payments. These conditions allowed for creation of the fast payment ecosystem in Brazil, backed by different measures, such as the possibility of carrying out transactions between various agents (P2P, P2B, B2B, P2G, B2G),[28] the involvement of many participants in the fast payment system, low cost, and a simple user experience, among others. Each of these features is described in more detail below.

- Transactions between various agents.
- A high number of participants in the fast payment system and the obligation to take part.
- Low cost.
-A simple experience for users.

Transactions between various agents. Through Pix, transfers can be made between individuals, companies, and government. For example, Pix permits transactions primarily through mobile applications and the Internet banking platforms. A Pix transaction is generally addressed to a predefined contact from the mobile phone list or a QR code associated with the beneficiary's transaction account. So, it is not necessary to know the recipient's account information.

A high number of participants in the fast payment system and the obligation to take part. The participants in Pix can be direct or indirect. The former are financial and payment institutions (about 780) that offer transactional accounts. Those authorized to operate by the BCB and have more than 500,000 active client accounts are obliged

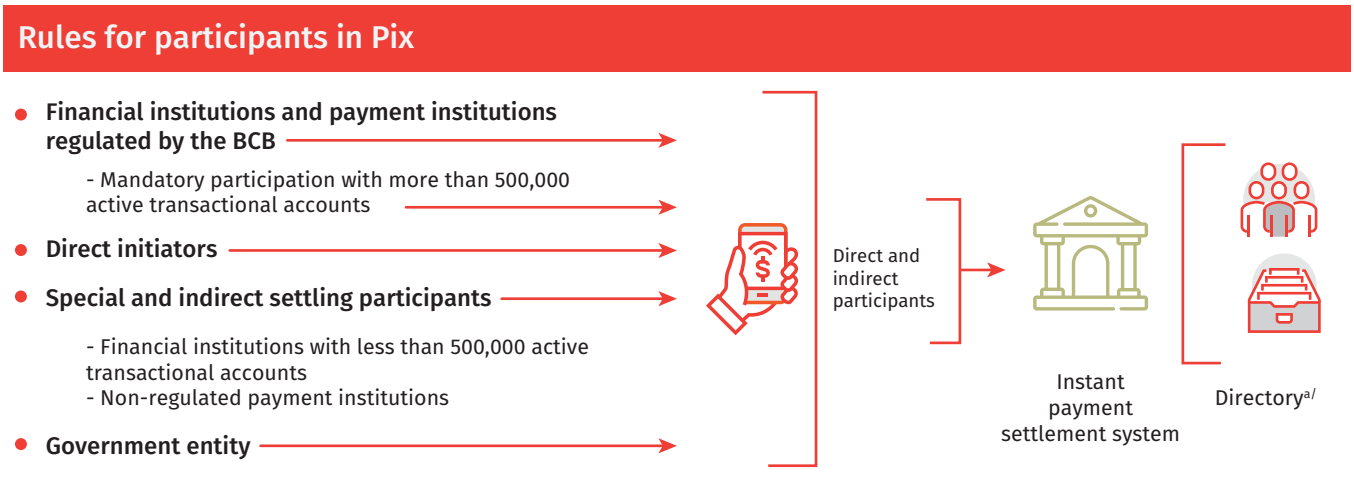
28 P2P: person to person; P2B: person to business; B2B: business to business; P2G: person to government, and B2G: business to government.

to take part, and must offer their clients the option to both send and receive transfers through Pix, so as to guarantee broader coverage of the population.

Indirect participants settle their transactions through a direct participant or special settlement agent, which exclusively provides the settlement service to those other than direct participants. Indirect participants include other financial institutions and payment institutions (including those that do not require authorization by the BCB[29]), which may subscribe to Pix. In these cases, they are considered part of the Brazilian payment system and are subject to minimal regulation, from the moment they submit a request to join Pix.

On the other hand, transactional account providers, special settlement agents, initiators and the government agency participate in Pix through different categories (Diagram 3.2):

Diagram 3.2
Pix Participants



a/ The BCB manages and operates the Directory of Transaction Account Identifiers (DICT), a component that allows for the practical initiation of payments with fraud risk mitigation. The DICT is a database that stores information on the recipient users and their respective transactional accounts. In Pix, the payer must have the recipient's Pix password, which can be any of the following: identification number (person or legal entity), email, telephone number or random password. If the payer has this information stored in his/her mobile phone, he/she can use it from the phone's contact list. All institutions that are direct participants in the instant payment system must access the DICT directly.
Source: Central Bank of Brazil

- The transactional account provider is a financial or payment institution that offers a transactional account to the end user for the purpose of making or receiving payments through Pix.
- The special settlement agent is a financial or payment institution authorized to operate by the BCB, and its purpose is to provide settlement services to other (indirect) participants. In doing so, it must comply with the requirements to act as a settlement participant in the fast payment system. This agent does not meet the criteria for mandatory participation in Pix and does not send or receive money via Pix to end users.

29 Payment institutions not subject to operating authorization or in the process of being subject to operating authorization by the BCB must comply with the following requirements:

• Compliance with the regulations, especially those related to the technical and operational capacity to fulfill duties and obligations.
• Contract with the participant; that is, having a signed contract with a responsible participant.
• Capital. Proof of payment and maintenance of at least BRL 1,000,000.00 (one million reals) in capital.

- The initiator is a financial institution, payment institution or other institution that is authorized to operate by the BCB and intended exclusively, within the scope of Pix, to provide a payment transaction initiation service.[30]
- National Treasury Secretariat (government entity) exclusively handles collections and payments related to its own activities.

End users, on the other hand, are not Pix participants, since only institutions approved for that purpose are considered participants.

Simple user experience. Pix is available in face-to-face channels, such as branches, ATMs or banking correspondents, and in non-face-to-face channels, such as mobile phones and the Internet. The latter can be used through applications or online stores. In these cases, the consumer must give his consent to initiate the transaction and is automatically directed to the institution where he has an account in order to authenticate the transaction, doing so with the usual mechanisms such as password, biometrics or facial recognition. The purpose of Pix is to offer the end user easy transactions.

Low cost. The BCB charges financial and payment institutions participating in Pix a fee to cover the operating costs of the system on a non-profit basis. Pix does not represent a cost for private individuals and charges fees to legal entities. Individuals are not charged for sending or receiving funds.[31] In the case of legal entities, the institution holding the client's account may charge a fee for sending and receiving funds for the purpose of a transfer or purchase.[32]

On the other hand, it is possible to charge the client, even if the client is a private individual,[33] a fee for providing the service of initiating payment transactions. The fee model (fixed cost or percentage) and the fee values can be defined freely by the institutions.

A simple experience for the user. Pix is available in face-to-face channels, such as branch offices, ATMs or banking correspondents, and through non-face-to-face channels, such as mobile phones and the Internet. The latter can be used through applications or online stores. In these cases, consumers must give their consent to initiate the transaction and are automatically directed to the institution where they have an account in order to authenticate the transaction, with the usual mechanisms

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30 In the payment transaction initiation service in Pix, the user authorizes the initiation of a payment transaction at an institution other than the one with which the user has an account.

31 Individuals are charged in Pix for using the institution's face-to-face or personal service channel. Also, they are charged when receiving a payment through Pix for commercial sales, in cases such as:

- More than thirty transactions in Pix per month.
- Receiving payment with a dynamic QR code.
- Receiving payment with a QR code from a paying legal entity.
- Receiving payment in an account defined in the contract as exclusively for commercial use

Another concept for which persons are charged in Pix corresponds to a specific number of transactions involving cash withdrawals or exchange services. These are free of charge up to the eighth transaction. From the ninth transaction onwards, the financial or payment entities holding the payer's account may charge a fee for the transaction. The amount of the fee charged is determined freely by the institution and must be indicated to the paying user before the step in which the transaction is confirmed. Withdrawal agents may not directly bill these charges to users.

32 The fees for merchants are no higher than the commissions on credit and debit cards (BIS, 2020b).

33 https://www.bcb.gov.br/estabilidadefinanceira/exibenormativo?tipo=Resolu %C3 %A7 %C3 %A3o %20BCB&numero=19

Table 3.1
Other Aspects of the Instant Payment System Model in Brazil

Aspect	Description
Payment instrument	Instant electronic transfer[a/].
Security	Pix was designed to ensure security in terms of the different aspects of the ecosystem, in transactions, personal information, anti-fraud and anti-money laundering. The requirements for availability, confidentiality, integrity, and authenticity of information were studied and controls were implemented to ensure a high level of security[b/].
Settlement	Accounts. Instant payments are settled through special purpose accounts that are maintained in the BCB by the institutions participating directly in the system. These are called "instant payment accounts". There is no possibility of a negative balance in an instant payment account. Type. Brazil's instant payment system has real-time gross settlement. That is, it processes and settles transaction by transaction. It notifies both the payer and the payee of the completion of the transaction (funds are available in the receiving institution's account within up to 10 seconds). Funds can be transferred between accounts, and payment is sent from a checking, savings or prepaid account. The technological structure of the system is centralized, with communication between the different participants and the CB being done through messaging.
Rediscount line	The BCB received authorization from the National Monetary Council to grant a rediscount line to financial entities that participate directly in the instant payment system. These are purchase operations with a commitment to sell federal government securities registered in the Special Systems for Settlement and Custody (Selic), with financial institutions that participate directly in the instant payment system. The objective is to offer liquidity outside the operating hours of the Reserves Transfer System (RTS), thereby minimizing the risk of participants having insufficient resources. An institution does not have to participate in the RTS to have access to this rediscount line. However, it must be a financial institution to participate in Selic and the instant payment system.

a/The entities that offer Pix may establish maximum limits on the amounts be transferred according to criteria associated with mitigation of the risk of fraud, money laundering and terrorism financing. At night (between 8 p.m. and 6 a.m.), transactions between individuals are subject to a maximum limit of BRL 1,000.00 (one thousand reals, which are equivalent to USD 212). Pix participants cannot limit the number of transactions end users may send or receive. The objective is to avoid limits on the use of Pix.
b/ Pix security is based on four dimensions: user authentication, transaction traceability, secure traffic of information and work rules. User authentication can only be done within the secure environment of the user's institution, which is accessed through the user's password or methods integrated into the user's mobile phone, such as biometrics, facial recognition or the use of tokens. Pix's technological design allows all operations to be traceable, thus guaranteeing the traceability of transactions.
Transaction information traffic is encrypted in the National Financial System Network, which is a network separate from the Internet and through which the transactions of the Brazilian payment system are carried out. All Pix participants must issue security certificates to conduct transactions in this network. In addition, all transaction information and personal data linked to Pix passwords are stored encrypted in BCB's internal systems.
Source: BCB (Pix)

such as password, biometrics or facial recognition being used. The purpose of Pix is to offer the end user easy transactions.[34]

In addition, Table 3.1 explains other aspects of the fast payment system model related to security and settlement.

In conclusion, the conditions that existed in Brazil prior to the advent of Pix, particularly in terms of extensive Internet and mobile phone use, as well as the role of the BCB as being responsible for regulation and operation of the clearing and settlement infrastructure for fast payments, have been key factors in the accelerated and effective implementation and adoption of this payment instrument in Brazil. On the other hand, the design of the ecosystem, as reflected in the main features of the model, such as the possibility of diverse transactions (P2P, P2B, B2B, P2G, B2G) that respond to the needs of users, the creation of a critical mass of users given mandatory participation by the largest banking institutions (Duarte et al., 2022), the low cost of sending and receiving funds (in general, private individuals are not charged, with some exceptions, and legal entities are charged, a fact that stimulates provision of the service by payment service providers), and the simple experience for users, among other aspects, have made Pix a system that, although having begun to operate only recently, has higher rates of adoption than those of fast pay-

34 Pix was designed to offer the user a simple and intuitive experience that is secure and has a clear, agile, precise, transparent and convenient language, among other requirements.

ment systems in countries such as Denmark, Sweden and Australia. Undoubtedly, this is an experience that invites a closer look to learn from its success.

References

BCB (2019). "El brasileño y los hábitos de uso de medios de pago" [online], available at: https://www.bcb.gov.br/content/estabilidadefinanceira/Publicacoes_SPB/Relatorio_Decem_2157_2021.pdf

BCB (2020). "O que é Pix?" [online], at: https://www.bcb.gov.br/estabilidadefinanceira/pix

BCB (2020). Informe de economía bancaria, recuadro 19 Pix el nuevo método de pago Brasileño, available at: https://www.bcb.gov.br/publicacoes/relatorioeconomiabancaria

BIS (2017). Methodology of the Statistics on Payments and Financial Market Infrastructures in the CPMI Countries (Red Book statistics), August.

BIS (2020a). "Estadísticas Libro Rojo a 2020" [online], available at: https://stats.bis.org/statx/srs/table/T1?c=BR

BIS (2020b). Quarterly Review, International Banking and Financial Market Developments, December.

BIS (2021). Developments in Retail Fast Payments and Implications for RTGS systems, Washington, D.C.

Duarte, Angelo; Frost, Jon; Gambacorta, Leonardo; Koo Wilkens, Priscilla; Song Shin, Hyun (2022). "Central Banks, the Monetary System and Public Payment Infrastructures: Lessons from Brazil's Pix", BIS Bulletin, no. 52, March.

Gutiérrez (2021). "Por qué Pix es la revolución de la experiencia del consumidor en Brasil" [online], at: https://www.paymentsjournal.com/why-pix-is-the-revolution-of-consumer-experience-in-brazil/

Pinho de Mello, João Manoel (2021). "Pix: Hace 1 año facilitando pagos en todo Brasil" [online], available at: https://www.bcb.gov.br/detalhenoticia/590/noticia

Riquelme, R. (2021). "¿Por qué Pix sí funcionó en Brasil y CoDi no ha despegado en México?" [online], available at: https://www.eleconomista.com.mx/sectorfinanciero/Por-que-Pix-si-funciono-en-Brasil-y-CoDi-no-ha-despegado-en-Mexico-20211015-0029.html

World Bank (2020). "Indicadores de desarrollo mundial" [online], at: http://wdi.worldbank.org/table/5.12

3.2 Possible Cases of the Use of Central Bank Digital Currency for Cross-border Payments

Cross-border payments are those in which the party sending and the party receiving a transfer of money reside in different jurisdictions. Such payments are generated by international trade, foreign investments, and remittances between individuals (BIS et al. 2022; Sankar 2022). Because these cross-border money transfers are costly, time-consuming, and not very transparent and accessible, the FSB, the CPMI and other international bodies established their improvement as a priority task from the beginning of 2020 (FSB, 2020).

The speed with which cross-border payments are processed and finalized can be slowed by the frictions generated by long intermediation chains in payment processing, as well as by differences in time zones and banking processes (BIS et al., 2021a). Intermediation chains in cross-border payments depend on the number of commercial banks that process money transfers and include those that offer payment services (the bank that originates and receives the payment) and those that offer correspondent banking services that are responsible for settlement (see Auer et al., 2021).[35] A long chain of intermediation can lead to delays in cross-border payments, making them more costly and less efficient (FSB, 2020). The difference in the time zones of the originating and receiving countries can also slow down the speed with which such payments are processed by restricting the hours at which both jurisdictions are operating at the same time (BIS et al., 2021a). Other sources

35 The number of participating banks will be much larger when the currencies of the jurisdictions involved must be converted (Auer et al., 2021).

of friction are the conversion of transferred values when the jurisdictions involved handle different currencies, and differences in compliance with legal and regulatory standards between countries (Auer et al., 2021)

The introduction of a wholesale central bank digital currency (hereafter wCBDC) could increase the efficiency of cross-border payments by enabling settlement at any time of the day (24/7), and by simplifying the finalization process. This sort of digital currency would be a form of money the central bank would issue for financial institutions and other payment service providers to settle transactions in financial markets (BIS et al., 2022).[36] With wCBDC, the interconnection between large-value payment systems in different jurisdictions (operating under real-time gross settlement, RTGS) could be facilitated, which could streamline the settlement and clearing of these money transfers between countries (Payments Canada, 2022). This section describes the main issues related to wCBDC for cross-border payments and several recent or ongoing pilot projects.

3.2.1 Expected Benefits and Risks of Issuing a wCBDC for Cross-border Use

The introduction of a wCBDC for cross-border payments could generate macroeconomic and financial effects that central banks should review in advance to find the best way to deal with them. This section presents a summary of the BIS et al. (2021a) view on the risks and benefits that could arise if this new form of central bank money were to be implemented. Among the expected benefits are greater access and lower cost of remittances, which would be very favorable for the people sending and receiving these transfers. Other potential benefits would be greater integration of capital markets and increased investment opportunities.

Currency substitution is one of the risks of this initiative and could generate undesirable effects in the countries involved.[37] An increase in external demand for a wCBDC could cause considerable movement in capital flows for the issuing country, which could interfere with its monetary policy. The country adopting another jurisdiction's wCBDC could experience a reduction in the monetary policy transmission mechanism due to a decline in the quantity of money over which the central bank could have influence. The risk of currency substitution will be much greater in countries with volatile exchange rates and high levels of inflation.

Increased capital market integration could lead to greater transmission of global financial conditions by increasing the volatility of capital flows and the risk of contagion. This could reduce the effectiveness of the measures traditionally used to control inflows and outflows of money in the economy, which could reduce the central bank's ability to control the exchange rate and local financial conditions. Therefore, financial regulation will be required to limit, when deemed necessary, the substitution of central bank digital currencies in different jurisdictions (wCBDC) and to mitigate the adverse effects of volatility in capital flows and the risk of contagion. Cooperation among central banks will also be essential to define policy measures aimed at reducing these risks.[38]

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36 Another central bank digital currency is the retail CBDC, which would be issued for the use of the public and merchants.

37 Currency substitution generally originates with a loss of confidence in the local currency, caused by worsening local conditions. This substitution will depend, to a large extent, on the macroeconomic and financial conditions of the countries involved.

38 Legal harmonization to prevent money laundering and terrorist financing also requires close coordination between countries.

3.2.2 Central Bank Digital Currency Interoperability Models

International wCBDC systems (or interoperability models) are based on multiple central bank digital currency arrangements for cross-border payments and are known as multiCBDC or mCBDC (see Auer et al., 2021). Such systems would be operated jointly by participating central banks and would try to improve the processing of cross-border payments by increasing their compatibility and by interconnecting local payment systems (Carstens, 2021).

At the international level, interoperability refers to the ease with which commercial banks and payment service providers from different jurisdictions can execute, clear and settle transactions without the need to connect to multiple payment systems (Boar et al., 2021).[39] International interoperability can be defined between wCBDC systems, or between wCBDC systems and traditional payment systems (BIS, 2021b).[40] The CBDC systems described below are differentiated from each other by the degree of interoperability they allow to participating jurisdictions.

3.2.2.1 Model 1: System of Compatible wCBDCs

International interoperability in a system of compatible wCBDCs occurs through the coordination of technical standards (i.e., market practices, messaging formats, data requirements, user interfaces, etc.) and legal, regulatory, supervisory and oversight standards. The latter, which are non-technical standards, will be fundamental to achieve broad participation by financial institutions and to facilitate compliance with customer-focused regulations, monitor transactions and prevent money laundering and terrorist financing (BIS et al., 2021a). There are still no projects or experiments concerned with this type of system.

3.2.2.2 Model 2: Systems of Bilaterally Connected wCBDCs

The CBDC networks in this system will be interconnected through a shared technical interface or a common clearing mechanism. In the shared technical interface, contractual arrangements are required to allow participants in one system to make payments to participants in another system. With the common clearing mechanism, systems would be interconnected through designated settlement accounts (BIS et al., 2021a). The following is a brief description of two projects based on the idea of a bilateral interconnection system.

- The Jasper-Ubin Project: In 2016, the Bank of Canada initiated its Jasper Project to evaluate the use of distributed ledger technology (DLT) in the clearing and settlement of payments and financial assets. Phases 1 and 2 involved proof-of-concepts to evaluate different design alternatives for a DLT-based interbank payment system. Phase 3 included a wCBDC to evaluate the delivery versus payment (DvP) settlement mechanism for tokenized assets, and Phase 4 incorporated the Central Bank of Singapore and its Ubin Project to evaluate a system that combines each jurisdiction's projects (Didenko and Buckley, 2021). In that last phase, experiments have been conducted to evaluate a cross-border network between Canada and Singapore that connects two platforms (i. e., Corda and Quorum) to enable

39 Central banks should also consider other design aspects, such as rules on settlement finality and criteria for the participation of large-value payment systems in settlement with Central Bank money (BIS et al., 2021a).

40 International interoperability is a design aspect of the wCBDC that will be crucial to avoiding fragmentation in the markets (see BIS, 2021b).

large-value payments. The network prototypes evaluated so far have been able to interoperate, facilitating cross-border payments between these jurisdictions (Bank of Canada, Monetary Authority of Singapore, 2019).

- The Jura project involved the Banque de France, the BIS Innovation Hub, the Swiss National Bank, and a consortium of private companies. The experiments were conducted with real-value transactions settled by commercial banks in their respective RTGS system, and not in a regulatory sandbox, as was done in other projects. In this project, euro- and Swiss franc-denominated wCBDCs were exchanged on the same (distributed ledger, DLT) platform, allowing cross-border payments to flow directly between financial institutions domiciled in France and Switzerland. Additionally, tokenized assets were used, and cross-border settlement of foreign exchange (FX) and other financial assets was done. The Jura project evaluated payment-versus-payment (PvP) and delivery-versus-payment (DvP) settlement mechanisms and explored how the security of central bank money can be extended for cross-border payment settlement. The results of the project showed that wCBDC would enable secure and efficient settlement of financial transactions. Regarding securities transactions, it was possible to verify that the use of wCBDC could increase operational efficiency in the primary and secondary markets (Banque de France et al., 2021).[41]

3.2.2.3 Model 3: Single System for Multiple wCBDCs

The single system for multiple wCBDCs consists of creating a new multilateral payments platform that would be operated jointly by the participating central banks (BIS et al., 2022). The new platform would serve as an international payment system that would record all obligations and have a single set of rules, technical systems and participants. The latter would be able to use the new payment system to transact on a single common platform, which would allow the payer to send its payment in a wCBDC and the recipient to obtain the payment in its local wCBDC (BIS et al., 2021a). With this system for multiple CBDCs, long intermediation chains can be avoided by bypassing the correspondent banking services currently used to process cross-border payments, since central banks and financial institutions would be able to exchange wCBDCs directly (Carstens, 2021).[42] The following is a brief description of three projects based on the concept of a single multiCBDC system:

- The Inthanon-LionRock Project, currently known as m-Bridge, involves the BIS Innovation Hub and the central banks of Thailand, the United Arab Emirates, China and Hong Kong. It aims to design a cross-border infrastructure that offers payment services that are low-cost, fast, operationally efficient, and resilient to complex payment flows. The first phase of the project consisted of a proof of concept for Hong Kong and Thai commercial banks to conduct foreign currency transactions and settlements by developing a common platform to facilitate real-time cross-border funds transfers. The second phase involved enhancing the initial phase prototype to include wCBDCs from other jurisdictions. Cross-border payments in this phase were processed through a network of corridors that connected the wCBDC systems of Hong Kong, Thailand and China. The third phase of the project started in February 2021 and included the

41 Cross-border settlement, which involves an exchange of currencies and assets between financial institutions domiciled in different jurisdictions, is currently carried out through international arrangements (e.g., International Central Securities Depository, or ICSD), or correspondent banks (Banque de France et al., 2021).

42 According to Carstens (2021), the correspondent banking system is slow, opaque and very costly.

United Arab Emirates. At that point, the name of the project was changed to mCBDC Bridge or mBridge (BIS et al., 2021b)

- The Aber Project brings together the central banks of the UAE and Saudi Arabia, and three financial institutions from each jurisdiction. This DLT-based wCBDC pilot initiative has two objectives: to shorten cross-border transaction chains and to eliminate the involvement of correspondent banks in the settlement process. In this project, funds have been moved in real time, and the finality of settlement and its irrevocability are guaranteed by a signature (BIS et al., 2021b). The frequent use of cross-border corridors will speed up the settlement and transparency of payments, in addition to reducing their costs and risks (Payments Canada, 2022).

- The Dunbar project involves central banks, financial institutions and technology partners in Australia, Malaysia, Singapore and South Africa. It consists of evaluating a common platform (multiCBDC) that will allow financial institutions to settle cross-border transactions in different wCBDCs. At the end of the first phase of the project, two prototypes of a shared technical platform were finalized and different DLT prototypes and several validation mechanisms were explored to support the common platform (Carstens, 2022; Payments Canada, 2022). Although the project has only focused on interbank payments, the multiCBDC platform can provide other types of services, such as the issue and exchange of digital assets, conditional payments, integration with other platforms, and applications to support the financing of international trade. The next phase of the project involves plans to develop and evaluate a common platform, and to develop mechanisms to ensure connectivity with other multiCBDC projects (BIS et al., 2022).

3.2.3 Conclusions

Cross-border payments can be affected by multiple frictions that make it difficult to increase in their speed, lower their costs and improve their operational efficiency. The issue of a wholesale central bank digital currency (wCBDC) could help to improve these aspects by simplifying lengthy intermediation chains (i.e., dispensing with correspondent banks in the settlement process) and by allowing cross-border payments to be more transparent and immediate. The wCBDC system to be adopted must be interoperable with the systems of other countries. This degree of international interoperability is precisely what differentiates the three existing models: the compatible wCBDC system, which consists of coordinating policies and standards among participating countries; the system that bilaterally interconnects wCBDC networks; and the single system for multiCBDC, which offers a common platform for financial institutions in several countries to transact in different central bank digital currencies. The groups of countries that are currently working on projects to improve cross-border payments have focused on the bilateral interconnection system and the single multicurrency system. The aforementioned projects and pilots are in experimental phases, and none have moved on to definitive implementation.

References

Auer, R.; Haene, P.; Holden, H. (2021). "Multi-CBDC Arrangements and the Future of Cross-Border Payments," BIS Papers, no. 115, March.

Bank of Canada; Monetary Authority of Singapore (2019). "Jasper-Ubin Design Paper: Enabling Cross-Border High Value Transfer Using Distributed Ledger Technologies".

Banque de France; BIS; Swiss National Bank (2021). "Project Jura: Cross-Border Settlement Using Wholesale CBDC," December.

BIS; CPMI; IMF; World Bank (2021a). "Central Bank Digital Currencies for Cross-Border Payments - Report for the G-20," July.
BIS; Hong Kong M. A.; Bank of Thailand; Digital Currency Institute of the People's Bank of China; Central Bank of the United Arab Emirates (2021b). "Inthanon-LionRock to mBridge: Building a multi CBDC platform for international payments," September.
BIS; Reserve Bank of Australia; Central bank of Malaysia; Monetary Authority of Singapore; South African Reserve Bank (2022). "Project Dunbar: International Settlements Using multiCBDCs," March.
Boar, C.; Claessens, S.; Kosse, A.; Leckow, R.; Rice, T. (2021). "Interoperability between Payment Systems across Borders," *BIS Bulletin*, no. 49, December.
Carstens, A. (2021). "Multi-CBDC Arrangements: Transforming Words into Works," Speech during Hong Kong Fintech Week, November.
Carstens, A. (2022). "Digital Currencies and the Soul of Money," Speech at the Conference on Data Digitalization, the New Finance and Central Bank Digital Currencies: The Future of Banking and Money, Goethe University, January.
Didenko, A.; Buckley, R. (2021). "Central Bank Digital Currencies: A Potential Response to the Financial Inclusion Challenge of the Pacific," *Issues in Pacific Development*, August.
FSB (2020). "Enhancing Cross-Border Payments: Stage 3 Roadmap," October.
Payments Canada (2022). "Wholesale CBDC Global Developments," Central Bank Digital Currencies: The Series, vol. 4, January.
Sankar, R. (2022). "Cryptocurrencies: An Assessment," Keynote address at the Indian Banks Association 17th Annual Banking Technology Conference and Awards, February.

3.3 *Fintech* Ecosystem and Digital Payments

Fintech companies are known for using technological developments to provide innovative financial services. In Colombia, these companies have evolved significantly in terms of their number, asset value and registered revenue.

Regarding their number, Graph 3.1, according to Colombia FinTech, shows there were 299 companies of this type in the country by 2021 and 2018 was the year with the highest number of new companies to enter the FinTech ecosystem (forty in total). As for the distribution of these companies according to their type of business, 60% are focused on credit and digital payments (Graph 3.2).

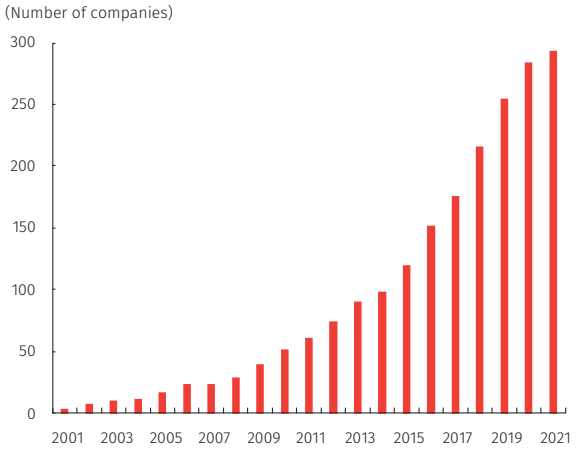
Accordingly, both credit and digital payments are the niches with the highest contribution to the value of assets and revenue in the ecosystem. As for assets, the 299 companies were valued at COP 6.4 trillion (t) by the end of 2021, with digital credit accounting for about 52% and digital payments, 16% (Graph 3.3). With respect to revenue, 62% of the total recorded in 2021 by the ecosystem (COP 3.7 t) pertained to digital payments and 25% to digital credit (Graph 3.4).

Regarding the main characteristics of the companies involved in digital payments, they may or may not be financial institutions, offering their services at different stages of the value chain. In general, these services include the offer of payment methods such as electronic deposit, and involve digital channels such as the Internet, mobile telephony, and point-of-sale terminals, among others, and use cards and electronic funds transfers as payment instruments.

Considering that a payment process is made up of three stages: 1) payment initiation, 2) clearing and settlement, and 3) receipt of payment, FinTechs focus on the first and last stages. They offer services such as payment gateways, mobile wallets, point-of-sale terminals, QR codes, and acquisition, among others. Given their nature, they provide a high degree of technological development; the construction of APIs is one example.[43] These are interfaces that have allowed for the develo-

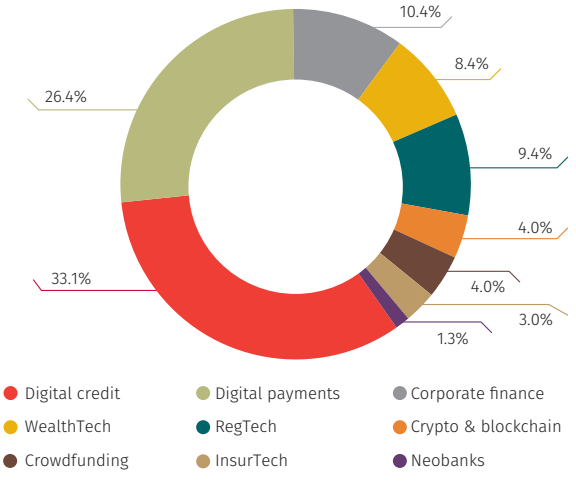
43 Application programming interface (API): a set of rules and specifications for software programs

Graph 3.1
Evolution of the Fintech Ecosystem in Colombia



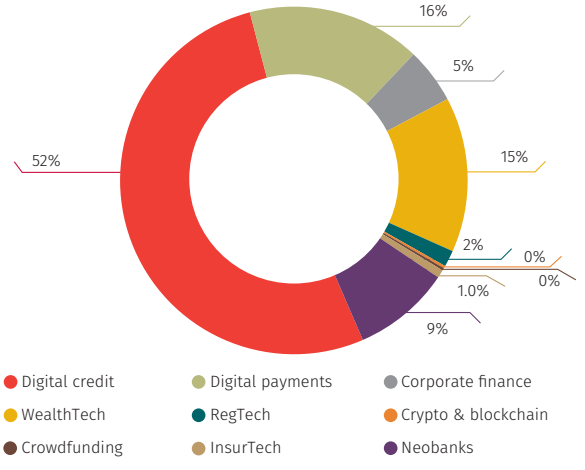
Source: Colombia Fintech.

Graph 3.2
Distribution of Companies by Activity, 2021



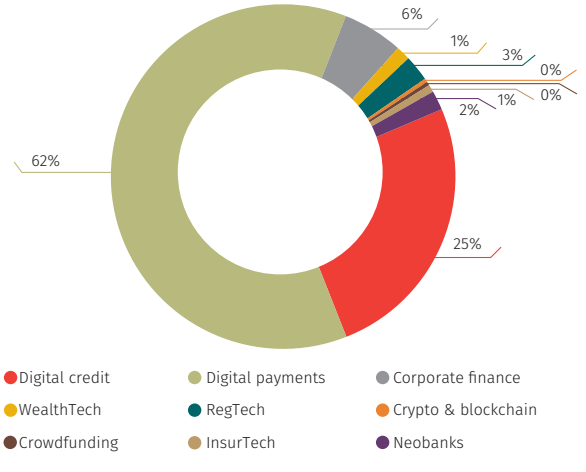
Source: Colombia Fintech.

Graph 3.3
Distribution of Assets by Activity, 2021



Source: Colombia Fintech.

Graph 3.4
Distribution of Income by Activity, 2021



Source: Colombia Fintech.

pment of innovative and customized business models that incorporate different payment instruments (debit cards, credit cards, electronic funds transfers, cash) with broad geographical coverage in the country, which generates accessibility and financial inclusion (Colombia Fintech, 2022a; BIS, 2012).

Generally, in the first stage, payment instruments and channels are used to communicate users with their entities to authorize payments. Through their innovations, FinTechs have facilitated the user experience by simplifying access to digital payments for individuals and merchants.

to communicate with another program, which forms an interface between different programs and facilitates their interaction (BIS, 2019).

The third stage is characterized predominantly by the activity of several FinTech companies in linking customers to the financial system through electronic deposits to facilitate the receipt of payments. This is like conventional acquisition. Businesses (mostly small) have benefited from online sales, which are made by offering their products through the Internet. Consumers access this information through their computers and mobile devices. Generally, these online sales are accompanied by online payment solutions.

Image 4.1 shows a group of entities that actively participate in the payment processes within the stages described above.

Image 4.1
Group of Companies Participating in the Payment Value Chain

Source: Colombia Fintech (2021)

The foregoing shows the FinTech ecosystem has undergone an important evolution in terms of digital payments and these, in turn, have dynamized the value chain of payment services. This is not only because of the greater number of participating entities, but also because of the innovations they have managed to introduce into the market. According to Colombia Fintech (2022b), FinTechs have helped to expand and develop a number of services, such as instant messaging payments, QR codes or biometrics, among others. The isolation generated by Covid-19 was an accelerator for these technologies, as it forced businesses to provide new, reliable and secure non-face-to-face payment channels, thereby boosting economic reactivation and financial inclusion.

References

BIS (2012). *Innovations in Retail Payments*, Report of the Working Group on Innovations in Retail Payments, May, https://www.bis.org/cpmi/publ/d102.pdf

BIS (2019). *Report on Open Banking and Application Programming Interfaces*, November, https://www.bis.org/bcbs/publ/d486.pdf

Colombia Fintech (2022a). *Informe económico*, May, https://www.colombiafintech.co/static/uploads/Informe%20Economico%20Colombia%20Fintech.pdf

Colombia Fintech (2022b). Respuestas al cuestionario realizado por el Departamento de Seguimiento a la Infraestructura Financiera, May.
Colombia Fintech (2021). *Mapa* fintech *Colombia*, May, https://www.colombiafintech.co/static/uploads/Mapa%20CF%202021.pdf

Annex 1: Payments in Financial Markets

The life cycle of financial market operations begins with an order to buy, sell or transfer a financial asset and ends with delivery of the traded asset. Public and private bonds, equities, and foreign exchange and financial derivatives are the assets that are normally traded. For final compliance, most of these operations require the financial asset to be cleared and settled through the infrastructures created for that purpose (securities depositories, foreign exchange clearing houses and central counterparties, among others), and the money to be transferred.

That transfer of money, which involves large sums daily, must be represented by a secure asset for final settlement of the obligation through an infrastructure that supports operations between financial intermediaries. In this respect, international best practices, as outlined in the *Principles for Financial Market Infrastructures* (BIS and the International Organization of Securities Commissions, IOSCO), recommend this settlement be carried out in central bank money, so as to avoid the credit and liquidity risks that would exist if means of payment issued by commercial banks were to be used (Principle 9).

As mentioned in the overview of the financial market infrastructure in Colombia, the large-value payment system; that is, the deposit account system (CUD) managed by *Banco de la República*, is the backbone of the country's financial infrastructure. It is where operations originating in financial asset clearing and settlement systems are paid, as are the net multilateral obligations of entities participating in retail-value payment systems.

1. Large-value Payment Systems

1.1 General Aspects and Development

There were 136 direct participants with deposit accounts in *Banco de la República*'s large-value payment system (CUD) by December 2021. Table A1.1 shows the number of participants for each type of institution.

As for how the figures have evolved, Graph 1.1 and Table 2.2 show the number of operations processed through the system and their value. The daily average number of operations (6,188) declined by 5.34% in 2021 with respect to the year before. The nominal value (COP 53.2 t) was down as well, by 4.10% compared with that same year. In real terms, the average daily value declined by 9.2%. As for the annual total, the amount processed was 11.1 times Colombia's GDP[1] in 2021. In other words, the daily average was equivalent to 4.53% of GDP, which is less than in 2020, when it accounted for 5.56%.

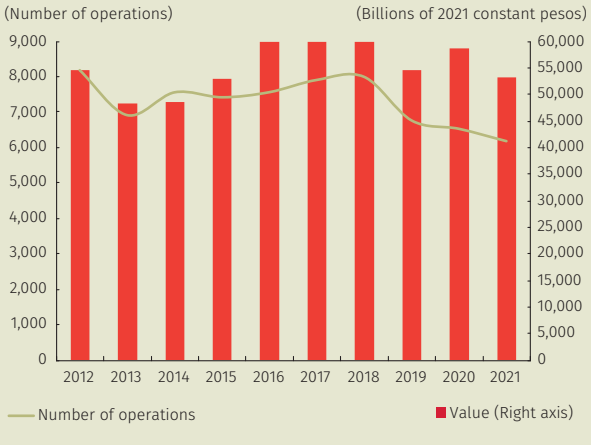
1 The GDP values noted herein are official estimates developed by the National Administrative Department of Statistics (DANE) using the new base year for the national accounts, which is 2015. The preliminary GDP estimated by DANE for 2021 comes to COP 1,176 t and is used as a reference.

Table A1.1
Number of Participants by Type of Institution

Type of institution	Number of participants
Banks	28
Trust companies	27
Brokerage firms	16
Insurance companies	13
Finance companies	10
Public financial entities	8
Social security information operators	6
Financial cooperatives	5
Retail-value payment systems (ACH Colombia and networks)	5
Pension and severance funds	4
Finance corporations	3
Companies specialized in electronic deposits and payments - SEDPE	3
Capitalization companies	1
Banco de la República	1
General Directorate of Public Credit and the National Treasury	1
The Nation Ministry of Finance and Public Credit: general royalties system	1
Stock exchange	1
Centralized securities depository	1
Central counterparty clearing houses	1
Securitization firms	1
Total	136

Source: *Banco de la República* (CUD).

Graph A1.1
Statistics on the Number and Value of Operations in the Large-value Payment System (CUD), daily averages



Source: *Banco de la República* (CUD).

1.2 Concentration Indicators

Table A1.3 contains estimates of the level of concentration in payments made among the direct participants in the large-value payment system (excluding some payments).[2] Using 70% of total payments as a reference, it is possible to determine how many institutions and what percentage of the total number of participants that reference covers. The result shows the concentration between 2020 and 2021 remained stable with fifteen institutions, but the total percentage of participants that generated this concentration decline slightly from 11.5% in 2020 to 10.9% in 2021.

Specifically, while 10.9% of the most active participants (15 institutions) initiated 72.9% of the payments made through the CUD in 2021 (twelve banks: 60.96%; one trust company: 4.64%; one brokerage firm: 4.26% and one finance corporation: 2.34%), the other 89.1% accounted for barely 2.91% of the total number of payments.

Table A1.4 shows the chronology of the CUD system. It illustrates, by one-hour time slots from the start of service for transfers up to closing time, the accumulated settlement rates for

2 Payments from the DGCPTN and *Banco de la República* are excluded.

Table A1.2
Number and Value of Operations in the CUD System

Year	Daily average					Annual value			
	Number of operations	Value		Average transaction value		Number of operations	(Billions of pesos)	Annual value (Billions of 2021 constant pesos)	(Number of times GDP)
		(Billions of pesos)	(Billions of 2021 constant pesos)	(Billions of pesos)	(Billions of 2021 constant pesos)				
2012	8,196	38,132	54,432	4.7	6.6	2,016,269	9,380,456	13,390,308	14.1
2013	6,925	34,543	48,372	5.0	7.0	1,689,588	8,428,598	11,802,844	11.8
2014	7,570	35,925	48,531	4.7	6.4	1,847,039	8,765,618	11,841,654	11.5
2015	7,430	41,767	52,847	5.6	7.1	1,805,454	10,149,449	12,841,824	12.6
2016	7,574	52,083	62,318	6.9	8.2	1,863,090	12,812,358	15,330,051	14.8
2017	7,921	55,305	63,573	7.0	8.0	1,932,687	13,494,365	15,511,854	14.7
2018	8,007	54,977	61,250	6.9	7.6	1,969,837	13,524,386	15,067,518	13.7
2019	6,774	50,752	54,473	7.5	8.0	1,652,880	12,383,453	13,291,334	11.7
2020	6,537	55,527	58,649	8.5	9.0	1,589,352	13,516,504	14,276,391	13.5
2021	6,188	53,253	53,253	8.6	8.6	1,516,294	13,047,093	13,047,093	11.1

Source: *Banco de la República* (CUD).

Table A1.3
Number and Percentage of CUD Participants Accounting for 70% of the Value of Payments

Year	Number of participants	Percentage of participants
2012	16	10.0
2013	15	9.4
2014	14	9.3
2015	14	9.9
2016	14	9.9
2017	13	9.6
2018	13	9.4
2019	15	10.7
2020	15	11.5
2021	15	10.9

Source: *Banco de la República* (DSIF).

transactions involving the most relevant items that affect the balances in deposit accounts. For example, on a daily average for the year 2021, 65% of secondary market trades and 70% of intraday repos had already been finalized by 2:59 p.m. In terms of aggregate value for the entire system, one sees, for instance, that 30% of the transactions had already been settled by 1:59 p.m.

The total value settled (daily average) for each item is shown on the far right of Table A1.4, so each percentage of accumulated compliance can be translated into its respective value. Continuing with the example of sales and purchases, the aforementioned 65% corresponds to COP 2.2 t of COP 3.4 t.

An additional objective in presenting this information is to detail the effects the diversity of transactions has on the system's intraday liquidity. For easier monitoring, the information is broken down by color to show the various effects on that liquidity, namely, 1) yellow denotes operations that have a neutral or zero-sum effect on the aggregate, since the funds debited from one participant are simultaneously credited to another for the same amount; 2) red indicates operations that drain or withdraw liquidity from the payment system aggregate, since the funds debited from one participant are transferred to agents outside the system, such as *Banco de la República* or the Ministry of Finance, or remain frozen in another external system (e.g.

Table A1.4
Timeline for Settlement of Transactions in the CUD (daily averages for 2021)

	0:00	7:00	8:00	9:00	10:00	11:00
Origin and concepts of operations						
Public debt transactions in the DCV						
Primary market				Percentage of cumulative settlement in each time slot		
Placements	0.00	0.00	0.00	0.55	1.62	19.30
Payment of principal and yield	2.89	2.89	17.25	17.40	18.35	47.10
Secondary market						
Purchase/sales	0.13	0.13	0.13	0.19	0.63	18.25
Money market						
Sell/buy backs, third party repo and TTS MHCP	0.21	0.21	0.21	0.43	1.74	29.72
Reverse sell/buy backs, third party repos and TTS MHCP	0.21	0.71	4.16	6.59	9.73	56.39
Monetary policy						
Repose to increase money supply	0.01	0.01	0.01	0.01	0.16	0.47
Reverse repos to increase money supply	0.00	0.03	0.77	2.35	3.87	6.56
Provision of liquidity in the payment system (*Banco de la República*)						
Intraday repos	0.00	1.63	5.51	16.94	31.41	40.90
Reverse intraday repos	0.45	0.47	0.55	0.94	1.43	1.84
Direct funds transfers in the CUD						
Securities (money uploads/downloads)	0.35	5.83	8.93	13.44	17.18	20.19
Intraday interbank loans	5.73	5.73	10.24	47.63	55.19	56.51
Reverse intraday interbank loans	0.00	0.25	0.25	0.37	0.46	1.76
Interbank loans at one or more days	0.00	0.00	0.00	0.00	0.00	0.08
Reverse interbank loans at one or more days	0.00	0.00	0.00	0.29	0.99	3.07
Interbank loans: IBR	0.00	0.00	0.00	0.00	0.00	97.33
Reverse interbank loans: IBR	0.00	0.00	0.10	1.36	2.91	5.45
Taxes	0.01	0.05	15.08	62.44	96.32	99.77
Custodians	1.34	1.44	2.39	7.47	17.26	23.59
Currencies settled outside the clearing house	0.00	0.01	1.78	3.83	6.96	13.41
Deceval						
Primary market						
Placements	0.04	0.04	0.04	0.70	3.73	10.27
Payment of principal and yield	0.13	0.13	0.13	0.41	1.22	1.53
Secondary market						
Purchase/sales	0.00	0.00	0.01	0.17	0.76	2.31
Money market						
Sell/buy backs	0.03	0.03	0.03	0.04	0.18	2.75
Reverse sell/buy backs	0.00	0.00	8.76	29.31	51.49	64.35
Repos	0.02	0.02	0.02	2.85	12.93	30.87
Reverse repos	0.00	0.00	79.23	80.02	95.62	96.71
Others						
Change of depositor	0.13	0.13	0.14	4.20	13.90	22.09

Neutral liquidity effect
Neutral effect of operations settled with liquidity-saving mechanisms
Liquidity drainage effect
Liquidity injection effect
Source: *Banco de la República* (DSIF).

12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	Daily average total liquidated value (billions)
Percentage of cumulative settlement in each time slot										
26.42	44.55	65.58	80.25	94.27	98.71	99.79	100.00			COP 270.09
19.79	19.95	19.97	19.97	19.97	19.97	19.98	19.97	22.14	100.00	COP 199.72
20.03	23.36	64.66	77.69	92.48	97.87	99.36	99.71	99.98	100.00	COP 3,409.77
29.72	31.08	33.20	76.74	87.39	97.00	99.11	99.59	99.83	99.99	COP 5,866.06
56.39	57.22	57.70	82.27	89.36	97.97	99.34	99.77	99.88	99.98	COP 5,837.12
1.42	15.10	44.57	73.81	93.31	99.12	99.79	100.00			COP 6,325.38
10.13	25.13	76.75	89.45	98.19	99.74	99.86	99.97	100.00		
53.39	62.82	69.82	81.74	90.51	96.47	98.78	99.96	100.00	100.00	COP 1,721.27
2.95	4.68	7.48	13.93	37.25	75.89	96.15	99.80	99.93	100.00	COP 1,736.20
22.95	26.54	32.99	47.29	62.64	77.12	88.87	98.47	99.58	100.00	COP 6,187.45
60.47	64.49	70.20	72.60	73.67	73.96	74.04	74.07	94.32	100.00	COP 276.85
6.57	12.84	14.91	16.91	24.49	39.51	82.26	97.61	99.74	100.00	COP 143.02
0.48	1.19	3.65	21.45	59.21	89.36	98.83	100.00			COP 489.15
4.36	7.90	20.62	44.17	70.22	95.96	99.86	100.00			COP 468.12
97.33	97.74	99.97	99.97	100.00						COP 320.00
9.13	11.09	95.52	97.38	99.07	99.49	100.00				COP 320.02
99.93	99.94	99.98	99.99	100.00						COP 687.17
28.29	33.37	40.81	51.67	67.70	83.39	95.21	98.93	99.56	100.00	COP 3,831.21
21.04	29.80	46.96	66.49	83.92	96.66	99.48	99.97	100.00		COP 265.95
13.00	16.22	21.60	35.40	57.29	84.71	97.85	99.65	99.99	100.00	COP 171.08
3.93	5.96	6.77	19.73	82.55	96.87	99.20	99.38	100.00		COP 275.92
5.26	10.72	23.27	46.79	74.67	93.46	98.92	99.60	99.95	100.00	COP 299.93
10.44	21.57	60.63	81.14	92.56	98.84	99.85	99.98	99.98	100.00	COP 56.59
74.18	82.17	92.21	96.85	99.11	99.85	100.00				COP 56.55
58.66	80.52	90.98	94.93	98.34	99.19	99.96	100.00			COP 2.77
97.89	98.47	99.65	99.73	99.86	99.86	99.86	100.00			COP 2.77
26.97	29.63	32.64	42.99	67.34	90.69	98.14	99.36	99.80	100.00	COP 143.77

Table A1.4 (Continued)
Timeline for Settlement of Transactions in the CUD (daily averages for 2021)

	0:00	7:00	8:00	9:00	10:00	11:00
Central Counterparty Risk Clearing House (CRCC)						
Institutions pay debit positions to the CRCC	0.01	76.87	78.66	79.18	79.67	80.25
CRCC pays credit positions to institutions		72.21	89.71		89.75	91.30
Central Counterparty Risk of Colombia (CRCC) – Forex segment						
Institutions pay debit positions to the CRCC	1.60	5.39	13.36	21.13	29.46	37.74
CRCC pays credit positions to institutions	0.00	0.00	0.00	0.00	0.00	0.00
Retail-value payment systems						
ACH	0.00	0.01	0.03	7.85	41.27	44.18
Card and ATM networks		0.07	0.08	0.46	5.60	28.14
Checks (Cedec and delegated clearing houses)	0.00	0.00	0.02	0.05	0.09	95.80
Aggregated timeline for the entire CUD system	1.67	2.59	4.03	7.17	12.43	21.50
Percentage of the number of operations processed per hour (not cumulative)	0.03	1.74	3.27	5.09	6.42	10.83

Neutral liquidity effect
Neutral effect of operations settled with liquidity-saving mechanisms
Liquidity drainage effect
Liquidity injection effect
Source: *Banco de la República* (DSIF).

the CRCC) for a certain period and are subsequently returned; and 3) green indicates operations that inject or add liquidity to the payment system aggregate for reasons exactly opposite to the previous ones.
At the end of the timeline, the percentage of the number of transactions processed (not accumulated) is broken down, for each hour, to identify the intraday periods in which the CUD system has low or high transaction processing loads, regardless of the amounts. This information is relevant for monitoring the system from an operational standpoint, as well as for decision-making when certification activities for contingency scenarios need to be scheduled with the system in production.

2. Clearing and Settlement of Securities and Financial Derivatives

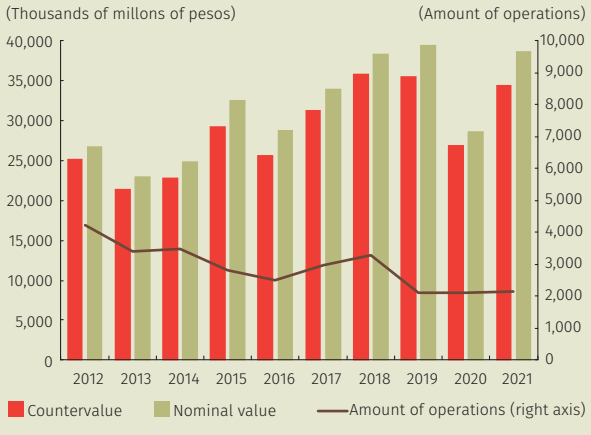
This section refers to other components of the financial infrastructure that clear and settle transactions with financial assets (i.e., securities, financial derivatives and foreign exchange), which must interact, in turn, with the large-value payment system to settle the currency leg of the respective operation. These are the central securities depositories (DCV and Deceval) and the CRCC.

2.1 The Central Securities Depository (DCV)

The DCV saw an increase in the value of settled transactions during 2021, mainly due to added momentum in monetary operations and in the primary market, despite less value in repos, sell/buy backs and sale/purchase transactions. The balance in custody rose as well.

12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	Daily average total liquidated value (billions)
80.55	80.94	82.75	89.98	95.62	98.18	99.83	99.98	100.00		COP 42.09
92.85	95.87	97.27	98.07	99.20	99.88	99.89	99.98	100.00	100.00	COP 42.09
44.52	88.14	89.31	89.40	89.40	89.40	89.40	89.40	97.35	100.00	COP 1,128.30
0.00	1.88	97.10	100.00							COP 1,128.30
52.09	56.31	64.10	72.84	82.11	93.64	97.08	99.85	99.93	100.00	COP 2,230.58
53.58	60.35	70.04	82.93	84.61	84.77	85.02	99.95	100.00		COP 321.82
98.23	98.48	98.71	99.03	99.48	99.77	99.93	99.99	100.00	100.00	COP 192.23
24.24	29.64	47.51	57.59	68.12	74.44	77.45	89.21	91.58	100.00	COP 53,253.00
5.30	5.65	17.17	13.35	14.43	8.79	3.87	1.98	0.73	1.35	COP 6,188.00

Graph A1.2
Large-value Payment System (CUD), operations effected (daily averages)[a/]



a/ Corresponds to the nominal value of the debt.
Source: *Banco de la República* (CUD).

Graph A1.2 shows the evolution in transactions settled by the DCV in terms of nominal value (indicative), settled or market value [3] and number of operations. The settled or market value increased during 2021, which is one of the aspects that stands out. Indeed, the daily average settled or market value (COP 34.4 t) represents an increase of 27.9% compared to the previous year. The number of transactions rose by 2.9%, from 2,090 in 2020 to 2,150 in 2021.

Table A1.5 contains a breakdown of the transactions carried out in the DCV, according to their origin. As for the primary market, which includes the placement of securities through different ways and means (forced, agreed and auction), as well as payment of yield and amortization of capital by the national government, one sees the daily average number of transactions in 2021 (138) registered a negative variation of 3.6% compared to the previous year, while the settled or market value (COP 797.5 b) increased by 56%.

Regarding the secondary market, broken down by type of operation, the settled or market value of repos and sell/buy backs declined compared to the previous year. Specifically, the settled or market value of repos and sell/buy backs in 2021 was COP 11.4 t. Compared to 2020, this amounts to a reduction of 11.4%. Similarly, the settled value of purchase and sale transactions delivered against payment (COP 3.5 t) de-

3 The amount that is actually paid in trading. It represents what will, in fact, be moved out of the deposit account. It considers market prices and is not the nominal value.

Table A1.5
Daily Average of Transactions in the DCV, by Type of Service
(Values in billions of pesos)

Year	Primary market			
	Quantity	Nominal value	Settled value	
			Current	Constant
2012	143	249	286	408
2013	128	346	371	519
2014	113	440	412	557
2015	99	338	363	459
2016	82	399	407	487
2017	76	396	422	485
2018	77	445.9	453.0	505
2019	76	565.1	513.5	551
2020	143	733.4	510.5	539
2021	138	1,108.6	797.5	798

Year	Secondary Market											
	Delivery vs. Payment Purchase/Sales				Monetary Policy Purchase/Sales				Free of Payment Transfers			
	Quantity	Nominal value	Settled Value		Quantity	Nominal value	Settled value		Quantity	Nominal value	Settled value	
			Current	Constant			Current	Constant			Current	Constant
2012	2,029	6,786	7,864	11,225	0	34	1	1	933	4,123	0	0
2013	1,667	4,890	5,700	7,982	2	15	11	15	690	3,630	0	0
2014	2,006	5,936	6,575	8,882	2	7	7	10	439	3,603	0	0
2015	1,557	4,516	4,997	6,323	1	8	8	11	170	5,134	0	0
2016	1,451	3,873	4,141	4,955	9	61	63	75	136	4,388	0	0
2017	1,825	5,657	6,294	7,235	4	26	17	19	146	4,761	0	0
2018	2,107	8,424	9,220	10,272	1	26	27	30	147	4,705	0	0
2019	1,051	4,370	4,807	5,159	7	34	35	37	145	5,518	0	0
2020	875	3,308	3,675	3,882	4	19	20	21	200	3,258	0	0
2021	841	3,288	3,484	3,484	11	122	69	69	208	5,167	0	0

Year	Secondary Market							
	Transfers between deposits				Repos and Sell/buy backs			
	Quantity	Nominal value	Settled value		Quantity	Nominal value	Settled value	
			Current	Constant			Current	Constant
2012	3	11	0	0	838	4,352	5,062	7,226
2013	3	11	0	0	686	5,607	6,409	8,975
2014	1	5	0	0	722	7,026	7,703	10,406
2015	1	2	0	0	787	9,242	10,008	12,663
2016	0	1	0	0	656	9,363	10,035	12,007
2017	0	1	0	0	763	10,537	11,643	13,383
2018	0	2	0	0	787	12,405	13,600	15,152
2019	1	2	0	0	622	9,428	10,363	11,122
2020	0	1	0	0	684	11,702	12,874	13,597
2021	1	2	0	0	691	10,634	11,402	11,402

Table A1.5 (Continued)
Daily Average of Operations Conducted in the DCV, by Type of Service
(Values in billions of pesos)

Year	Monetary Operations			
	Quantity	Nominal Value	Settled Value	
			Current	Constant
2012	262	11,189	11,999	17,129
2013	229	8,549	8,963	12,551
2014	210	7,884	8,213	11,095
2015	207	13,292	13,943	17,641
2016	180	10,748	10,971	13,127
2017	175	12,632	12,931	14,864
2018	171	12,388	12,564	13,998
2019	220	19,526	19,807	21,259
2020	184	9,604	9,823	10,376
2021	260	18,390	18,650	18,650

Source: *Banco de la República* (DCV).

creased by 5.2 %. As for the number of operations, there was an increase of 1.1% in repos and sell/buy backs and a decline of 3.9% in delivery-versus-payment sales and purchases.

In terms of other secondary market operations, the settled value of monetary policy purchases and sales for COP 0.07 t increased with respect to the previous year by nearly 245%.

As to the services provided by the DCV to *Banco de la República*, which involve open market operations (OMO) and the provision of liquidity to the large-value payment system, positive variations were recorded at the end of 2021. COP 18.6 t in settled value represented an increase of 89.8% with respect to the previous year. The number of transactions also rose, having gone from a daily average of 184 to 260, which amounts to an increase of 41.4%.

Table A1.6
Total Value Held in Custody
in the DCV at Year's End
(Billions of pesos)

Year	Current	Constant
2012	160,443	229,027
2013	183,580	257,073
2014	202,604	273,702
2015	207,943	263,105
2016	239,717	286,823
2017	265,680	305,401
2018	304,235	338,948
2019	323,440	347,153
2020	372,275	393,204
2021	424,035	424,035

Source: *Banco de la República* (DCV).

With regard to the DCV's role as a depository, Table A1.6 shows the total nominal values under custody at the close of each year since 2012, at current and constant prices.

The balance in custody in current pesos rose 13.9% in 2021. Of this balance, 97% pertained to bonds issued by the national government, while the remaining 3.0% was made up of securities issued by the Fund to Finance the Agricultural Sector (Finagro).

Of all outstanding issues managed by the DCV, class B TES continued to be highly relevant, accounting for 93.8% of the total balance and 96.7% with respect to domestic public debt issued by the national government. TDS solidarity securities were the second most important item in terms of sovereign bonds, with close to COP 9.74 t (Table A1.7).

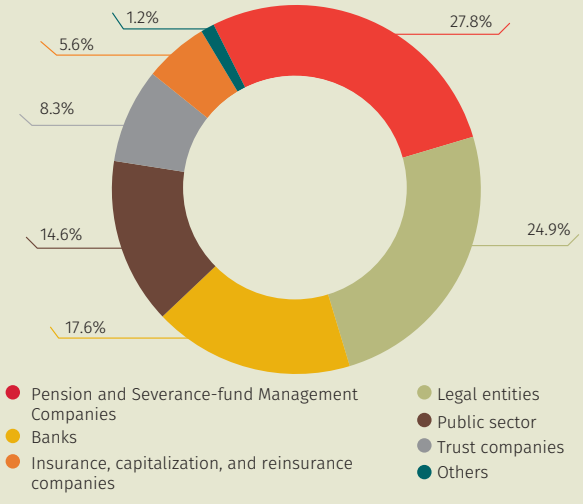
Graph A1.3 shows the distribution of the balance on deposit, by type of institution. Pension and severance fund management companies (including pension liabilities), together with legal entities (including foreigners, among others), account for most holdings, with close to 52.7% (COP 224 t). In third and fourth place are banks, with 17.6% (COP 75 t), and the consolidated public sector, which includes both the financial and non-financial sectors and companies of a special nature, with 14.6% (COP 62 t). They are followed by trust companies (including trusts and collective

Table A1.7
Details on the Balance Held in the DCV at the End of 2021, by Issuer
(In millions of pesos)

Issuer	Balance	Percentage
National Government		
Class B TES	397,888,200	93.8
Solidarity bonds (TDS)	9,741,703	2.30
TIDIS	2,170,053	0.51
Constant value bonds – Series B	1,029,577	0.24
CERT	418,052	0.10
Constant value bonds - Series A	68,399	0.02
Solidarity Bonds for Peace	822	0.00
Security Bonds	1	0.00
National Government Total	411,316,807	97.0
Finagro		
Agricultural Development Bonds – Class A	8,914,227	2.10
Agricultural Development Bonds – Class B	3,804,227	0.90
Finagro total	12,718,454	3.0
General total	424,035,261	100

Source: *Banco de la República* (DCV).

Graph A1.3
Total Balance Held in Custody in the DCV, by Type of Institution
(At December 2021)

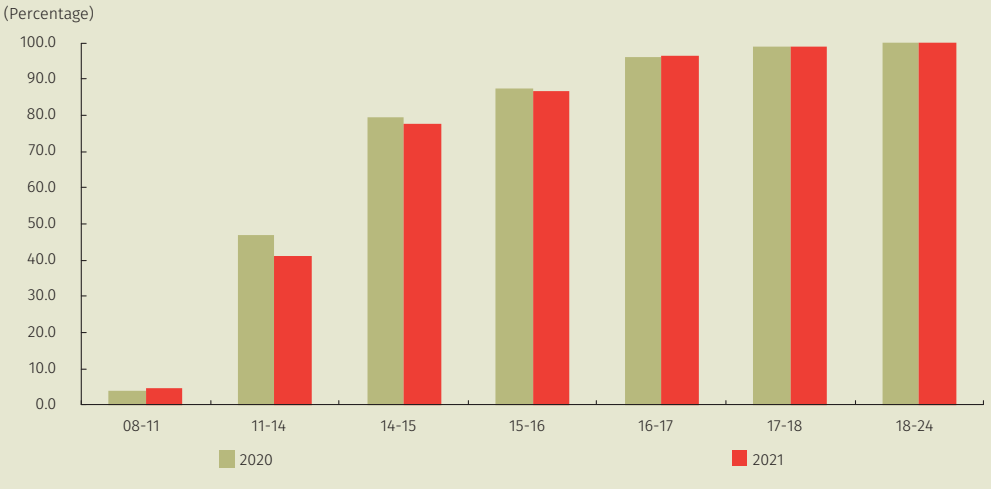


Source: *Banco de la República* (DCV).

investment funds), with 8.3% (COP 35 t). The remaining 6.5% is made up mostly of holdings belonging to insurance, reinsurance, and capitalization companies, with 5.6% (COP 24 t).
As for the DCV operational indicators, the system was available to participants 99.87% of the time, during the hours established for service in 2021. With respect to timeliness in settling transfer orders, Graph A1.4 shows that about 96.4% of the transactions were settled before 17:00 hours.

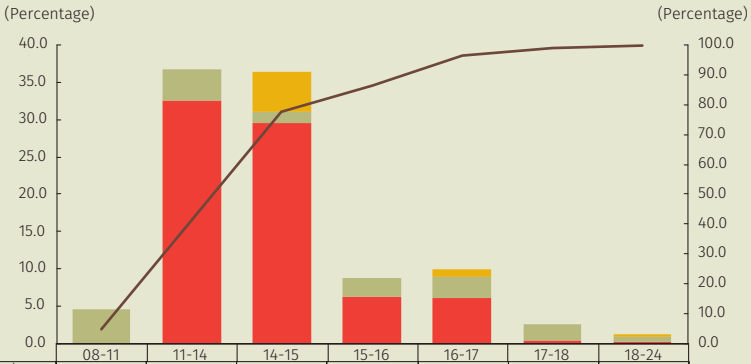
Graph A1.5 contains a breakdown of the activation mechanisms used to settle transactions received by the DCV last year. It shows, for example, that all participants activated their trades manually between 8:00 a.m. and 11:00 a.m. Between 11:00

Graph A1.4
Timeliness in Settling Transfer Orders
Received in the DCV



Source: *Banco de la República* (DCV).

Graph A1.5
Distribution of the Operation Activation Mechanism, by Type (2021)



	08-11	11-14	14-15	15-16	16-17	17-18	18-24
Automatic retry of funds (6.8%)	0.0	0.0	5.5	0.0	1.0	0.0	0.3
Manual activation (18.2%)	4.5	4.2	1.4	2.5	2.8	2.0	0.7
Liquidity savings (75.0%)	0.0	32.5	29.6	6.2	6.1	0.4	0.2
Cumulative settled percentage (right axis)	4.5	41.2	77.7	86.5	96.4	98.8	100.0

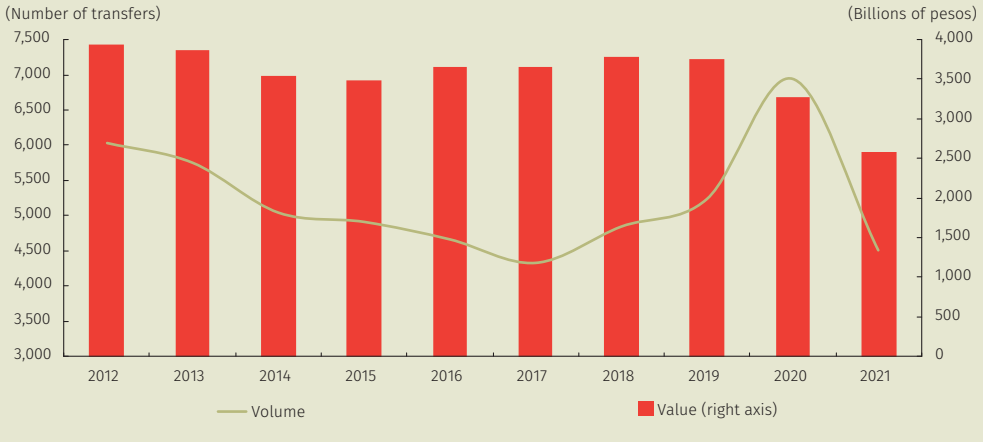
Source: *Banco de la República* (DCV).

a.m. and 2:00 p.m., the liquidity-saving facility was used as well, and automatic retry of funds was added in the time slots thereafter. The liquidity-saving facility, which is the mechanism that contributes most to the settlement of operations, is used predominately during the 11:00-14:00 cycle. Accordingly, 81.8% of all trades received by the DCV in 2021 were activated automatically (automatic retry of funds and the liquidity-saving facility), while 18.2% were activated by means of direct instructions from participants.

2.2 Centralized Securities Depository of Colombia (Deceval)

Graph A1.6 and Table A1.8 illustrate how the transactions conducted through Deceval have evolved. They include primary market operations (placement of fixed-income securities and equities), secondary market operations for private fixed-income securities and equities (purchases/sales between depositors and free-of-payment transfers), and money market transactions (repos, sell/buy backs and temporary transfers of securities -TTS), with respective retrocession and cash collateral. The

Graph A1.6
Statistics on Deceval Value and Volume
(Daily averages)



Source: Deceval.

Table A1.8
Deceval Statistics

Year	Transfers Processed								
	Daily Average					Annual Value			
	Volume	Value		Average Value Transferred					
	(Number of transfers)	(Billions of pesos)	(Billions of 2021 constant pesos)	(Millions of pesos)	(Millions of 2021 constant pesos)	(Number of transfers)	(Billions of pesos)	(Billions of 2021 constant pesos)	(Number of times GDP)
2012	6,032	3,944	5,630	654	933	1,471,831	962,331	1,373,697	1.44
2013	5,752	3,867	5,415	672	941	1,403,374	943,534	1,321,262	1.32
2014	5,046	3,539	4,781	701	947	1,231,272	863,508	1,166,531	1.13
2015	4,915	3,478	4,401	708	895	1,199,378	848,744	1,073,893	1.05
2016	4,668	3,652	4,370	782	936	1,143,678	894,841	1,070,682	1.04
2017	4,335	3,662	4,209	845	971	1,049,081	886,131	1,018,613	0.96
2018	4,849	3,778	4,209	779	868	1,178,228	917,961	1,022,700	0.93
2019	5,239	3,752	4,027	716	769	1,283,659	919,146	986,532	0.87
2020	6,941	3,278	3,462	472	499	1,686,627	796,526	841,306	0.80
2021	4,514	2,577	2,577	571	571	1,105,892	631,438	631,438	0.54

Source: Deceval.

average daily volume increased from 6,941 transactions in 2020 to 4,514 in 2021, with a positive variation of 35%. The average daily value of transfers had declined by the end of the year, having gone from COP 3.29 t in 2020 to COP 2.58 t in 2021 (a variation equivalent to -21 %).

In terms of Deceval's function as a depository, Table A1.9 shows the total amounts held in custody at the end of each year since 2012, at current and constant prices. The balance in custody during 2021, in current pesos, implies an increase of 1.8%.

Table A1.10 shows that shares of stock (common and preferred) account for the largest portion of all outstanding issues managed by Deceval, with 56.5%, while term deposit certificates in (CDT) represent 20.6%, and bonds, 15.4%. Other instruments, such as commercial paper and acceptances, among others, account for 7.5%.

Table A1.9
Total Amount Held in Custody in Deceval at Year-end[a/]
(Billions of pesos)

Year	Current	Constant
2012	362,513	517,477
2013	387,405	542,496
2014	421,697	569,679
2015	381,310	482,461
2016	440,282	526,800
2017	486,555	559,297
2018	470,519	524,205
2019	560,596	601,696
2020	545,372	576,032
2021	535,794	535,794

a/ Balances valued on the last working day of each year. In the case of equities, the valuation price of each share of stock is used, multiplied by the number of shares in custody.
Source: Deceval

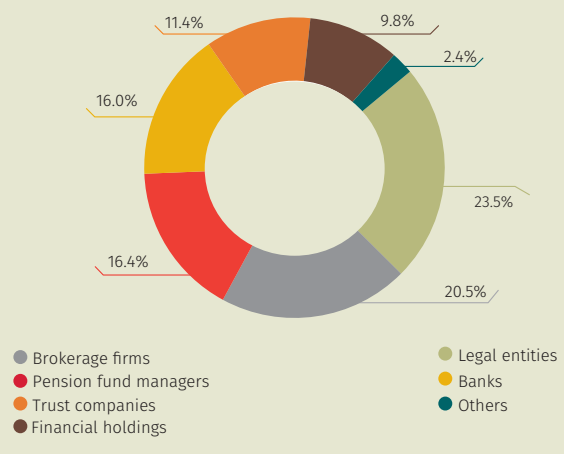
Table A1.10
Details on the Balance of Securities Held in Deceval at the end of 2021, by Type
(Millions of pesos)

Type	Balance	Percentage
Common equities	287,344,696	53.63
Term certificates of deposit	110,391,625	20.60
Bonds	82,505,598	15.40
Participation certificates securities	36,590,052	6.83
Preferred equities	15,149,686	2.83
Securitization	3,296,990	0.62
Treasury bonds (TES)	513,508	0.10
Tax refund securities (TIDI)	1,579	0.00
Bank acceptances	30	0.00
General total	535,793,64	

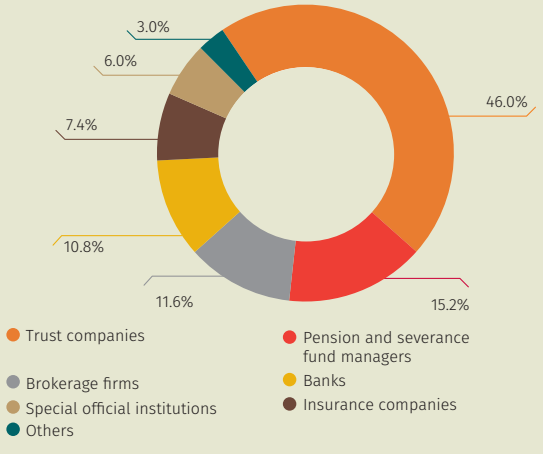
Source: Deceval

Graph A1.7
Total Balance Held in Custody in Deceval,
by Type of Institution (December 2021)

A. Equity income



B. Fixed income



Source: Deceval

When the balance in custody is grouped according to the type of securities and the type of depositor, legal entities rank first in terms of equity-income securities (COP 303 t), with 23.5% (COP 71 t), followed by brokerage firms, with 20.5% (COP 62 t), and pension and severance fund management companies, with 16.4% (COP 50 t); then banks, with 16% (COP 48 t), trust companies, with 11.4% (COP 35.9 t), and financial holding companies, with 9.8% (COP 30 t). The remaining 2.4% (COP 7 t) is made up of entities such as: financial corporations, insurance companies and government agencies, among others (Graph A1.7, panel A). In all, 99.7% of the balances held in custody by brokerage firms are in non-proprietary positions and only 0.3%, in proprietary positions. Additionally, dematerialized issues accounted for 94% of all securities in this market, while 5.9% were physical issues and 0.1%, foreign deposits.

With respect to fixed income securities (COP 233 t) which include CDTs (47%), bonds (35%) and others (17%), trust companies account for the largest share, with 46% (COP 107 t), of which 99.7% is in a non-proprietary position and 0.3%, in a proprietary position), followed by pension and severance fund managers, with 15% (COP 35 t), and brokerage firms, with 11.6% (COP 27 t). Then come banks, with 10.8% (COP 25 t), and insurance companies and special official institutions, with 7.4% (COP 17 t) and 6.0% (COP 14 t), respectively, followed at the end by other institutions with 3.0% (COP 7 t). Legal entities, finance companies, capitalization companies and financial corporations are the most representative of the latter (Graph A1.7, panel B). In this market, 99.2% correspond to dematerialized issues, 0.5% to foreign deposits and 0.3% to physical issues.

As for the time it takes to settle transfer orders in the large-value payment system, nearly 91% of all operations were settled before 17:00 hours.

2.3 Central Counterparty Risk of Colombia S.A. (CRCC)

The value of transactions cleared and settled [4] by the CRCC in 2021 on products in the financial derivatives segment came to COP1,125.64 t, which represents an increase of 11.04% compared to the value of transactions in 2020. The share of these operations, in total and by type of product, was: 18.09% (COP 203.59 t) on standardized derivative financial instruments, and 81.91% (COP 922.05 t) on non-standardized derivatives. This represents an increase of 12.53% for standardized derivatives and 10.72% for non-standardized derivatives compared to the previous year.

Most of the products in the financial derivatives segment increased during 2021. Total operations cleared and settled on TRM options were up by 138.3%, going from COP 0.19 t to COP 0.45 t; OIS-IBR increased by 45.41%, from COP 71.68 t to COP 104.23 t; TRM futures grew by 15.68%, from COP 103.37 t to COP 119.58 t; futures on TES of specific references increased by 8.84%, from COP 73.34 t to COP 79.8 t; and foreign currency NDF forwards (pesos/dollars) rose by 7.45%, from COP 761.11 t to COP 817.81 t. The products that contracted were OIS futures and stock futures. The former fell by 10.38%, going from COP 2.16 t to COP 1.94 t; and the latter declined by 3.22%, from COP 1.84 t to COP 1.78 t.

The portion represented by the different types of standardized futures contracts out of the total for products of this type was as follows: TRM futures, with 58.74% (COP 119.58 t), TES futures on specific references, with 39.21% (COP 79.83 t), OIS futures, with 0.95% (COP 1.94 t), and 1.1% (COP 2.24 t) for other products, which include futures on shares, indexes and electricity. As for non-standardized products, foreign currency NDF forwards (pesos/dollars) accounted for 88.70% (COP 817.81 t), and OIS IBR and OIS IBR overnight forwards, 11.30% (COP 104.23 t).

On the other hand, the total value of operations in the fixed income segment represented by sell/buy backs on government debt securities managed by the clearing house, for subsequent gross settlement through the DCV, declined by 11.17%. This reduced their value to COP 2,708.55 t. [5]

With respect to the equity income segment, repo on equities operations were down by 17.66%, having gone from COP 7.58 t to COP 6.24 t. Cash operations and temporary transfer of securities (TTS) came to COP 50.62 t and COP 2.4 t, respectively.

In the CRCC's first year of operation in the foreign exchange segment, total operations cleared and settled in the spot market (peso-dollar) came to COP 2,658.04 t, with 86.75% (COP 2,305.89 t) settled on the same day, 13.16% (COP 349.77 t) within one day and 0.09% (COP 2.37 t) within two or three days (Graph A1.8).

The number of futures contracts[6] cleared and settled in the CRCC declined. The daily average number of contracts went from 7,474 in 2020 to 6,085 in 2021. The total value of transactions accepted for net clearing in the financial derivatives segment increased from COP 4.17 t in 2020 to COP 4.58 t in 2021.

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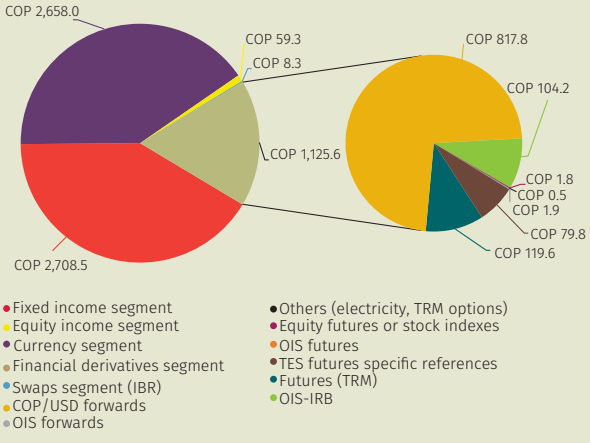
4 Due to novation by the CRCC, a negotiated transaction is accounted for as two transactions cleared and settled in the CRCC, since the original counterparty link disappears and, in its place, two links appear in which the clearing house becomes the buyer and the seller for the initial counterparties.

5 This amount takes into account the two transactions resulting from novation on the date they were constituted.

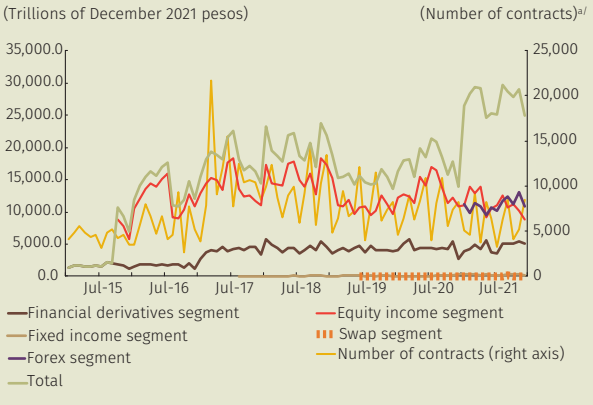
6 Only standardized products are included. Therefore, this figure does not consider exchange rate forwards or operations in the equity and fixed-income segments.

Graph A1.8
Central Counterparty Risk of Colombia
Share in Trillions of Pesos by Product
(Total value of operations in 2021)



Source: CRCC and *Banco de la República* (DSIF).

Graph A1.9
Value and Number of Transaction Contracts Accepted by the CRCC in Each Segment
(Daily average)



a/ Financial derivatives segment. Does not include exchange rate or interest rate forwards.
Sources: CRCC and *Banco de la República* (DSIF).

On the other hand, the average daily value of operations cleared on a gross basis in the fixed income segment (sell/buy backs with TES) went from COP 12.55 t in 2020 to COP 11.05 t in 2021. The average daily value of operations cleared on a gross basis in the equity income segment (repo, spot and TTS operations on equities) rose from COP 114.16 b in 2020 to COP 242.1 b in 2021. The daily average for operations in the foreign exchange segment was COP 10.83 t in 2021 (Graph A1.9).

A more detailed look at how the products in each segment evolved during 2021 shows the highest average daily value accepted in April was for TES sell/buy backs, with COP 13.38 t, and in May for cash, repos and TTS on shares, at COP 292.31 b. On the other hand, in the financial derivatives segment, the highest daily averages were obtained in May for specific-reference TES futures, with COP 770.14 b; in December for TRM futures, with COP 814.9 b; in February for OIS futures, with COP 814.9 b; in February for OIS futures, with COP 41.22 b; in September for stock futures, with COP 14.66 b; in November for currency NDF forwards (pesos/dollars), with COP 4.11 t; and in December for OIS-IBR, when they reached COP 830.52 b (Graphs A1. 9 and A1.10).

In the foreign exchange segment, 1,734 transactions were cleared and settled on average, daily, with USD 1,481.47 million gross and USD 236.06 million net. Of these transactions, 96.36% were settled on the same trading day, while the remaining percentage were transactions with settlements from *t* + 1 to *t* + 3.

The gross-valued open positions[7] at the end of 2021 totaled COP196.3 t. This amount represents an increase of 69.96% with respect to the open position at the close of 2020.

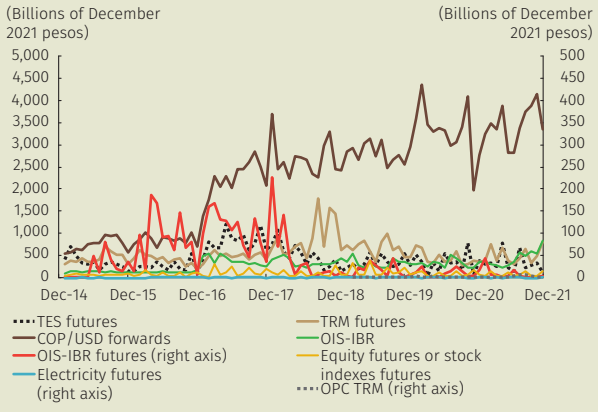
Graph A1.11 shows the most representative products with declining open positions[8] were futures on specific reference TES (-20.46%) and OIS futures (-16.42%). The products with increased open positions were swaps (IRS and OIS) in the financial derivatives and swaps segments (125.04%) and (57.29%) respectively, repos on equities (102.88%), currency NDF forwards (pesos/dollars) (50.85%), and TRM options (3,860.05%).

Transactions with non-standardized derivatives in 2021 were received entirely from the recording systems, while standardized derivatives on shares and indexes were received entirely from the electronic trading systems. As for operations with the other standardized derivatives, 4.4% were incorporated through the trading

7 Both the buy and sell position generated by the same transaction are taken into account. For example, when interposing in a transaction for the purchase of a TES forward contract, the open position for the CRCC will be two contracts, because one participant has a long open position, while the other has a short one.

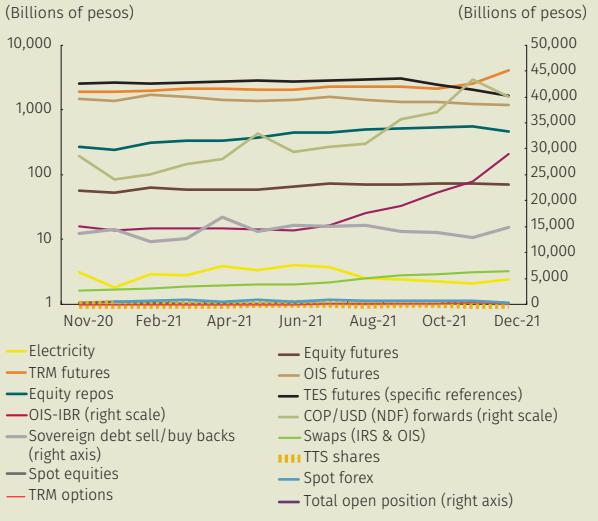
8 The comparison considers the open position on the last day of November 2020 and the last day of November 2021. December is not considered, since it is a month characterized by seasonal performance.

Graph A1.10
Evolution in Operations with Products in the Financial Derivatives Segment
(Daily average)



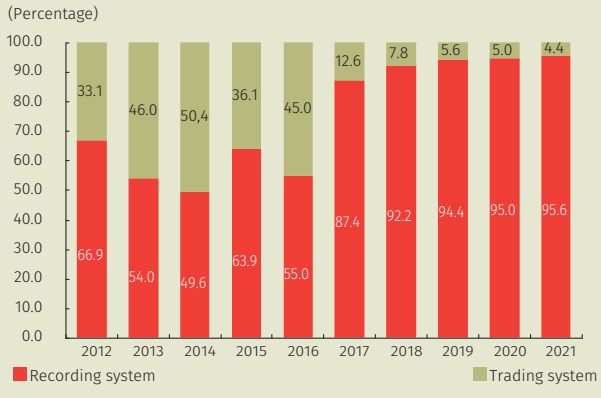
Sources: CRCC and *Banco de la República* (DSIF).

Graph A1.11
Evolution in the Open Position during 2021, by Product Group
(Only one point)



Sources: CRCC and *Banco de la República* (DSIF).

Graph A1.12
Evolution in the Number of Standardized Derivative Contracts Received from Recording or Trading Systems[a/]



a/ Does not include equity and index contracts, which come entirely (100%) from a trading system.
Sources: CRCC and *Banco de la República* (DSIF).

systems of the BVC [9] and Derivex, and 95.6% through their respective recording systems, maintaining the trend of the previous year (Graph A1.12).

With respect to sell/buy backs with TES, 25.72% came from the MEC system and 74.28%, from the SEN trading system.

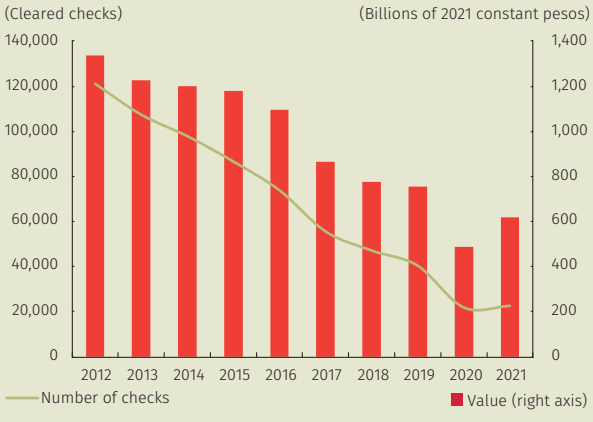
The CRCC experienced 77 delays during 2021. However, none had an impact on service delivery, nor was it necessary to execute collateral. Most of the delays (71) were related to delays in the delivery of shares, three, to the delivery of collateral and the remaining three, to the payment of multilateral net proceeds from the foreign exchange segment. For the latter, it was not necessary to use the credit lines agreed with the liquidity providers.

The following are the most important changes introduced by the CRCC during 2021. The first was implementation and regulation of interposition as a central counterparty in peso-dollar spot market operations in the foreign exchange segment, starting on February 1. As discussed in last year's *Payment Systems Report*, with elimination of the legal and operational relationships in initial bilateral operations and with the use of risk mitigation tools, in addition to individual collateral, participants and the market benefited from the elimination of bilateral trading quotas and from the creation of incentives for the clearing house to keep its risk management model calibrated by having its equity involved in the security rings to manage default by its members. The second was the establishment of a 5.0% limit on cash in US dollars as part of all collateral posted in favor of the clearing house. This limit will not apply to collateral in dollars in the foreign currency segment.

9 The regulations on the electronic trading and recording system managed by the BVC allow trading to be done directly in the system or a transaction to be recorded once it has been conducted in the over-the-counter market.

Annex 2: Retail Payments

Graph A2.1
Value and Number of Checks Cleared through Cedec
(daily averages)



Source: *Banco de la República* (Cedec).

1. Retail-value Payment Systems

The function of the country's retail-value payment systems is to clear and settle operations conducted with the various payment instruments that are available in Colombia. The main ones are checks, credit and debit transfers through the ACHs (electronic payments between companies and people), and credit and debit cards. Their main features, amount and number of operations are described in this section.

1.1 Check Clearing Houses and the Cedec System Managed by *Banco de la República*

1.1.1 The Clearing System for Checks: Cedec

During 2021, 5.6 million checks were cleared (on an average of 22,819 per day) for a total value of 152.2 t (COP 0.62 t daily, on average), [1] which represents 13% of GDP. These figures are higher than the 5.4 million checks and 118.5 t in value recorded in 2020 and imply an increase of 4.1% and 28.4%, respectively (Graph A2.1 and Table A2.1).

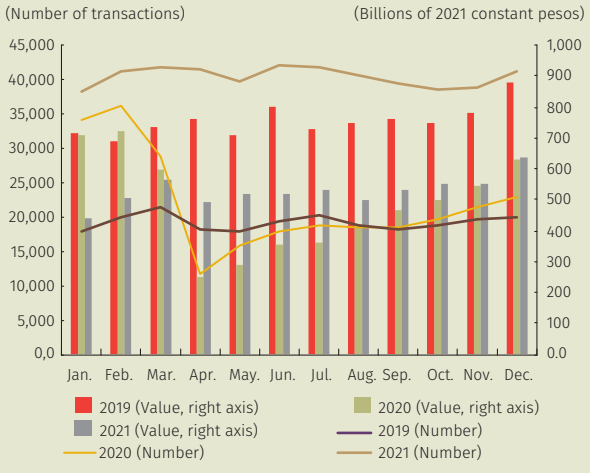
Table A2.1
Statistics on Checks Cleared through Cedec

	Daily Average					Annual Value			
	Number of Checks	Value		Average Transaction Value					
	Number of Operations	(Billions of Pesos)	(Billions of 2021 Constant Pesos)	(Millions of Pesos)	(Millions of 2021 Constant Pesos)	(Millions of Checks)	(Billions of Pesos)	(Billions of 2021 Constant Pesos)	(Number of Times GDP)
2012	120,857	1,336	1,908	11.1	15.8	29.5	326,056	465,435	0.49
2013	107,239	1,226	1,717	11.4	16.0	26.2	299,225	419,015	0.42
2014	97,762	1,201	1,622	12.3	16.6	23.9	293,048	395,884	0.38
2015	86,537	1,179	1,492	13.6	17.2	20.9	285,374	361,076	0.35
2016	73,852	1,094	1,309	14.8	17.7	18.1	268,009	320,674	0.31
2017	55,674	863	992	15.5	17.8	13.5	208,944	240,182	0.23
2018	47,254	777	865	16.4	18.3	11.5	188,771	210,310	0.19
2019	40,553	757	813	18.7	20.0	9.9	185,567	199,172	0.18
2020	22,097	488	515	22.1	23.3	5.4	118,569	125,234	0.12
2021	22,819	621	621	27.2	27.2	5.6	152,214	152,214	0.13

Source: *Banco de la República* (Cedec).

1 These figures on the use of checks only consider interbank payments; that is, payments between the customers of different financial institutions. Consequently, they do not include intrabank checks, which are settled within each institution and do not go through a check clearing house. Statistics on intrabank payments are provided at the end of this section.

Graph A2.2
Evolution in Amount and Daily Average Value per Month, Cedec



Source: *Banco de la República* (Cedec).

The changes in the number and value of average daily transactions cleared through Cedec each month for the years 2019, 2020 and 2021 are compared in Graph A2.2. Although, in general, the levels recorded in 2021 show a slight recovery compared to those for 2020, they are, in any case, lower than those in 2019 (pre-pandemic).

As for liquidity needs, Table A2.1 shows COP 621 b were cleared daily, in gross, on average, during 2021. However, because of multilateral netting, COP 192.23 b were required to settle obligations between financial institutions (Table A2.3). So, the liquidity savings came to 69.08%.

According to the figures reported by commercial banks, intrabank checks (the drawer and the drawee share the same financial institution; so, the checks are not sent to CEDEC or physical clearing houses) accounted for 37% of the value and 57.3% of the total number interbank checks cleared in 2021, having increased 18.7% in value and declined 21.9% in the number of checks with respect to 2020 (Table A2.2).

1.1.2 Concentration and Operational Efficiency Indicators

There were 25 entities involved in the check clearing process by December 31, 2021 (Table A2.3). However, the trend in concentration of operations continues, as it has for some time, with the five largest participants accounting for 70% of the value cleared, as per the CR5 indicator.

Table A2.2
Comparison Between Interbank and Intrabank Checks in Value and Number

Year	Interbank Checks Cleared[a/]		Intrabank Checks[b/]			
	Number	Value	Number		Value	
	(Number of Checks)	(Billions of Pesos)	(Number of Checks)	(As a Percentage of Interbank Checks)	(Billions of Pesos)	(As a Percentage of Interbank Checks)
2012	29,489,131	326,056	13,362,676	45.3	98,033	30.1
2013	26,166,386	299,225	11,894,023	45.5	88,791	29.7
2014	23,853,920	293,048	13,745,083	57.6	109,282	37.3
2015	20,900,000	285,374	11,207,337	53.6	106,209	37.2
2016	18,093,721	268,009	9,530,565	52.7	88,672	33.1
2017	13,472,000	208,944	7,990,110	59.3	89,619	42.9
2018	11,482,000	188,771	7,004,212	61.0	72,738	38.5
2019	9,935,390	185,567	6,019,882	60.6	73,447	39.6
2020	5,369,615	118,569	4,039,429	75.2	47,238	39.8
2021	5,590,533	152,214	3,192,381	57.3	56,077	37.0

a/ Corresponds to the number and value of checks cleared through Cedec.
b/ Checks that are cleared within each financial institution and do not pass through the check clearing house.
Sources: Commercial banks and *Banco de la República* (Cedec).

Table A2.3
Cedec
(Participants and Concentration)

	Total participants	CR5 (percentage)	Number of participants that clear 70% of the value
2012	24	70.3	5.0
2013	25	69.7	5.0
2014	25	72.1	5.0
2015	27	72.1	5.0
2016	25	72.2	5.0
2017	25	73.3	5.0
2018	25	71.3	5.0
2019	26	70.1	5.0
2020	25	70.5	5.0
2021	25	71.4	5.0

Source: *Banco de la República* (DSIF).

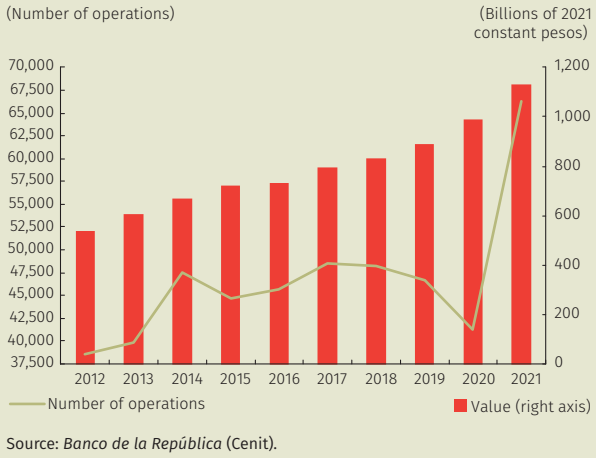
In terms of operational efficiency, Cedec's availability was 99.73% during 2021. In other words, there were occasional suspensions in service for a period equivalent to 0.27% of the time.

1.2 Automated Clearing Houses (ACH)

There are two automated clearing houses operating in Colombia: the ACH-Cenit (managed by *Banco de la República*) and the ACH-Colombia, which is owned by commercial banks.

Together, they cleared 310.5 million in transactions during 2021, 16.76 % more than in 2020. On average, this amounts to 1,267,439 payment instructions issued daily (66,225 were processed in ACH-Cenit and 1,201,214 through ACH-Colombia) for a value equivalent to COP 6.7 t (COP 1.13 t in ACH-Cenit and COP 5.61 t in ACH-Colombia). The total gross amount cleared by these ACHs in 2021, together, came to COP 1,652.9 t; that is, 21.75% more than in 2020 and 1.4 times nominal GDP in 2021. The net amount settled through these infrastructures in 2021 came to COP 546.4 t in total (COP 2.23 t daily, on average) and was equivalent to 33.05 % of the gross value. This implies a liquidity savings of 66.94 % (Table A2.3).

Graph A2.3
Value and Number of Operations in ACH Cenit
(daily averages)



Source: *Banco de la República* (Cenit).

1.2.1 ACH-Cenit

As illustrated in Graph A2.3 and Table A2.4, more than 16.22 million transactions (66,225 daily, on average) were processed through ACH-Cenit in 2021, including credit (crediting funds) and debit (discounting funds) operations. The respective gross amount was over COP 276.1 t (COP 1,130.2 b daily, on average). These figures, when compared to those for 2020, reflect an increase of 60.9% in the number of operations and 14.9% growth in value. The low amount of liquidity savings (1.5% for 2021) resulting from the net amounts cleared through ACH-Cenit is

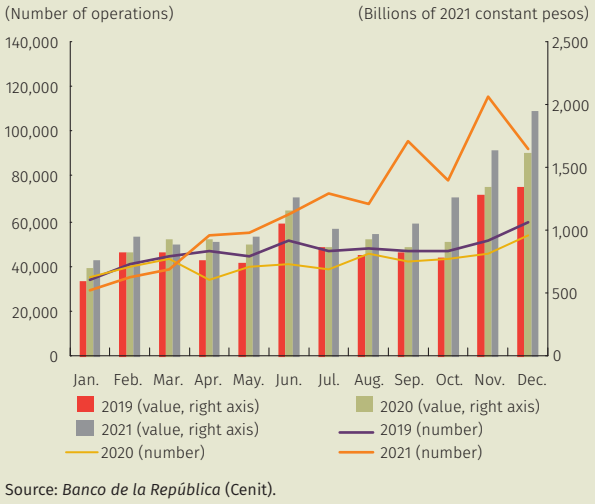
Table A2.4
ACH Cenit Clearing House Statistics[a/]

Year	Average Daily				
		Value		Average transaction value	
	(number of transactions)	(billions of pesos)	(billions of constant 2021 pesos)	(millions of pesos)	(millions of constant 2021 pesos)
2012	38,504	539.2	769.6	14.0	20.0
2013	39,852	607.0	850.0	15.2	21.3
2014	47,586	670.8	906.2	14.1	19.0
2015	44,743	722.8	914.5	16.2	20.4
2016	45,697	733.8	878.0	16.1	19.2
2017	48,572	797.7	916.9	16.4	18.9
2018	48,284	832.8	927.8	17.2	19.2
2019	46,741	890.0	955.2	19.0	20.4
2020	41,327	987.1	1,042.6	23.9	25.2
2021	66,225	1,130.2	1,130.2	17.1	17.1

Year	Annual total							
	Number of transactions			Value of transactions (billions of pesos)			Annual value (billions of constant 2021 pesos)	Number of times of GDP
	Credit	Debit	Total	Credit	Debit	Total		
2012	9,378,640	93,385	9,472,025	132,504	129.0	132,633	189,329	0.20
2013	9,522,192	201,586	9,723,778	147,926	188.5	148,114	207,409	0.21
2014	11,035,981	574,941	11,610,922	163,238	429.0	163,667	221,101	0.21
2015	10,410,511	417,239	10,827,750	174,408	505.5	174,914	221,314	0.22
2016	10,909,837	285,842	11,195,679	179,164	617.7	179,782	215,110	0.21
2017	11,549,242	205,292	11,754,534	192,463	574.9	193,038	221,898	0.21
2018	11,567,335	165,728	11,733,063	201,849	511.2	202,360	225,449	0.20
2019	11,249,571	201,856	11,451,427	217,549	493.9	218,043	234,029	0.21
2020	9,817,581	266,197	10,083,778	240,297	566.3	240,863	254,404	0.24
2021	15,905,326	319,814	16,225,140	276,150	743.8	276,894	276,894	0.24

a/ Includes credit and debit transfers.
Source: *Banco de la República* (Cenit).

Graph 2.4
Evolution in Daily Average Number and Value of Operations per Month in Cenit



Source: *Banco de la República* (Cenit).

due to payments sent by the DGCPTN and the General Royalties System, which accounted for the majority (90%).

Credit operations represented the bulk of all transactions in 2021, both in number (98.03%) and value (99.73%). Debit operations were up 20.14% in number and 31.34% in value with respect to 2020 (Table 3.4).

Graph A2.4 compares the average daily number and value of transactions cleared by ACH-Cenit each month in 2019, 2020 and 2021. In general, one sees growth in both the number of transactions and the amount cleared. Moreover, it is important to highlight the significant rise in the number of operations in the past year, especially during the second half, which coincides with an increase in economic activity.

In terms of operational efficiency, ACH-Cenit's availability during 2021 was 99.62%. In other words, there were occasional

suspensions in the provision of the service for a period equivalent to 0.28% of the time.

1.2.2 ACH-Colombia

ACH-Colombia processed 294.2 million transactions in 2021, including both credit and debit operations, for more than COP 1,376 t gross. These figures imply an increase of 15.02% in the number of operations and 23.2% in value with respect to 2020 (Table A2.5 and Graph A2.5).

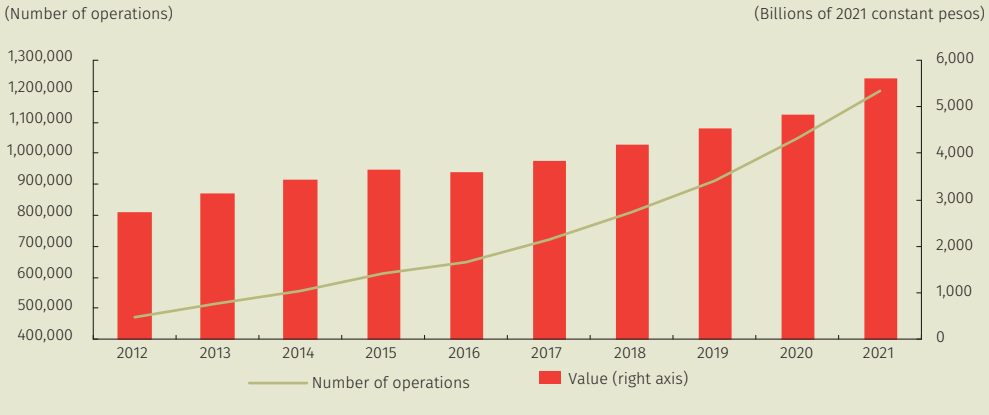
ACH-Colombia settles the net amounts that result from clearing in five intraday trading cycles. Once the net positions are calculated, the participants with net debtor positions transfer the funds to ACH-Colombia's account, so it can eventually distribute them from its deposit account to the participants with net creditor positions. The net amount settled in all of 2021 came to COP 273.7 t (COP 1,117.3 b daily, on average), which is equivalent to 19.8% of the gross value. This represents a liquidity saving of 80.2%.

Table A2.5
ACH Colombia Statistics

Year	Daily Average					Annual Value			
		Value		Average Value per Operation					
	(Number of Operations)	(Billions of Pesos)	(Billions of 2021 Constant Pesos)	(Millions of Pesos)	(Millions of 2021 Constant Pesos)	(Number of Operations)	(Billions of Pesos)	(Billions of 2021 Constant Pesos)	(Number of Times GDP)
2012	471,629	1,921	2,742	4.1	5.8	116,020,691	472,495	674,472	0.7
2013	516,603	2,238	3,134	4.3	6.1	126,051,206	546,108	764,733	0.8
2014	556,449	2,536	3,426	4.6	6.2	135,773,574	618,750	835,882	0.8
2015	611,228	2,877	3,640	4.7	6.0	147,917,150	696,124	880,787	0.9
2016	648,858	2,995	3,583	4.6	5.5	158,970,262	733,736	877,919	0.8
2017	721,067	3,340	3,839	4.6	5.3	174,498,262	808,298	929,144	0.9
2018	808,832	3,750	4,178	4.6	5.2	196,546,261	911,333	1,015,316	0.9
2019	909,622	4,215	4,524	4.6	5.0	221,947,874	1,028,475	1,103,877	1.0
2020	1,048,593	4,577	4,834	4.4	4.6	255,856,641	1,116,811	1,179,597	1.1
2021	1,201,214	5,616	5,616	4.7	4.7	294,297,520	1,376,035	1,376,035	1.2

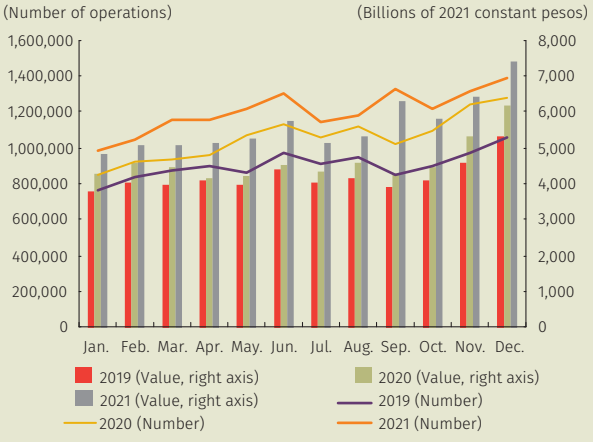
Source: ACH Colombia.

Graph A2.5
Value and Number of Operations in ACH Colombia
(daily averages)



Source: ACH Colombia.

Graph A2.6
Evolution in Daily Average Number and Value per Month in ACH Colombia



Source: ACH Colombia.

The value and number of transactions cleared by ACH Colombia daily, on average, during 2019, 2020 and 2021 are compared in Graph A2.6. The figures show growth in both the amount and number of transactions. While the amount cleared in 2020 rose 10% compared to the previous year, the increase in 2021 was 20%. As for the number of operations, the growth rates were 17% for 2020 and 14% for 2021.

Table A2.6 shows the CR5 concentration rate, which is constructed as the sum of the five largest percentages or proportions of the value of transactions. In 2021, it was 72.2% for credit operations, which represents an increase of 2.9% with respect to 2020. The CR5 rate for debit transactions reflects a decline of 4.14%, having gone from 89.3% in 2020 to 85.6% in 2021.

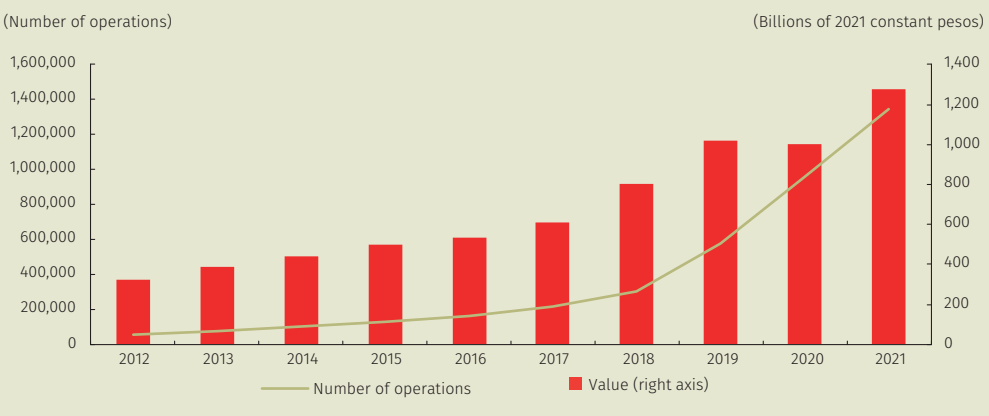
Graph A2.7 shows how use of the PSE button has evolved. This service, which is provided by ACH Colombia, experienced a

Table A2.6
ACH Colombia
(participants and concentration in value of payment sent)

Year	Credit transactions			Debit transactions		
	Number of participants	CR5 (Percentage)	Number of participants who clear 70% of the value	Number of participants	CR5 (Percentage)	Number of participants who clear 70% of the value
2012	20	76.1	6	20	71.2	5
2013	21	68.5	5	21	93.5	5
2014	20	70.2	5	20	92.1	5
2015	20	70.22	5	20	88.1	5
2016	20	73.50	5	20	85.3	5
2017	23	73.80	5	23	91.0	5
2018	25	74.32	5	25	92.91	5
2019	27	74.00	5	27	92.00	5
2020	27	74.37	5	27	89.30	5
2021	31	72.20	5	31	85.60	5

Source: ACH Colombia.

Graph A2.7
Value and Number of Operations Using the PSE Service (ACH Colombia)
(Daily averages)



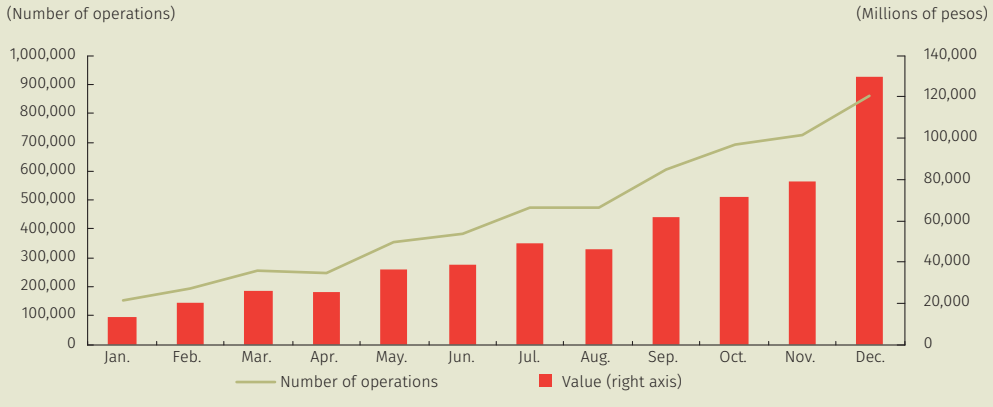
Source: ACH Colombia.

considerable increase in both the number of transactions and in monetary value compared to 2020: 40.9% and 34.5%, respectively.

ACH Colombia inaugurated an fast payment system called Transfiya at the beginning of 2020. It enables a person to transfer or receive money from another person in less than ten seconds, using their respective mobile phone numbers. Graph A2.8 shows how the use of Transfiya has evolved in terms of the number and value of transactions. December 2021 is particularly important as the month with the highest number and value of transactions. In contrast with the previous year, the average daily number of transactions increased from 6,109 to 22,140 (+262 %) while the amount transferred went from 766 to 2,440 million (+218 %).

To complement the statistics on the use of electronic funds transfers as a payment instrument, Table A2.7 shows the figures for intrabank transfers, based on information provided by the commercial banks from 2012 to 2021. In these cases, the drawer

Graph A2.8
Monthly Value and Number of Monthly Operations through the Transfiya Instant Payment System (ACH Colombia)



Source: ACH Colombia.

Table A2.7
Comparison Between Interbank and Intrabank Operations in Value and Number

Year	Interbank Transfers Cleared[a/]		Interbank Transfers[b/]			
		Value	Number of Operations		Value	
	(Number of Operations)	(Billions of Pesos)	(Number of Operations)	(As a Percentage of Interbank Operations)	(Billions of Pesos)	(Number of Times Interbank Operations)
2012	125,492,716	605,128	70,701,523	56.3	1,005,437	1.7
2013	135,774,984	694,222	96,171,547	70.8	1,050,129	1.5
2014	147,384,496	782,417	112,103,184	76.1	1,025,864	1.3
2015	158,744,900	871,038	145,895,871	91.9	1,581,650	1.8
2016	170,165,941	913,518	189,358,265	111.3	2,393,927	2.6
2017	186,252,796	1,001,336	179,104,744	96.2	2,138,592	2.1
2018	208,279,324	1,113,693	304,602,311	146.2	2,965,085	2.7
2019	233,399,301	1,246,518	353,430,214	151.4	2,773,874	2.2
2020	265,940,419	1,357,674	498,345,093	187.4	3,236,407	2.4
2021	310,522,660	1,652,929	815,131,209	262.5	3,315,448	2.0

a/ Number and value of operations cleared through ACH Cenit and ACH Colombia.
b/ These transfers are settled within each financial institution and do not go through ACHs.
Sources: Commercial banks and ACHs.

and the drawee of the funds share the same bank, which means the operation is not cleared through an ACH.

In terms of the number of operations, intrabank transfers were equivalent to 262.5% of all interbank transfers in 2020. As to value, they were 2.0 times more than interbank transfers.

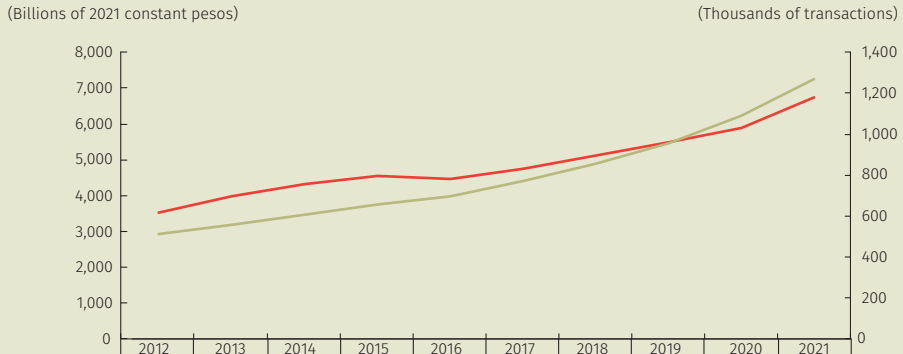
2. Payment Instruments

2.1 Electronic Funds Transfers

The use of debit and credit transfers has increased in recent years. In 2021, interbank and intrabank transfers together came to an average daily gross payment value of COP 20.3 t, being the electronic instrument used the most in Colombia in the market for goods and services.

Interbank transfers (those done by ACH Colombia and ACH Cenit) have trended upward both in value and the number of transactions, averaging COP 6.7 t in value and 1.3 m transactions daily (Graph A2.9).

Graph A2.9
Interbank Transfers
(Daily average)



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Value	3,511	3,984	4,332	4,554	4,461	4,756	5,106	5,479	5,877	6,747
Number of transactions (right axis)	510	556	604	656	695	770	857	956	1,090	1,267

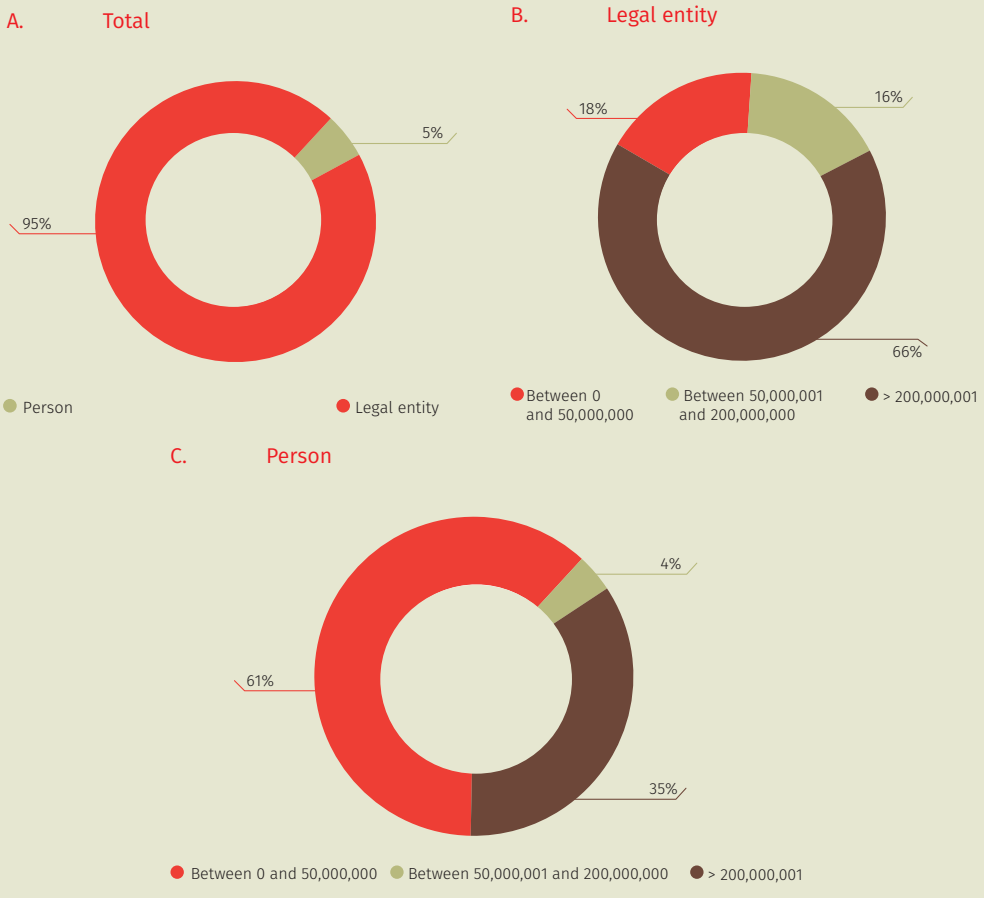
Source: ACH Colombia and *Banco de la República*.

According to the information provided by the ACH Colombia up to 2021 (COP 5.6 t daily, on average), 95% of the transfers originate with companies and only 5.0% are used by individuals[2] (Graph A2.10).

Sixty-six percent of the transfers made by companies are for more than COP 200 m, and 61% of those from individuals are for less than COP 50 m.

2 In terms of intrabank transfers, 73% originate with legal entities and 27%, with individuals.

Graph A2.10
Electronic funds transfers, by Originator, 2021
(Share of value)



Source: Commercial banks.

2.2 Checks

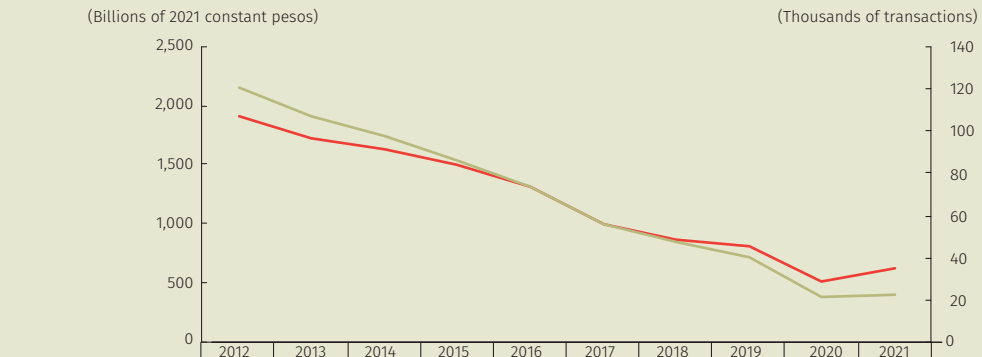
The trend in the use of checks has declined in the last ten years. However, it did increase 18.1% between 2020 and 2021, having gone from a gross daily average of COP 720.7 b in payments to COP 850.9 b.

A similar trend is evident in the series for interbank checks. There has been a decline in the value of number of transactions in the last ten years. However, between 2020 and 2021, the average value increased from COP 515 b to COP 621 b, and the number of transactions went from 22,097 to 22,819 (Graph A2.11).

Based on data reported by commercial banks, Graph 2.12 shows 79% of checks, in terms of value, are drawn by companies and the other 21%, by individuals.[3] Most of those drawn by companies (37%) are separate checks for amounts over COP 200 m, followed by checks for up to COP 50 m (35%). Forty percent (40%) of the checks drawn by individuals are for amounts between COP 50 m and COP 200 m.

3 Likewise, the majority of intrabank checks originate with legal entities (89%) and the rest with individuals (11%).

Graph A2.11
Interbank Checks
(Daily average)

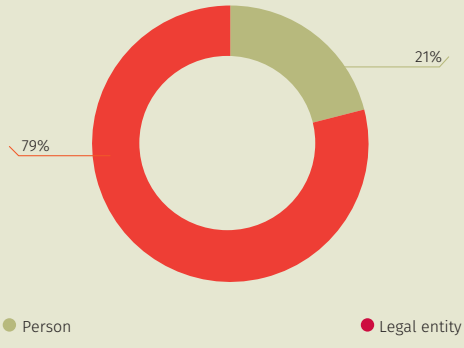


	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Value	1,908	1,717	1,622	1,492	1,309	992	865	813	515	621
Number of transactions (right axis)	121	107	98	87	74	56	47	41	22	23

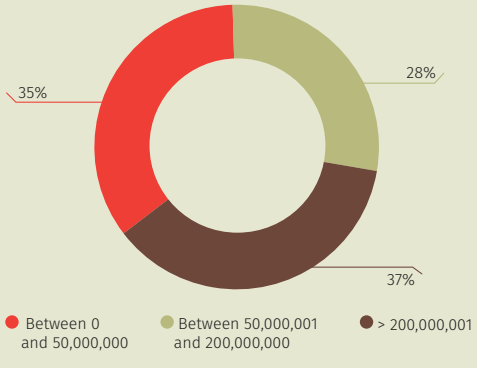
Source: *Banco de la República.*

Graph A2.12
Checks, by Originator
(Share of value)

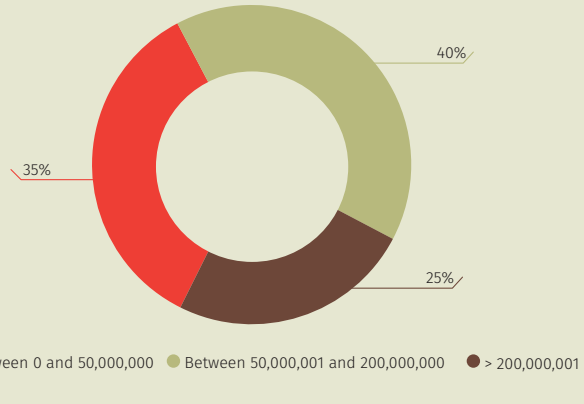
A. Total



B. Legal entity



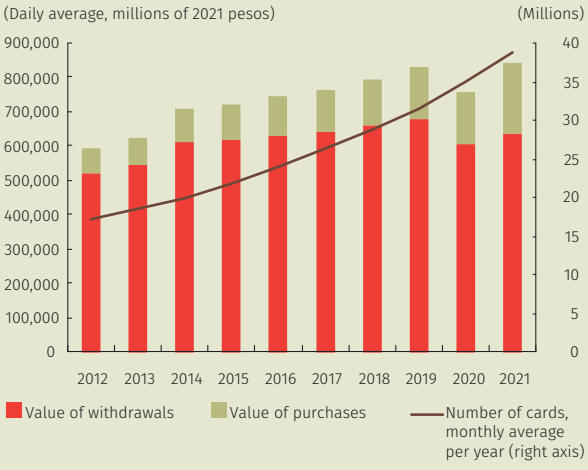
C. Person



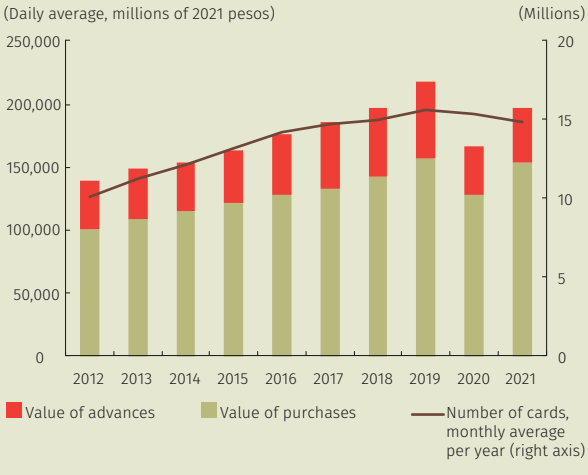
Source: Commercial banks.

Graph A2.13
Use of Cards

A. Debit card

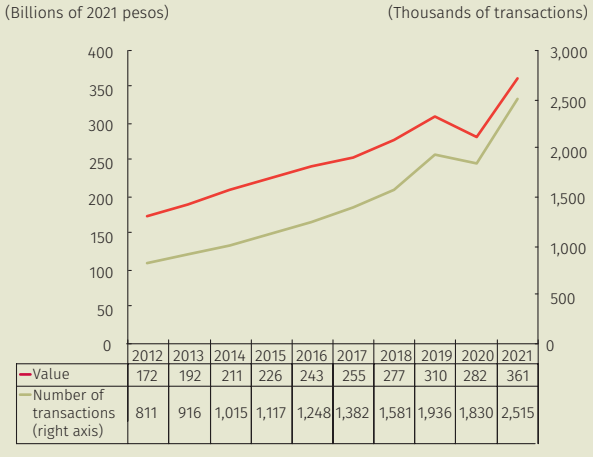


B. Credit card



Source: Office of the Financial Superintendent of Colombia; calculations by *Banco de la República*.

Graph A2.14
Purchases with Debit and Credit Card
(Daily average)



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Value	172	192	211	226	243	255	277	310	282	361
Number of transactions (right axis)	811	916	1,015	1,117	1,248	1,382	1,581	1,936	1,830	2,515

Source: Office of the Financial Superintendent of Colombia; calculations by *Banco de la República*.

2.3 Cards

The use of credit and debit cards increased in 2021 with respect to 2020 (Graph A2.13).

The number of debit cards averaged 38.7 m monthly in 2021, with a daily average value of COP 844.6 b in terms of use. Withdrawals accounted for 70% and purchases, the remaining 25%.

On the other hand, the number of credit cards averaged 14.8 m monthly in 2021, with an average daily value of COP 197.8 b in terms of use. Purchases accounted for around 77% and cash advances, 23%.

Debit and credit cards purchases have trended upward in the last few years. However, they declined in 2020 with respect to value and in the number of transactions. In 2021, the daily average value reached COP 361.3 b and the number of transactions came to 2.5 m, with positive variations of 28.0% and 37.4%, respectively, compared to the year before (Graph A2.14).

With information reported by commercial banks on purchases, Graph A2.15 shows that 94% of debit card transactions and 91% of those with credit cards originate with individuals, and most transactions by individuals are for amounts up to COP 1m (71% of debit card transactions and 55% of credit card transactions).

2.4 Comparative Use of Payment Instruments with Electronic Processes: Cards, Checks and Electronic Funds Transfers

The information on payment instruments provided in this section is divided between individuals and legal entities. This classification is based on who initiates the transaction. As noted earlier, individuals make the most use of debit and credit cards, while electronic funds transfers and checks are used more often by companies and other types of legal entities.

2.4.1 Number of Transactions

With respect to the number of transactions, Graph A2.16 shows that 59% of the transactions carried out by individuals in 2021 were made with debit cards and 25%, with credit cards. Jointly, these payment instruments account for 84%. Electronic funds transfers accounted for 16% and checks, less than 1%. As for legal entities, electronic funds transfers represented the largest share of their transactions (94%), followed to a lesser extent by credit cards (3%), checks (2%) and debit cards (1%).

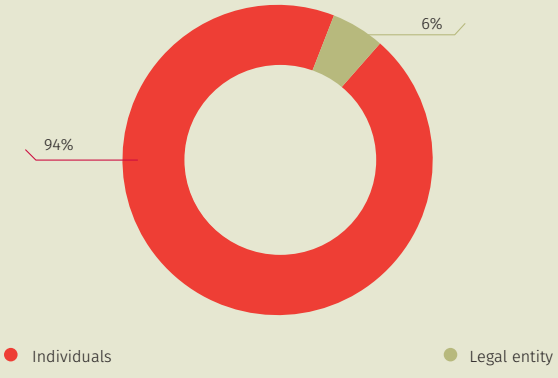
2.4.2 Value of Transactions

As to the value of transactions originating with individuals (Graph A2.17), debit cards accounted for 26% and credit cards, 18%. Together, their share was 44%. Checks, on the other hand, represented 17% and electronic funds transfers, 39%. In terms

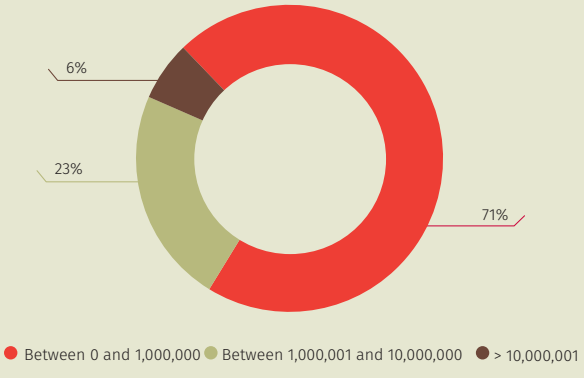
Graph A2.15
Debit and Credit Cards, by Originator: 2021
(Share in value)

A. Debit cards

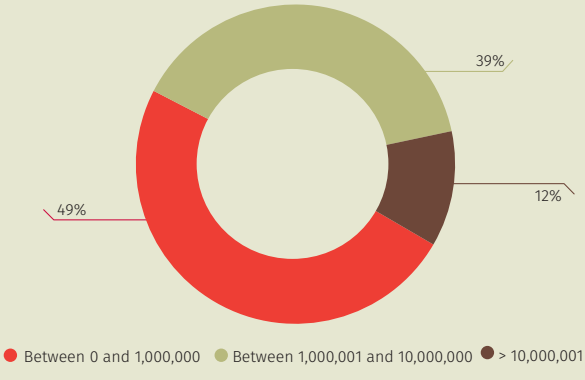
i. Total



ii. Individuals

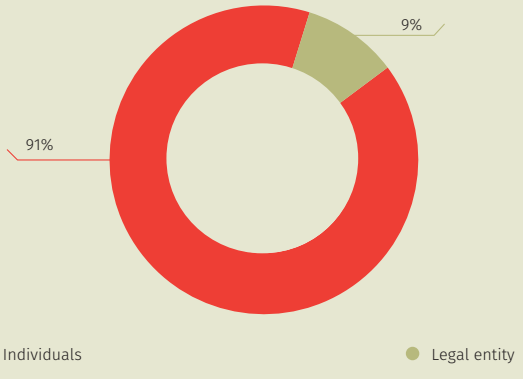


iii. Legal entity

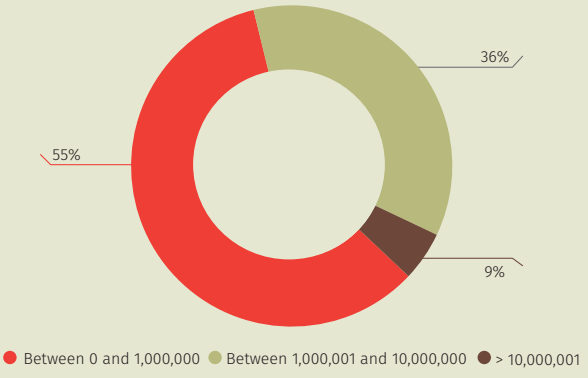


B. Credit cards

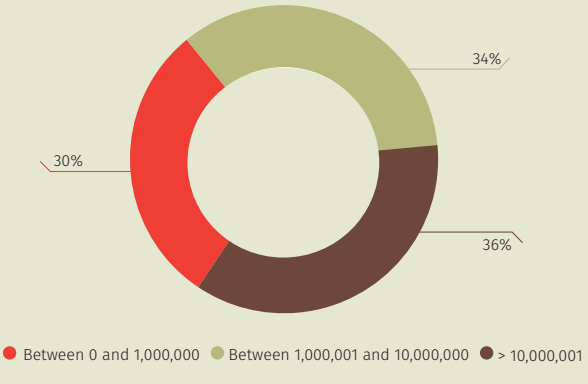
i. Total



ii. Individuals



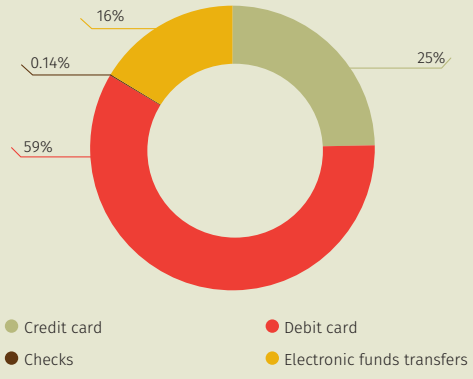
iii. Legal entity



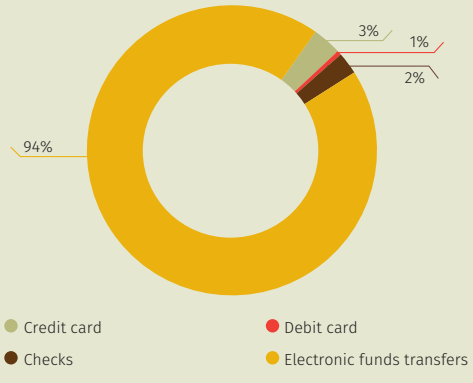
Source: Commercial banks.

Graph A2.16
Share in the Number of Transactions, 2021

A. Individual



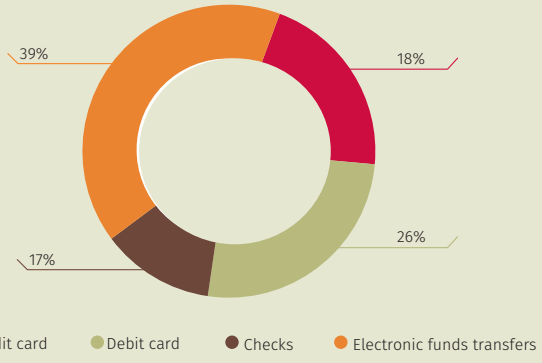
B. Legal entity



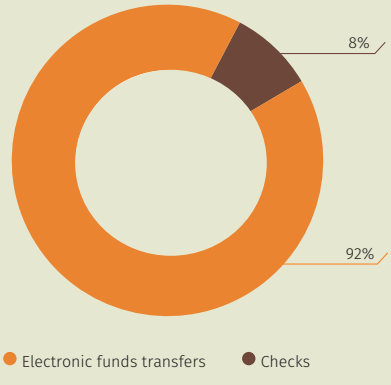
Source: Commercial banks.

Graph A2.17
Share in value, 2021

A. Individual



B. Legal entity



Sources: Office of the Financial Superintendent of Colombia, ACH Colombia, *Banco de la República*, and commercial banks; calculations by *Banco de la República*.

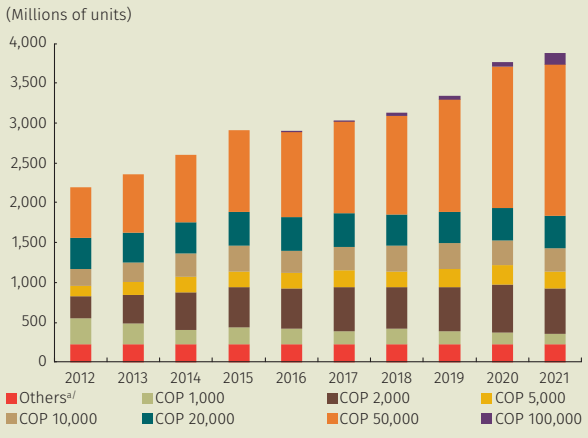
of legal entities, electronic funds transfers accounted for 91% in value and checks, 8.4% (the use of cards by legal entities is not representative).

2.5 Cash

Banco de la República conducts a survey to monitor the use of cash as a payment instrument.[4] Another way to track the use of cash is to analyze the amount of banknotes and coins in circulation, which is understood as an approximation to the potential use of cash in the economy and not as a direct reference to payments made in cash.

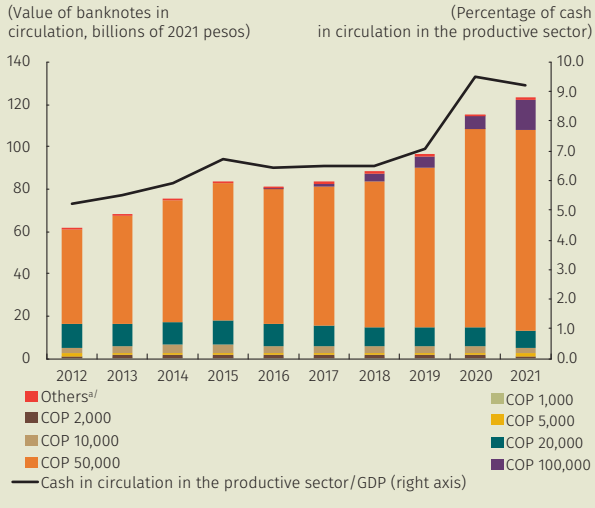
4 The latest survey was done in the first half of 2022. It shows that most routine monthly payments for food, beverages, clothing, transportation, housing and utilities, among other items, are made in cash (78.4% with respect to the number of transactions and 74.6% in terms of value). Similarly, commerce ratifies the public's response and indicates that cash is the preferred instrument for customer payments. The main results of this survey can be found in an infographic in the Executive Summary and in more detail on *Banco de la República's* website.

Graph A2.18
Banknotes in Circulation, 2021



Note: According to denomination, in 2021 the high denomination banknotes (100 thousand pesos, 50 thousand pesos, 20 thousand pesos and 10 thousand pesos) represented nearly 71%, while the low denomination banknotes (5 thousand pesos, 2 thousand pesos and the others) accounted for the remaining 29%.
a/ These include the following denominations: COP 500, COP 200, COP 100, COP 50, COP 20, COP 10, COP 5, COP 2, COP 1.
Source: Calculations by *Banco de la República*.

Graph A2.19
Value of Banknotes and Cash in Circulation/GDP



a/ These include the following denominations: COP 500, COP 200, COP 100, COP 50, COP 20, COP 10, COP 5, COP 2, COP 1.
Source: Calculations by *Banco de la República*.

In terms of the changes in the number of banknotes in circulation up to 2021,[5] Graph A2.18 shows the number of units increased annually during the 2012-2021 period by 6.6%, on average, and amounted to 3,877 units in 2021.

As for the number of units by denomination, the high denomination banknotes (100 thousand pesos, 50 thousand pesos, 20 thousand pesos and 10 thousand pesos) accounted for about 71% in 2021. The low denominations (5 thousand pesos, 2 thousand pesos, and the others) accounted for the remaining 29%.[6]

Graph A2.19 shows how the total value of banknotes in circulation evolved during the 2012-2021 period, in real terms. The average growth in real value during the period was around 8.1% and accounted for nearly COP 122.4 t in value in 2021.

As to value by denomination, the 50-thousand-peso banknote accounted for 77% of the total value of currency in circulation in 2021. The 100-thousand-peso banknote accounted for 12%, the 20-thousand-peso banknote, 7%, and the other denominations, less than 2.0% each.

The ratio of cash in circulation in the real sector to GDP shows an average of 6.9% between 2012 and 2021, with an upward trend in recent years. In 2021, this share was 9.23%.

2.6 Comparison of International Payment Instruments

Presented below is a graphic comparison of the evolution in payment instruments; namely, electronic funds transfers, checks, and debit and credit cards for different indicators, such as number of transactions per capita, value of transactions per capita in dollars[7] and value of transactions in relation to GDP, with data up to 2020.[8] The value per capita in dollars and the value of cash in circulation with respect to GDP are also shown (Graph A2.20).

The comparison includes twenty countries and Colombia, all with information available in the BIS comparative statistics. As for the indicators on the number of transactions, Colombia is in the bottom quartile of the distribution, with ample room to increase its position with respect to the countries in the sample.

5 Given that during the period 2012-2021 in the total circulation value of banknotes and coins the former represented on average 98% and coins the remaining 2%, only the evolution of banknotes is presented.

6 The 50-thousand-peso banknote accounted for the largest share, with 49%, followed by the two-thousand-peso banknote, with 15%.

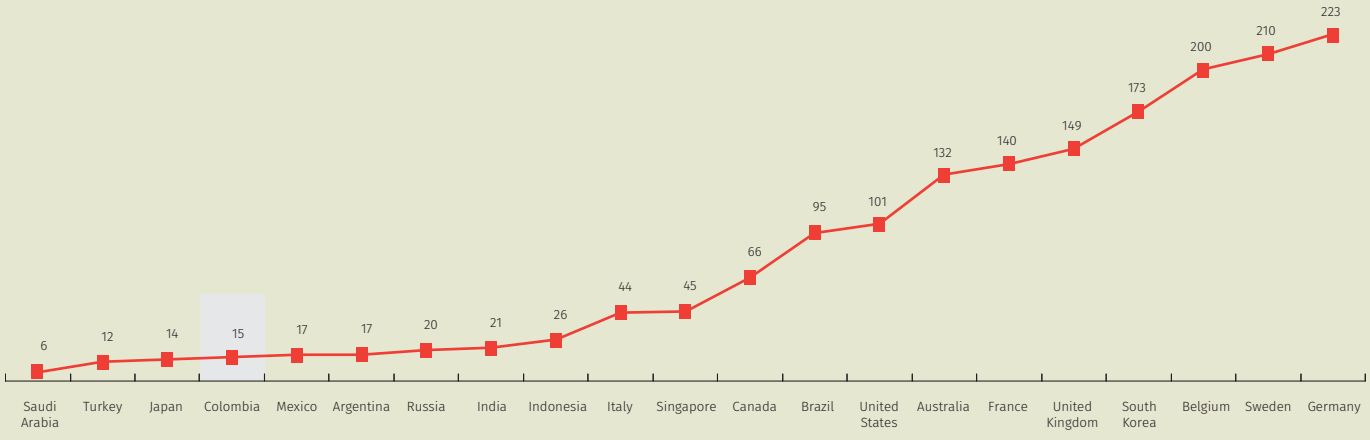
7 In general, indicators that include value are presented in dollars due to the impossibility of doing a comparative analysis in local currencies. To mitigate the effect of the exchange rate, the BIS uses the average annual exchange rate.

8 Latest available information as of April 2022.

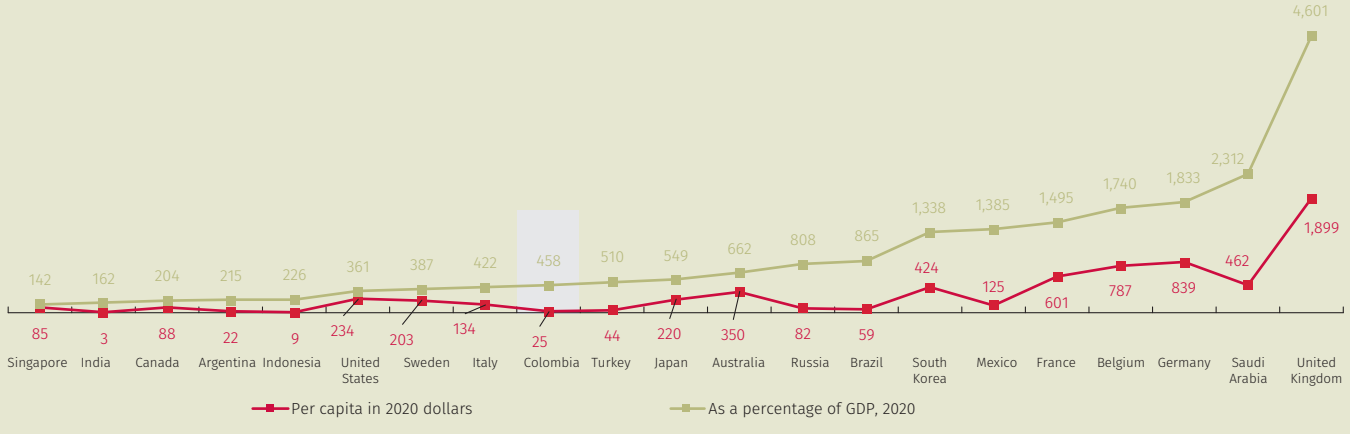
The indicators of value relative to GDP (without cash) represent an intermediate position for Colombia within the group of selected countries. By type of instrument, value with respect to the product in electronic funds transfers was 4.58 times GDP (the range is between 1.4- and 46-times GDP for the group of countries in the sample). For checks, it was 17% (the country with the highest value was 2.3 times GDP); for debit cards, 5.0% (the country with the highest value was 70% of GDP); and for credit cards, 5.0% (the country with the highest value was 37% of GDP). For cash, it was 10.8% (the countries in the sample are in a range of 1.3% to 23% of GDP).

Graph A2.20
Payment Instrument, International Comparison, 2020

A. Electronic funds transfers
i. Number of transactions per capita

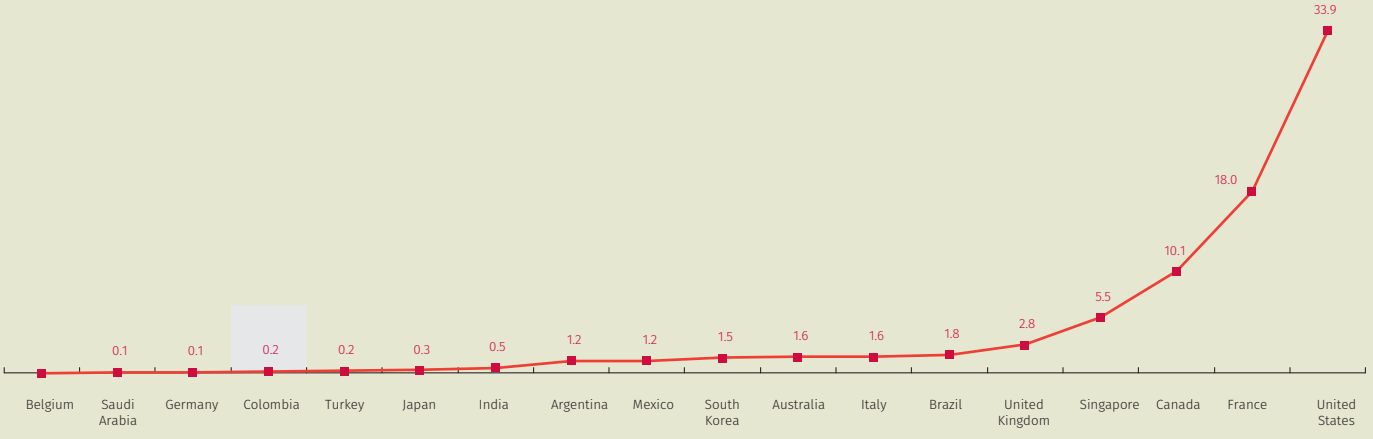


ii. Value per capita and in relation to GDP



B. Checks

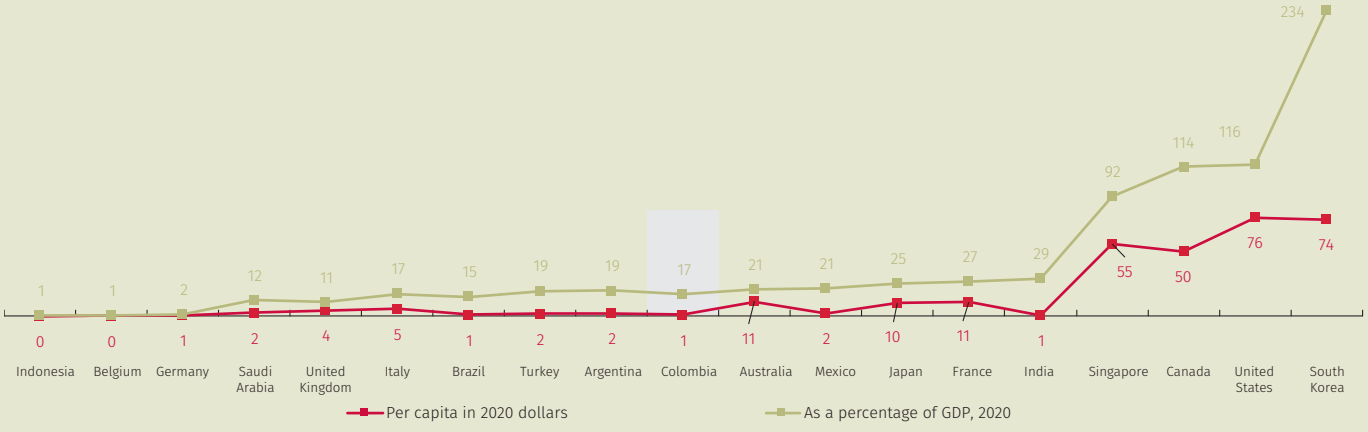
i. Number of transactions per capita



Graph A2.20 (continuation)
Payment Instrument, International Comparison, 2020

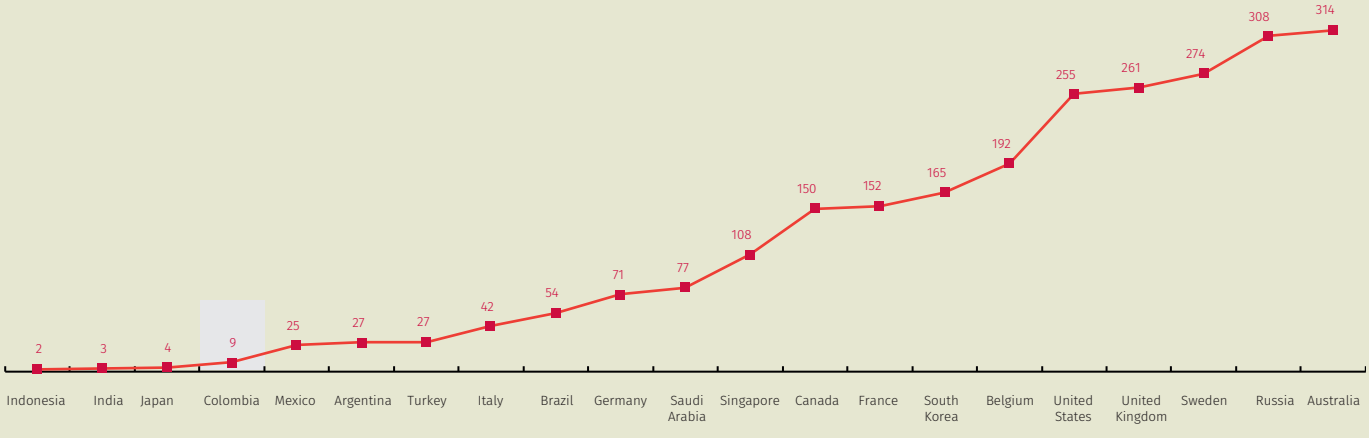
B. Checks

ii. Value per capita and in relation to GDP



C. Debit cards

i. Number of transactions per capita

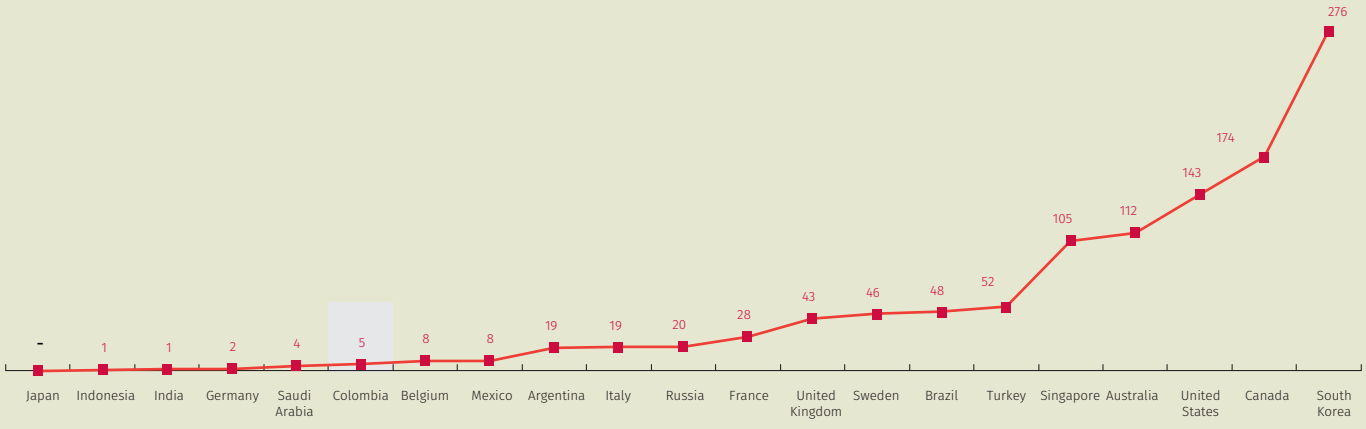


ii. Value per capita and in relation to GDP

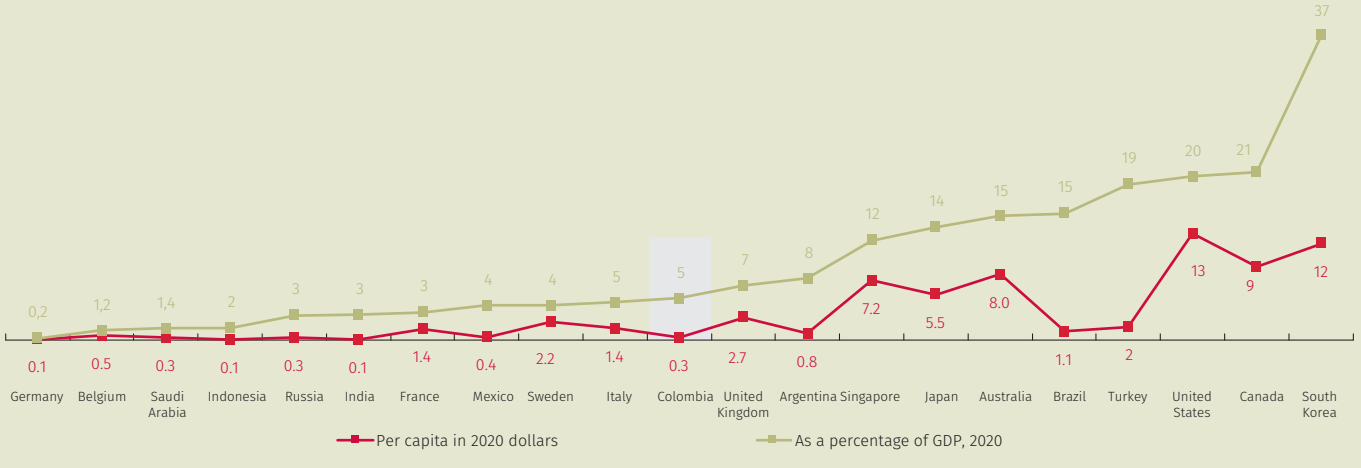
Graph A2.20 (continuation)
Payment Instrument, International Comparison, 2020

D. Credit cards

i. Number of transactions per capita

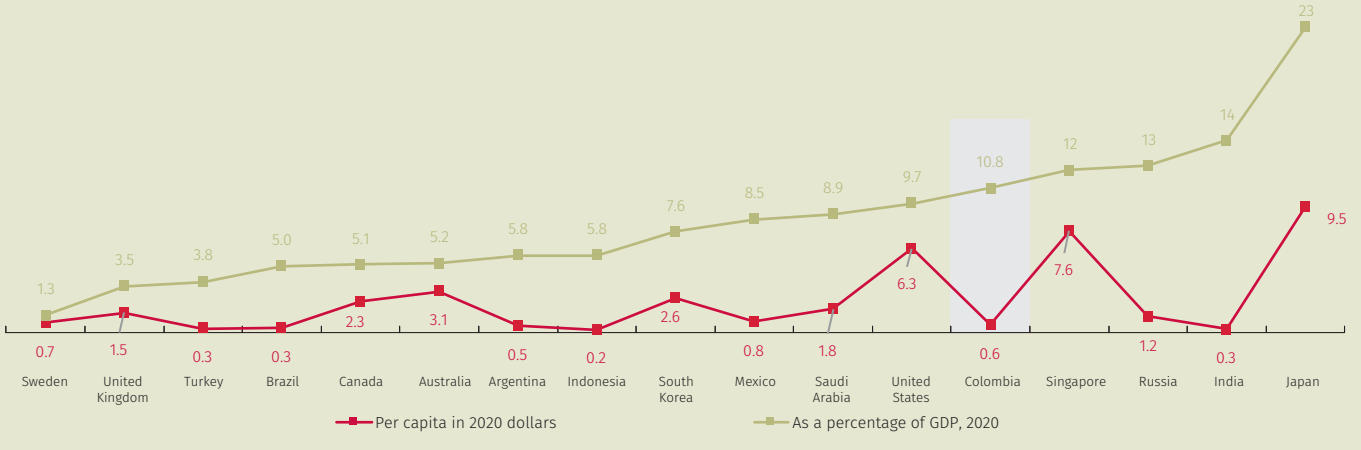


ii. Value per capita and in relation to GDP



E. Cash in circulation

i. Value per capita and in relation to GDP



Sources: BIS (Red Book), ACH Colombia, Office of the Financial Superintendent of Colombia, and *Banco de la República* (DSIF).

Table A2.9
Payment Instrument, International Comparison, 2019-2020

Country	Electronic funds transfers						Checks					
	Operations per capita		Value per capita in dollars		Value with respect to percentage of GDP		Operations per capita		Value per capita in dollars		Value with respect to percentage of GDP	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Germany	211	223	808	839	1,740	1,833	0.1	0.1	1.0	0.7	2.1	1.5
Saudi Arabia	5	6	376	462	1,621	2,312	0.1	0.1	3.0	2.4	13.2	12.2
Argentina	10	17	22	22	190	215	1.7	1.2	2.7	2.0	23.1	19.4
Australia	123	132	295	350	540	662	2.1	1.6	14.9	10.9	27.3	20.6
Belgium	194	200	814	787	1,768	1,740	0.1	0.0	0.5	0.3	1.1	0.6
Brazil	85	95	70	59	796	865	2.6	1.8	1.8	1.0	21.0	14.8
Canada	64	66	83	88	179	204	11.9	10.1	54.6	49.6	117.5	114.4
Colombia	12	15	24	25	379	458	0.3	0.2	1.6	0.9	24.4	16.5
South Korea	147	173	361	424	1,134	1,338	1.8	1.5	70.4	74.0	221.1	233.9
United States	93	101	212	234	321	361	38.1	33.9	78.5	75.6	118.8	116.4
France	133	140	464	601	1,107	1,495	24.5	18.0	14.0	10.7	33.6	26.7
India	14	21	3	3	144	162	0.8	0.5	0.8	0.6	39.3	28.8
Indonesia	21	26	9	9	218	226	0.0	0.0	0.0	0.0	0.8	0.7
Italy	41	44	144	134	434	422	2.2	1.6	7.0	5.3	21.0	16.9
Japan	13	14	213	220	529	549	0.4	0.3	13.4	10.0	33.2	24.9
Mexico	14	17	133	125	1,310	1,385	1.7	1.2	2.9	1.9	28.8	21.3
United Kingdom	143	149	1,733	1,899	4,100	4,601	4.1	2.8	8.1	4.4	19.2	10.7
Russia	18	20	86	82	740	808	0.0	0.0	0.0	0.0	0.0	0.0
Singapore	36	45	77	85	118	142	8.1	5.5	73.3	55.0	112.4	91.9
Sweden	184	210	196	203	379	387	0.0	0.0	0.0	0.0	0.0	0.0
Turkey	9	12	41	44	448	510	0.2	0.2	1.9	1.7	21.2	19.3

Country	Debit card						Credit card					
	Operations per capita		Value per capita in dollars		Value with respect to percentage of GDP		Operations per capita		Value per capita in dollars		Value with respect to percentage of GDP	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Germany	57	71	3.1	3.7	6.7	8.0	1.7	1.7	0.1	0.1	0.3	0.2
Saudi Arabia	42	77	1.9	2.4	8.2	12.2	3.7	4.2	0.3	0.3	1.3	1.4
Argentina	24	27	0.5	0.6	4.3	5.8	23.2	18.9	0.9	0.8	8.1	7.5
Australia	292	314	9.2	10.4	16.9	19.7	117.6	111.8	9.1	8.0	16.7	15.1
Belgium	179	192	8.1	9.0	17.6	19.9	9.2	8.0	0.7	0.5	1.4	1.2
Brazil	52	54	0.8	0.7	9.2	10.9	47.8	47.7	1.4	1.1	15.5	15.4
Canada	167	150	5.2	5.1	11.1	11.8	154.0	173.7	11.7	8.9	25.2	20.5
Colombia	9	9	0.3	0.3	4.9	5.3	6.8	5.4	0.4	0.3	6.1	5.1
South Korea	171	165	3.2	3.3	10.2	10.3	285.7	275.9	11.9	11.7	37.4	37.1
United States	237	255	9.2	10.0	13.9	15.4	134.1	143.1	12.0	13.0	18.2	19.9
France	156	152	6.8	6.8	16.3	16.8	31.6	27.6	1.5	1.4	3.6	3.4
India	4	3	0.1	0.1	3.6	3.2	1.6	1.3	0.1	0.1	3.5	3.1
Indonesia	3	2	0.1	0.1	2.1	1.8	1.3	1.0	0.1	0.1	2.1	1.5
Italy	41	42	2.4	2.6	7.4	8.2	20.2	19.4	1.6	1.4	4.9	4.6
Japan	3	4	0.1	0.2	0.3	0.4	0.0	0.0	5.3	5.5	13.3	13.8
Mexico	23	25	0.6	0.6	5.8	6.5	8.8	8.2	0.5	0.4	4.5	4.2
United Kingdom	278	261	11.9	12.9	28.1	31.1	53.5	42.5	3.4	2.7	8.0	6.6
Russia	248	308	6.4	7.1	55.1	70.2	19.4	19.5	0.3	0.3	2.9	3.0
Singapore	101	108	4.5	4.4	7.0	7.4	104.2	105.4	8.6	7.2	13.2	12.1
Sweden	299	274	8.5	8.1	16.4	15.5	55.6	46.2	2.7	2.2	5.1	4.2
Turkey	26	27	0.3	0.3	3.0	3.6	51.9	51.8	1.8	1.6	19.5	19.0

Table A2.9 (continuation)
Payment Instrument, International Comparison, 2019-2020

Country	Cash			
	Value per capita in dollars		Value with respect to percentage of GDP	
	2019	2020	2019	2020
Germany	n. a.	n. a.	n. a.	n. a.
Saudi Arabia	1.7	1.8	7.3	8.9
Argentina	0.4	0.5	4.6	5.8
Australia	2.4	3.1	4.4	5.2
Belgium	n. a.	n. a.	n. a.	n. a.
Brazil	0.3	0.3	3.9	5.0
Canada	2.1	2.3	4.3	5.1
Colombia	0.5	0.6	7.1	10.8
South Korea	2.1	2.6	6.6	7.6
United States	5.5	6.3	8.3	9.7
France	n. a.	n. a.	n. a.	n. a.
India	0.3	0.3	12.0	14.4
Indonesia	0.2	0.2	5.0	5.8
Italy	n. a.	n. a.	n. a.	n. a.
Japan	8.6	9.5	21.3	22.9
Mexico	0.7	0.8	7.1	8.5
United Kingdom	1.5	1.5	3.4	3.5
Russia	1.2	1.2	9.6	12.5
Singapore	6.8	7.6	10.3	12.2
Sweden	0.7	0.7	1.3	1.3
Turkey	0.3	0.3	3.6	3.8

n. a.: Not available
Sources: BIS (Red Book), ACH Colombia, Office of the Financial Superintendent of Colombia, and *Banco de la República* (DSIF).

Annex 3: Financial Infrastructures and Markets

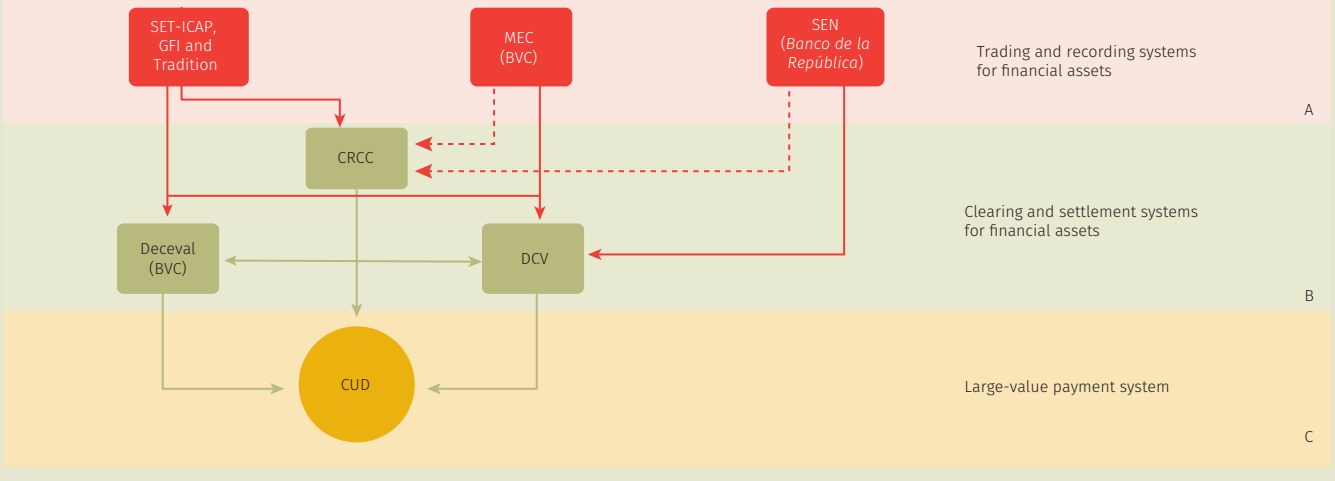
The description provided in this section makes it possible to identify and understand the role infrastructures play in the markets they support and the relationships that exist between them. For this purpose, they have been grouped into fixed income, equity, foreign exchange and standardized derivatives markets. More is explained about the retail-value payment systems as well.

Fixed Income

Diagram A3.1 shows the infrastructures that provide trading, clearing and settlement services for operations in the fixed-income market. The flow starts at the top with the trading and recording systems, where participants conduct their transactions using automatic matching mechanisms (SEN and MEC) and hybrid voice and data systems (SET-ICAP Securities, GFI and Tradition). In each of these transactions, the seller must inform the system manager of the depository where the securities to be delivered are located, so they can be sent by system manager and the respective process and settlement can be completed. The securities leg is settled when the change in ownership in favor of the buyer is noted in the securities deposit account, and the cash leg is settled when the funds are transferred to the seller, through the CUD large-value payment system.

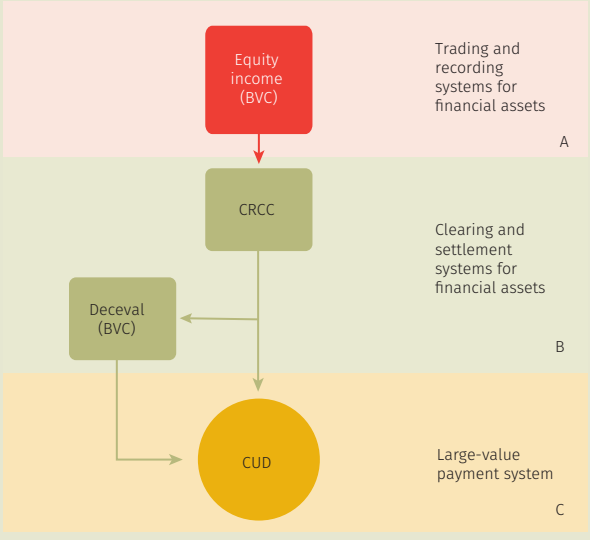
Forward operations (TES sell/buy backs) are sent by SEN and MEC to the Central Counterparty Risk of Colombia (CRCC) for respective risk management (dotted lines in Diagram A3.1); while gross clearing and settlement are done in the DCV-CUD (continuous lines in the same diagram).

Diagram A3.1
Flow of Operations in the Fixed Income Market



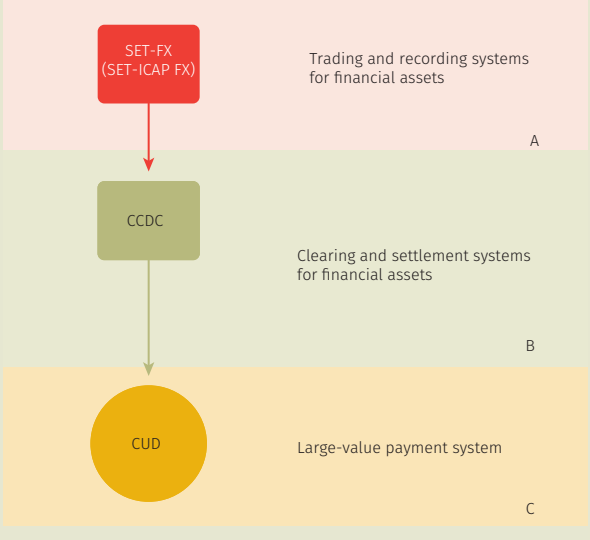
Source: *Banco de la República* (DSIF).

Diagram A3.2
Flow of Operations in the Equity Income Market



Source: *Banco de la República* (DSIF).

Diagram A3.3
Flow of Operations in the Currency Market



Source: *Banco de la República* (DSIF).

Equity income

The BVC manages equity market trading in Colombia. Clearing and settlement for forward transactions (equity repos), as of August 2017, and for spot and TTS transactions, as of August 2020, is carried out through the CRCC.[1]

As shown in Diagram A3.2, the flow starts in the trading system where participants concur to make offers on available securities. These operations are confirmed and complemented after closing. The BVC sends the trades for risk management, clearing and settlement to the CRCC. The cash leg is settled in the CUD and the securities leg in Deceval.

Foreign Currency

SET-ICAP-FX, GFI, and Tradition manage the trading and recording systems in the Colombian foreign exchange market. The first does so through a matching system whereby participants voluntarily decide which offers to accept, while the other two use voice and data systems, with foreign exchange offers received privately from each participant and then circulated to the rest of the market. The CRCC is responsible for clearing and settling spot foreign exchange transactions (pesos-dollars) [2] and forward forex transactions (pesos-dollars) with financial settlement (NDF forwards) between its members, on their own account for the latter or on behalf of third parties (Diagram A3.3).

Standardized Derivatives

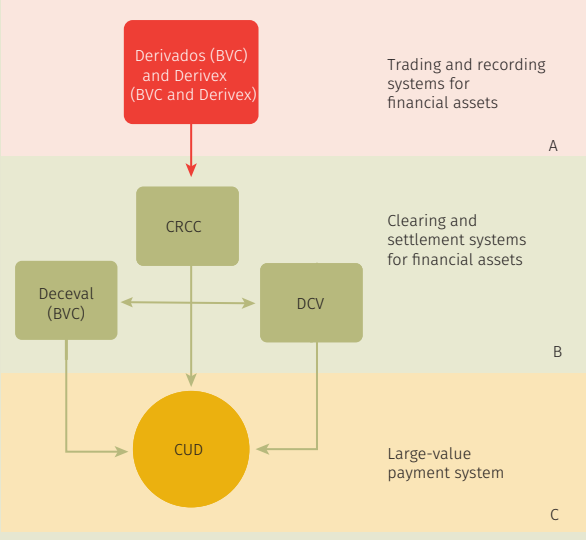
The BVC and Derivex manage the trading and recording systems for the standardized derivatives market. As illustrated in Diagram A1.4, the transactions handled through these systems are sent to the CRCC for clearing and settlement.

From that moment onward, the CRCC, as the central counterparty, does the novation for the operations. Accordingly, it becomes every buyer's seller and every seller's buyer. It then generates the obligations or liabilities of its participants (clearing) and proceeds to settle them in the CUD large-value payment system. When settlement involves delivery of the underlying asset, the CRCC uses the depositories (DCV and Deceval) to receive the securities from the net debtor and deliver them to the net creditor.

1 See Decree 2219 Issued on December 27, 2017, by the Ministry of Finance and Public Credit, which amends Decree 2555 of 2010 in relation to certain provisions applicable to transactions that are cleared and settled in a central counterparty risk clearing house and the creation of a protocol for crisis or contingency situations in the securities market.

2 According to External Resolution 1 of 2018, the terms in the foreign exchange spot market are from t + 0 to t + 3.

Diagram A3.4
Flow of Operations in the Market for Standardized Derivatives



Source: *Banco de la República* (DSIF).

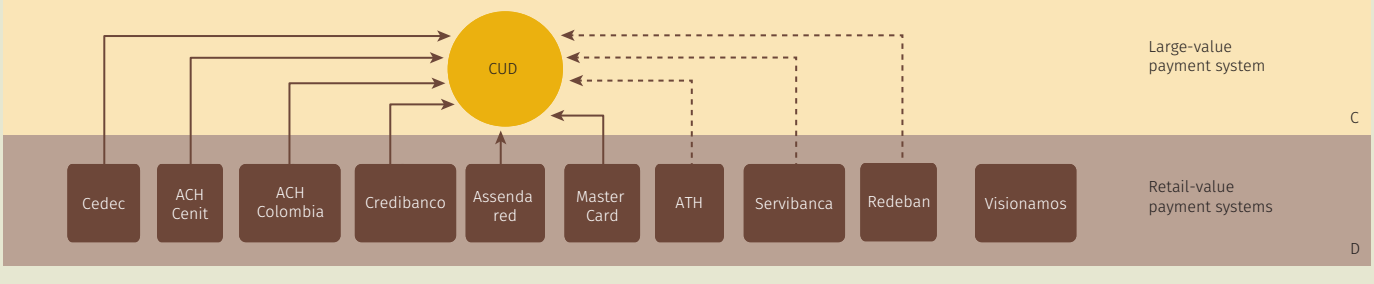
Retail-value Payment Systems

The retail-value payment systems are depicted in Diagram A1.5. The Electronic Check Clearing House (Cedec), managed by *Banco de la República*, clears checks and other payment instruments nationwide. The automated clearing houses for electronic payments (ACH); namely, ACH-Cenit (also managed by *Banco de la República*) and ACH Colombia, process orders for retail-value electronic payments and funds transfers or collections generated by associated institutions on behalf of their clients (persons or legal entities) with checking or savings accounts, while the Credibanco, Assenda Red, Mastercard, ATH, Servibanca and Redeban networks process debit and credit card transactions, among others, made at ATMs and commercial establishments.

Credibanco, Assenda Red and Mastercard have deposit accounts with the large-value payment system and, therefore, can clear and settle their operations directly, using the resources in those accounts. The other networks do not have a deposit account of their own with the central bank system.[3] Consequently, they only clear operations, which are then settled by a commercial bank through a deposit account opened in its name with *Banco de la República*. There is also Visionamos, a network that belongs to the solidarity sector of the economy and processes credit card transactions that are covered by participating cooperatives or international franchises.

Although each institution performs a specific function within the structure of the payment systems, a substantial proportion of the obligations generated by their participants in the clearing process are settled, ultimately and for the most part, through the CUD large-value payment system.

Diagram A3.5
Flow of Operations in Retail-value Payment Systems



Source: *Banco de la República* (DSIF).

3 The dotted lines in Diagram A1.5 refer to the fact that these ATM and card networks do not have their own deposit account in the central bank's CUD system. Visionamos is a low-value payment system, but it does not settle multilateral clearing in the CUD. It does so through Banco Coopcentral, which in turn settles through Cenit.