PAYMENT SYSTEMS REPORT

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Content

Graphs

Tables

Diagrams

Glossary

ACH: Cámara de compensación automatizada
ACH-Cenit: Compensación electrónica nacional interbancaria administrada por el Banco de la República
ACH-Colombia: Cámara de Compensación Automatizada de Colombia S. A.
ATH: A Toda Hora S. A., red de cajeros electrónicos y agilizadores (ATM network and accelerators)
BIS: Banco de Pagos Internacionales (por su sigla en inglés)
BVC: Bolsa de Valores de Colombia
CCDC: Cámara de Compensación de Divisas de Colombia S. A.
CDT: Certificado de depósito a término
Cedec: Sistema de compensación electrónica de cheques y de otros instrumentos de pago, administrado por el Banco de la República
CRCC: Cámara de Riesgo Central de Contraparte de Colombia S. A.
CR5: Índice de concentración construido como la suma de las cinco mayores participaciones
CUD: Sistema de cuentas de depósito, administrado por el Banco de la República para liquidación de transferencia de fondos, también denominado sistema de pagos de alto valor.
DANE: Departamento Administrativo Nacional de Estadística
DCV: Depósito Central de Valores, administrado por el Banco de la República
Deceval: Depósito Centralizado de Valores de Colombia S. A.
DGCPTN: Dirección General de Crédito Público y del Tesoro Nacional
EcP: Modalidad de entrega contra pago aplicable en la liquidación de valores (DvP, por su sigla en inglés)
FIC: Fondos de inversión colectiva
Finagro: Fondo para el Financiamiento del Sector Agropecuario
IBR: Indicador bancario de referencia
JDBR: Junta Directiva del Banco de la República
MEC: Mercado Electrónico Colombiano de propiedad de la Bolsa de Valores de Colombia S. A.
NDF: *Forward* de cumplimiento financiero (*non delivery forward*)
PIB: Producto interno bruto
PSE: Pagos seguros en línea
SEN: Sistema electrónico de negociación administrado por el Banco de la República
SET-ICAP-FX: Sistema electrónico de transacción en moneda extranjera, administrado por Servicios Integrados en Mercado Cambiario S. A., con el respaldo de la Bolsa de Valores de Colombia S. A. y SIF-ICAP de México
SET-ICAP Securities: Sistema electrónico y de voz para la negociación y registro de instrumentos financieros, y proveedor de información financiera.
TES: Sítulos de deuda pública emitidos por el Gobierno y administrados por el Banco de la República
TRM: Tasa representativa de mercado
TTV: Transferencia temporal de valores

As used in English

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
JDBR: *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

The Payment Systems Report, 2020

With its annual *Payment Systems Report*, *Banco de la República* offers a complete overview of the infrastructure of Colombia's financial market. Each edition of the report has four objectives: 1) to publicize a consolidated account of how the figures for payment infrastructures have evolved with respect to both financial assets and goods and services; 2) to summarize the issues that are being debated internationally and are of interest to the industry that provides payment clearing and settlement services; 3) to offer the public an explanation of the ideas and concepts behind retail-value payment processes and the trends in retail payments within the circuit of individuals and companies; and 4) to familiarize the public, the industry, and all other financial authorities with the methodological progress that has been achieved through applied research to analyze the stability of payment systems. This edition introduces changes that have been made in the structure of the report, which are intended to make it easier and more enjoyable to read.

The initial sections in this edition, which is the eleventh, contain an analysis of the statistics on the evolution and performance of financial market infrastructures. These are understood as multilateral systems wherein the participating entities clear, settle and register payments, securities, derivatives and other financial assets.

The large-value payment system (CUD) saw less momentum in 2019 than it did the year before, mainly because of a decline in the amount of secondary market operations for government bonds, both in cash and sell/buy-backs, which was offset by an increase in operations with collective investment funds (CIFs) and *Banco de la República*'s operations to increase the money supply (repos). Consequently, the Central Securities Depository (DCV) registered less activity, due to fewer negotiations on the secondary market for public debt. This trend was also observed in the private debt market, as evidenced by the decline in the average amounts cleared and settled through the Central Securities Depository of Colombia (Deceval) and in the value of operations with financial derivatives cleared and settled through the Central Counterparty of Colombia (CRCC).

Section three offers a comprehensive look at the market for retail-value payments; that is, transactions made by individuals and companies. During 2019, electronic transfers increased, and payments made with debit and credit cards continued to trend upward. In contrast, payments by check continued to decline, although the average daily value was almost four times the value of debit and credit card purchases.

The same section contains the results of the fourth survey on how the use of retail-value payment instruments (for usual payments) is perceived. Conducted at the end of 2019, the main purpose of the survey was to identify the availability of these payment instruments, the public's preferences for them, and their acceptance by merchants. It is worth noting that cash continues to be the instrument

most used by the population for usual monthly payments (88.1% with respect to the number of payments and 87.4% in value). However, its use in terms of value has declined, having registered 89.6% in the 2017 survey. In turn, the level of acceptance by merchants of payment instruments other than cash is 14.1% for debit cards, 13.4% for credit cards, 8.2% for electronic transfers of funds and 1.8% for checks. The main reason for the use of cash is the absence of point-of-sale terminals at commercial establishments.

Considering that the retail-payment market worldwide is influenced by constant innovation in payment services, by the modernization of clearing and settlement systems, and by the efforts of regulators to redefine the payment industry for the future, these trends are addressed in the fourth section of the report. There is an account of how innovations in technology-based financial payment services have developed, and it shows that while this topic is not new, it has evolved, particularly in terms of origin and vocation. One of the boxes that accompanies the fourth section deals with certain payment aspects of open banking and international experience in that regard, which has given the customers of a financial entity sovereignty over their data, allowing them, under transparent and secure conditions, to authorize a third party, other than their financial entity, to request information on their accounts with financial entities, thus enabling the third party to offer various financial services or initiate payments. Innovation also has sparked interest among international organizations, central banks, and research groups concerning the creation of digital currencies. Accordingly, the last box deals with the recent international debate on issuance of central bank digital currencies.

In terms of the methodological progress that has been made, it is important to underscore the work that has been done on the role of central counterparties (CCPs) in mitigating liquidity and counterparty risk. The fifth section of the report offers an explanation of a document in which the work of CCPs in financial markets is analyzed and corroborated through an exercise that was built around the Central Counterparty of Colombia (CRCC) in the Colombian market for non-delivery peso-dollar forward exchange transactions, using the methodology of network topology. The results provide empirical support for the different theoretical models developed to study the effect of CCPs on financial markets.

Finally, the results of research using artificial intelligence with information from the large-value payment system are presented. Based on the payments made among financial institutions in the large-value payment system, a methodology is used to compare different payment networks, as well as to determine which ones can be considered abnormal. The methodology shows signs that indicate when a network moves away from its historical trend, so it can be studied and monitored. A methodology similar to the one applied to classify images is used to make this comparison, the idea being to extract the main characteristics of the networks and use them as a parameter for comparison.

Juan José Echavarría
Governor
Banco de la República

01

General Overview of Colombia's Financial Infrastructure

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

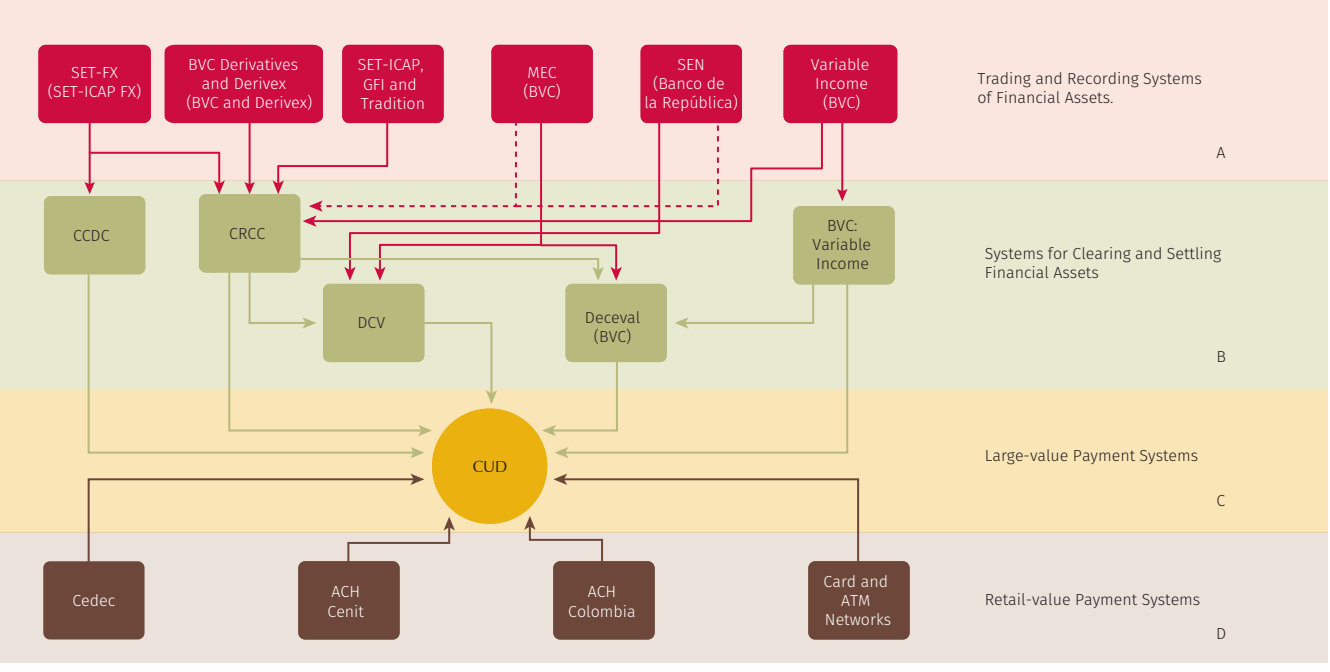
Diagram 1.1 shows the infrastructures that participate, as a whole, in the clearing and settlement of securities and other financial assets in Colombia. It also illustrates the main platforms for trading and registering these assets, so as to arrive at a comprehensive overview of the entire value chain. The core role of the large-value payment system managed by *Banco de la República*, known as the Deposit Account System (CUD), is evident. It is the central axis and foundation of the entire infrastructure and is where the cash leg 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 registering systems for securities and currencies. The former includes the Electronic Trading System (SEN), managed by *Banco de la República*, where transactions with government debt securities are traded and registered. The Colombian Electronic Market (MEC), managed by the Colombian Stock Exchange (BVC), is where government and private debt is traded and registered. The BVC also manages the market for equities and standardized financial derivatives with underlying assets other than energy-related commodities.

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 conducted by member financial brokers, in both their own name and on behalf of third parties.

Diagram 1.1
Overview of Financial Market Infrastructures (FMIs) and Other Participants[a/] (2019)



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 takes place the gross settlement in the DCV-CUD.
Source: *Banco de la República* (DSIF).

There is the Derivex system, which manages the market for standardized derivatives where the underlying assets are energy-related commodities, and with other trading and registering systems[3] that allow for trading and registering 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 of some trading and registering systems[5] provide trading and registering 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 systems concerned with securities, Diagram 1.1 includes the Central Securities Depository (DCV), managed by *Banco de la República* and used solely for government debt securities; the Centralized Securities Depository of Colombia (Deceval), which is for all types of securities, both government and

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

4 As of 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. It is intended 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.

private; the Central Counterparty of Colombia (CRCC), which handles forward operations, standardized derivatives (both financial and energy derivatives) and non-standardized derivatives, such as interest rate forwards and swaps (IRF and IRS); and the Colombian Stock Exchange (BVC), which is for equities.

The infrastructure for foreign currency includes the Foreign Exchange Clearing House of Colombia (CCDC), where exchange operations are settled in cash, and the CRCC, where standardized derivatives are cleared and settled at the representative market rate of exchange (TRM), as are non-standardized non-deliverable forwards (COP/USD).

Band C shows the large-value payment system (CUD, the core of the country's financial infrastructure), where the cash leg of operations converge to be settled, including those of operations in financial asset clearing and settlement systems, as well as those 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 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 those obligations do not imply the movement of money or because the systems use net settlement mechanisms.

As mentioned, the settlement of obligations from the other external systems[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 daily average value of the transactions settled there in 2019 came to COP 50.7 trillion (t), which is equivalent to 4.78% of the country's annual gross domestic product (GDP), followed by operations in the equities market (COP 39.4 t), which include the DCV (COP 35.5 t); Deceval, (COP 3.75 t); and equity operations conducted through the BVC (COP 0.19 t). Next, in order of importance,

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 system to clear and settle futures, options and other financial assets, including central counterparty clearing houses, provided they are duly authorized by the competent authority to operate in Colombia.

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)		
	2018	2019	2018	2019	
Large-value Payment System					
Large Value					
CUD	8,007	6,774	54,977	50,752	-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 remunerated deposits -Transfers of funds originated directly by participants. -Debit to accounts for interbank clearing, VAT, GMF and commissions, among others.
Systems for Clearing and Settling Financial Assets					
Securities Depositories					
DCV[b/]	3,290	2,122	35,863	35,524	-Corresponds to transactions with government securities on the primary market (trusteeship), the secondary market, and monetary operations by Banco de la República.
Deceval[c/]	4,849	5,239	3,778	3,752	-Comprised of transactions with government securities, corporate debt and equities on the primary and secondary markets. Includes cash collateral.
Other Securities Clearing and Settlement Systems					
BVC: Variable Income	2,311	2,326	183	188	Operations with common equities, preferred equities and subscription rights. -As of August 2017, equity repos are cleared and settled at the CRCC.
Counterparty Clearing Houses					
CRCC S.A.	466	433	3,898	3,842	-Clearing and settlement of standardized financial and energy derivatives - Clearing and settlement of non-standardized derivatives such as interest-rate and foreign-exchange derivatives. - Clearing and settlement of equity repos - Term operations (sell/buy-backs with sovereign debt (TES)) are sent by the SEN and MEC systems to the Central Counterparty Clearing House (CRCC) for respective risk management, while gross clearing and settlement are done at the DCV-CUD. An average of 724 operations daily, worth COP 10.1 trillion, were handled in 2019.
Forex Clearing and Settlement Systems					
CCDC[d/]	1,741	1,834	3,844	4,352	-Purchase and sale of dollars between exchange market intermediaries on the spot market (t + 0, t + 1, t + 2 and t + 3).
Retail-value Payment Systems					
ACH Colombia	808,832	909,622	3,750	4,215	-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	48,284	46,741	833	890	-Mainly drafts and payments from the National Treasury to territorial entities.

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

	Daily Averages[a/]				Main Operations
	Number of Operations		Value (Billions of Pesos)		
	2018	2019	2018	2019	
Retail-Value Payment Systems					
Cedec	47,254	40,553	777	757	-Checks for the purchase and sale of goods, services and to discharge obligations, among others.
Cards and ATM Networks	3,254,002	4,084,011	752	769	- Transactions with debit and credit cards, as well as clearing transactions between ATMs.

a/ Averages calculated based on the days of operation of each infrastructure.
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 and return operations.
c/ Pertains to the settled value sent by the investor in the acquisition of a security.
d/ Nominal values in Colombian pesos as the settled value of transactions.
Sources: *Banco de la República*, Deceval, BVC, ACH Colombia, CCDC and CRCC.

is the sum of the two ACHs (Cenit and Colombia) (COP 5.1 t); followed by settlements of the peso leg of operations carried out by the CCDC (COP 4.35 t); the amount of operations with stock derivatives and repos cleared and settled through the CRCC (COP 3.84 t); interbank clearing of checks settled in the CEDEC system (COP 0.75 t); and, finally, the value of card and ATM clearing (COP 0.77 t).

02

Payments in the Market for Financial Assets

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), [7] 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.

As mentioned in the previous section, the large-value payment system in Colombia; that is, the deposit account system (CUD) managed by *Banco de la República*, is the axis of the 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.

2.1 The Large-value Payment System

2.1.1 General Aspects and Development

There were 138 direct participants with deposit accounts in *Banco de la República*'s large-value payment system (CUD) by December 2019. Table 2.1 shows the number of participants for each type of institution.

7 BIS and IOSCO (2012). *Principles for Financial Market Infrastructures*, Principle 9.

Table 2.1
Number of Participants by Type of Entity

Type of Institution	Number of Participants
Banks	26
Trust companies	27
Brokerage firms	19
Financing companies	13
Insurance Companies	12
Public financial institutions	8
Social security information operators	6
Financial cooperatives	5
Financial corporations	4
Pension and severance funds	4
Retail-value payment system (ACH Colombia and networks)	4
Capitalization companies	2
Banco de la República	1
Stock exchange	1
Central counterparty clearing houses	1
Centralized securities depositories	1
General Directorate of Public Credit and the National Treasury	1
Ministry of Finance and Public Credit: general royalty system	1
Forex clearing and settlement system	1
Companies specialized in electronic deposits and payments (SEDPE)	1
Total	138

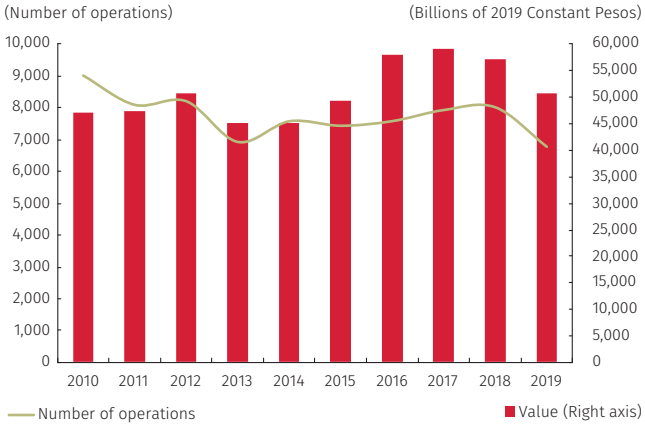
Source: *Banco de la República* (CUD).

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 for the number of operations (6,774) declined by 15.4% in 2019 with respect to the year before. The nominal value (COP 50.7 t) was down as well, by 7.69% compared with that same year. In real terms, the average daily value declined by 11.06%. In the annual total, the amount processed was 11.7 times Colombia's GDP [8] in 2019; in other words, the daily average was equivalent to 4.78% of GDP, which is less than in 2019, when it represented 5.63%.

Table 1.4 provides details on the origin and description of the operations that resulted in debits to the deposit accounts in the CUD system. As illustrated, settlement of the cash leg of investments, purchase/sales, sell/buy-backs and repos on the primary and secondary markets for government debt, through the delivery versus payment (DvP)

8 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 2019 comes to COP 1,062 t and is used as a reference.

Graph 2.1
Statistics of the Number and Value of CUD Large-value Payment System Operations, Daily Averages



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

mechanism in the DCV, accounted for 30.69% of the total value in 2019. Monetary policy operations involving repos, definitive TES purchases, and liquidity operations for the payment system (intraday repos) backed by government bonds accounted for 16.33%. According to these figures, 47.02% of all operations in the CUD were carried out with government securities held in custody by the DCV. Monetary policy operations related to remunerative deposits accounted for 8.42%, of which 8.05% were remunerative deposits made by the Ministry of Finance and Public Credit and 0.37% by other entities.

As for direct transfers of funds in the CUD[9], which account for 43.92% of all operations, it is important to point out that 11% involves transfers (money "uploads") from lending institutions to other depositor account institutions, giving them the liquidity they need to meet the cash leg of their operations with securities. On

Table 2.2
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)	(Billions of 2019 constant pesos)	(Number of times GDP)
		(Billions of pesos)	(Billions of 2019 constant pesos)	(Billion of pesos)	(Billions of 2019 contant pesos)				
2010	8,998	33,330	47,098	3.7	5.2	2,204,510	8,165,754	11,539,119	15.0
2011	8,083	34,676	47,241	4.3	5.8	1,988,418	8,530,296	11,621,274	13.8
2012	8,196	38,132	50,714	4.7	6.2	2,016,269	9,380,456	12,475,666	14.1
2013	6,925	34,543	45,068	5.0	6.5	1,689,588	8,428,598	10,996,636	11.8
2014	7,570	35,925	45,216	4.7	6.0	1,847,039	8,765,618	11,032,795	11.5
2015	7,430	41,767	49,237	5.6	6.6	1,805,454	10,149,449	11,964,647	12.6
2016	7,574	52,083	58,061	6.9	7.7	1,863,090	12,812,358	14,282,913	14.8
2017	7,921	55,305	59,231	7.0	7.5	1,932,687	13,494,365	14,452,298	14.7
2018	8,007	54,977	57,066	6.9	7.1	1,969,837	13,524,386	14,038,313	13.7
2019	6,774	50,752	50,752	7.5	7.5	1,652,880	12,383,453	12,383,453	11.7

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

9 This information is generated based on discretional use of the transaction codes each financial institution applies in the CUD system.

Table 2.3
Origin and Concept 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 at the DCV [a/]	Year 2018		Year 2019		Year 2018		Year 2019	
	Number of Operations	Value	Number of Operations	Value	Number of Operations	Value	Number of Operations	Value
					(Percentage)			
Primary Market								
Placements[b/]	20	216.24	16	180.75	0.2	0.4	0.2	0.4
Payment of Principal and Yield[c/]	33	145.19	31	220.22	0.4	0.3	0.5	0.4
Secondary Market[d/]								
Purchase/sales	2,096	9,202.02	1,046	4,796.69	26.2	16.7	15.4	9.5
Money Market[d/]								
Sell/buy-backs	387	6,759.61	309	5,167.68	4.8	12.3	4.6	10.2
Reverse Sell/buy-backs	387	6,753.04	309	5,168.08	4.8	12.3	4.6	10.2
Repos between Financial Institutions	1	19.51	1	21.42	0.0	0.0	0.0	0.0
Reverse Repos between Financial Institutions	1	19.51	1	21.41	0.0	0.0	0.0	0.0
Total Operations with Government Debt in the DCV (1)	2,925	23,115	1,713	15,576	36.5	42.0	25.3	30.7
Others DCV[e/] (2)	23	39.40	24	230.95	0.3	0.1	0.4	0.5
Total (1) + (2)	2,949	23,155	1,737	15,807	36.8	42.1	25.6	31.1
Monetary Policy	**Number of Operations**	**Value**	**Number of Operations**	**Value**	**Number of Operations**	**Value**	**Number of Operations**	**Value**
Repos to Increase Money Supply[f/]	40	4,526.78	62	7,196.08	0.5	8.2	0.9	14.2
Reverse Repos[g/]	0	0.00	0	0.00	0.0	0.0	0.0	0.0
Definitive TES Purchases	1	4.38	6	34.89	0.0	0.0	0.1	0.1
Remunerated Deposits[h/]	70	8,370.96	54	4,275.66	0.9	15.2	0.8	8.4
Total Monetary Policy Operations	111	12,902	121	11,507	1.4	23.5	1.8	22.7
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/]	40	981.28	39	1,056.84	0.5	1.8	0.6	2.1
Total Operations to Provide Liquidity	40	981.28	39	1,056.84	0.5	1.8	0.6	2.1
Direct Fund Transfers in CUD[j/]	**Number of Operations**	**Value**	**Number of Operations**	**Value**	**Number of Operations**	**Value**	**Number of Operations**	**Value**
Securities (uploads and downloads of money)[k/]	647	5,224.51	675	5,584.62	8.1	9.5	10.0	11.0
Intraday interbank loans	24	219.39	24	265.93	0.3	0.4	0.4	0.5
Reverse Intraday interbank loans	14	131.12	15	147.24	0.2	0.2	0.2	0.3
Interbank loans to one or more days	16	391.25	16	338.57	0.2	0.7	0.2	0.7
Reverse Interbank loans to one or more days	18	389.63	17	330.78	0.2	0.7	0.2	0.7

Table 2.3 (continued)
Origin and Concept of Operations for which Deposit Accounts in the CUD System are Debited, Number and Value of Transactions (Daily Averages in Billions of Pesos)

Direct Fund Transfers in CUD[j/]	Year 2018		Year 2019		Year 2018		Year 2019	
	Number of Operations	Value	Number of Operations	Value	Number of Operations	Value	Number of Operations	Value
					(Percentage)			
Interbank loans in the IBR	16	320.00	16	320.00	0.2	0.6	0.2	0.6
Reverse Interbank loans in the IBR	16	320.06	16	321.37	0.2	0.6	0.2	0.6
Currencies settled outside the clearing house	42	184.20	50	246.90	0.5	0.3	0.7	0.5
Taxes	113	487.26	89	541.51	1.4	0.9	1.3	1.1
Transfers from administrators to custodians: CIF operations	111	1,255.28	250	3,921.55	1.4	2.3	3.7	7.7
Custodian transfers to administrators: CIF operations	146	958.50	339	2,309.35	1.8	1.7	5.0	4.6
Other transfers[l/]	1,949	3,269.78	1601	3,624.31	24.3	5.9	23.6	7.1
Deceval [m/]								
Placements	48	188.10	59	230.39	0.6	0.3	0.9	0.5
Payment of principal and yield	201	254.20	216	245.47	2.5	0.5	3.2	0.5
Purchase/sales	144	369.19	143	431.36	1.8	0.7	2.1	0.8
Sell/buy-backs	61	92.93	66	95.64	0.8	0.2	1.0	0.2
Reverse Sell/buy-backs	61	92.68	66	96.21	0.8	0.2	1.0	0.2
Repo Ops.	11	8.79	10	9.27	0.1	0.0	0.2	0.0
Reverse Repo Ops.	11	8.87	11	9.32	0.1	0.0	0.2	0.0
Temporary transfers of securities	11	0.009	10	0.006	0.1	0.0	0.1	0.0
Change of depositor	275	200.61	276	231.80	3.4	0.4	4.1	0.5
Term transactions	5	0.25	5	0.35	0.1	0.0	0.1	0.0
Total Deceval Operations	828	1,215.64	863	1,349.80	10.3	2.2	12.7	2.7
Colombian Stock Exchange (BVC)[n/]	50	55.13	46	60.47	0.6	0.1	0.7	0.1
Central Counterparty Clearing House (CRCC)[o/]	20	28.74	20	22.13	0.2	0.1	0.3	0.0
Foreign Exchange Clearing House of Colombia (CCDC)[p/]	17	640.45	17	787.44	0.2	1.2	0.3	1.6
Retail-value Payment Systems[q/]								
Automated clearing houses (ACHs)	129	1,658.83	144	1,803.13	1.6	3.0	2.1	3.6
Card and ATM networks	44	180.96	49	190.45	0.5	0.3	0.7	0.4
Checks (CEDEC and delegated clearing houses)	38	121.46	35	125.98	0.5	0.2	0.5	0.2
Total Retail-value Payment Systems	211	1,961.25	229	2,119.56	2.6	3.6	3.4	4.2
Total Direct Funds Transfers in CUD	4,237	17,052	4,282	22,292	52.9	31.0	63.2	43.9

Table 2.3 (continued)
Origin and Concept of Operations for which Deposit Accounts in the CUD System are Debited, Number and Value of Transactions (Daily Averages in Billions of Pesos)

Other Transactions	Year 2018		Year 2019		Year 2018		Year 2019	
	Number of Operations	Value	Number of Operations	Value	Number of Operations	Value	Number of Operations	Value
					(Percentage)			
Total Other Transactions[r/]	670	886.90	595	89.64	8.4	1.6	8.8	0.2
Total Debit Operations in the CUD	8,007	54,977	6,774	50,752	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 certificate (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* investments.
d/ Does not include cross trades; that is, operations where a financial entity is both the originator and recipient of the cash leg.
e/ Deposit account debits originating with the collection of fees, penalties and commissions in the DCV.
f/ Corresponds to repo retrocession. In the case of repo chains, it includes only the net value and interest.
g/ Constitution of reverse repos.
h/ Constitution of remunerated deposits, this includes the DGCPTN.
i/ Corresponds to intraday repo retrocession. 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 the 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 entities 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 entity; transfers of funds from the Foreign Exchange Clearing House 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 Foreign Exchange Clearing House are in item p/; credit disbursements; payment by issuers of securities; transfers of funds from the account of the Central Counterparty Clearing House to entities with a multilateral creditor position in pesos; initial transfers from entities 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 entities 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 with Deceval.
n/ Multilateral net clearing and settlement of the cash leg in stock trades.
o/ Transfers of funds from entities with a debtor position in pesos to the Central Counterparty Clearing House, so it can guarantee derivative clearing settlement (daily settlement and at contract maturity).
p/ Transfers of funds from foreign exchange market intermediaries with a debtor position in pesos to the Foreign Exchange Clearing House of Colombia (CCDC), so it can guarantee settlement through payment-versus-payment.
q/ Transfers of funds from entities 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 transfers and operations with debit, credit and ATM cards. It also includes check clearing and settlement.
r/ Provision of cash from *Banco de la República*'s treasury to financial entities with deposit accounts, payment of services, commissions and fees, liens and financial transaction tax collection.
Source: *Banco de la República* (CUD).

the other hand, 7.7% corresponds to transfers of resources from collective investment funds (CIFs) managers to the custodians of those funds, so they can settle purchase and/or sell/buy-back operations with securities from the DCV; 4.6% represents transfers of funds from CIF custodians to the managers of those funds for sale and/or sell/buy-back operations with securities settled through the DCV; 4.18% represents multilateral netting in the retail-value payment systems (3.55% ACH, 0.38% cards and ATM networks, and 0.25% checks); 3.4% corresponds to constitution and retrocession of interbank loans; 2.66%, to settlement of the cash leg of investments, purchase/sales and money market transactions backed by corporate bonds (fixed income) and equities (variable income) settled through Deceval: and 1.6%, to multilateral netting through the CCDC.

Lastly, other direct transfers of funds account for 7.1% of the total value channeled by the CUD. The remaining percentage (1.68%) pertains, among others, to the sum of operations involving transfer to the government of taxes collected by commercial banks, the settlement

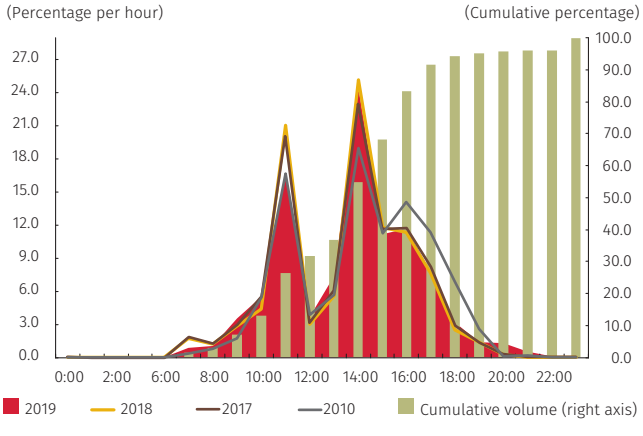
of forex purchases and sales outside the CCDC, cash provisions made through *Banco de la República*'s treasury, settlements for the purchase/sale of equities in the BVC, and the settlement of derivative contracts in the CRCC, both daily and at maturity.

A comparison of the total daily average values settled through the CUD in 2018 and 2019 (see Table 2.3) shows the main items with increased variability include the purchase/sale of government securities, which declined by COP 4.4 t, remunerated deposits, which were down by COP 4.09 t, and the constitution and retrocession of sell/buy-backs with government securities, with a decline of COP 3.1 t. These reductions were offset by an increase of COP 4.01 t in operations with CIFs; COP 2.66 t in monetary policy repos by *Banco de la República*; COP 0.36 t in money uploads; and COP 0.146 t in clearing through CCDC and COP 0.134 t through Deceval. The variation in these items generally explains the net decline of COP 4.2 t in the value of operations conducted through the CUD between 2018 and 2019.

2.1.2 Indicators of Liquidity in the CUD

The payment systems have a liquidity indicator that is reflected in the concentration of payments occurring at given times during the day. In this respect, it is important to bear in mind that Colombia is one of the few countries in the world where it is common market practice for transactions to be paid and settled the same day, prior to closure of the services provided by these systems (technically known as $t + 0$). This applies to trading in securities (apart from the purchase and sale of equities, which is $t + 3$) and forex trades agreed on during the course of the day.

Graph 2.2
Distribution of Transactions in the CUD System, by Time Range in Value



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

In 2019 (Graph 2.2), 38.56% of the payments accumulated during the day were settled between 7:00 and 13:59 hours. The four hours thereafter (between 14:00 and 17:59 hours) exhibit a high concentration of payment settlements (55.03% of the daily total), making for a total of 93.59% before 18:00 hours.

The steep peaks denoting 24%, 23% and 25% settled by 14:00 hours in 2017, 2018 and 2019, respectively, were due to the liquidity-saving mechanisms the DCV offers for settling security and cash legs and to retrocession for operations to increase the supply of money through repos.

In 2019, one sees a reduction (of 3.8%) in the transactions settled by 11:00 hours with respect to 2017 and 2018. This is attributed to the aforementioned decline in the purchase/sale of government securities and in sell/buy-backs with government securities. As a result, fewer operations of this type arrived in the queue for the DCV's

liquidity-saving mechanism during that time slot, which means not as many operations were settled with that mechanism.

2.1.3 Concentration, Operating Efficiency and Other Indicators

Table 2.5 contains estimates of the level of concentration in payments made among the direct participants in the large-value payment system (excluding some payments).[10] 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 a slight decline in concentration between 2018 and 2019: from 13 to 15 institutions and from 9.4% to 10.7% with respect to the total percentage of participants that generated this concentration.

Table 2.4
Number and Percentage of Participants in the CUD that Account for 70% of the Value of Payments

Year	Number of Participants	Percentage of Participants
2010	16	10.3
2011	16	10.2
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

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

Specifically, while 10.7% of the most active participants (15 institutions) originated 72% of the payments made through the CUD in 2019 (nine banks: 56.44%; two brokerage firms: 7.04%; one trust company: 5.46%, and one financial corporation: 2.7%), the remaining 89.3% sent barely 28% of the total number of payments.

As for operating efficiency in 2019, the CUD provided continuous service during 99.72% of its normal business hours. In other words, there were occasional interruptions in the provision of service for a period of time equivalent to 0.28%.

The timeline of the CUD system is depicted in Table 2.5. It shows the cumulative settlement percentages for transactions involving the more relevant items that affect deposit-account balances, according to one-hour time slots from the time the transfer service opens until it closes.[11]

The transactions that were settled with the benefit of the DCV's liquidity-saving and transaction optimization facilities are highlighted in the shaded sections.

10 The payments excluded are those from the General Directorate of Public Credit and the National Treasury (DGCPTN) and *Banco de la República*.

11 Earlier editions of this report contain examples for interpreting the timeline accurately. Refer to http://www.banrep.gov.co/es/reporte-sistemas-pago

Table 2.5
Timeline for Settling Operations in the CUD (Daily Averages for 2019)

	0:00	7:00	8:00	9:00	10:00	11:00
Operations: Origin and Concept						
Operations with Government debt at the DCV						
Primary Market	Percentage of Accumulated Settlements per Time Periods					
Placements	0.00	0.00	0.00	0.57	1.94	13.97
Payment of principal and yield	0.00	0.00	15.55	15.61	15.99	16.87
Secondary Market						
Purchase/sales	0.00	0.00	0.03	0.37	1.70	22.57
Money Market						
Sell/buy-backs and repos among financial institutions	0.00	0.00	0.00	0.27	0.82	34.33
Reverse sell/buy-backs and repos among financial institutions	0.00	0.15	1.69	4.54	7.35	60.67
Monetary Policy						
Repos to increase money supply	0.00	0.00	0.00	0.00	0.00	0.07
Reverse repos to increase money supply	0.00	0.13	0.76	2.31	4.46	10.15
Provision of Liquidity in the Payment System (Banco de la República)						
Intraday repos	0.00	0.61	2.03	11.10	26.71	37.78
Reverse intraday repos	0.01	0.01	0.03	1.42	5.43	7.72
Direct Funds Transfers in the CUD						
Securities (uploads/downloads of money)	0.11	5.30	7.47	12.70	17.04	20.84
Intraday interbank loans	1.39	1.39	1.59	40.63	48.65	50.72
Reverse Intraday interbank loans	0.08	0.15	0.15	0.15	0.15	0.97
Interbank loans to one or more days	0.00	0.00	0.00	0.00	0.00	0.04
Reverse Interbank loans to one or more days	0.00	0.00	0.00	0.49	2.05	3.57
Interbank loans: IBR	0.00	0.00	0.00	0.00	0.00	97.68
Reverse interbank loans: IBR	0.00	0.00	0.79	2.24	4.18	6.99
Taxes	0.00	0.12	4.50	54.92	98.20	99.71
Custodians	0.00	0.00	0.40	5.40	14.57	21.11
Currencies settled outside the clearing house	0.00	0.38	0.50	2.22	4.51	10.25
Deceval						
Primary Market						
Placements	0.04	0.04	0.04	0.64	4.25	9.39
Payment of principal and yield	0.08	0.08	2.46	2.68	2.68	2.96
Secondary Market						
Purchase/sales	0.09	0.09	0.10	0.30	1.28	4.19
Money Market						
Sell/buy-backs	0.00	0.00	0.00	0.03	0.36	3.19
Reverse sell/buy-backs	0.00	0.00	5.46	18.39	36.26	50.96
Repos	0.00	0.00	0.00	0.32	4.87	15.57
Reverse repos	0.00	0.00	0.00	0.00	80.18	92.89
Temporary transfer of securities	0.02	0.00	0.04	0.58	3.25	7.18
Others						
Change of depositor	0.11	0.11	1.47	6.00	12.75	21.54

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	Total Settled Value, Daily Average (Billions of pesos)
Percentage of Accumulated Settlements per Time Periods										
28.39	46.05	64.56	81.97	94.13	99.63	100.00				COP 180.75
18.00	18.26	18.26	18.27	18.59	18.59	18.59	18.59	44.04	100.00	COP 220.22
24.29	27.91	65.51	79.60	93.83	98.81	99.68	99.94	99.99	100.00	COP 4,796.69
35.73	38.60	79.96	89.13	97.06	99.35	99.93	99.98	100.00		COP 5,189.10
62.15	63.41	86.58	93.70	98.71	99.68	99.96	99.99	100.00		COP 5,189.50
0.53	21.99	59.65	87.64	97.47	99.63	99.96	100.00			COP 7,272.12
16.14	39.16	84.47	96.75	99.46	99.90	99.98	100.00			COP 7,196.08
46.15	60.88	77.29	85.95	93.17	97.04	98.27	99.96	99.97	100.00	COP 1,007.05
9.23	11.60	20.54	27.48	51.93	85.40	98.15	99.85	99.97	100.00	COP 1,056.84
23.63	26.87	34.07	47.59	65.53	82.63	92.46	99.31	99.89	100.00	COP 5,584.62
54.64	59.49	66.66	70.82	71.95	72.40	72.72	72.78	97.65	100.00	COP 265.93
7.32	15.97	20.80	23.35	65.61	93.03	99.42	99.84	100.00		COP 147.24
0.16	0.41	3.28	20.53	70.51	96.05	99.67	99.94	99.94	100.00	COP 338.57
4.59	7.84	27.73	56.87	81.82	97.65	99.55	99.85	99.85	100.00	COP 330.78
98.09	98.09	100.00								COP 320.00
10.00	11.91	94.72	97.22	99.90	100.00					COP 321.37
99.73	99.92	99.94	99.99	100.00						COP 541.51
26.07	31.49	42.57	52.41	72.29	89.22	98.63	99.98	100.00		COP 3.921.55
19.01	25.73	41.89	60.21	80.83	96.82	99.39	99.68	100.00		COP 246.90
13.40	16.20	22.10	41.24	72.72	94.45	99.47	99.66	99.66	100.00	COP 230.39
5.47	7.82	13.55	25.88	89.19	98.30	99.74	99.98	100.00	100.00	COP 245.47
7.60	13.33	30.66	57.13	83.92	97.50	99.57	99.95	99.96	100.00	COP 431.36
7.66	16.19	44.46	75.32	92.68	98.68	99.69	100.00			COP 95.64
60.66	70.78	88.18	96.40	98.99	99.58	99.89	100.00			COP 96.21
38.49	54.80	76.05	90.98	96.52	98.71	99.43	99.57	99.95	100.00	COP 9.27
97.57	98.48	99.14	99.83	99.84	100.00					COP 9.32
11.11	15.56	28.28	56.27	81.06	95.89	99.64	100.00			COP 0.01
28.09	32.03	37.85	49.74	75.79	95.22	98.70	99.01	99.62	100.00	COP 231.80

Table 2.5 (continued)
Timeline for Settling Operations in the CUD (Daily Averages for 2019)

	0:00	7:00	8:00	9:00	10:00	11:00	
Colombian Stock Exchange (BVC)							
Secondary Market: Equities Purchase/sales							
Entities pay debit position to the BVC.	0.00	0.00	5.66	15.37	23.97	42.74	
The BVC pays credit position to entities.	1.08	1.08	1.08	21.88	30.67	42.14	
Central Counterparty Clearing House (CRCC)							
Entities pay debit position to the CRCC.	0.00	92.34	92.51	92.52	92.64	93.35	
The CRCC pays credit positions to institutions.	0.00	87.01	89.14	89.38	89.49	92.00	
Foreign Exchange Clearing House of Colombia (CCDC)							
Entities pay debit position to the CCDC.	0.72	1.78	7.06	11.49	16.30	22.49	
The CCDC pays credit positions to institutions.	0.00	0.00	0.00	0.00	0.00	0.00	
Retail-value payment systems							
ACH	0.04	0.77	1.63	4.77	9.76	23.80	
Card and ATM networks	4.44	5.93	7.46	11.11	16.70	29.56	
Checks (Cedec and delegated clearing houses)	0.00	0.00	0.00	0.00	0.00	97.00	
Aggregated timeline for the entire CUD system	0.71	1.27	2.03	4.88	10.00	20.69	
Percentage of the number of operations processed per hour (not cumulative)	0.01	1.25	1.69	4.41	7.13	11.92	

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

2.2 Clearing and Settlement of Securities and Financial Derivatives

In this and the following subsection, reference is made to other components of the financial infrastructure for clearing and settling transactions with financial assets, such as securities, financial derivatives and foreign currencies. Those components, in turn, must interact with the large-value payment system to settle the cash leg of the respective transaction. These are the central securities depositories (DCV and Deceval), the BVC, the CRCC and the CCDC. Since these infrastructures are responsible for clearing, settling or registering transactions in the fixed income, equity, derivatives, and foreign exchange markets, this edition of the *Payment Systems Report* includes a brief description of the economic variables that influenced how international and local financial markets performed during 2019, so as to put in context the clearing and settlement activity registered by those systems.

2.2.1 The Macroeconomic Context

The way international financial markets performed in 2019 was determined largely by reduced prospects for global economic growth, by trade tensions between the United States and its major trading partners, by the political situation in Asia, Europe and Latin America, by the uncertainty surrounding

	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	Total Settled Value, Daily Average (Billions of pesos)
	53.67	53.94	70.62	93.66	96.39	99.59	99.84	99.96	99.96	100.00	COP 60.47
	52.98	54.94	73.20	88.04	93.30	97.15	98.44	99.38	99.92	100.00	COP 60.47
	93.44	93.50	93.99	95.79	98.60	99.69	99.96	100.00			COP 22.13
	94.28	95.00	95.97	96.75	99.13	100.00	100.00				COP 22.13
	27.01	76.94	80.59	80.59	80.59	80.59	80.59	80.59	98.35	100.00	COP 787.44
	0.00	0.00	98.68	100.00							COP 787.44
	27.11	36.74	63.45	76.90	88.14	94.99	97.84	99.07	99.73	100.00	COP 1,803.13
	35.10	40.08	59.13	72.47	87.31	95.66	98.62	99.50	99.85	100.00	COP 190.45
	100.00										COP 125.98
	23.28	30.44	50.19	60.35	69.00	74.40	76.56	88.47	94.18	100.00	COP 50,752
	5.67	5.25	16.93	13.13	14.02	8.01	2.71	1.85	1.28	1.12	

the monetary stimulus provided by central banks, and by appreciation in price of non-agricultural raw materials. In this environment, the markets experienced periods of volatility and ended the year with gains, but with differences among the regions.

Intensification of the trade war between the United States and China, Brexit in Europe, and political and social instability in emerging economies, particularly in Latin America, negatively affected the rate of global growth.

Economic activity in the United States registered a positive pace during the year, although less so than in 2018 and driven mainly by private consumption and employment, despite deterioration in the manufacturing sector as a result of ambiguity with respect to trade. In Europe the situation was less favorable, given trade uncertainty and Brexit in a context where inflation was nowhere near the central bank's target and the economic gap between developed and emerging countries persisted.

With slower growth in output worldwide, many central banks either cut monetary policy rates (three times during the year in the United States, ending in a range of 1.50%-1.75%) or continued with unconventional monetary stimulus programs, as in Europe and Japan. In this environment of uncertainty, assets traditionally considered as safe havens appreciated;

namely, precious metals and the dollar, which strengthened against its peers and against the currencies of emerging market economies.

The price of oil rose as well, due to less supply during the first half of the year and an increase in industrial activity in China at the end of the year (despite devaluations during the third quarter, which was marked by trade tensions between the United States and China). On the other hand, agricultural products devaluated as a result of a worldwide increase in supply.

With respect to Latin America, social protests and the onset of terms in office for presidents who are considered to be anti-market (in Mexico and Argentina) had an impact on investor confidence in the region.

During the year, the major stock indexes in the world's financial markets posted higher prices in the midst of a favorable international environment and with better liquidity conditions. Stock market indexes continued to perform well during the final quarter, driven largely by the trade agreement between the United States and China at the end of the year.

In line with what happened in the developed economies, the main Latin American stock indexes, with the exception of Chile's, closed the year on positive ground, influenced by favorable external conditions. Accordingly, the best performing market in the region was that of Brazil (31.6%), followed by Colombia (25.4%), Peru (6.1%) and Mexico (4.6%), while Chile fell by 8.5%.[12]

As for the world's fixed-income markets, it was a positive year due to controlled and stable inflation or expansive monetary policies. There were gains in the United States, mainly due to a more flexible monetary policy adopted by the Fed in response to lower growth and inflation. In the region, there was appreciation as well, consistent with US treasuries and the interest rate cuts in some countries.

In the local environment, economic activity in Latin America was positive and exceptional, with 3.2% growth for the year, which is higher than in 2018 (2.6%). This improved performance was fueled mainly by the rise in household consumption and the surge in investment.

With respect to monetary policy, although Colombia continued to consolidate its trend towards economic recovery, the surplus in its productive capacity persisted and headline and core inflation were somewhat above the target (due to shocks affecting the CPI). However, agents in the economy still expect inflation to remain near 3%, reflecting the transitory nature of the shocks and the credibility of the target. This being the case, the Board of Directors of *Banco de la República* (BDBR) agreed to hold the benchmark interest rate steady

12 *Banco de la República* (2020). *Reporte de Mercados Financiero* (Report on Financial Markets), IV Quarter 2019.

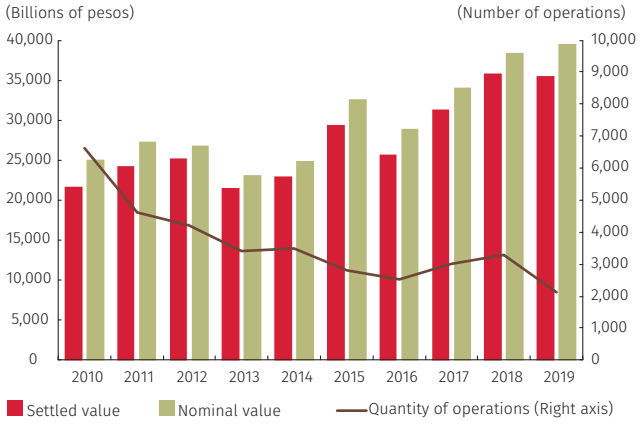
at 4.25% throughout 2019, a level that can be said to have been moderately expansive.

2.2.2 The Central Securities Depository (DCV)

The government debt market was influenced favorably during the first half of the year by the expectation of less inflation and by an increase in demand on the part of foreign investors. Later, in the second half, there was a positive impact from the performance of U.S. Treasuries, the fact that the country's credit rating was maintained, the expectation of a more expansive monetary policy on the part of *Banco de la República*, and publication of the medium-term fiscal framework for 2019, which sought to reduce borrowing.

Therefore, the country's domestic government debt appreciated during the first half of the year and remained relatively stable during the second half, ending 2019 with 9.5% annual appreciation in the Coltes Index, which is above that observed in 2018 (5.8%) and slightly below that of 2017 (9.9%).

Graph 2.3
Central Securities Depository (DCV), Operations Conducted
(Daily averages)[a/]



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

Graph 2.3 shows how transactions settled through the DCV have evolved, highlighting the increase in nominal value and a slight decline in the settled value (market value) during 2019. The daily averages for the nominal and settled value (COP 39.4 t and COP 35.5 t) represent a respective increase of 2.7% and a decline of 0.9% with respect to the previous year. As for the number of operations, the graph shows a negative variation of 35.5%, from 3,290 in 2018 to 2,122 in 2019.

Table 2.6 offers a breakdown of the operations handled through the DCV, according to their origin. In terms of the primary market, which includes the sale of securities in different categories (mandatory, agreed, and auctioned), as well as payments by the national government for yield and amortization towards principal, the average daily nominal value in 2019 (COP 565.1 b) and the settled value (COP 513.5 b) saw positive variations of 26.7% and 13.4%, respectively, compared with the year before, while the average daily number of operations (76) declined by 2.1%.

As for the secondary market, a breakdown by type of operation shows the nominal value and the settled value of purchase/sale transactions with delivery versus payment declined compared to the previous year, as did repos and sell/buy-backs. Specifically, for 2019, the nominal value of delivery-versus-payment purchase/sale transactions was COP 4.4 t and the settled value, COP 4.8 t, compared with 2018. These values amount to respective reductions on the order of 48.1% and 47.9%. Similarly, the nominal value of repos and sell/buy-backs (COP 9.4 t) and their settled value (COP 10.4 t) declined by 24% and 23.8%, respectively. The number of operations was down by 50.1% for purchases and sales

Table 2.6
Daily Average for Operations Conducted in the DCV, by Type of Service
(Amounts in billions of pesos)

Year	Primary Market			
	Quantity	Nominal Vale	Settled Value	
			Current	Constant
2010	206	313	331	467
2011	172	343	367	500
2012	143	249	286	380
2013	128	346	371	484
2014	113	440	412	519
2015	99	338	363	428
2016	82	399	407	454
2017	76	396	422	452
2018	77	445.9	453.0	470
2019	76	565.1	513.5	514

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	Contant			Current	Contant			Current	Contant
2010	2,405	6,464	7,333	10,363	2	39	9	12	1,201	4,771	0	0
2011	1,609	4,602	5,197	7,080	1	21	2	3	1,040	4,057	0	0
2012	2,029	6,786	7,864	10,459	0	34	1	1	933	4,123	0	0
2013	1,667	4,890	5,700	7,436	2	15	11	14	690	3,630	0	0
2014	2,006	5,936	6,575	8,275	2	7	7	9	439	3,603	0	0
2015	1,557	4,516	4,997	5,891	1	8	8	10	170	5,134	0	0
2016	1,451	3,873	4,141	4,617	9	61	63	70	136	4,388	0	0
2017	1,825	5,657	6,294	6,741	4	26	17	18	146	4,761	0	0
2018	2,107	8,424	9,220	9,570	1	26	27	28	147	4,705	0	0
2019	1,051	4,370	4,807	4,807	7	34	35	35	145	5,518	0	0

Year	Secondary Market							
	Transfers between Deposits				Repos and Sell/buy-backs			
	Quantity	Nominal Value	Settled Value		Quantity	Nominal Value	Settled Value	
			Current	Contant			Current	Contant
2010	11	26	0	0	2,460	6,548	7,065	9,984
2011	6	26	0	0	1,123	4,103	4,556	6,206
2012	3	11	0	0	838	4,352	5,062	6,733
2013	3	11	0	0	686	5,607	6,409	8,362
2014	1	5	0	0	722	7,026	7,703	9,695
2015	1	2	0	0	787	9,242	10,008	11,798
2016	0	1	0	0	656	9,363	10,035	11,187
2017	0	1	0	0	763	10,537	11,643	12,469
2018	0	2	0	0	787	12,405	13,600	14,117
2019	1	2	0	0	622	9,428	10,363	10,363

Table 2.6 (continued)
Daily Average for Operations Conducted in the DCV, by Type of Service
(Amounts in billions of pesos)

Year	Monetary Operations			
	Quantity	Nominal Value	Settled Value	
			Current	Contant
2010	215	7,908	7,923	11,195
2011	263	12,702	12,980	17,683
2012	262	11,189	11,999	15,959
2013	229	8,549	8,963	11,693
2014	210	7,884	8,213	10,337
2015	207	13,292	13,943	16,436
2016	180	10,748	10,971	12,230
2017	175	12,632	12,931	13,849
2018	171	12,388	12,564	13,041
2019	220	19,526	19,807	19,807

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

with delivery versus payment and 21% in the case of repos and sell/buy-backs. Although there was less momentum in the market during the year, the reductions were due mainly to corrections to the atypical trading registered during 2018, when the nominal and market values for purchases and sales with delivery versus payment and for repos and sell/buy-backs appreciated by 48.9% and 46.5%, and by 17.7% and 16.8%, respectively.

As for other secondary market operations, the nominal value of monetary policy purchases and sales, free of payment transfers and transfers between deposits, for COP 0.034 t, COP 5.5 t and COP 0.002 t, increased over the previous year by nearly 33%, 17% and 7%, respectively.

Table 2.7
Total Value Held in the DCV at Year-end
(Billions of pesos)

Year	Current	Constant
2010	142,327	201,124
2011	155,818	212,278
2012	160,443	213,383
2013	183,580	239,514
2014	202,604	255,007
2015	207,943	245,133
2016	239,717	267,231
2017	265,680	284,540
2018	304,235	315,796
2019	323,440	323,440

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

As for 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 witnessed at the end of 2019. With respect to the previous year, the amount associated with the nominal value (COP 19.5 t) and the settled value (COP 19.8 t) represent respective increases of 57.6% and 57.7%. The number of operations went from a daily average of 171 to 220, which implies an increase of 29.1%.

With regard to their function as a deposit, the total nominal values held in custody at the end of each year since 2010, at current and constant prices, are shown in Table 2.7.

During 2019 the balance in custody, in current pesos, rose by 6.3%. Of this balance, 97% pertained to securities issued by the national government, while the remaining 3.0% was comprised of securities issued by the Fund for Financing the Agricultural Sector (Finagro).

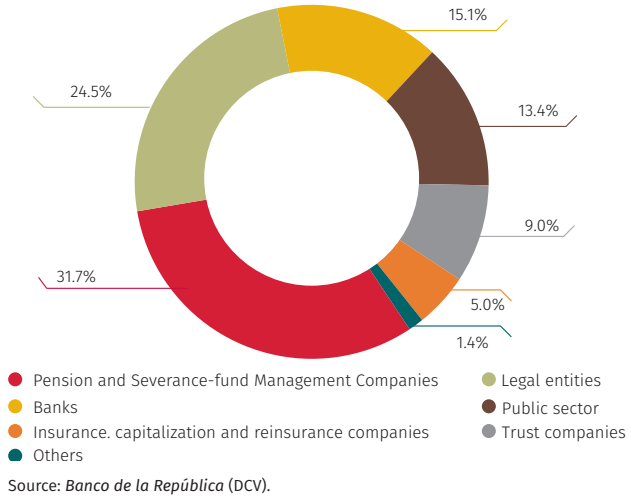
Out of all the current issues managed by the DCV, Class B TES continued to be particularly relevant, accounting for 96.6% of the total balance and 99.6% with respect to domestic debt issued by the national government (Table 2.8).

Table 2.8
Details on the Balance Held in the DCV at the End of 2019, by Issuer
(Millions of pesos)

Issuer	Balance	Percentage
National Government		
Class B TES	312,387,093	96.6
Constant value bonds – Series A	62,604	0.02
Constant value bonds – Series B	1,265,453	0.39
Solidarity Bonds for Peace	1,632	0.00
Security Bonds	2	0.00
CERT	189	0.00
National Government Total	313,716,973	97.0
Finagro		
Agricultural Development – Class A	6,751,620	2.09
Agricultural Development – Class B	2,971,717	0.92
Finagro Total	9,723,337	3.0
General Total	323,440,310	100

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

Graph 2.4
Total Balance Held in the DCV, by Type of Institution
(At December 2019)



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

In terms of a breakdown of the balance on deposit, by type of institution, Graph 2.4 shows pension and severance-fund management companies, [13] along with legal entities,[14] account for most of the holdings, with nearly 56.2% (COP 181.8 t). In third and fourth place are the banks, with 15.1% (COP 48.7 t), and the consolidated public sector, which includes the financial and non-financial sectors and companies of a special nature, with 13.4% (COP 43.3 t). Then come the trust companies[15], with 9.0% (COP 29 t). The remaining 6.4% is comprised mostly of securities held by

13 Includes pension liabilities.

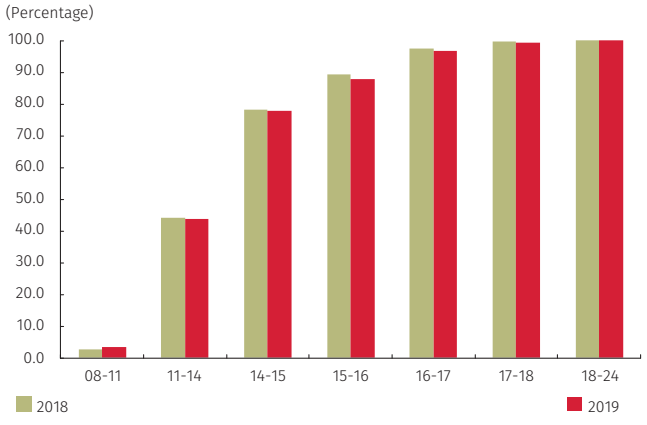
14 Includes foreign entities, among others.

15 Includes trust companies and mutual investment funds

insurance, reinsurance and capitalization companies, with 5.0% (COP 16.1 t).

The operational indicators for the DCV show the system was available to participants 99.95% of the time scheduled for its services in 2019. In terms of timing in the settlement of transfer orders, Graph 2.5 indicates that about 96.6% of all operations were settled prior to 17:00 hours.

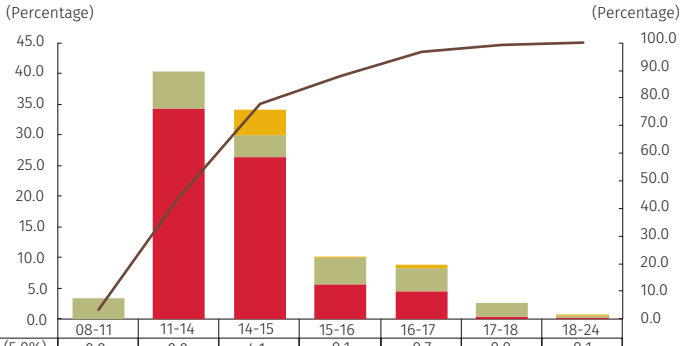
Graph 2.5
Timeliness in Settling Transfer Orders Received in the DCV



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

Graph 2.6 contains a breakdown of the activation mechanisms used to settle operations received by the DCV in the past year. For example, all participants activated their operations manually between 8:00 and 10:59 hours. Between 11:00 and 13:59 hours, the liquidity saving facility was used as well, and automatic retry of funds was added during the subsequent time slots. The liquidity saving facility, which is the mechanism that contributes the most to the settlement of operations, is used more during the period from 11:00 to 14:00 hours. Accordingly, 76.2% of all transactions received by the DCV in 2019 were activated automatically (automatic retry of funds and with the liquidity saving facility), while 23.8% were activated via direct instruction from the participants.

Graph 2.6
Distribution of the Operation Activation Mechanism, by Type (2019)



	08-11	11-14	14-15	15-16	16-17	17-18	18-24
Automatic retry of funds (5.0%)	0.0	0.0	4.1	0.1	0.7	0.0	0.1
Manual activation (23.8%)	3.3	6.1	3.5	4.3	3.7	2.3	0.5
Liquidity savings (71.2%)	0.0	34.3	26.5	5.6	4.5	0.4	0.1
Cumulative settled percentage (Right axis)	3.3	43.7	77.7	87.7	96.6	99.3	100.0

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

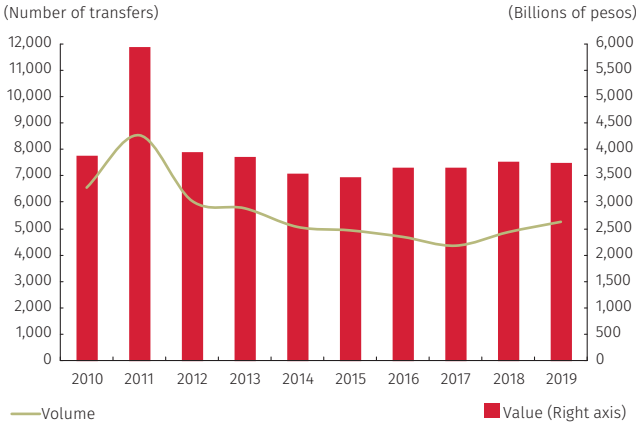
2.2.3 Centralized Securities Depository of Colombia (Deceval)

The total value of private debt products (purchase/sales and sell/buy-backs) traded during 2019 came to COP 135 t, having increased by 5.0% compared with the year before (COP 128 t). A breakdown, by type of operation, shows the volume traded through purchase/sales was up by 10% with respect to 2018 (COP 103 t), having reached COP 113 t, while the volume of sell/buy-backs declined by 12% to COP 22 t.

Considering Deceval also settles equities (variable income), the change in this market is outlined in the following section.

Graph 2.7 and Table 2.9 illustrate how the transactions carried out 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 (purchase/sales between depositors and free-of-payment transfers), and money market transactions (repos, sell/buy-backs and temporary transfers of securities (TTS)), with their respective retrocessions and cash collateral. The average daily volume of transactions increased from 4,849 in 2018 to 5,239 in 2019, with a positive variation of 8.06%. The average daily value of transfers had declined by the end of the year, having gone from COP 3.78 t in 2018 to COP 3.75 t in 2019 (a variation equivalent to -0.69%).

Graph 2.7
Statistics on Deceval Value and Volume
(Daily averages)



Source: Deceval.

Table 2.9
Deceval Statistics

Year	Transfers Processed								
	Daily Average					Annual Value			
	Volume	Value		Average Transferred Value					
	(Number of Transfers)	(Billions of Pesos)	(Billions of 2019 Constant Pesos)	(Millions of Pesos)	(Millions of 2019 Constant Pesos)	(Number of Transfers)	(Billions of Pesos)	(Billions of 2019 Constant Pesos)	(Number of Times GDP)
2010	6,536	3,881	5,484	594	839	1,601,310	950,766	1,343,538	1.75
2011	8,520	5,932	8,081	696	948	2,095,997	1,459,175	1,987,911	2.36
2012	6,032	3,944	5,245	654	870	1,471,831	962,331	1,279,865	1.44
2013	5,752	3,867	5,045	672	877	1,403,374	943,534	1,231,012	1.32
2014	5,046	3,539	4,454	701	883	1,231,272	863,508	1,086,850	1.13
2015	4,915	3,478	4,101	708	834	1,199,378	848,744	1,000,539	1.05
2016	4,668	3,652	4,072	782	872	1,143,678	894,841	997,548	1.04
2017	4,335	3,662	3,922	845	905	1,049,081	886,131	949,035	0.96
2018	4,849	3,778	3,921	779	809	1,178,228	917,961	952,843	0.93
2019	5,239	3,752	3,752	716	716	1,283,659	919,146	919,146	0.87

Source: Deceval.

In terms of Deceval's function as a depository, Table 2.10 shows the total values held in custody at the end of each year since 2010, at current and constant prices. The balance in custody during 2019, in current pesos, implies an increase of 19.1%.

As illustrated in Table 2.11, equities (ordinary and preferred) are the securities that account for the largest proportion, with 58.3%, followed

Table 2.10
Total Amount Held in Deceval at Year-end[a/]
(Billions of pesos)

Year	Current	Constant
2010	281,767	398,169
2011	299,041	407,400
2012	362,513	482,130
2013	387,405	505,440
2014	421,697	530,766
2015	381,310	449,506
2016	440,282	490,816
2017	486,555	521,094
2018	470,519	488,398
2019	560,596	560,596

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

by term certificates of deposit (CDs), with 23.2%, and ordinary bonds, with 9.9%. All other instruments, such as commercial paper and acceptances, among others, account for 8.6%.

When the balance held in custody is grouped according to the type of security and the type of depositor, brokerage firms rank first in equities (COP 327.1 t), with 27.3% (COP 89.1 t), followed by legal entities, with 23.3% (COP 76.2 t) and banks, with 17% (COP 55.7 t). Pension and severance fund managers accounted for 15.9% (COP 52 t) and trust companies, 14.3% (COP 46.8 t). The other 2.2% (COP 7.2 t) is made up of institutions such as finance corporations, insurance companies and government entities, among others (Graph 2.8, Panel A). In all, 99.8% of the balances held in custody by brokerage firms is in a non-proprietary position, and only 0.2%, in

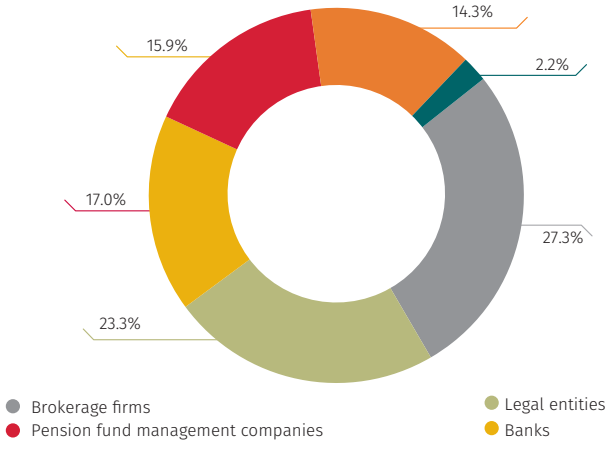
Table 2.11
Details on the Balance of Securities Held in Deceval at the end of 2019, by Type
(Millions of pesos)

Year	Current	Constant
Common equities	281,298,954.54	50.18
Certificates of deposit	129,843,775.08	23.16
Ordinary bonds	55,381,240.40	9.88
Preferred equities	45,804,327.42	8.17
Participation certificates	28,585,924.82	5.10
Sovereign bonds other than TES	11,178,253.03	1.99
Mortgage securities with credit content	4,133,291.03	0.74
Pension bonds	1,520,843.97	0.27
Securities with credit content	720,202.81	0.13
Tax refund securities (TIDI)	708,406.13	0.13
Structured mortgage bonds	344,018.55	0.06
Treasury bonds (TES)	334,634.91	0.06
Non-mortgage participation certificates with credit content	316,260.79	0.06
Real estate investment securities	251,299.33	0.04
Colombian foreign debt securities	157,953.09	0.03
Commercial paper	16,960.00	0.00
Bank acceptances	30.00	0.00
General total	560,596,375.90	

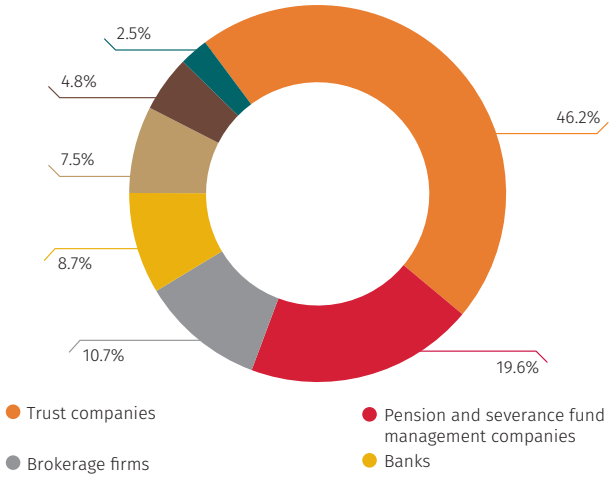
Source: Deceval.

Graph 2.8
Total Balance Held by Deceval, by Type of Entity
(December 2019)

A. Equity income



B. Fixed income



Source: Deceval.

a proprietary position. Furthermore, dematerialized issues accounted for 94.1% of all securities, while 5.8% were physical issues and 0.1%, foreign deposits.

With respect to fixed-income securities (COP 233.5 t), which include CDs (56%), bonds (24%) and others (20%), trust companies account for the largest share, with 46.2% (COP 108 t, of which 99.6% is in a non-proprietary position and 0.4% in a proprietary position), followed by pension and severance fund managers with 1.,6% (COP 45.8 t) and brokerage firms with 10.7% (COP 24.9 t). Then come banks with 8.7% (COP 20.3 t) and insurance companies and special official institutions with 7.5% (COP 17.4 t) and 4.8% (COP 11.3 t), respectively, followed at the end by other institutions with 2.5% (COP 5.8 t). Legal entities, finance companies, capitalization companies, and finance corporations are the most representative of the latter (Graph 2.8, Panel B). In this market, 99.6% is represented by dematerialized issues, 0.2% by foreign deposits, and 0.2% by physical issues.

As for the time it takes to settle transfer orders in the large-value payment system, nearly 82.2% of all operations were settled before 17:00 hours.

2.2.4 The Colombian Stock Exchange (BVC)

The domestic equity market in 2019 was favored primarily by growth in the nation's economy and by positive corporate earnings. Therefore, and in line with the world's major stock indexes, the Colcap Index posted a positive variation of 25.4%, largely due to good performance by companies in the financial and service sectors.

With respect to the volume of trading on the equity market, COP 46 t were traded during 2019, including COP 35.1 t in spot operations, COP 9.3 t in repo operations and COP 1.6 t in TTS operations. Compared with 2018, this trading volume represents a decline of 2.1% on the spot market and an increase of 28.2% in repo operations and 20.5%, in TTS operations.

The Colombian Stock Exchange provides and manages electronic platforms that allow its participants to make trading offers in different markets. The market with the largest number of participants is the fixed-income market, with 106, followed by the standardized derivatives market, with 33, and the equity market, with 20. Although different types of institutions take part in the fixed-income market and

standardized derivatives market (e.g., banks, trust companies, etc.), the stock market is comprised exclusively of brokerage firms.

In the equity market, the BVC manages clearing and settlement for spot market trading (purchase/sales). To do so, it relies on an arrangement that combines its own developments with services provided by other infrastructures, the most important being Deceval (gross settlement of securities legs) and the large-value payment system managed by *Banco de la República* (net multilateral cash leg settlements). As a whole, the interaction that exists among these entities makes up the financial infrastructure of the equity market.

As for the cash leg of these operations, the BVC does multilateral netting in which, unlike gross clearing, there is a single position associated with all purchase/sale operations. Consequently, once participants who are responsible for a net multilateral position become aware of it, they transfer the resources to the BVC's deposit account, doing so through the large-value payment system, which then pays the participants who have a net multilateral position in their favor.

Since Deceval maintains centralized custody of equities, the BVC sends instructions to Deceval on an ongoing basis throughout the day, once the respective securities leg has been cleared, so Deceval can make the corresponding book entry.

With respect to term operations, Decree 2555 of 2010 stipulates that repos, sell/buy-backs and TTS traded or registered on stock markets and in authorized trading and registration systems are to be cleared and settled through the DvP mechanism in approved clearing and settlement systems. It also establishes that stock exchanges must indicate, in their rules and regulations, if those securities are to be cleared and settled through their own system, or via a system that is managed by another entity and authorized by the Office of the Superintendent of Financial Institutions in Colombia. Accordingly, the BVC's regulations indicate repo operations carried out in its system are to be cleared and settled at a central counterparty clearing house authorized by the BVC itself. As a result, equity repos traded through the BVC have been cleared and settled in the CRCC as of August 2017.

Graph 2.9
Developments Operations on the Colombian Stock Exchange (BVC)
(Daily averages)

Source: Colombian Stock Exchange (BVC).

Transactions on the equity market[16] increased in 2019 with respect to the year before. The daily averages in terms of value (COP 187.8 b) and the number of operations (2,326) represented a positive change of 2.7% and 0.6%, respectively, with respect to the previous year (Graph 2.9).

16 Includes cash, repo, and TTS operations.

Table 2.12 offers a breakdown of equity operations in the BVC, according to the type of operation. For the spot market (i.e., buying and selling), one sees the average amount traded daily in 2019 came to COP 143.4 b; that is, 2.9% less than the year before, while the number of transactions was 2,267, which represents an increase of 0.7% compared with 2018. In contrast, performance on the equity repo market was positive, with a daily average of COP 37.8 b, or an increase of 27.2%, but with fewer daily operations, which averaged 49 and represent a

Table 2.12
Colombian Stock Exchange (BVC) Statistics

Year	Purchase/sale of equities					Equity Repos				
	Daily Average			Annual Value		Daily Average			Annual Value	
	Quantity	Amount (Billions of Pesos)		Amount (Billions of Pesos)		Quantity	Amount (Billions of Pesos)		Amount (Billions of Pesos)	
		Current	Constant	Current	Constant		Current	Constant	Current	Constant
2010	2,640	151.6	214.3	37,151.8	52,499.6	291	66.8	94.3	16,354.4	23,110.6
2011	2,947	166.6	227.0	40,989.0	55,841.5	478	110.5	150.5	27,181.4	37,030.7
2012	3,199	188.2	250.3	45,923.8	61,077.0	396	104.3	138.7	25,440.4	33,834.9
2013	2,550	167.5	218.6	40,879.4	53,334.6	145	34.2	44.7	8,352.1	10,896.8
2014	2,536	165.4	208.2	40,353.1	50,790.2	121	33.6	42.3	8,193.2	10,312.3
2015	2,294	134.3	158.3	32,489.0	38,299.6	88	27.9	32.9	6,754.3	7,962.3
2016	2,380	144.4	160.9	35,369.9	39,429.6	59	22.3	24.9	5,461.6	6,088.5
2017	2,106	138.6	148.5	33,548.9	35,930.5	48	25.8	27.6	6,241.4	6,684.5
2018	2,251	147.6	153.2	35,875.5	37,238.8	49	29.7	30.9	7,227.6	7,502.3
2019	2,267	143.4	143.4	35,127.9	35,127.9	49	37.8	37.8	9,265.6	9,265.6

Year	TTS Equities					Total				
	Daily Average			Annual Value		Daily Average			Annual Value	
	Quantity	Amount (Billions of Pesos)		Amount (Billions of Pesos)		Quantity	Amount (Billions of Pesos)		Amount (Billions of Pesos)	
		Current	Constant	Current	Constant		Current	Constant	Current	Constant
2010	n. a.	n. a.	n. a.	n. a.	n. a.	2,931	218	308.6	53,506.2	75,610
2011	1	0	0	44	59.4	3,426	277	377.8	68,214.1	92,932
2012	1	0.20	0.27	57.0	75.8	3,596	293	389.2	71,421.3	94,987.7
2013	2	0.35	0.45	84.2	109.8	2,697	202	263.7	49,315.7	64,341.3
2014	7	2.03	2.55	494.4	622.3	2,663	201	253.0	49,040.6	61,724.7
2015	7	1.96	2.31	475.2	560.2	2,389	164	193.5	39,718.6	46,822.1
2016	10	4.91	5.48	1,203.40	1,341.5	2,449	172	191.3	42,034.95	46,859.6
2017	12	5.91	6.33	1,431.19	1,532.8	2,166	170	182.4	41,221.54	44,147.8
2018	11	5.51	5.72	1,339.08	1,390.0	2,311	183	189.8	44,442.19	46,131.0
2019	10	6.58	6.58	1,613.1	1,613.1	2,326	188	187.8	46,006.6	46,006.6

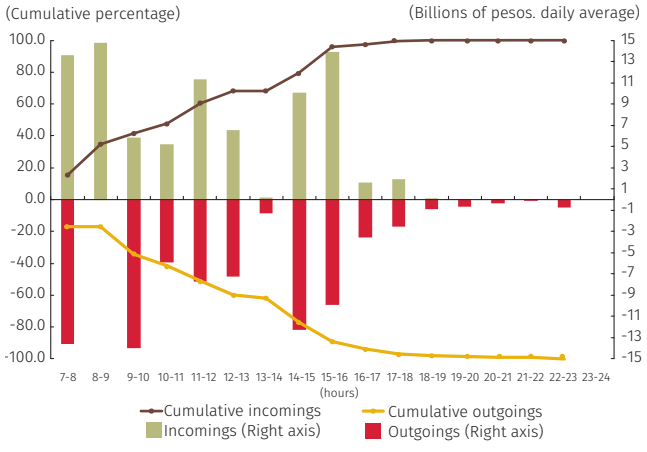
n. a.: Not available. There were no TTS transactions.
Source: Colombian Stock Exchange (BVC).

decline of 0.4%. The equities lending market (i.e., TTS), which has been operating since 2011, posted favorable performance, registering a daily average of COP 6.58 b during 2019. This implies an increase of 19.5% in light of the daily average in 2018, which was COP 5.51 b.

Graph 2.10 shows the momentum in the receipt of money by the BVC to clear and settle cash operations. In 2019, this monetary exchange took place throughout the day, with the BVC delivering 51% before 12:00 p.m. and 93.5% between 12:00 and 5:00 p.m.

Compared with the volume traded on the spot market, the quantities required by the BVC as a result of the multilateral clearing process represented savings of about 57.8% in terms of the liquidity needs of its participants.

Graph 2.10
Dynamics of Payments on the Spot Market for Equities in the Large-value Payment System
(Daily averages, 2019)

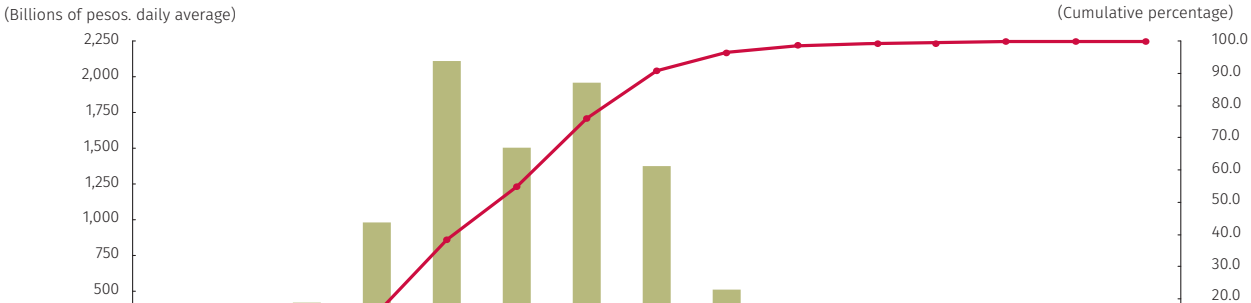


Source *Banco de la República* (CUD).

In the other equity markets (for repos and TTS), the BVC cleared and settled these types of transactions up to August 2017; since then, they have been handled by the CRCC. However, securities legs and cash legs were settled on a gross basis (transaction-by-transaction) in Deceval, which debits the money from the large-value payment system. Graph 2.11 shows how the momentum in repo and TTS operations processed through the large-value payment system changed during 2019.

During 2019, the BVC managed COP 633 b in outstanding repurchase (repo) obligations, on average. This represents an increase of 0.4% compared with the previous year, when the value of those obligations averaged COP 631 b (Graph 2.12).

Graph 2.11
Developments in Transactions Settled Throughout the Day by Deceval Pertaining to the BVC Market for Repos and TTS [a/]



(horas)	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23
Amount processed (millions)	COP 0.0	COP 30.0	COP 419.5	COP 987.3	COP 2.115.5	COP 1.505.7	COP 1.961.4	COP 1.379.2	COP 512.8	COP 202.8	COP 66.8	COP 12.7	COP 35.4	COP 4.4	COP 0.0
Cumulative percentage (Right axis)	0.00	0.32	4.87	15.56	38.47	54.78	76.02	90.96	96.51	98.71	99.43	99.57	99.95	100.00	100.00

a/ Includes only the initial operation. Operations registered up to August 14, 2017; since then, equity repos have been cleared and settled through the CRCC.
Source: *Banco de la República* (CUD).

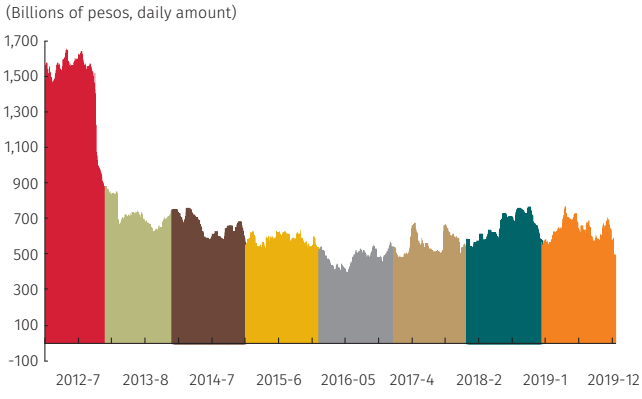
Graph 2.13 depicts the share of the average daily amount in outstanding repos, by maturity. Brokerage firms registered a financing pattern in 2019 with 40% concentrated at over sixty days, 50% between sixteen and sixty days, and 10% at a term equal to or less than fifteen days.

2.2.5 The Central Counterparty of Colombia (CRCC)

A look at the domestic market for derivatives, according to the type of underlying asset, shows contracts based on the representative market rate of exchange (TRM) were affected negatively by higher exchange rates throughout most of the year (ranging from a minimum of COP 3,072 in March to a maximum of COP 3,522 in December). This fluctuation in the TRM was due largely to appreciation of the dollar as a safe haven asset, and to oil price volatility and world trade tensions as well. In TRM futures trading, it appears many speculators do not operate when levels are near a high point, and this has an impact on the dynamics of the market.

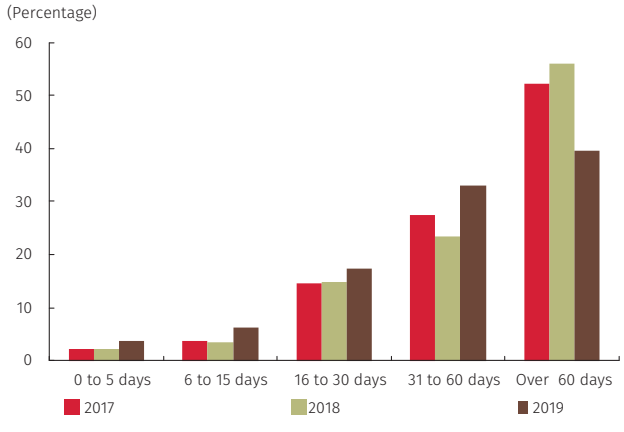
Interest rate futures responded to the reduced uncertainty surrounding monetary policy in Colombia. The benchmark rate remained unchanged throughout the year, dampening the appetite for this type of instrument.

Graph 2.12
Developments in Repos with Equities



Source: Colombian Stock Exchange (BVC).

Graph 2.13
Developments in Repos with Equities, by Maturity: 2017-2019



Source: Colombian Stock Exchange (BVC).

Performance in the case of equity futures (Colcap Index and stocks) was positive and in keeping with the appreciation witnessed in the spot markets for underlying assets of this type.[17]

During 2019, the value of operations with financial derivatives cleared and settled through the CRCC[18] declined to COP 899.6 t, which is 1.12% less than in 2018. The share of the sum of these operations, based on the type of product, was 24.9% (COP 224.3 t) in the case of standardized financial derivatives and 75.1% (COP 675.3 t) for non-standardized derivatives. This amounts to 24.84% less for standardized derivatives and 10.46% more for non-standardized derivatives compared with the year before. Among the standardized derivatives, TRM futures were the product with the greatest increase, having risen 75.2% from COP 1.75 t to COP 3.06 t, while NDF forwards (peso/dollar) were the non-standardized derivatives with the most

17 BVC (2019). *Informe de gestión* (Management Report).

18 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.

growth, having increased by 11% from COP 543.9 t to COP 603.74 t. In contrast, OIS futures were the product that declined the most, having dropped by 62.9% from COP 9.3 t to COP 3.45 t.

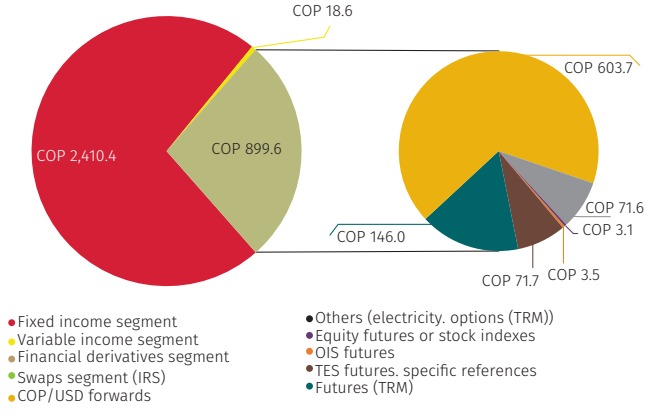
The share for each type of standardized futures contract with respect to all such products was 31.98% (COP 71.73 t) for specific reference TES futures, 6.1% (COP 146.02 t) in the case of TES futures, 1.54% (COP 3.45 t) for OIS futures, and 1.38% (COP 3.09 t) for other products, which include futures on equities, indices, and electricity. The proportion of non-standardized products came to 89.40% (COP 603.74 t) in the case of NDF forwards (peso/dollar) and 10.60% (COP 71.57 t) for OIS IBR and overnight OIS IBR forwards.

On the other hand, the total value of operations in the fixed-income segment represented by government debt sell/buy-backs managed by the CRCC for subsequent gross settlement through the DCV declined by 23.6% to COP 2,410.45 t.[19]

With respect to the variable-income segment, equity repo transactions rose by 28.05% to COP 18.61 t in total during 2019 (Graph 2.14).

The number of futures contracts[20] cleared and settled through the CRCC declined. The daily average went from 9,598 in 2018 to 7,627 in 2019. The total value of transactions accepted for net clearing in the financial derivatives segment declined from a daily average of COP 3.8 t in 2018 to COP 3.77 t in 2019.

Graph 2.14
The Central Counterparty of Colombia
Share in Trillions of Pesos, by Product
(Total value of operations in 2019)



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

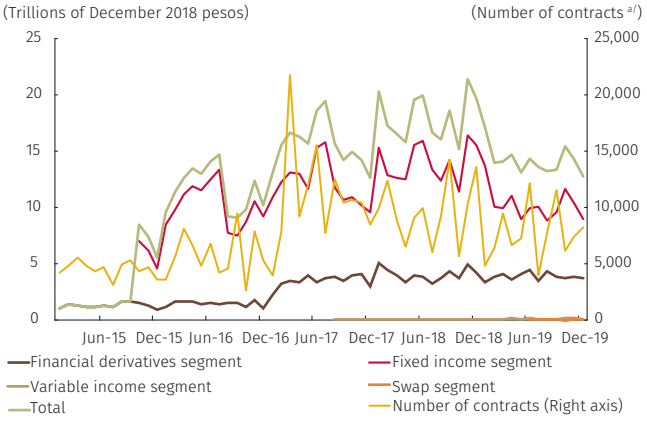
Average daily gross clearing in the fixed-income segment (TES sell/buy-backs) went from COP 13.3 t in 2018 to COP 10.1 t in 2019. Average daily gross clearing in the variable-income segment (equity repos) increased from COP 60.83 b in 2018 to COP 78.3 b in 2019 (Graph 2.15).

A detailed look at how the products in each segment evolved during 2019 shows the highest average daily amount accepted for TES sell/buy-backs was in January, with COP 13,7 t; for equity repos, it was in April, with COP 103.87 b. On the other hand, it is important to point out that the highest daily averages in the financial derivatives segment were in June for specific reference TES futures, with COP 527.34 b; in September for TRM futures, with COP 919.87 b; in October for OIS futures, with COP 40.62 b; in June for stock futures, with COP 35.52 b, and for NDF forwards (peso/dollar), with COP 2.89

19 This amount takes into account flows for constitution and retrocession in sell/buy-back operations.

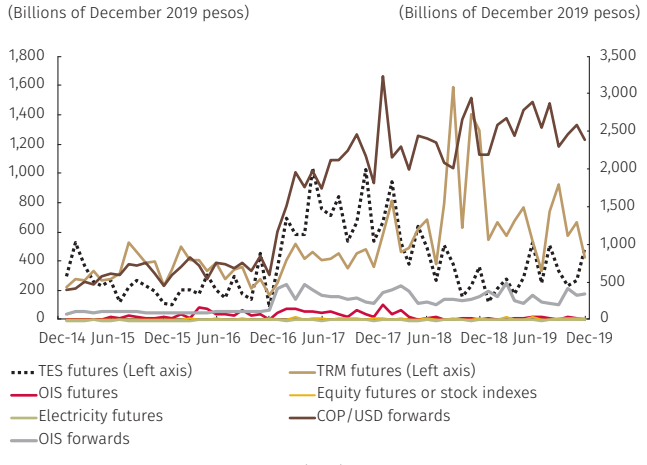
20 Only standardized products are included. Therefore, this number does not take into account exchange rate forwards or operations in the equity and fixed-income segments.

Graph 2.15
Value of Operations Accepted by CRCC S. A.
(Daily average)



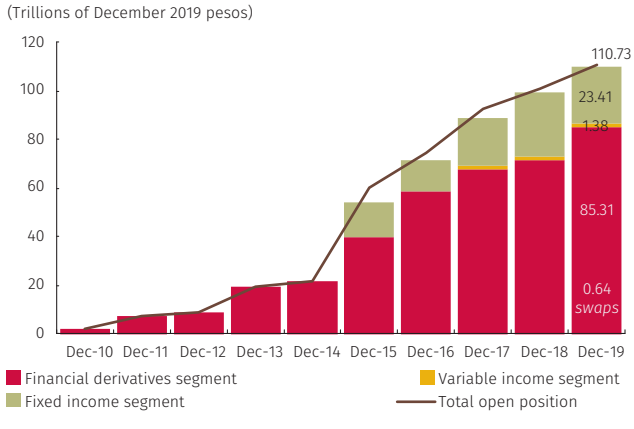
a/ Financial derivatives segment. Does not include exchange forwards or interest.
Sources: CRCC and *Banco de la República* (DSIF).

Graph 2.16
Developments in Operations on products on the Financial Derivatives segment
(Daily average)



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

Graph 2.17
Developments in the Open Position, by Segment at the Close of Each Year
(Gross open position, both sides -long and short positions-)



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

t; and in March for OIS-IBR, with COP 487.93 b (Graphs 2.15 and 2.16).

The value of gross open positions[21] came to COP 110.73 t by the end of the year, which implies an increase of 13.34% with respect to the open position at the close of 2018. In terms of the proportion pertaining to the different segments and gross open position values, the financial derivatives segment had an open position of COP 85.31 t (77.04%) as opposed to COP 23.41 t (21.14%) for the fixed-income segment, COP 1.38 t (1.25%) for variable income, and COP 0,64 t (0.58%) for interest rate swaps (Graph 2.17).

For 2018, Graph 2.18 shows the most representative products with declining open positions[22] were TRM futures (-68.8%) and OIS futures (-13.75%). On the other hand, the products with increased open positions were stock futures (206.98%), OIS forwards (48.86%) and specific reference TES futures (36.43%).

In 2019, 5.6% of all standardized operations were conducted through the BVC and Derivex trading systems; the other 94.4% were managed through registration systems (up from 92.2% in 2018) (Graph 2.19). All non-standardized derivatives operations are carried out through the registration systems. With respect to TES sell/buy-backs, 24.4% came from the MEC system and 75.6% from the SEN trading system.

According to the BVC, the trend in the increase in TES futures agreed on bilaterally and then reported to the BVC, through its registration system, for subsequent clearing and settlement in the CRCC, was maintained. This performance is explained by the fact that trading in notional TES futures (short, medium and long-term) was done initially through the trading systems. However, once specific reference TES futures were created, it began to be done bilaterally through

21 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.

22 The comparison takes into account the open position on the last day of November 2018 and the last day of November 2019. December is not considered, since it is a month marked by seasonal performance.

brokerage firms, which registered these operations to be sent later to the CRCC.

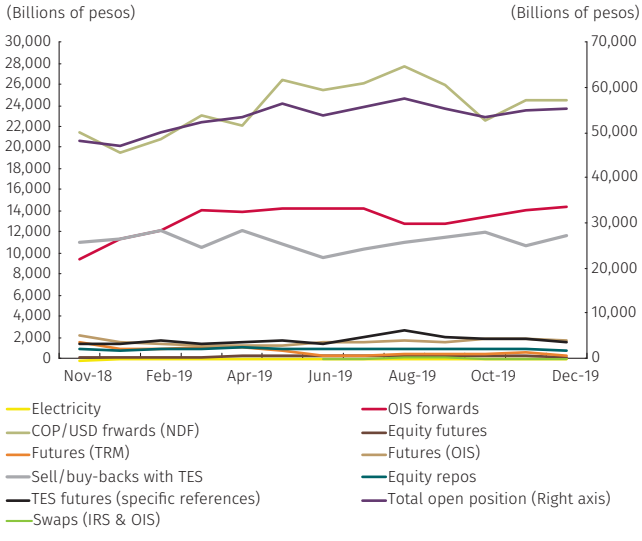
The limited liquidity on the trading platform for TES and TRM futures is also a factor. Participants use the money market, the TES spot market and the foreign exchange market to define their strategies for the futures market. Initially, they go to the platforms where futures with these underlying assets are traded and, if they do not obtain enough liquidity there, they resort to the over-the-counter market to carry out the operation. Graph 2.19 shows how the share of the number of standardized derivative contracts handled through electronic trading and registration systems has changed.

Risk clearing processes, by maturity and instrument, generate efficiencies in the demand for collateral to support members' open positions, which can lower their liquidity requirements. On a daily average, the collateral requirements in 2019 for the most representative products were reduced as follows: 19.62% for futures contracts on specific reference TES; 77.85% for TRM futures and NDF foreign exchange forwards (pesos/dollars); 73.6% for OIS futures, and 67.25% for OIS-IBR. These liquidity savings are represented as lower requirements for cash or securities (collateral per position) in the case of long positions (purchases) and short positions (sales) in the same product, but with different maturities (e.g., long and short positions in specific reference TES futures with different durations), or when there are different positions in several instruments with correlated underlying assets (e.g., long positions in TRM futures and short positions in NDF foreign exchange forwards (pesos/dollars)). In 2019, due to the regulatory change affecting the CRCC, whereby clearing between TRM futures and NDF foreign currency (pesos/dollars) forwards was included, liquidity savings increased from an average of 51.3% from clearing between maturities for each product to 77.85% of the aggregate value of those products. This percentage also includes clearing for the correlation between them.

The CRCC experienced two delays in 2019. However, neither of them had an impact on the provision of its services, nor was it necessary to enforce collateral.

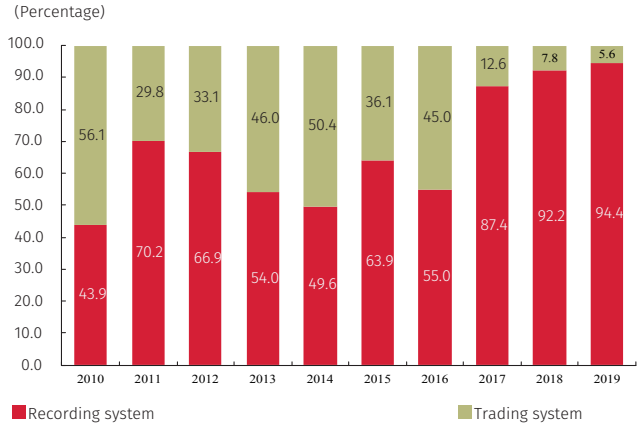
In terms of operating efficiency in the delivery of service, the CRCC's systems were available to participants during 99.97% of the time, as per the schedule established for 2019.

Graph 2.18
Developments in the Open Position, by Groups of Products in 2019
(Only one side)



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

Graph 2.19
Developments in the Number of Standardized Derivative Contracts
Received from Registration or Trading Systems



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

Among the major changes introduced by the CRCC during 2019, the following are particularly important: 1) admission of bridge banks as members of the CRCC, pursuant to Article 295A of the Organic Statute of the Financial System, provided the Office of the Superintendent of Financial Institutions in Colombia has authorized their constitution and they comply with all provisions relative to the admission process; 2) establishment of the rules required for the CRCC to manage clearing and settlement by acting as a central counterparty for the temporary transfer of securities and securities-backed cash operations, even though these products did not enter into operation during 2019; 3) inclusion of the general guarantee fund as part of the risk model; namely, a guarantee that may be constituted in favor of the CRCC through joint and several contributions from third parties intended to cover any debit balances that may be derived from default by a clearing member for a specific segment and are not covered by the collateral position, extraordinary collateral, contributions to collective guarantee funds, specific proprietary resources, or contributions for continuity of the service; and 4) the addition of cross-currency basis swaps overnight (CCBSO) as part of the swap segment, a contract whereby the parties exchange flows on nominal amounts denominated in different currencies (COP/USD), which are necessarily referenced to different interest rates, with the variable interest rate denominated in COP determined based on the average quoted by banks participating in the IBR overnight scheme.

2.3 The Foreign Exchange Clearing House of Colombia (CCDC)

The performance of the Colombian peso during 2019 exhibited mixed trends. The appreciation witnessed up to March was explained by higher oil prices and strengthening of the region's currencies. Then came depreciation up until May, due to uncertainty surrounding the country's sovereign rating and the increase in its current account deficit. The peso appreciated again, in June, followed by depreciation up until December, in response to a stronger dollar worldwide as a result of trade tensions. The appreciation observed in the final days of the year was due to the agreement between the United States and China. As a result, the peso depreciated slightly against the US dollar, by 0.8%, during the course of the year.

The average number of operations settled daily among the 33 direct participants in the CCDC during 2019 came to 1,834, which represent an increase of 5.3% compared with the daily average of the previous year. In terms of the gross value cleared and settled, the daily average was USD 1,324.9 m (COP 4,352.3 b)[23], which meant an increase of 2.17% in dollars and 9.08% in current pesos compared with 2018 (Table 2.13 and Graph 2.20).

Average daily savings in liquidity, as a result of multilateral netting, came to 86.0%, the same as the year before. The gross value of

23 Expressed in current pesos.

operations in 2019 averaged USD 1,324.9 m daily, while the net daily average was USD 185.9 m (COP 610.82 b).

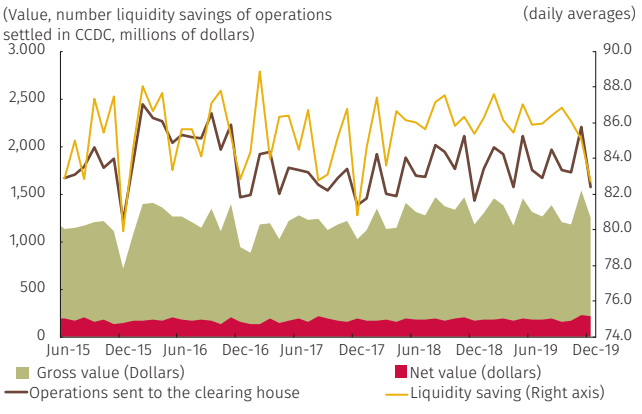
From the standpoint of risk mitigation mechanisms, the CCDC modified the required level of collateral during 2019. Specifically, the demand for collateral to support each participant's net selling position in the case of operations cleared and settled in t + 0 was reduced by one percentage point to 5.5%. It was kept at 6.5% for operations cleared and settled in t + 1, and at 8.0% for those cleared and settled in t + 2 and t + 3, with the collateral provided to the CCDC by direct participants averaging USD 65.95 m and COP 115.94 b daily.

Table 2.13
Statistics on the Foreign Exchange Clearing House of Colombia S.A. [a/]

	Daily Average			
	Number of Operations (Operations sent to the CCDC)	Gross Value		Liquidity Saving (Percentage)
		(Millions of dollars)	(Billions of December 2019 pesos[/b])	
Average-2010	1,825	1,274.0	3,423.1	88.2
Average-2011	1,544	1,088.0	2,738.9	84.0
Average-2012	1,399	1,037.7	2,481.8	81.6
Average-2013	1,388	1,125.7	2,750.1	81.8
Average-2014	1,482	1,179.2	2,964.7	80.4
Average-2015	1,823	1,163.9	3,733.8	84.3
Average-2016	2,102	1,243.4	4,242.4	85.7
Average-2017	1,673	1,150.0	3,638.7	85.0
Average-2018	1,741	1,297.8	3,990.2	86.0
Average-2019	1,834	1,324.9	4,352.3	86.0
Jan-19	1,761	1,306.2	4,116.5	86.3
Feb-19	1,990	1,440.0	4,526.0	87.6
Mar-19	1,923	1,387.4	4,348.0	86.2
Apr-19	1,570	1,173.1	3,709.4	85.5
May-19	2,110	1,452.3	4,816.7	87.1
Jun-19	1,754	1,310.9	4,257.1	85.9
Jul-19	1,669	1,270.3	4,082.3	86.0
Aug-19	1,966	1,378.6	4,711.3	86.4
Sept-19	1,749	1,207.0	4,103.8	86.8
Oct-19	1,730	1,187.6	4,076.7	86.1
Nov-19	2,208	1,537.9	5,256.3	85.1
Dec-19	1,572	1,247.4	4,223.8	82.7

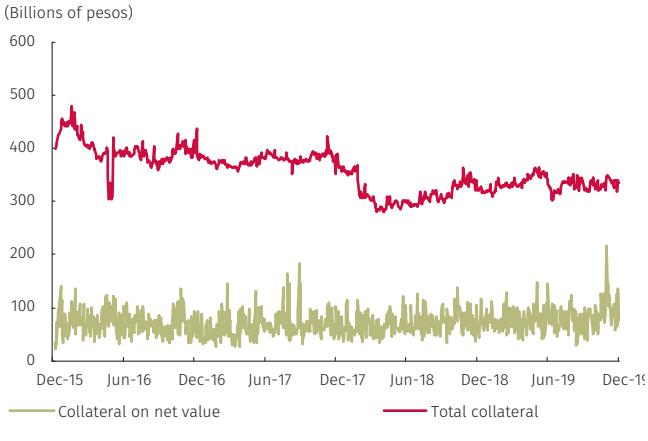
a/ Includes spot and next day market operations t + 1, t + 2 and t + 3 that reach compliance date.
b/ 2018 values are in current pesos.
Source: CCDC S. A.

Graph 2.20
Value, Volume and Liquidity Savings in CCDC Operations
(Daily averages)



Foreign Exchange Clearing House of Colombia S.A. (CCDC).

Graph 2.21
Developments in the Value of Collateral Received and Values Resulting from Applying the Required Percentage to Multilateral Net Values



Sources: Foreign Exchange Clearing House of Colombia S.A. (CCDC) and *Banco de la República*.

Graph 2.21 shows the peso value of the sum of collateral deposited by participants and the amounts when the aforementioned percentages are applied to the multilateral net values. The collateral they deposit allows participants to trade during the day with net selling positions up to the short-position limit defined by the CCDC. The values obtained by applying the required percentage of collateral to the multilateral net payments would tally with the collateral required to cover exchange-rate volatilities in the event of default on the payment of net multilateral liabilities. In some cases, the collateral that is provided might be more than what is required to manage default. Agents do this to reduce the operating risk generated by possible additional collateral requirements during the day.

The peso quotas agreed between the agents and their liquidity providers (LP) were kept at COP 350 b with six banks. The dollar quotas were increased by USD 5 m to a total of USD 120 m agreed with eight banks. The largest supplier of liquidity in dollars accounted for 33.3% (USD 40.0 m) of all borrowing facilities in dollars by the end of 2019.

In 2019, the CCDC established a new dollar settlement account for contingencies with J.P. Morgan Chase Bank NA.

On the other hand, the CCDC experienced four delays[24] in paying the multilateral obligations of some of its direct participants. Three of the delays were in dollars, for a total of USD 157.25 m. The other was in pesos, for COP 3,428.37 m. In any case, there was no need to use liquidity providers, and no default occurred (Table 2.14).

As for operating efficiency in service delivery, the CCDC's systems were available to participants during 99.9% of the time, according to the schedule established for 2019.

In 2019, the CCDC introduced changes in its internal regulations concerning the acceptance of bridge banks as direct participants, under article 295A of the Organic Statute of the Financial System, the definition of their particular operational characteristics, and the requirement to subscribe to and benefit from an adjustment plan to comply with obligations to the CCDC, in accordance with its regulations. The

24 The CCDC defines "delay" as the payment of an obligation resulting from the multilateral net balance that is made after the time limit established in the regulations (2:30 p.m.), provided it does not occur after 8:00 a.m. on the day following the date the payment was due.

CCDC also expanded its requirements to include policies, procedures and standards for data and cyber risk security management applicable to direct participants and liquidity providers, as part of the conditions that must be accredited for their acceptance.

Table 2.14
Foreign Exchange Clearing House of Colombia S.A. (CCDC): Delays and Defaults by CCDC Participants in 2019

	Number of Delays	Value of the Delays	Number of LP Used	Total Value of LP Use	Defaults	Value of Defaults
Dollars	3	USD 157,250,000.00	0	USD 0.00	0	USD 0.00
Pesos	1	COP 3,428,370.000.00	0	COP 0.00	0	COP 0.00

Source: CCDC S.A.

Box 1

International Experience in Quantifying and Mitigating Intraday Liquidity Risk

1. Introduction

The 2007 global financial crisis highlighted the importance of efficient liquidity management in maintaining the stability of the financial system. Given the reduced availability of alternative sources of funding, and despite the ample liquidity provided by central banks, some financial institutions were unable to maintain adequate levels of liquidity and, in several cases, this compromised their existence. The limited importance and priority given to liquidity risk during the times of high liquidity prior to the 2007 crisis contrasts with the speed and severity with which that risk materialized, as well as the magnitude of the effects it triggered in moments of crisis.

In response to the inefficient and inaccurate liquidity risk management observed during the crisis, and to improve management and control of exposure to liquidity risk, the Basel Committee on Banking Supervision (BCBS)[1] of the Bank for International Settlements (BIS) issued "Principles for the Sound Management and Supervision of Liquidity Risk" in September 2008 (BCBS, 2008). These principles included a set of key elements to create a sound framework for the efficient management and control of liquidity on the part of financial institutions, and for liquidity risk supervision by the competent authorities. The BCBS also established a series of guidelines aimed not only at increasing the extent to which internationally active banks are able to withstand global liquidity pressures, but also at improving international harmonization when it comes to liquidity risk supervision.

The international regulatory standards established by the BCBS to address liquidity risk seek independent but complementary objectives. In 2013, it created the Liquidity Coverage Ratio (LCR) to promote resilience to liquidity risk in the short term and, in 2014, it formulated the Net Stable Funding Ratio (NSFR) for longer-term horizons. With the LCR, the BCBS strives to ensure banks [2] have enough high-quality liquid assets that are easily convertible to cash to cover their liquidity needs in a 30-day liquidity problem scenario. With the NSFR, the aim is to generate additional incentives for banks to finance their activities, on a continuous structural basis, with more stable sources of liquidity. In addition, in 2010, the BCBS issued "Basel III: International Framework for Measuring, Standardizing and Monitoring Liquidity Risk" (BCBS, 2010). Intended to strengthen supervisory objectives and efforts, it establishes internationally consistent regulatory standards to increase the resilience of internationally active banks to liquidity pressures.

The idea behind these international standards for liquidity risk in the short and long term (LCR and NSFR) is to preserve the strength of the balance sheet. However, these standards do not consider banks' exposure to liquidity risk over a shorter time period; namely, the intraday horizon

Mitigating intraday liquidity risk is important for payment and settlement systems (PSS)[3] because it contributes to their normal functioning. Therefore, the considerations raised by the BCBS in 2008 with respect to efficient management and control of intraday liquidity risk on the part of financial institutions are valuable, as are the those put forth in 2012 by the Committee on Payments and Market Infrastructure and the International Organization of Securities Commissions (CPSS and IOSCO, respectively), as outlined in "Principles for Financial Market Infrastructure" (CPSS-IOSCO, 2012). Among these principles, which are intended to guide financial market infrastructures (FMIs) on how to appropriately manage the risks related to their operation, are those on the measurement, monitoring and effective management of intraday liquidity risk.

Later, specifically to address the issue of intraday liquidity risk, the BCBS published "Monitoring Tools for Intraday Liquidity Management" (BCBS-CPSS, 2013) in

1 The BCBS is the leading developer of global standards for the prudential regulation of banks and provides a forum for regular cooperation on banking supervision issues. It has 45 members, including central banks and banking supervisors in 28 jurisdictions. In addition, it has nine observers, including central banks, supervisory groups, international organizations and other bodies. Its mandate is to strengthen the regulation, supervision and practices of banks worldwide to enhance financial stability.

2 In this Box, the term *bank* is used interchangeably to refer to any institution or financial entity that participates in payment and settlement systems.

3 The term payment and settlement systems (PSSs) as used in this box refers to systems for payment and for the clearing and settlement of securities and derivatives, including central counterparties.

April 2013, as part of the reforms proposed by Basel III. That document, which is included in the body of regulations issued by the BCBS concerning the supervisory review process (or Pillar 2), has been a reference for regulatory measures adopted internationally to deal with intraday liquidity risk.

In view of the forgoing, and given the growing importance of managing and controlling intraday liquidity risk for the normal functioning of settlement and payment systems and its contribution to financial stability, this box presents four sections in addition to this introduction, all from the particular perspective of banks.[4] The first section discusses the concept of intraday liquidity and its associated risk, and describes the implications of its materialization. The second section presents a set of metrics and tools for banks and supervisors to consider when monitoring intraday liquidity, under both normal and stressed conditions. The third section outlines the experience of several countries in formally incorporating intraday liquidity risk into their regulatory and supervisory framework, while the final section offers some conclusions.

2. Intraday Liquidity and Its Risk

Among the principles established by the BCBS (2008) for the adequate liquidity risk management and supervision, Principle 8 is the only one that focuses specifically on the management and control of intraday liquidity risk by financial institutions. It reads as follows:

> **Principle 8** - A bank should actively manage its intraday liquidity positions and risks to meet its payment and settlement obligations on a timely basis, both in normal circumstances and under stress, thereby contributing to the smooth functioning of payment and settlement systems.

The BCBS-CPSS (2013) goes on to share a set of quantitative tools for the monitoring and efficient management of intraday liquidity risk. The concept of intraday liquidity and its associated risk are formally and explicitly defined as follows:

> **Intraday liquidity**: funds that can be accessed during the business day, generally to allow banks to make real-time payments.

> **Intraday liquidity risk**: the risk that a bank cannot manage its intraday liquidity effectively, which could leave it unable to meet a payment obligation at the expected time, thereby affecting its own liquidity position and that of other parties.

To understand the problems generated by inadequate management and control of intraday liquidity risk, it is necessary to know how PSS participants obtain and use intraday liquidity. A distinction is made between proprietary and alternative sources. The former include balances in accounts with the central bank; collateral pledged to the central bank or to ancillary systems that can be converted into intraday liquidity; uncommitted assets on a bank's balance sheet that are readily convertible to intraday liquidity; available intraday borrowing facilities, whether collateralized or not; and balances held at other financial institutions that are available for intraday settlement. Alternative sources include liquidity received for payments from other participants in the large-value payment system (LVPS), from ancillary systems and, where applicable, from the provision of correspondent banking payment services.[5] The uses of intraday liquidity include payments sent to other participants in the LVPS, to ancillary systems or for the provision of correspondent banking services; payments for the retrocession of intraday borrowing facilities, with or without collateral; and contingent payments arising from failures in a PSS (e.g., those to be made by certain entities as providers of emergency liquidity).

The difficulties financial institutions may face with respect to sources and uses of intraday liquidity could lead them to default on their payment obligations, thus affecting not only their liquidity position but also that of their counterparties. They could even impact the safe and efficient functioning of the PSS and other infrastructures that are interconnected to it for the settlement of other types of assets. These difficulties may generate or aggravate tension in financial markets, besides affecting the way the money market functions.

Behind the difficulties related to sources and uses is the asynchrony between the inflows and outflows of funds experienced by a bank. This asynchrony is associated with uncertainty in the amounts and timing of incoming and outgoing payments, which can lead to intraday liquidity shortfalls. Depending on the severity of those shortfalls, a financial institution may be forced to prioritize the payments it sends in an effort

4 Another possible perspective on treatment is that which can be addressed by FMIs to manage and mitigate this risk.

5 In the context of the payment and settlement system as understood in this box, the term *correspondent bank* refers to a participant that has direct access to the LVPS and provides payment clearing and settlement services to other entities that participate indirectly in the system.

to make sure its time-critical payments are met; to tap funding sources with other banks or the central bank; to hold liquid assets; to delay payments; or even to stop payments.

As warned by the BCBS (2010) and the Financial Stability Institute in 2017 (FSI, 2017), the measures for proper liquidity-risk management and control established in Basel III were designed to address liquidity risk at terms beyond an intraday horizon. Therefore, banks and regulators should be aware that LCR stress does not cover liquidity needs that occur during the day in an expected or unexpected way, and that disappear at the end of the day.

A case in point with respect to inadequate liquidity management is the one Ball et al. (2011) say led to the intraday liquidity problems that Lehman Brothers faced in 2008 and precipitated its downfall (see the shaded section hereafter). In that instance, the gradual deterioration in the firm's financial situation led the correspondent banks that provided it with clearing and settlement services in different countries to demand not only liquid resources to meet its payments

Intraday Liquidity Risk: The Case of Lehman Brothers

On September 15, 2008, Lehman Brothers Holdings Inc. filed for bankruptcy under Chapter 11.[1] The evidence presented in Valukas (2010) suggests a lack of liquidity was one of the key elements that precipitated the firm's collapse. On September 14, 2008 Lehman no longer had enough liquidity on hand to finance its daily operations. A significant factor in Lehman's liquidity shortage was the collateral provided to its correspondent banks to finance the firm's intraday liquidity positions. Lehman was using an increasing portion of its asset portfolio to cover intraday liquidity risk. This meant the firm's portfolio of liquid assets was not available to meet the flow of payment obligations for which it was calibrated. This is precisely the risk posed by "double duty".

Lehman's Correspondent Banking Relationships

Lehman used different correspondent banks to provide payment and settlement services throughout the world. The most important one in the United States was JP Morgan, which acted as its agent in tri-party repo arrangements.[2] Citibank provided Lehman with access to CLS, the multi-currency foreign exchange settlement system. HSBC supplied Lehman with settlement services in the UK, acting as its settlement bank in CREST (i.e. Central securities depository for markets in the U.K.). Lehman also had correspondent banking relationships with Bank of America, Bank of New York Mellon and Standard Bank. Each Lehman correspondent granted the firm intraday credit to enable it to settle transactions and make payments.

Lehman's Liquidity Portfolio

Lehman reported it had a pool of liquid assets "intended primarily to cover expected cash outflows for twelve months in a stressed liquidity environment". The pool was designed to cover a range of cash outflows, assuming the company could not issue unsecured debt or generate liquidity outside the pool (e.g., by selling assets that are less liquid).

Lehman informed [its investors] at the end of the first quarter of 2008 that its liquidity pool amounted to USD 34 billion. By the end of Q2, it amounted to USD 45 billion and at the end of Q3, USD 42 billion.[3] The size of the asset group gave market participants peace of mind in that Lehman's vulnerability to liquidity risk appeared to

1 This shaded section is based largely on Volume 4 of Chapter 11 in the proceedings report prepared by the examiner Anton R. Valukas. The full report is available at: http://lehmanreport.jenner.com.

2 A tri-party repo is one in which a third party (e.g, a custodian bank, a clearing house or a CSD) is responsible for managing the collateral during the life of the transaction.

3 Valukas, A (2010), page 1,409.

be low.[4] However, this pool of assets increasingly contained ones that Lehman had committed or transferred during the day to correspondent banks [which provided it with payment and settlement services]. While these assets were seen as available at the end of the day, any default on their availability at the beginning of the next day would likely have undermined the willingness of those correspondents to offset Lehman's operations. In other words, the assets were not available to meet other outflows.

Lehman's Correspondent Banks Requested Additional Collateral and Pre-funding for its Accounts

In the run-up to Lehman's bankruptcy, its correspondent banks were less willing to provide the intraday credit that would allow the firm to participate in payment and settlement systems.

Throughout 2008, Lehman's correspondents began to apply several conditions to reduce their exposure to the firm. Initially, they expanded the collateral haircuts in tri-party repos to protect the correspondent bank. This was followed by banks requesting explicit collateralization of positions. When market conditions deteriorated, Lehman's collateral was devalued, and it was required to pledge additional collateral. Some banks preferred to ask Lehman for cash deposits to pre-fund its intraday liquidity needs. By September 12, 2008, Lehman's correspondent banks had received more than USD 16 billion in collateralization and prefunding.

Lehman Runs Out of Liquidity

In Lehman's final days, its liquid asset pool contained a growing number of assets that had been pledged to its correspondent banks for intraday liquidity. According to Lehman's own post-mortem analysis, the liquid asset portfolio declined from USD 41 billion before its earnings were announced on September 9, 2008 to approximately USD 25 billion on September 12.

Stress conditions in the market meant that approximately USD 7 billion of those assets were not immediately liquid. Of the remaining USD 18 billion, USD 16 billion were required by Lehman's correspondent banks. This left only USD 2 billion in truly liquid assets available to cover its outflows. On September 15, Lehman was forecast to have a net cash outflow of USD 4.5 billion. With insufficient liquid assets to cover this deficit, Lehman filed for bankruptcy under Chapter 11.[5]

The risks posed by "double duty" finally materialized. Lehman had not calibrated its liquid asset pool to include intraday liquidity risk. Lehman discovered it was significantly less liquid than it and the market had thought.

4 Valukas, A (2010), page 1,415.

5 Valukas, A (2010), page 1,454.

Source: Ball *et al.* (2011), "Intraday Liquidity: Risk and Regulation", Bank of England Financial Stability Paper, núm. 11, Box 2, disponible en: https://www.bankofengland.co.uk/financial-stability-paper/2011/intraday-liquidity-risk-and-regulation

but also securities to support the intraday credit they could provide. In response, Lehman Brothers experienced what the UK Prudential Regulatory Authority (PRA) and Ball et al. (2011) call *double duty*, which meant compromising the liquid asset cushion it had built up specifically to address balance sheet resilience or short-term liquidity risk, in order to deal with intraday liquidity risk as well.

Just as the Basel III recommendations were not appropriate to deal with intraday liquidity risk, nor were the metrics designed therein applicable to monitor it. As acknowledged by the BCBS (2010), while the information collected (a bank's cash flows, balance sheet structure, uncommitted collateral and certain market indicators) was useful in identifying short-term liquidity management issues and guiding supervisory action, it was not as helpful in dealing with intraday liquidity.

The BCBS-CPSS (2013) addressed this regulatory gap by developing a set of tools to monitor and control intraday liquidity. These tools are useful not only for financial institutions with direct or indirect access to LVPS, but also for supervising and monitoring FMIs, including the financial institutions participating in FMIs.

3. BCBS-CPSS Tools for Intraday Liquidity Risk Monitoring and Control (2013)

The tools developed by the BCBS-CPSS (2013) are intended to monitor intraday liquidity and promote sound practices by banks to enhance their ability to meet payment and settlement obligations in a timely way. Moreover, according to the directive included in BCBS Principle 8 (2008), these objectives also are to be met under stressed conditions, for which intraday liquidity stress scenarios are developed.

Similarly, the BCBS-CPSS (2013) indicates the tools and metrics that should be applied to internationally active banks and others that are defined by supervisory authorities as the targets of the measure. It also states the metrics are to be reported to supervisory authorities on a monthly basis, as of the date the LCR became applicable.

The tools and metrics developed by the BCBS-CPSS (2013) are described below. They are divided according to their application to monitor liquidity under normal or stressed conditions.

a. Metrics for Monitoring Intraday Liquidity under Normal Conditions

The BCBS-CPSS (2013) has devised seven monitoring tools to be used under normal conditions. They are classified into three categories, according to their applicability.

Given the way the CUD large-value payment system operates and the direct access it grants to its participants, calculation of the tools included in categories A and C would be applicable and useful for monitoring intraday liquidity under normal conditions.

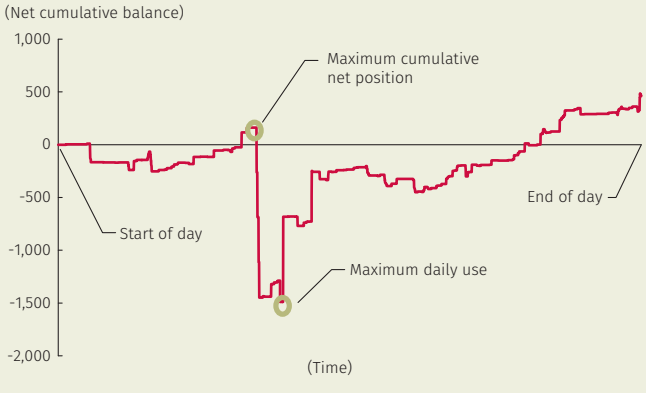
Category A. Monitoring Tools Applicable to All Banks Subject to the Measure

(I) Maximum daily use of intraday liquidity: This tool requires banks to register the net balance of the payments they send and receive throughout the day. A bank's maximum daily use of liquidity will tally with its maximum net negative position during the day.

As illustrated in Graph B1.1, calculating this metric for a bank assumes a zero balance at the beginning of the day and respects the sequence in which incoming (sources) and outgoing (uses) payments for any item occur. Because real-time monitoring is not required throughout the day, this metric should be calculated at the end of the trading day and allows supervisors to monitor a bank's use of intraday liquidity under normal conditions.

Graph B1.1 shows the maximum accumulated positive net position is reached at the moment during the day when the value of the payments a financial institution has received exceeds the value of the payments it has sent, a situation that may reflect the strategy of a financial institution to fund its outgoing payments with the liquidity it receives from its incoming payments. The maximum accumulated negative net position shows the maximum daily use of intraday liquidity, which is achieved when the difference between the accumulated value of payments sent and received is the greatest. When a financial entity faces a negative net position during the day, it requires intraday liquidity at that moment to finance this balance. The value with respect to maximum daily use of intraday liquidity may be interpreted as the minimum balance a financial entity should have in its account at the start of the day to settle all its payments in a timely way.

Graph B1.1
Daily Maximum Use of Intraday Liquidity



Source: BCBS-CPSS (2013); prepared by the authors.

(ii) Intraday liquidity available at the start of the day: This metric enables supervisory authorities to monitor the opening balance available to a financial institution at the start of the day to meet its intraday liquidity needs under normal conditions. The BCBS-CPSS (2013) suggests banks report the three lowest balances and the average amount for the defined period. It also recommends the report outline, in detail, the alternative sources of liquidity that are available, so as to provide for the possibility of discussing and reaching an agreement with the supervisory authority on which of those sources should be included when calculating this metric.

(iii) Total payments: For each business day in the reporting period, banks must calculate the total value of their gross payments (both sent and received), and report to the supervisory authority the three maximum

daily values and the average for that period, thereby allowing the supervisory authority to monitor the level of payment activity.

(iv) Time-specific obligations: Banks are required to report time-specific obligations.[6] In this case, the CBBS-CPSS (2013) recommends they calculate the total value settled in time-specific obligations on a daily basis and report the three highest values and the daily average for the established period. This tool is important, as failure to comply with time-specific obligations could result in financial penalties, reputational damage, and even the loss of future business.

Category B - Tools Applicable to Banks Subject to the Measure that Provide Services as Correspondent Banks

(i) Value of payments made on behalf of correspondent bank customers: As the value of these payments can significantly affect the management of a correspondent bank's intraday liquidity, correspondent banks are required to calculate, each day, the total value of the payments they make on behalf of all customers, and report the three highest total daily values and the average total daily value for the reporting period. With this tool, supervisors have a better understanding of the proportion of a correspondent bank's payment flows that pertains to the provision of correspondent banking services.

(ii) Intraday borrowing facilities extended to customers: With respect to the borrowing facilities correspondent banks extend to their customers, whether collateralized or not, correspondents must report the three largest intraday borrowing facilities in the reporting period, and the maximum extent to which those facilities were used. This tool enables supervisors to monitor the level or amount of intraday credit a correspondent bank provides to its customers.

Category C - Monitoring Tool Applicable to Banks Subject to the Measure that are Direct Participants

(i) Intraday payment processing capacity: For the reporting period, direct participants must indicate the average daily percentage of total payments settled at specific times of the day, by value within each hour of the working day. This tool helps supervisory authorities to identify changes in a bank's settlement and payment performance or pattern.

6 Also known as time-critical payment obligations, these are payments that must be made at a specific time during the day and are associated with the operation of FMIs, such as clearing houses and central counterparties.

b. Intraday Liquidity Stress Scenarios

The monitoring tools described up to this point provide valuable information on the intraday liquidity profile of financial institutions under normal conditions. However, because the availability and use of intraday liquidity can change significantly during times of stress, the CBBS-CPSS (2013) suggests the following four stress scenarios (non-exhaustive) to be considered. It is important to note that CBBS-CPSS (2013) does not require banks to report the results of stress scenarios to supervisors; these should be used by banks and supervisors to assess how the liquidity profile would change from that described under normal conditions, and for PSS participants to plan for intraday liquidity risk.

(i) Own financial stress: a bank suffers or is perceived to suffer from a stress event. When a financial institution that is a direct participant in a LVPS experiences a stress scenario of its own, whether operational or financial in nature, and other participants are aware of that stress, it could lead to a situation where the institution's counterparties delay their payments to it or restrict its intraday borrowing facilities. This could prompt it to seek other sources of intraday liquidity to meet its payment obligations on time. If it is an indirect participant that settles its payments through a correspondent bank that faces financial stress of its own, the correspondent bank may cease to provide intraday credit, or its counterparties may postpone sending payments. Therefore, in order to make its payments, the financial institution would have to prefund its payment obligations or pledge sufficient collateral to guarantee its intraday borrowing facilities.

(ii) Counterparty stress: **a major counterparty suffers an intraday stress event that prevents it from making payments.** In this scenario, direct and indirect participants could lose confidence in the payments sent to them by a major stressed counterparty, significantly reducing the availability of intraday liquidity they obtain from receipt of the counterparty's payments.

(iii) Customer bank stress: a customer bank of a correspondent bank experiences a stress event. In correspondent banking, a customer bank's stress could cause other counterparties to delay their payments. This can lead to intraday liquidity problems for both the stressed financial institution and its correspondent bank.

(iv) Widespread credit or liquidity stress in the market. This type of scenario occurs when the market experiences a generalized drop in the market value or credit rating of the uncommitted liquid assets of a financial entity. For example, in the event of a drop in the value of collateral made available to access

intraday liquidity provided by the central bank or other banks, a financial institution loses part of its own sources of intraday liquidity. When a bank using correspondent banking services experiences this type of stress, its ability to access the intraday liquidity provided by its correspondent bank is reduced.

4. International Experience

Although the BCBS-CPSS (2013) stated these monitoring metrics were to be reported to supervisory authorities on a monthly basis, from the time the LCR took effect in January 2015, this has not been the case in many countries. However, in some countries, the adoption of these metrics did go even further.

According to Neijs and Wycisk (2015), regulators in England and the Netherlands not only adopted the BCBS-CPSS guidelines (2013), but also converted these tools into detailed reporting requirements, and included the ability of banks to manage intraday liquidity as part of the internal liquidity adequacy assessment process (ILAAP).

In England, the Prudential Regulation Authority (PRA), as the agency charged with monitoring the payment system, has been the primary regulator to push for a comprehensive intraday regime. Accordingly, the PRA has developed an approach to addressing intraday liquidity risk and discussed it with the financial sector. In its policy statement (BoE, 2018), based on the BCBS-CPSS (2013) and known as *Pillar 2- Liquidity*, the PRA formally and explicitly defines liquidity risk and outlines its approach to assessing and calibrating intraday liquidity risk. PRA regulations address intraday liquidity risk for financial institutions with direct or indirect access in two main types of systems: payment systems and securities settlement systems that cover both gross and net settlement.

One of the main reasons cited by the PRA to justify calibrating the liquid asset cushion to cope with intraday liquidity risk is the existence of *double duty* risk (see the shaded section on page 50). *Double-duty* risk, which is associated with the use of the same set of assets to serve two separate purposes, does reduce the cost of participation in LVPS, but entails risks. If that pool of assets is used for one purpose, it would not be available for the other.

In practice, as described in Ball et al. (2011), this risk is manifest when balance-sheet resilience risk (short- and long-term liquidity risk) exists simultaneously with intraday liquidity risk. The former occurs when a bank's cushion of liquid asset serves to provide intraday liquidity but is not effective as a cushion against a run on liabilities. Intraday liquidity risk occurs when a bank depletes its pool of liquid assets and, therefore, does not have enough separate or alternative sources of liquidity to settle, in a timely way, all its obligations in payment and securities settlement systems.

Accordingly, in order to mitigate the *double duty* risks described above, the PRA recognizes intraday liquidity risk as an individual and distinct risk. For an overall assessment of a bank's intraday liquidity risk, the PRA considers several metrics in addition to those developed by the BCBS-CPSS (2013); namely, a firm's average maximum daily use of liquidity; the framework for testing a bank's resilience; the quality of a firm's operations, processes, technology and policies; and a firm's relevant characteristics in the markets where it operates. The PRA also includes, as alternative measures, the extent of liquidity recycling or the ratio of the amount of payments sent to the use of liquidity, and the firm's intraday credit facilities. It warns a reduction in the daily profile of maximum liquidity use does not necessarily imply a reduction in the assessment of intraday liquidity risk, since strategic changes in the sequence or intraday behavior of a firm's payments could reduce the value of this metric. With respect to the stress scenarios associated with intraday liquidity that can be obtained in a collateralized way, the PRA suggests considering those related to the risk of an increase in haircuts and changes in the eligibility of collateral.

Along the same lines as the PRA, the European Banking Authority (EBA), in its capacity as an independent EU agency, shared a set of guidelines with local supervisory authorities, in 2014, on common procedures and methodologies for the supervisory review and evaluation process (PRES). This set of guidelines explicitly defines intraday liquidity risk (EBA, 2014).

The European Central Bank (ECB) updated its guidance on ILAAP in 2018, outlining its understanding of the requirements relative to liquidity risk, including intraday liquidity risk. While not defining or devoting a section exclusively to intraday liquidity risk, the ECB (2018) does incorporate the expression "including intraday" into key topics such as ensuring institutions have sound strategies, policies, processes and systems, and are able to manage and monitor liquidity risk. In doing so, the ECB confirms intraday liquidity must be included in the scope of all bank liquidity management and monitoring processes.

On the other hand, in the United States, the Fed's Board of Governors, in its Report on Supervision and Regulation (Fed, 2019), specifically included intraday liquidity risk as a component in its horizontal liquidity priority. In that document, the Fed states liquidity oversight or supervision focuses on the adequacy of a financial institution's cash flow forecasting capabilities, its

practices for setting liquidity risk limits, and its measurement of intraday liquidity risk.

In January 2020, the Office of the Canadian Superintendent of Financial Institutions (OSFI) devoted a separate section to intraday liquidity risk in its *Guide to Principles of Liquidity*. That section includes Principle 8 of the BCBS (2008) and acknowledges this type of risk has become more pronounced as the capacity and degree of automation in LVPSs has increased. This situation requires banks to understand the liquidity implications of a disruption in a payment system and to have adequate contingency plans in place to manage any such incident. Banks also must design stress scenarios that reflect such events and should use the results as a basis for building a contingency plan that considers disruption of the normal flow of payments in a LVPS. Moreover, if a bank relies on bilateral credit or deferred net settlement systems to settle time-critical payments, it should have a clear understanding of the requirements for additional safeguards in the event of contingencies.

In December 2019, the BCBS published a compendium of all its global standards for prudent bank regulation. That compendium is contained in a document known as the *Basel Framework*, wherein the BCBS members also agreed on the implementation and application of those standards to the internationally active banks in their jurisdictions. The document issued by the BCBS-CPSS (2013) on tools for monitoring intraday liquidity is an individual component of the *Basel Framework*. In this regard, the increased attention intraday liquidity has gained as a key liquidity risk factor among regulators is matched by its inclusion as one of the global rules defined within the framework's "Supervisory Review Process".

In that framework, it is recognized that a bank that does not effectively manage intraday liquidity could be prevented from meeting its payment and settlement obligations in a timely way, thereby causing disruptions in the flow of liquidity that quickly and systemically affect other systems and institutions. It is, therefore, emphasized that intraday liquidity risk management must be regarded as a crucial part of liquidity risk management, and that banks must be able to actively manage their collateral.

Recent international experience illustrates the growing importance of intraday liquidity as a key liquidity risk factor for regulators and in terms of their efforts to review their supervisory arrangements. Regulators such as the ECB, the EBA, the Fed and the OSFI, as well as those in countries such as Argentina, India, the Philippines, Saudi Arabia, Singapore and Turkey, among others, have afforded particular attention to intraday liquidity and have formally adopted the BCBS-CPSS recommendations (2013) as part of their supervisory guidelines and principles.

5. Conclusions

The Basel III directives (LCR and NSFR) marginally mention intraday liquidity when it comes to liquidity risk. The principles issued by the BCBS (2008) and the CPSS-IOSCO (2012) became recommendations for the proper management of intraday liquidity in financial institutions and FMIs.

The monitoring tools outlined by the BCBS-CPSS (2013) have contributed to the importance financial institutions must assign to the efficient measurement and management of intraday liquidity and the risks associated with it. Furthermore, the BCBS-CPSS (2013) document has become a key reference that has been incorporated into the regulatory framework adopted by regulators and supervisory authorities in several countries.

The fact that the metrics and monitoring tools defined by the BCBS-CPSS (2013) have been included in the compendium of standards in the *Basel Framework* is a clear response from the BCBS with regard to the growing importance of intraday liquidity.

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03

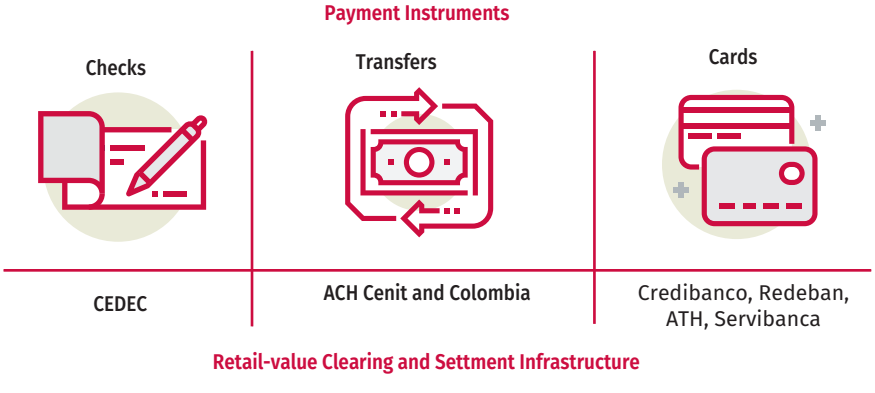
Payments in the Market for Goods and Services

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

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

Specifically, the financial infrastructures associated with each of the retail-value payment instruments in the economy include the Electronic Clearing System for Checks (Cedec), managed by *Banco de la República*; the automated clearing houses for electronic payments (ACH); namely, ACH-Cenit (managed by *Banco de la República*) and ACH Colombia, which receive electronic payment orders for the transfer of funds; and the Credibanco, Redebán, ATH and Servibanca networks, among others, which process debit and credit card transactions carried out at commercial establishments and ATMs (Diagram 3.1).

Diagram 3.1
Retail-value Infrastructures Operating Through the Use of Payment Instruments in Colombia



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

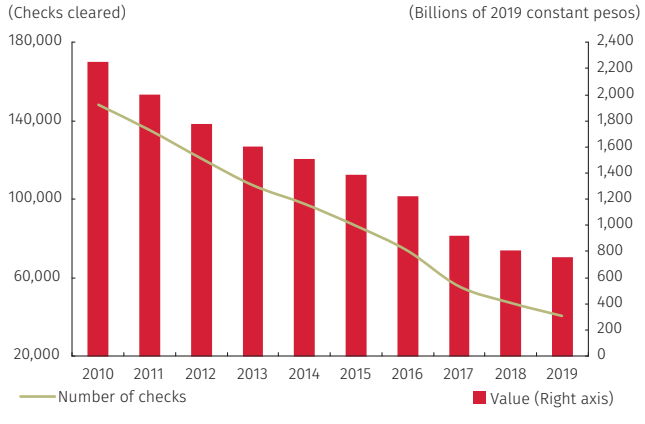
3.1 Retail-Value Payment Systems

The work of retail-value payment systems is to clear and settle transactions conducted through the various payment instruments that are available in Colombia. The main ones are checks, credit and debit transfers through the ACHs (electronic payments within the circuit of companies and individuals), credit cards and debit cards. Their principal characteristics, value and number of operations are described in this section.

3.1.1 The Clearing Houses for Checks and the Cedec System Managed by *Banco de la República*

3.1.1.1 Electronic Clearing System for Checks (Cedec)

Graph 3.1
Value and Number of Checks Cleared Through Cedec
(Daily averages)



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

In all, 9.9 million checks (an average of 40,553 per day) for a total of COP185.5 t (with a daily average of COP 0.75 t)[25] were cleared during 2019. This amount represents 17% of GDP and is less than the 11.5 million checks and 188.7 t in value registered for 2018, accounting for reductions of 13.5% and 1.7%, respectively (Graph 3.1 and Table 3.1).

As for liquidity needs, Table 3.1 shows daily gross clearing in 2019 averaged COP 757 b. However, as a result of multilateral netting, COP 125.98 b were required to settle the obligations between financial institutions (Table 2.3). Therefore, the liquidity savings came to 83.36%.

According to the information reported by commercial banks, intrabank checks accounted for 39.6% of the value and 60.6% of the number of checks cleared in 2019. These figures represent a decline of 18.8% in value and 12.3% in the total number of interbank offsets in 2019, with a slight increase of 0.97% in value and a decline of 14.1% in the number of checks compared with 2018 (Table 3.2). In the case of intrabank checks, the drawer and the drawee share the same financial institution. So, the checks are not sent to CEDEC, nor to the central bank's physical clearing houses, or to its delegates.

25 These figures on the use of checks only take into account 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.

Table 3.1
Statistics on Checks Cleared in Cedec

	Daily Average					Annual Value			
	Number of Checks	Value		Average Transaction Value					
	Number of Operations	(Billions of Pesos)	(Billions of 2019 Constant Pesos)	(Billions of Pesos)	(Billions of 2019 Constant Pesos)	(Millions of Checks)	(Billions of Pesos)	(Billions of 2019 Constant Pesos)	(Number of Times GDP)
2010	148,342	1,591	2,248	10.7	15.2	36.0	389,769	550,787	0.72
2011	135,334	1,467	1,999	10.8	14.8	33.3	360,922	491,703	0.58
2012	120,857	1,336	1,777	11.1	14.7	29.5	326,056	433,643	0.49
2013	107,239	1,226	1,600	11.4	14.9	26.2	299,225	390,393	0.42
2014	97,762	1,201	1,512	12.3	15.5	23.9	293,048	368,843	0.38
2015	86,537	1,179	1,390	13.6	16.1	20.9	285,374	336,412	0.35
2016	73,852	1,094	1,219	14.8	16.5	18.1	268,009	298,770	0.31
2017	55,674	863	925	15.5	16.6	13.5	208,944	223,776	0.23
2018	47,254	777	806	16.4	17.1	11.5	188,771	195,944	0.19
2019	40,553	757	757	18.7	18.7	9.9	185,567	185,567	0.17

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

Table 3.2
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)
2010	36,343,795.0	389,768.8	13,992,620	38.5	164,547.8	42.2
2011	33,292,130.0	360,922.2	15,721,623	47.2	104,215.6	28.9
2012	29,489,131.0	326,056.0	13,362,676	45.3	98,033.5	30.1
2013	26,166,386.0	299,225.0	11,894,023	45.5	88,791.3	29.7
2014	23,853,920.0	293,047.9	13,745,083	57.6	109,281.5	37.3
2015	20,900,000.0	285,374.0	11,207,337	53.6	106,209.0	37.2
2016	18,093,721.0	268,008.5	9,530,565	52.7	88,672.4	33.1
2017	13,472,000.0	208,944.0	7,990,110	59.3	89,618.7	42.9
2018	11,482,000.0	188,771.0	7,004,212	61.0	72,738.3	38.5
2019	9,935,390.0	185,567.3	6,019,882	60.6	73,446.9	39.6

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

3.1.1.2 Indicators of Concentration and Operating Efficiency

There were 26 entities involved in the check clearing process by December 31, 2019 (Table 3.3), which is three more than in 2010. However, the trend in concentration of operations continued as it has for some time, as evidenced by the CR5 indicator, which shows the five major participants accounted for 70% of the amount cleared.

As for operating efficiency, CEDEC's availability in 2019 came to 99.79%. In other words, there were occasional suspensions that affected the provision of its services for an amount of time equivalent to 0.21% of the total.

Table 3.3
Cedec
(Participants and concentration)

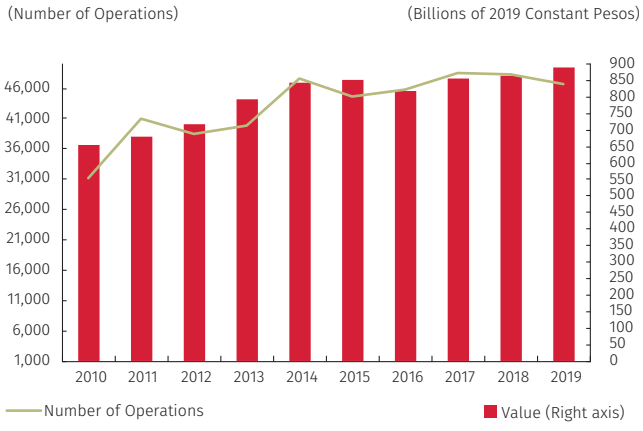
	Total Participants	CR5 (Percentage)	Number of Participants Accounting for 70% of the Amount Cleared
2010	23	70.7	5.0
2011	24	70.8	5.0
2012	24	70.3	5.0
2013	25	69.7	5.0
2014	25	72.1	5.0
2015	27	72.1	5.0
2016	25	72.2	5.0
2017	25	73.3	5.0
2018	25	71.3	5.0
2019	26	70.1	5.0

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

3.1.2 Automated Clearing Houses (ACH)

There are two authorized automated clearing houses in Colombia: ACH-Cenit (managed by *Banco de la República*) and ACH Colombia, which is owned by the commercial banks. Together, they cleared more than 233.3 million in operations during 2019. The daily average comes to 956,363 payment orders (46,741 processed through ACH-Cenit and 909,622 through ACH Colombia), for an amount equivalent to COP 5.1 t (COP 0.89 t in ACH-Cenit and COP 4.2 t in ACH Colombia). During 2019, the total gross amount cleared by these ACHs, together, was COP 1,246.6 t; that is, 11.93% more than in 2018, and represented 1.17 times the nominal GDP in 2019. The net total settled through these ACHs in 2019 came to COP 439.9 t (COP 1.80 t daily, on average), which is equivalent to 35.3% of the gross value, representing a liquidity savings of 64.7%.

Graph 3.2
Value and Number of Operations in ACH Cenit
(Daily averages)



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

3.1.2.1 ACH-Cenit

As illustrated in Graph 3.2 and Table 3.4, more than 11.4 million transactions (46,741 daily, on average) were processed through ACH-Cenit during 2019, including both credit and debit transactions, for a gross value of over COP 218.04 t (COP 890 b daily, on average). These figures, with respect to 2018, show a decline of 2.4% in the number of transactions and an increase of 7.7% in their value. The limited liquidity savings (1.04% for 2019) resulting from the net amounts cleared through ACH-Cenit is due to the payments sent by the DGCPTN and the General System of Royalties, which accounted for the majority (85.8%).

Table 3.4
ACH Cenit Statistics[a/]

Year	Daily Average				
		Value		Average Value per Operation	
	(Number of Operations)	(Billions of Pesos)	(Billions of 2019 Constant Pesos)	(Millions of Pesos)	(Millions of 2019 Constant Pesos)
2010	31,150	464.4	656.2	14.9	21.1
2011	41,005	500.4	681.7	12.2	16.6
2012	38,504	539.2	717.1	14.0	18.6
2013	39,852	607.0	792.0	15.2	19.9
2014	47,586	670.8	844.3	14.1	17.7
2015	44,743	722.8	852.1	16.2	19.0
2016	45,697	733.8	818.0	16.1	17.9
2017	48,572	797.7	854.3	16.4	17.6
2018	48,284	832.8	864.4	17.2	17.9
2019	46,741	890.0	890.0	19.0	19.0

Year	Annual Total							
	Number of Operations			Value of Transactions (Billions of Pesos)			Annual Value (Billions of 2019 Constant Pesos)	Number of Times GDP
	Credit	Debit	Total	Credit	Debit	Total		
2010	7,587,763	43,912	7,631,675	111,993	1,781.5	113,775	160,776	0.21
2011	10,042,726	44,405	10,087,131	122,829	268.0	123,097	167,702	0.20
2012	9,378,640	93,385	9,472,025	132,504	129.0	132,633	176,397	0.20
2013	9,522,192	201,586	9,723,778	147,926	188.5	148,114	193,242	0.21
2014	11,035,981	574,941	11,610,922	163,238	429.0	163,667	205,999	0.21
2015	10,410,511	417,239	10,827,750	174,408	505.5	174,914	206,197	0.22
2016	10,909,837	285,842	11,195,679	179,164	617.7	179,782	200,416	0.21
2017	11,549,242	205,292	11,754,534	192,463	574.9	193,038	206,741	0.21
2018	11,567,335	165,728	11,733,063	201,849	511.2	202,360	210,050	0.21
2019	11,249,571	201,856	11,451,427	217,549	493.9	218,043	218,043	0.21

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

Credit operations represented for a large share of all transactions in 2019, both in terms of number (98.2%) and value (99.77%). Debit operations were up by 21.8% in number and down by 3.4% in the value with respect to 2018 (Table 3.4).

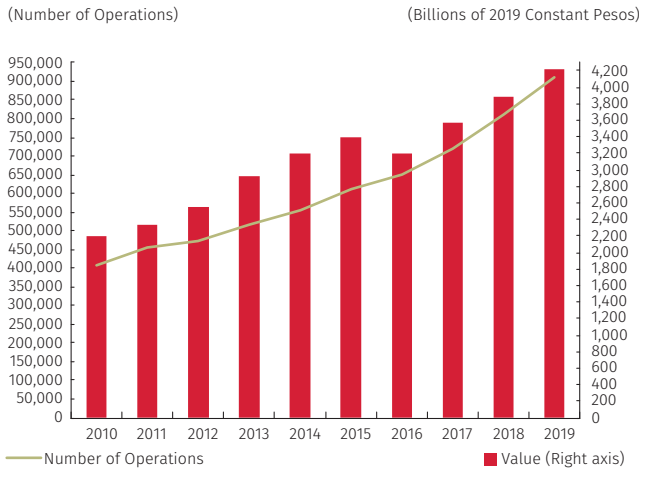
As for operating efficiency in 2019, Cenit was available 99.48% of the time. In other words, there were occasional disruptions in service for an amount of time equivalent to 0.52% of the entire schedule.

3.1.2.2 ACH Colombia

ACH Colombia handled 221.9 million operations during 2019, including both credit and debit operations, for more than COP 1,028.4 t gross. These figures imply an increase of 12.92% in the number of operations and 12.85% in value with respect to 2018 (Graph 3.3 and Table 3.5).

ACH Colombia settles the net amounts resulting from clearing during five intraday operating cycles. Once the net positions are calculated, the participants with net debtor positions transfer the funds to ACH Colombia's account, so it can then distribute the resources to participants with net creditor positions. During 2019, the net value settled was COP 224.9 t (COP 921.99 b daily, on

Graph 3.3
Value and Number of Operations in ACH Colombia
(Daily averages)



Source: ACH Colombia.

Table 3.5
ACH Colombia Statistics

Year	Daily Average					Annual Value			
		Value		Average Value per Operation					
	(Number of Operations)	(Billions of Pesos)	(Billions of 2019 Constant Pesos)	(Millions of Pesos)	(Millions of 2019 Constant Pesos)	Number of Operations	(Billions of Pesos)	(Billions of 2019 Constant Pesos)	(Number of Times GDP)
2010	407,587	1,558.2	2,201.9	3.8	5.4	99,858,818	381,754	539,462	0.70
2011	455,086	1,710.6	2,330.4	3.8	5.1	111,951,241	420,796	573,272	0.68
2012	471,629	1,920.7	2,554.5	4.1	5.4	116,020,691	472,495	628,401	0.71
2013	516,603	2,238.1	2,920.1	4.3	5.7	126,051,206	546,108	712,497	0.76
2014	556,449	2,535.9	3,191.7	4.6	5.7	135,773,574	618,750	778,786	0.81
2015	611,228	2,876.5	3,391.0	4.7	5.5	147,917,150	696,124	820,624	0.87
2016	648,858	2,876.5	3,206.7	4.4	4.9	158,970,262	733,736	817,951	0.85
2017	721,067	3,340.1	3,577.2	4.6	5.0	174,498,262	808,298	865,678	0.88
2018	808,832	3,750.3	3,892.9	4.6	4.8	196,546,261	911,333	945,963	0.92
2019	909,622	4,215.1	4,215.1	4.6	4.6	221,947,874	1,028,475	1,028,475	0.97

Source: ACH Colombia.

average), which was equivalent to 21.8% of the gross amount, which represents a liquidity savings of 78.13%.

Table 3.6 shows the CR5 concentration rate, which is constructed as the sum of the five largest percentages of the value of the transactions. In 2019, it was 74% for credit operations; that is, 0.43% less than in 2018. For debit transactions, the rate also reflects a slight drop; in this case, 0.97%, having gone from 92.91% in 2018 to 92% in 2019.

Chart 3.4 shows how the use of the PSE button has evolved. This service, provided by ACH Colombia, grew 32.1% in value and 58.3% in number of operations during 2019 with respect to 2018.

To complement the statistics on the use of electronic transfers of funds as a payment instrument, Table 3.7 shows the figures for intrabank transfers, based on the information reported by commercial banks from 2010 to 2019. In these cases, the originator and the recipient of the funds belong to the same bank, which means the operation is not cleared through the ACHs.

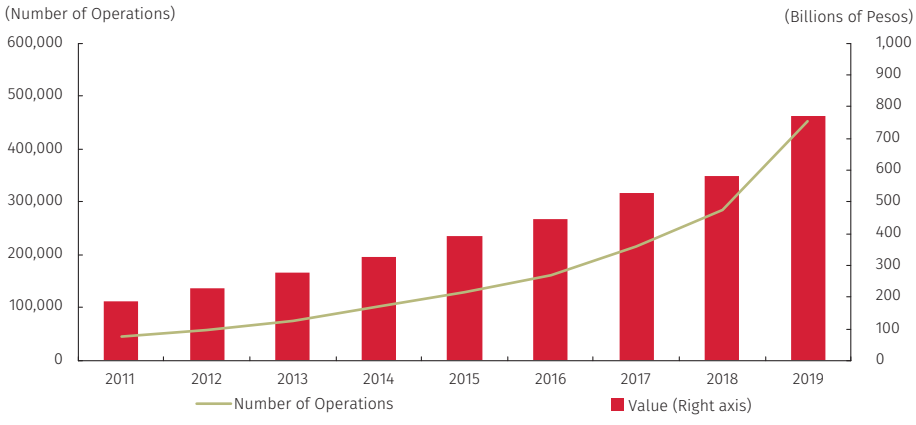
In terms of numbers, intrabank transfers accounted for 151.4% of interbank transfers during 2019. This amounts to an increase of 16% over 2018. With respect to value, they were 2.2 times more than interbank transfers.

Table 3.6
ACH Colombia
(Participants and concentration with respect to the value of payments sent)

Year	Credit Transactions			Debit Transactions		
	Number of Participants	CR5 (Percentage)	Number of Participants that Account for 70% of the Value	Number of Participants	CR5 (Percentage)	Number of Participants that Account for 70% of the Value
2010	19	70.1	5	15	72.6	5
2011	21	68.0	6	21	77.8	5
2012	20	76.1	6	20	71.2	5
2013	21	68.5	5	21	93.5	5
2014	20	70.24	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	92.0	5

Source: ACH Colombia.

Graph 3.4
Value and Number of Operations Using the PSE Service (ACH Colombia)
(Daily averages)



Source: ACH Colombia.

Table 3.7
Comparison Between Interbank and Intrabank Operations in Value and Number

Year	Interbank Transfers Cleared[a/]		Intrabank 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)
2010	107,490,493	495,529.2	74,964,949	69.7	1,436,046	2.9
2011	122,038,372	543,892.5	82,950,682	68.0	1,347,365	2.5
2012	125,492,716	605,127.9	70,701,523	56.3	1,005,437	1.7
2013	135,774,984	694,221.8	96,171,547	70.8	1,050,129	1.5
2014	147,384,496	782,417.0	112,103,184	76.1	1,025,864	1.3
2015	158,744,900	871,037.9	145,895,871	91.9	1,581,650	1.8
2016	186,252,796	1,001,336.4	189,358,265	101.7	2,393,927	2.4
2017	186,252,796	1,001,336.4	179,104,744	96.2	2,138,592	2.1
2018	208,279,324	1,113,692.7	304,602,311	146.2	2,965,085	2.7
2019	233,399,301	1,246,518.2	353,430,214	151.4	2,773,874	2.2

a/ The number and value of operations cleared in ACH Cenit and ACH Colombia.
b/ Transfers that are settled within each financial institution and do not go through an ACH.
Sources: Commercial banks and ACHs.

In focus 1:
Immediate Payment Service: *Transfiya* - ACH Colombia

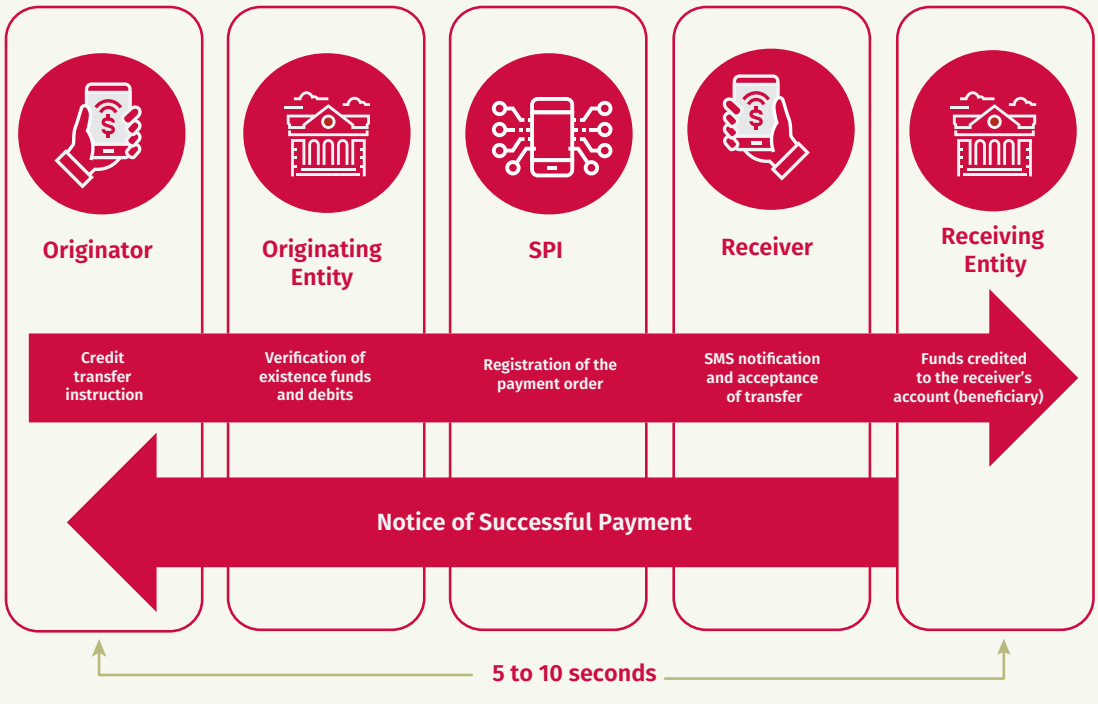
According to the Euro Retail Payments Board (ERPB)[1], instant or immediate payments are defined as electronic payment solutions with full 24/7/365 availability. They allow immediate or almost immediate inter-bank clearing, thereby ensuring the transaction and respective credit to the beneficiary's account, including confirmation to the payer, occur within seconds of initiation of the payment.

In Colombia, the immediate payment system/service is called Transfiya. Provided by ACH Colombia, it is based technologically on Cloud data storage, with the use of text messaging via mobile phones and blockchain. Available initially for person-to-person (P2P) transfers, this service will be scalable, in the near future, to person-to-business (P2B) transfers.

Diagram A shows the flow of the immediate payment process provided by ACH Colombia, from the moment the originator of the payment orders a transfer of funds, until the beneficiary of those funds receives them in his/her account.

The originator of the payment uses his/her mobile phone to accesses the application of the financial institution where his/her account is located and, through the Transfiya service, he/she enters the mobile phone number of the beneficiary (recipient) of the payment, a description of the payment, and the amount to be transferred.

Diagram A
Immediate Payment Flow – *Transfiya*



Source: ACH Colombia.

1 The Euro Retail Payments Board is a high-level strategic body responsible for promoting integration, innovation and competitiveness in euro retail payments in the European Union. It was created on December 19, 2013.

The originator's bank checks its own system to determine if the customer has enough funds for the transfer; if so, it debits the account accordingly and sends an authorization to the Transfiya system, which sends an SMS message to the recipient of the funds (receiver), who will have the opportunity to decline or accept the payment. If the recipient accepts the payment, his/her bank (receiving bank) will deposit the funds immediately in his/her account (savings, checking or electronic deposit).

Lastly, everyone in the entire chain of participants and users is notified of the success or decline of the transfer. The entire process takes no more than five to ten seconds.

ACH Colombia, in agreement with its participating entities, enables Transfiya to operate with transfers of up to a maximum of 250,000 Colombian pesos per transaction. The amount will increase, depending on the extent to which the public uses the service. It also allows an originator to make up to five transfers daily, equivalent to a maximum of 1,250,000 pesos per day. Participating institutions will not charge inter-bank fees, and the costs for individuals will be defined by their respective financial institution.

1.1 Clearing and Settlement of Immediate Interbank Payments

1.1.1 The Pre-funding Process

Each of Transfiya's affiliated entities transfers resources from its deposit account to ACH Colombia's deposit account, through the CUD system.

ACH Colombia conducts a movement inquiry in its CUD account and manually uploads the amounts pre-funded by its affiliated entities to the accounts in its own Transfiya system.

1.2 The Clearing and Settlement Process

Each time the ACH receives a transfer order via Transfiya and that order is confirmed by the receiver, it affects the Transfiya accounts in real time; that is, it debits the account of the originating entity and credits the account of the receiving entity. For that reason, clearing and settlement are considered gross and in real time, but without affecting the deposit accounts with *Banco de la República*.

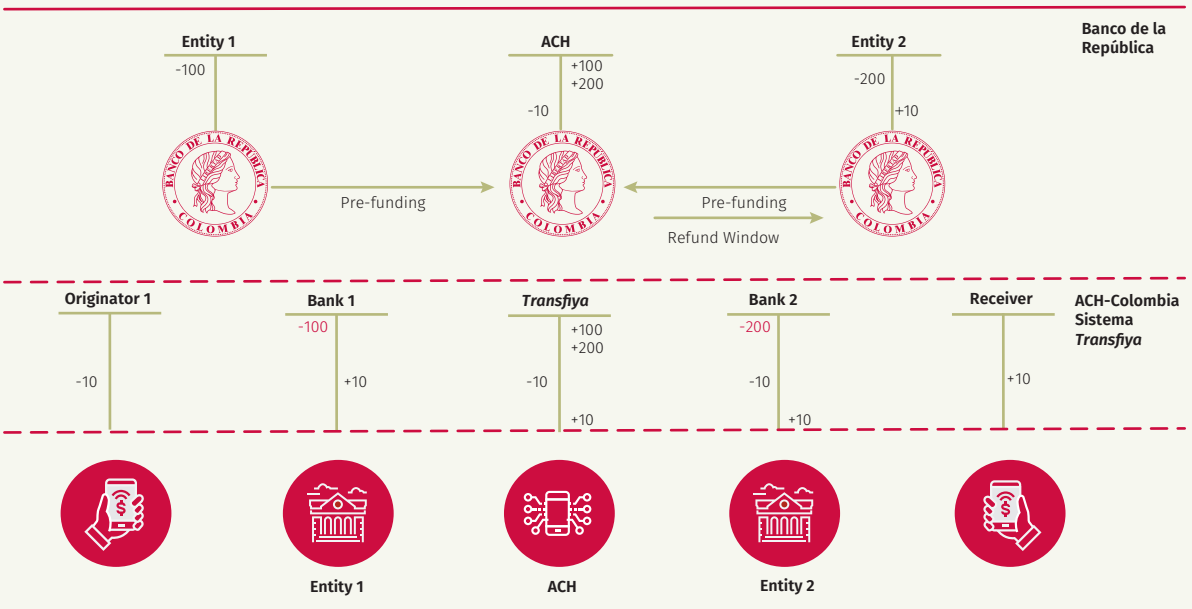
If the resources in any account with Transfiya are depleted, the ACH informs the respective entity, so it can prefund more money from its CUD account to the ACH's account with the CUD, after which the ACH will again upload that amount to the respective account with Transfiya. An entity can ask ACH Colombia to return the funds in its deposit account, when applicable.

If an institution runs out of funds in its Transfiya account on a weekend or holiday, Transfiya will not allow any more immediate transfers and will reject any request made by a customer (originator) of that institution.

Diagram B shows the pre-funding process, in detail, an example of a payment by Transfiya, real-time interbank clearing and settlement, and the final credit to the receiver (beneficiary):

1. Entity 1 transfers 100 from its *Banco de la República* deposit account to the deposit account at ACH Colombia (this payment for entity 1 is reflected in Diagram B with a negative sign).
2. Entity 2 transfers 200 from its deposit account at *Banco de la República* to the deposit account at ACH Colombia (this payment for entity 2 is reflected in Diagram B with a negative sign).
3. Arithmetically, all values must add up to zero.
4. ACH Colombia consults its CUD account and then updates the information in its system (-100 for entity 1, -200 for entity 2 and 300 for the Transfiya account).
5. A customer (originator) of entity 1 orders an immediate payment in the amount of 10; these resources are debited from the customer's account (-10).
6. ACH Colombia credits +10 to the account of entity 1 and debits -10 from Transfiya's account.
7. ACH Colombia credits +10 to Transfiya's account and debits -10 from the account of entity 2.
8. Finally, ACH Colombia credits +10 to the account of entity 2 so the latter, in its own system, may credit the resources to the receiver (+10).

Diagram B
Interbank Pre-funding of Resources and an Example of a Payment by Transfiya



Source: ACH Colombia.

A beneficiary also can use the Transfiya service to request funds, in which case it is the beneficiary who initiates the service by entering the payer's cell phone number, a description of the payment, and the value of the transfer. Once the message is received by the payer, he/she accepts or declines the request. If the request is accepted, the aforementioned Transfiya flow is initiated.

As of the date of this document, five banks and one Sedpe[2] were affiliated with the Transfiya service.

2 A company specialized in electronic payments and deposits.

3.2 Payment Instruments

Cash, cards (debit and credit), checks and electronic transfers (debit and credit) are the main payment instruments used in the Colombian economy to discharge monetary obligations in the market for goods and services.

Cash and cards[26] are the means used the most by individuals, while legal entities rely more on transfers and checks (Table 3.8).

26 In general, these instruments are used for retail-value payments.

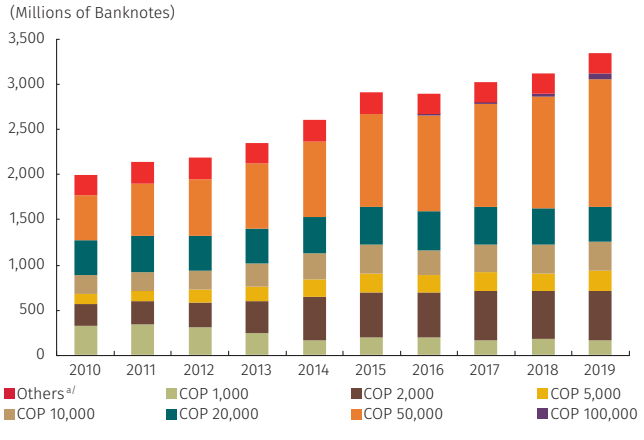
Table 3.8
Main Payment Instruments in the Colombian Economy

Market	Instrument	Most Use by Type of Individual/Entity	
		Individual	Legal Entity
Goods and Services	Cash	X	
	Debit Card	X	
	Credit Card	X	
	Check		X
	Transfers		X

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

These non-cash payment instruments involve an electronic process or incorporate an electronic format at some point in the payment process (checks are an example). They are used to convey orders for the transfer of funds from the payer's account with a financial institution to a payment beneficiary to compensate for goods, to pay for services provided by the beneficiary, to transfer resources as such, or for all of these reasons.

Graph 3.5
Banknotes in Circulation



a/ For 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*.

3.2.1 Cash

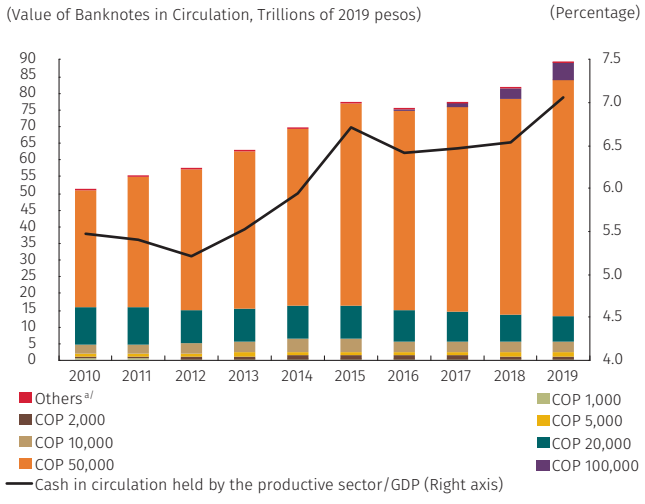
Banco de la República has conducted a survey in the past[27] to monitor the use of cash as a payment instrument. However, another way to track the use of cash is to analyze the number of banknotes and coins in circulation. This variable is understood as an approximation to the potential use of cash in the economy, not as a direct reference to payments made in cash.

With respect to the changes in banknotes in circulation during 2019[28], Graph 3.5 shows the number of notes increased annually between 2010 and 2019 by 6%, on average, and amounted to 3,346 million units (at the close of 2019). As to the number of units, by denomination, the larger ones (COP 100,000, COP 50,000, COP 20,000 and COP 10,000) account for nearly 65%, while the

27 The latest survey covers the second half of 2019. It indicates cash is used in most routine monthly payments for food, beverages, clothing, transportation, housing and public utilities, among other items (with respect to the number and value of these transactions, 88.1% and 87.4% involve cash, in that order). Similarly, businesses ratify the public's response and say cash is the instrument of payment its customers prefer. The findings of this survey are described, in detail, in Point 3.3 of this report (see: https://www.banrep.gov.co/es/noticias-y-publicaciones).

28 Only the growth in banknotes is discussed, since they accounted for 98% of the cash in circulation during 2010-2019, on average. Coins made up the other 2%.

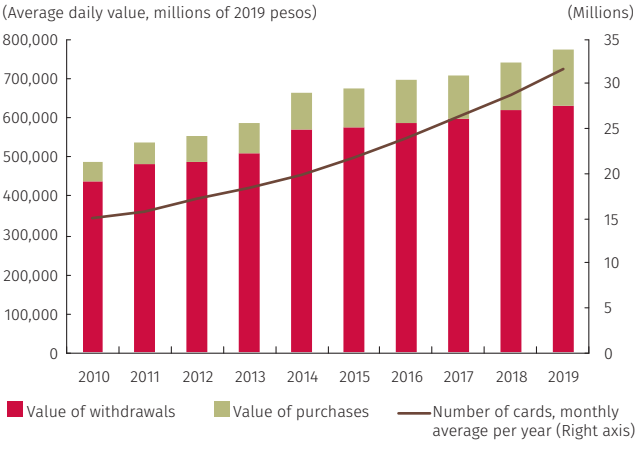
Graph 3.6
Value of Banknotes in Circulation and Cash/GDP



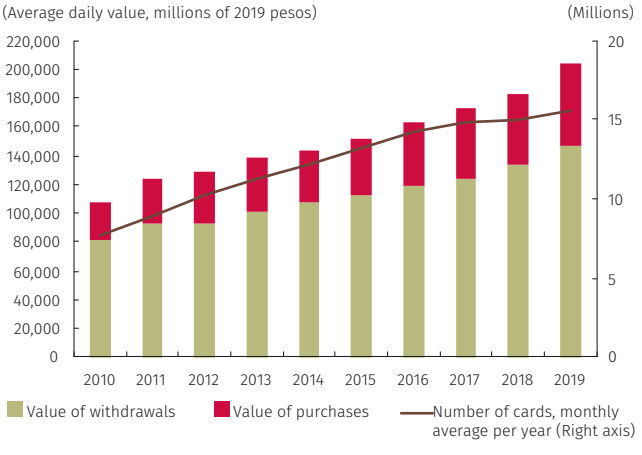
a/ For the following denominations: COP 500, COP 200, COP 100, COP 50, COP 20, COP 10, COP 5, COP 2, COP 1.
Source: Calculations by *Banco de la República.*

Graph 3.7

A. Debit card



B. Credit card



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

low denominations (COP5,000, COP 2,000 and the rest) account for the other 35%.[29]

Graph 3.6 illustrates how the total value of all banknotes in circulation evolved during the 2010-2019 period. The average growth in real value during the period was around 6.5%, representing nearly COP 89.1 t in 2019 (at the end of the year).

As to the total amount in circulation during 2019, in terms of value, the 50 thousand-peso banknote accounted for 79% of the total in circulation, the 20 thousand-peso banknote 9.0%, and the 10 thousand-peso banknote, 4.0%. The other denominations were each under 4.0%.

The amount of cash in circulation in the productive sector of the economy, as a share of GDP, averaged 6.1% between 2010 and 2019, having trended upward in recent years. In 2019, the proportion was 7.0%.

3.2.2 Cards

The use of debit and credit cards has grown steadily in the last decade (Graph 3.7). The number of debit cards averaged 31.6 m per month in 2019 and COP 772.2 b in daily use, on average. Of that amount, 82% pertained to withdrawals and 18% to purchases.

In 2019, the number of credit cards averaged 15.5 m per month, and daily use was COP 2036 b, on average, with purchases accounting for around 72% and cash advances, 28%.

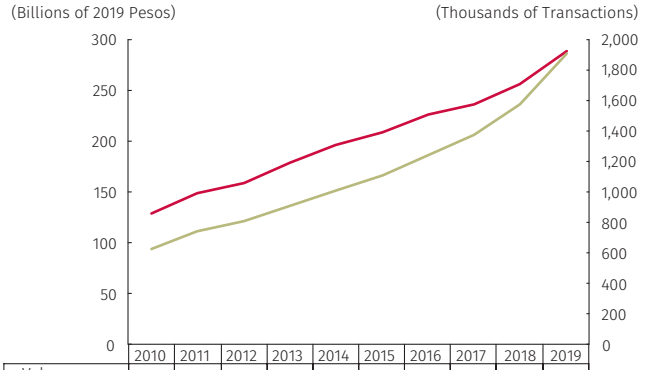
There has been an upward trend in debit and credit card purchases during the last ten years, both in value and the number of transactions. By 2019, the average daily value was COP 289.2 b and the number of transactions was 1.9 m (Graph 3.8).

Based on the purchase data reported by commercial banks, Graph 3.9 shows individuals account for 94% of the value of debit card purchases and

29 The fifty thousand-peso banknote (COP 50,000) represents the largest share, with 42%, followed by the two thousand-peso note (COP 2,000), with 17%.

90% of the value of those made with a credit card. Most of the transactions made by individuals are separate operations for amounts up to COP 1 m (78% with debit cards and 59% with credit cards).

Graph 3.8
Debit and Credit Card Purchases
(Daily average)



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Value	130	150	160	178	197	211	226	238	258	289
Number of transactions (Right axis)	626	735	811	916	1,015	1,117	1,248	1,382	1,581	1,916

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

3.2.3 Checks

Although the use of checks has declined in the last ten years, interbank and intrabank checks, as a whole, accounted for COP 1.05 t in gross payments made daily, on average. This is a representative amount out of sum the payments made in the market for goods and services.

A similar trend is evident in the series for interbank checks. One sees an annual decline in both the value and number of transactions, with a daily average of COP 757 b in 2019 and 41,000 transactions (Graph 3.10).

Based on the figures reported by the commercial banks, Graph 3.11 shows 82% of the checks, in terms of value, are drawn by companies and the other 18% are used by individuals. Most of those drawn by companies (39%) are individual checks for amounts up to COP 50 m and over COP 200 m; 49% of the checks drawn by individuals are for amounts up to COP 50 m.

3.2.4 Electronic Transfers

Recent years have seen an increase in the use of transfers (debit and credit). In 2019, interbank and intrabank transfers, as a whole, accounted for COP 16.4 t in average daily gross payments, making electronic transfers the most widely used instrument of payment in Colombia in the market for goods and services.

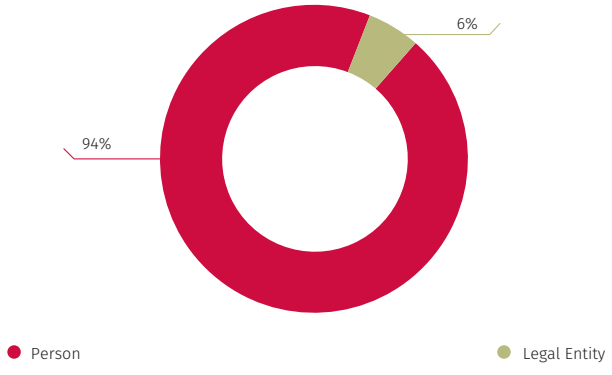
Interbank transfers (those done through ACH Colombia and ACH Cenit) have trended upward in both value and number of transactions, reaching a daily average of COP 5.1 t and 956,000 transactions daily, on average, in 2019 (Graph 3.12).

One of the most relevant electronic transfer services used by the population and companies to acquire goods and services is the so-called “secure online payment button,” better known as PSE, which was implemented by ACH Colombia. It allows companies to offer their customers (individuals or other businesses) the possibility of making payments or purchases via the internet by debiting the resources from the customer’s account with a financial institution and depositing them in the account of the financial institution defined by the company or merchant.

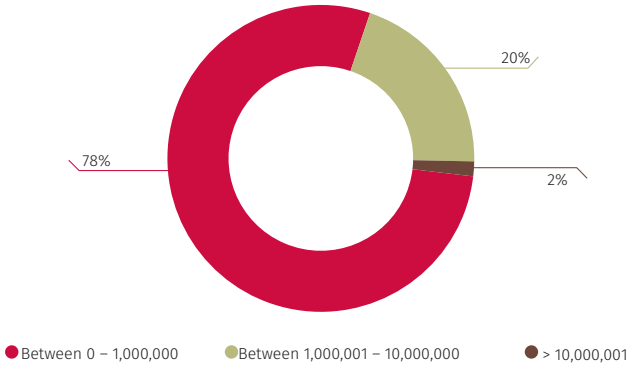
Graph 3.9
Debit and Credit Cards, by Originator: 2019
(Share of value)

A. Debit cards

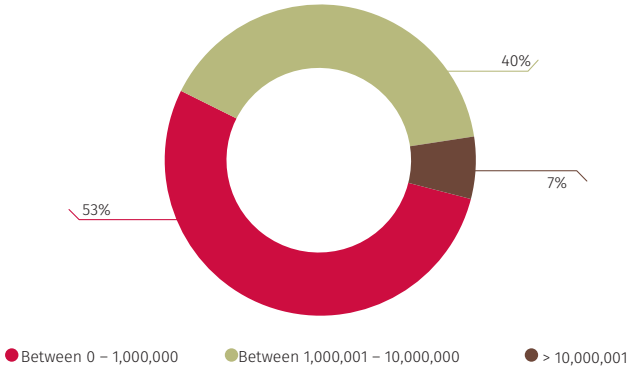
i. Total



ii. Person

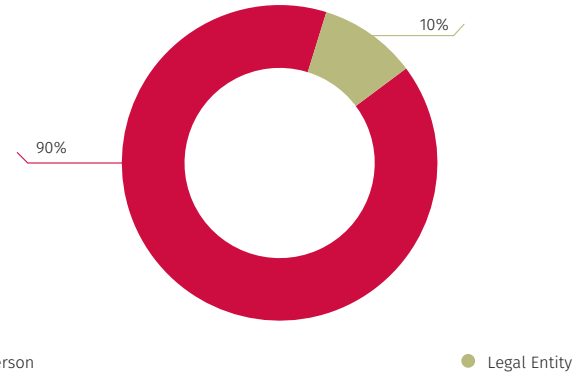


iii. Legal entity

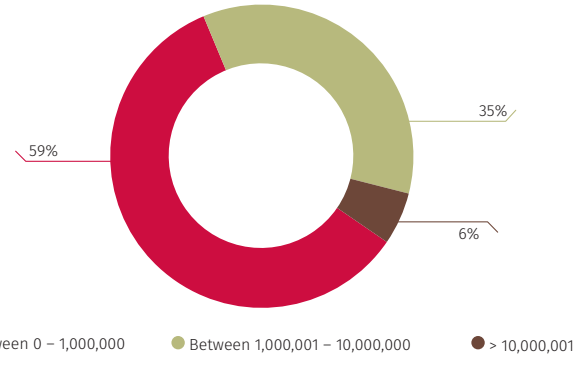


B. Credit Cards

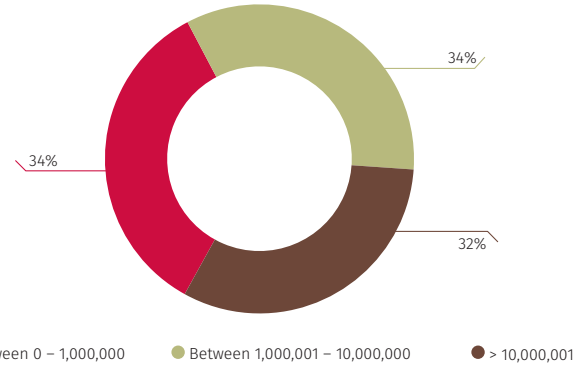
i. Total



ii. Person

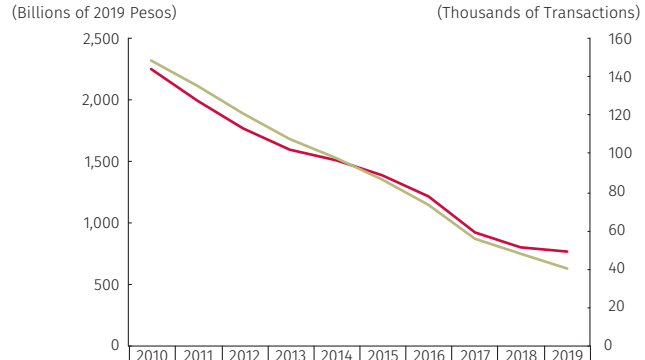


iii. Legal entity



Source: Commercial banks.

Graph 3.10
Interbank Checks
(Daily average)



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Value	2,248	1,999	1,777	1,600	1,512	1,390	1,219	925	806	757
Number of transactions (Right axis)	148	135	121	107	98	87	74	56	47	41

Source: *Banco de la República.*

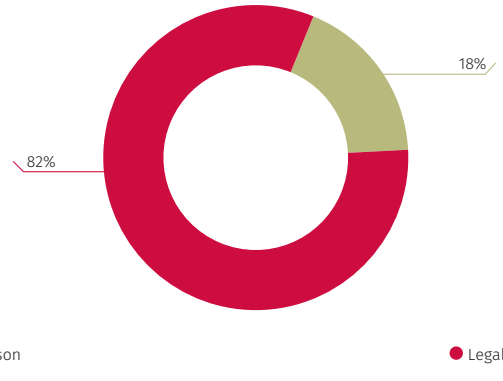
The benefits of this service are: 1) swiftness and efficiency in the process of collection or sale; 2) ease in operational processes and in reconciling information; 3) security in managing information and financial resources, and 4) a reduction in costs and processing time.[30]

In 2011, the daily average was COP 185.3 b; by 2019, it was COP 769.1 b, which implies a compound annual growth rate of 19.5%. Similarly, for the same years in question, growth in the average number of operations conducted daily was 33.5%.

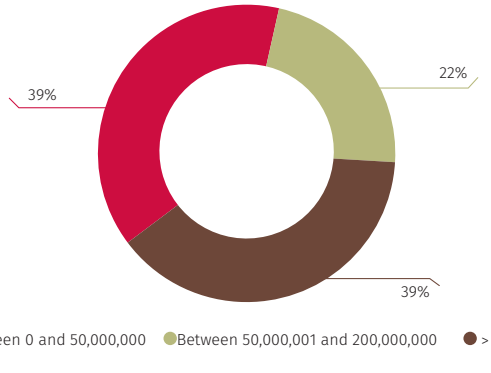
According to data provided by ACH Colombia (a daily average of COP 4.2 b), 97% of all transfers are ordered by businesses and only 3.0% by individuals (Graph 3.13).

Graph 3.11
Checks by Originator, 2019
(Share in value)

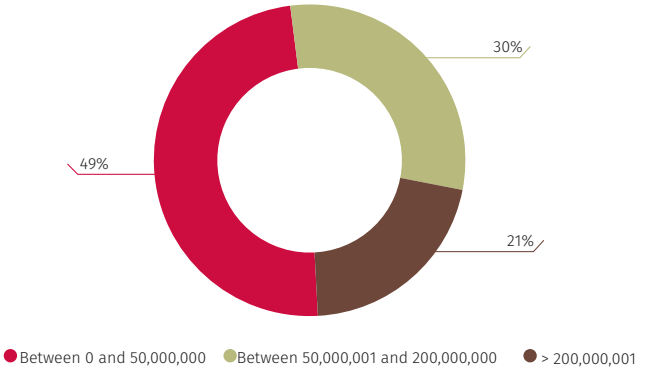
A. Total



B. Legal entity

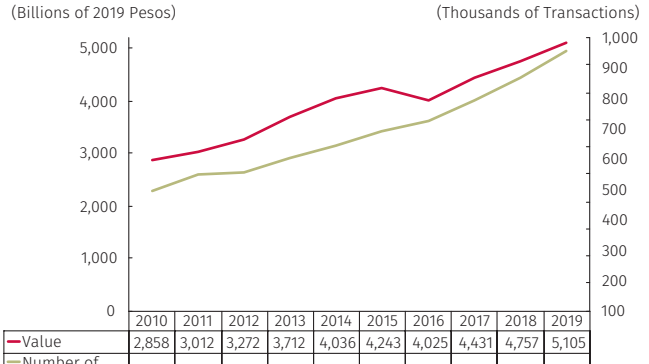


C. Person



Source: Commercial banks.

Graph 3.12
Interbank Transfers
(Daily average)



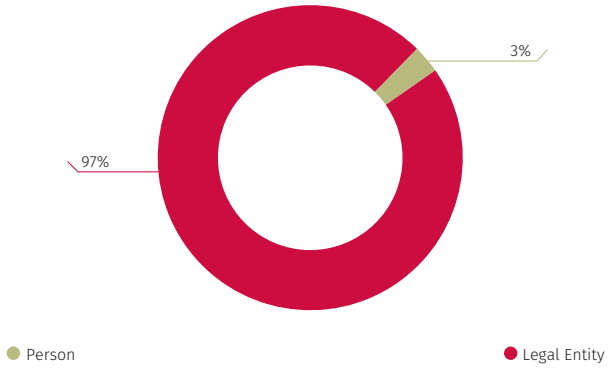
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Value	2,858	3,012	3,272	3,712	4,036	4,243	4,025	4,431	4,757	5,105
Number of transactions (Right axis)	439	496	510	556	604	656	695	770	857	956

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

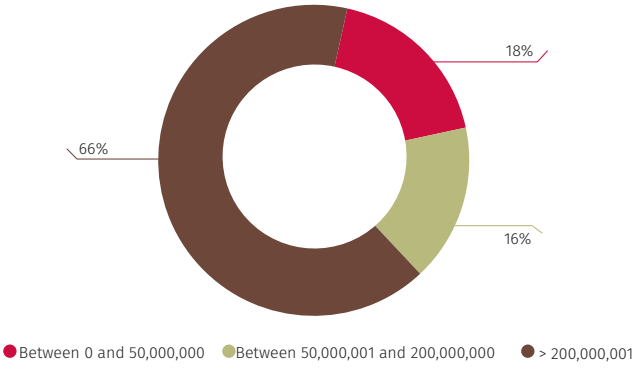
30 Source: ACH Colombia.

Graph 3.13
Transfers by Originator, 2019
(Share of value)

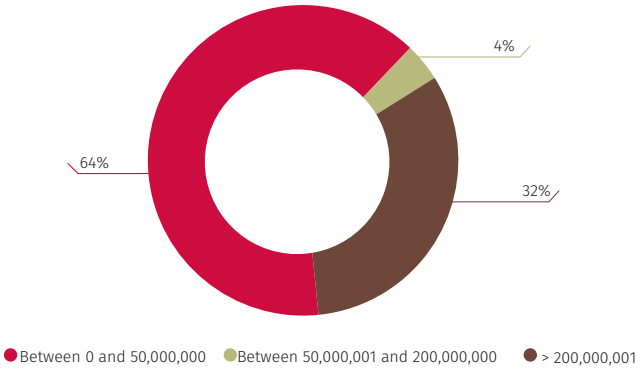
A. Total



B. Legal entity



C. Person



Source: ACH Colombia.

In all, 66% of the transfers ordered by companies are for more than COP 200 million, and 64% of those ordered by individuals are for less than COP 50 million.

3.2.5 Comparative Use of Instruments with Electronic Processes: Cards, Checks and Transfers

The information on payment instruments presented in this section is divided between individuals and legal entities. This classification is based on the type of person who initiates the transaction. As mentioned earlier, individuals make more use of debit and credit cards, while transfers and checks are used more often by legal entities.

3.2.5.1 Number of Transactions

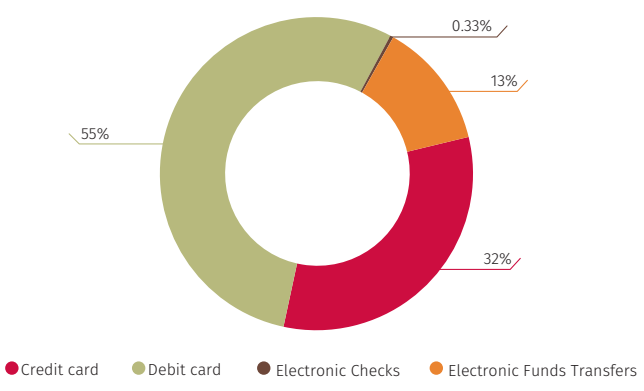
In terms of numbers, Graph 3.14 shows 55% of the transactions carried out by individuals in 2019 were done with a debit card and 32%, with a credit card. This amounts to 87%. Electronic fund transfers accounted for 13% and checks, less than 1%. In the case of legal entities, electronic fund transfers accounted for the largest share of transactions, with 91%, followed to a lesser degree by checks (5%) and credit cards (4%).

3.2.5.2 Value of the Transactions

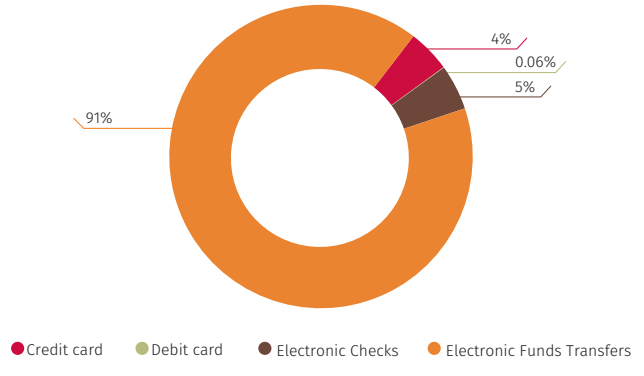
With respect to value, debit cards accounted for 25.04% of all transactions originating with individuals (Graph 3.15) and credit cards, 24.69%; together, their share was 49.73%. Checks accounted for 25.28% and electronic funds transfers, 24.98%. In terms of legal entities, electronic funds transfers accounted for 87% of the value and checks, 13% (the use of cards by legal entities is not representative).

Graph 3.14
Share in the Number of Transactions, 2019

A. Person



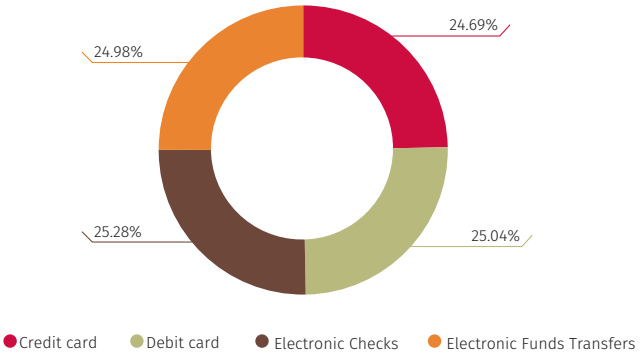
B. Legal entity



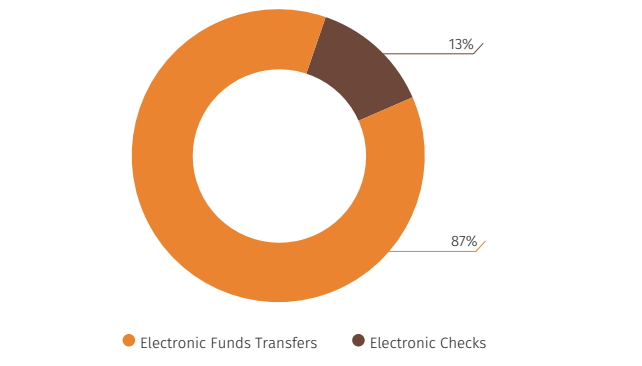
Sources: Office of the Superintendent of Financial Institutions in Colombia, ACH Colombia, *Banco de la República* and commercial banks; calculations by *Banco de la República*.

Graph 3.15
Share in Value, 2019

A. Person



B. Legal entity



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

In focus 2
Use of E-deposits for Transactions

At the end of 2011, in an effort to promote electronic payments, transactions and collections, the government of Colombia authorized credit institutions to create electronic deposits established in the name of persons or legal entities and different from checking and savings accounts. Demand deposits are one example. Later, in 2014, legislation was passed allowing for the creation of new financial entities specialized in electronic deposits and payments (Sedpes)[1]; in this case, the objective was to strengthen access to financial transaction services.

According to the commercial banks and Sedpes[2], payments (purchases)[3] made in 2019 through electronic deposits, using payment instruments, transfers, and cards with a debit function, amounted to COP 4.7 t in value and 37 m in terms of the number of operations (on a daily average, the value was COP

1 Decree 4687of 2011 and Law 1375 of 2014.

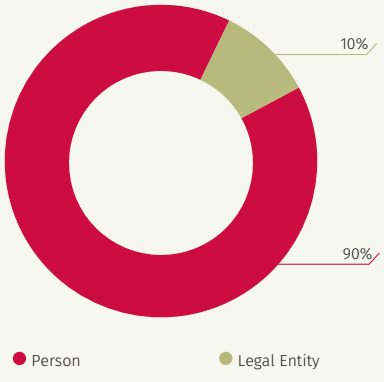
2 Commercial banks: Bancamía, Citibank, Davivienda, Popular, Bancolombia and AV Villas. Sedpes: Aval Soluciones Digitales, Coink, Movii, Pagos GDE S. A. and Tecnipagos.

3 Includes payment of bills, top-ups, and transfers.

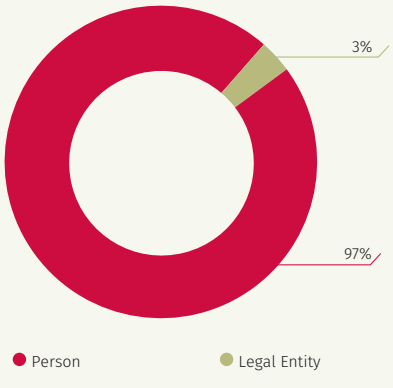
18.7 b and the number was 147,280 operations). By originator, 90% of the value pertained to individuals and 10% to legal entities. As for the number of operations, 97% originated with individuals and the remaining 3%, with legal entities (Graph A).

Chart A
Electronic Deposits

1. Value



2. Number of operations



Sources: Commercial banks and Sedpes.

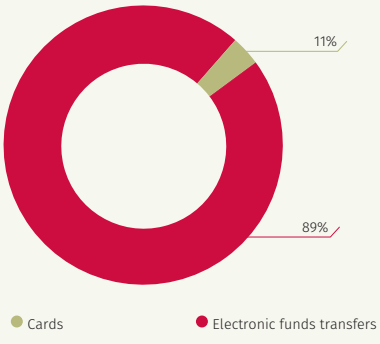
Transfers, on the other hand, accounted for around 90% and card transactions, 10%, both in value and number of operations (Graph B).

With respect to operations in Colombian pesos, by range, those up to COP 500,000 accounted for 54% of the value, followed by those between COP 500,001 and COP 1,000,000, with 21%. As for the number of operations, 95% were within the range up to COP 500,000 (Graph C).

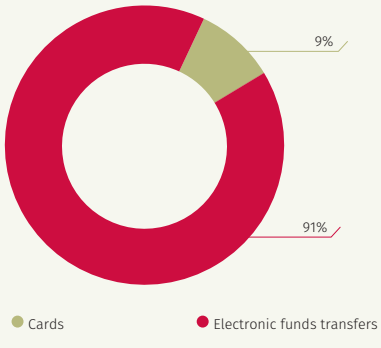
Based on this information, it is possible to conclude that electronic deposits in Colombia are

Chart B
Payment Instruments
Electronic Deposits

1. Value



2. Number of operations

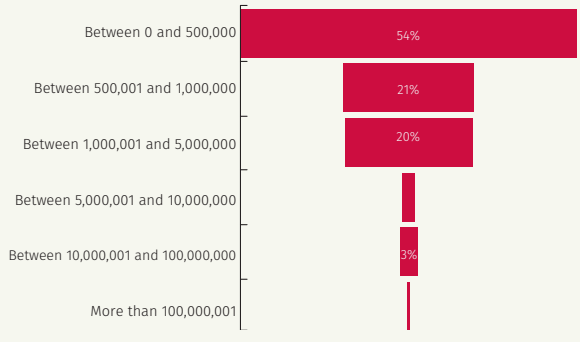


Sources: Commercial banks and Sedpes.

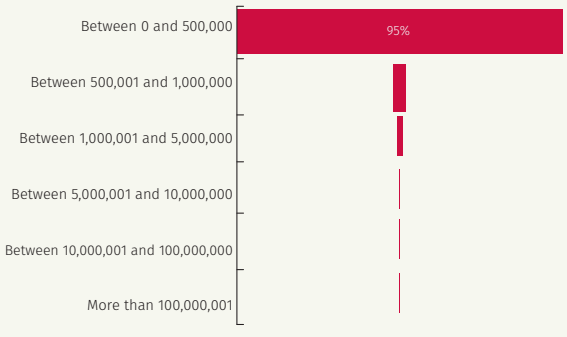
used more by individuals than by legal entities. Similarly, transfers are the payment instrument used for most of their transactions involving purchases, with payments largely in the range of COP 500,000 or less.

Chart C
Payments by Range in Pesos

1. Value



2. Number of operations



Sources: Commercial banks and Sedpes.

3.3 Findings of the Survey of Perception on the Use of Instruments for Routine Payments in Colombia in 2019

3.3.1 Introduction

Every two years, the Industrial Department at *Banco de la República* conducts a survey, with methodological support from the Department of Economic Studies, on the supply of banknotes, coins and payment instruments (EPBMIP). The primary purpose is to identify the perception of individuals (the general public) and legal entities (merchants) with respect to the provision of cash (banknotes and coins) in the economy. In one module of the survey, the Financial Infrastructure Oversight Department (DSIF) at *Banco de la República* measures aspects related to the population's preferences for different payment instruments (cash, cards, checks and electronic funds transfers) when making regular monthly payments in the market for goods and services; that is, payments limited to the purchase of food, beverages, clothing and payments for public utilities, as well as those related to transportation and housing. Accordingly, 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, the purchase of vehicles, financial liabilities other than mortgage loans or the purchase of equities or government bonds).

Since cash is the most widely used instrument in this niche of "routine payments" for goods and services, and considering it cannot be traced, as can electronic payment instruments (debit and credit cards, checks and electronic fund transfers), which leave a register of each transaction, a survey of perception is necessary to identify how the use of cash has changed in the last eight years. The results presented in this section of the report are from the fourth survey. They make it possible to calculate the percentage of cash being used with respect

to other instruments, as well as the reasons behind the preference for cash to make such payments, as applies to both the general public and commerce. Access to and use of other payment instruments also can be identified with demographic aspects of population (age, socio-economic level, income bracket, education, social security contribution, etc.).

3.3.2 Specifications

The National Consulting Center (CNC) was in charge of the most recent survey, which featured questionnaires developed by *Banco de la República*. It was conducted between October 26 and November 28, 2019 and included a sample of 4,558 surveys: 2,567 applied to the general public (persons between 18 and 80 years of age) and 1,991 to merchants (business owners or managers). The latter include persons associated with commercial activities in the following channels: drugstores, service stations, hardware stores, hypermarkets, mini-markets and neighborhood supermarkets, other shops (ice-cream parlors, butcher shops, dairy stores), bakeries, stationery and variety stores, hairdressers, restaurants and cafeterias, means of transportation (buses and taxis) and neighborhood shops.[31]

The research was done using a multi-stage probability sampling method, with simple stratified random sampling of elements. Mapped blocks were chosen in each municipality under study. Within each block, households were selected in the case of the general public, and those in charge of commerce were selected in the case of merchants. A person from the target population was chosen from each household, using the Kish method (an algorithm to select an adult within the household), and from shops and chains (per city blocks) in the case of commerce, and from means of transportation, bus stops and places where they group. No incentives were used.

When defining the sample for the survey, specifically in the case of commerce, the number of persons employed by the establishments in question was taken into account (employment generated by the shops) and not the number of commercial establishments (as was done in 2017). Two DANE surveys constitute the main source of this data; namely, the *Annual Commerce Survey of 2017* and the *Micro-Business Survey of 2016.* This methodological adjustment resulted in greater representativeness and a redistribution in the portions or segments per trade channel.

The survey covered 46 municipalities in Colombia: Acacías, Arauca, Armenia, Barrancabermeja, Barranquilla, Bello, Bogotá, Bucaramanga, Buenaventura, Calarcá, Cali, Cartagena, Chinchiná, Chía, Cúcuta, Dosquebradas, Duitama, Envigado, Espinal, Florencia, Girardot, Guadalajara de Buga, Ibagué, Ipiales, Itagüí, Leticia, Lorica, Magangué, Manizales, Medellín, Montería, Neiva, Pasto, Pereira, Popayán, Quibdó, Riohacha, San Andrés,

31 In contrast to the survey conducted in 2017, this version includes additional channels such as hardware stores, bakeries, hairdressers, ice-cream parlors, butcher shops and dairy stores.

Santa Marta, Sincelejo, Soacha, Soledad, Tunja, Valledupar, Villavicencio and Yopal.

The findings presented in this report are those obtained by applying expansion factors (provided by the CNC) to the answers registered by the surveyors. Accordingly, the answers from the members of the public who were interviewed represent a population of 18,571,641 inhabitants and those obtained from the merchants who were interviewed represent 1,538,126 commercial establishments.

3.3.3. Findings

The findings for the general public and for merchants are presented separately. Each is broken down according to demographic aspects, availability or acceptability, use and reasons for the use of cash.

3.3.3.1. Findings from the Surveys of the General Public

a. Demographic Aspects of the Surveyed Population

The surveys of the general public were targeted on persons between the ages of 18 and 80 who reside in the urban areas of 46 municipalities throughout the country. The population surveyed is represented as follows: 12.8% were between 18 and 24 years of age; 49.8% between 25 and 54 years of age, and 37.4%, over 55 years of age. The population is 48.4% male and 51.6% female. By occupation level, 34.6% are self-employed, 26.6% are employees, 16.4% are engaged in domestic work, 9.1% are seeking employment, 8.6% are retired, and 4.7% are students. By income level, 39.0% earn less than the current legal minimum wage (SMLV), 34.9% earn between one and two times the SMLV, 10.8% earn between two and three times the SMLV, 4.7% earn between three and five times the SMLV, and about 1.4% claim to receive more than five times the SMLV. On the other hand, 9.2% did not disclose information about their income, and 47.2% contribute to social security (health, pension and coverage for occupational risks).

With respect to level of education, 14.4% of the population surveyed have a primary education, 42.4% have secondary schooling, 19.2% have technical or technological training, 18.0% have some degree of higher education (13.2% completed their higher education and 4.8%, only in part), and 4.2% have postgraduate studies. The other 1.6% indicated they had no level of schooling, and 0.2% did not respond to the question. In terms of socio-economic level, 51.7% pertain to strata 1 and 2, 40.6% to strata 3 and 4, and the remaining 7.2% corresponds to persons in strata 5 and 6.

Graph 3.16
Tenure of Means and Instruments of Payment

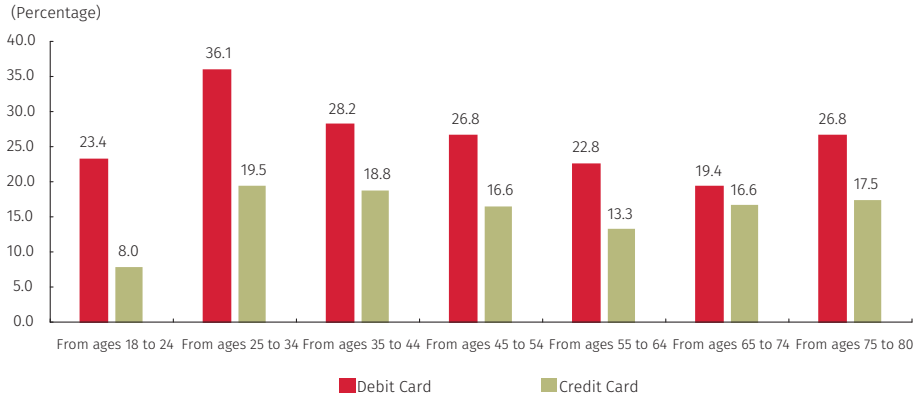
Source: *Banco de la República* (Epbmip).

b. Availability of Payment Means and Instruments

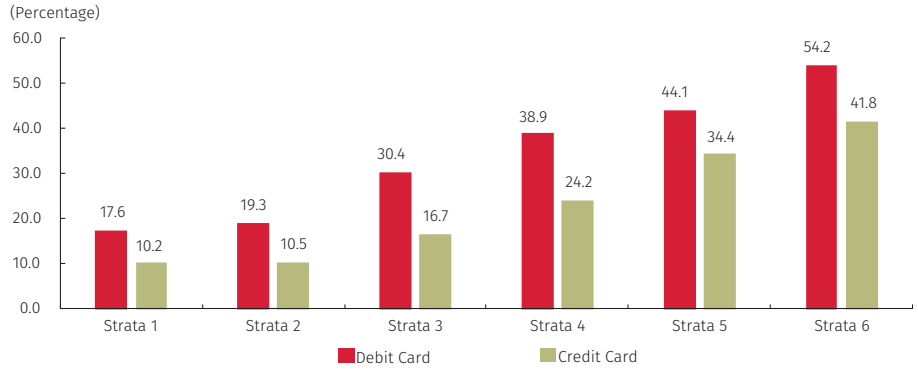
The findings of the survey show 39.9% of the population has a savings account; 26.5%, a debit card; 15.7%, a credit card; 9.7%, a checking account; and 1.8%, a checkbook (Graph 3.16). Similarly, about 10% has some type of credit or loan. In general, the population that indicated having at least one financial product (savings and checking accounts, debit and credit cards, a checkbook or any type of credit) corresponds to 47.7% (in other words, 52.3% of the population has no financial product whatsoever).

Graph 3.17
Availability of Debit and Credit Cards

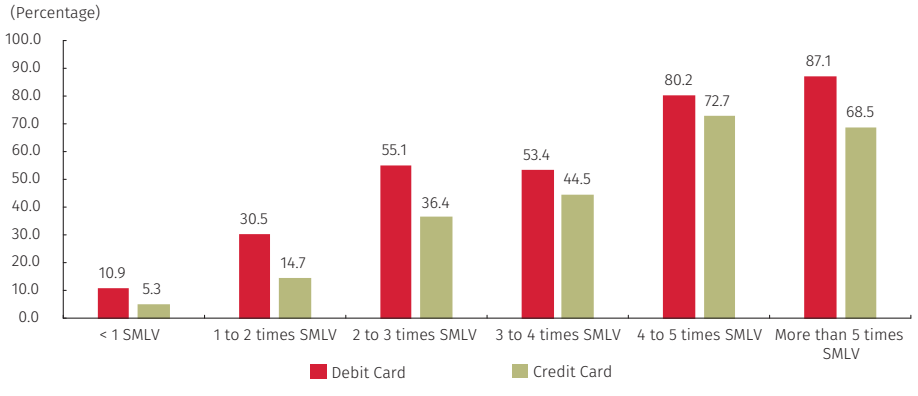
A. By age



B. By socio-economic level



C. By income bracket

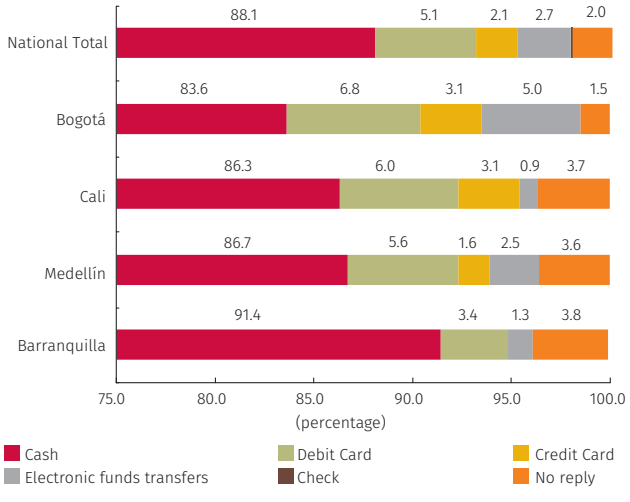


Source: *Banco de la República* (Epbmip).

As for the age of the population with credit and debit cards, the most availability is in the range between 25 and 34 years of age, with 36.1% of debit cards and 19.5% of credit cards (Graph 3.17, Panel A).

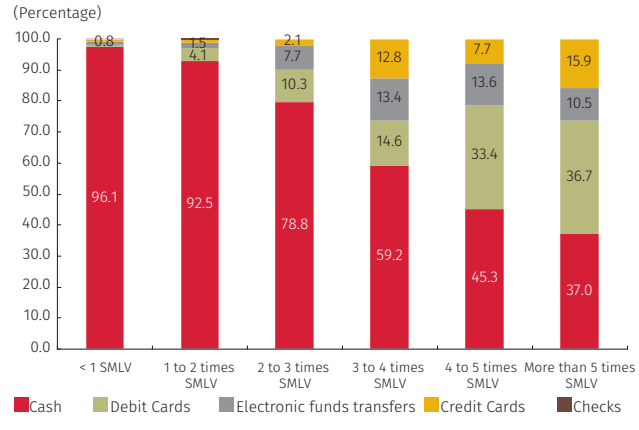
The findings, according to socio-economic level, indicate the higher the level, the greater the proportion of the population with credit and debit cards. The population at socio-economic level 6 has the highest share of debit cards (54.2%) and credit cards (41.8%), while the population at socio-economic level 1 has a lower share of these instruments (17.6% of debit cards and 10.2% of credit card) (Graph 3.17, Panel B).

Graph 3.18
Preferred Payment Instrument
(Number of transactions)



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

Graph 3.19
Preferred Payment Instrument
(Number of transactions, by income bracket)



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

With respect to debit cards, the population with the largest share (87.1%) is the one with the highest income. In the case of credit cards, the population with an income between four and five times the minimum wage has the largest proportion (72.7%). The population with an income below the minimum wage has the lowest share of both debit cards (10.9%) and credit cards (5.3%) (Graph 3.17, Panel C).

c. Use of Payment Instruments

The findings from the survey correspond to measurements of the number and amount of retail-value payments made by the population on a monthly basis, so as to identify preferences for the use of payment instruments. Regarding the number of transactions, the public's perception with respect to the national total shows that cash is the most widely used instrument (88.1%), followed by debit cards (5.1%), credit cards (2.1%) and electronic funds transfers (2.7%)[32] (Graph 3.18).

In cities such as Cali and Medellín the proportions are similar to those obtained for the national total. In Barranquilla, cash accounts for 91.4%, while Bogotá registers the lowest use of cash (83.6%), together with the highest use of debit cards (6.8%) and transfers (5.0%).

By income range, the preference for cash is greater among those with a low income (96.1%). Graph 3.19 shows the use of cash declines as the income level increases. The higher the income, the greater the use of other payment instruments. For the population with an income equal to more than

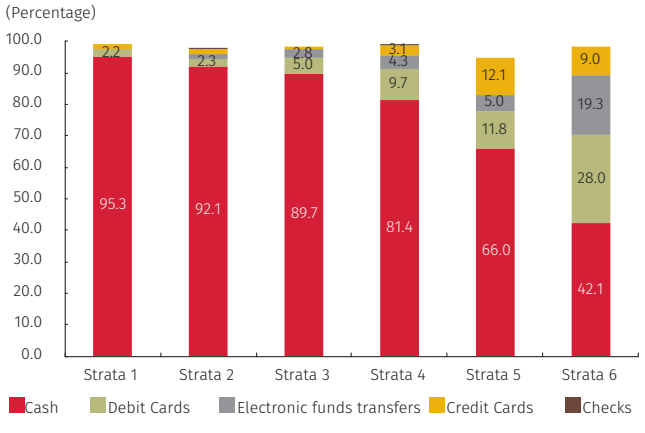
32 With respect to the findings from the 2017 survey, there was a decline in the share of the volume of monthly payments, from 92.4% to 88.1%, while the share of electronic fund transfers and credit card payments increased from 0.4% to 2.3% and from 1.3% to 2.1%, respectively.

five times the minimum wage, the use of cash payments (37.0%) and debit cards (36.7%) is similar, as it is for the use of credit cards (15.9%) and electronic funds transfers (10.5%), although less so.

The findings with respect to socio-economic level coincide with those registered according to income range, with cash being the most used payment instrument at levels 1 (95.3%), 2 (92.1%) and 3 (89.7%). Similarly, persons at level 4 prefer cash (81.4%), but payment with debit cards was more representative than at levels 1-3 (9.7%), followed by electronic funds transfers (4.3%) and credit cards (3.1%). The share of non-cash instruments rose as the socio-economic level increased. At level 6, the use of different instruments is more varied, after cash (42.1%) come debit cards (28.0%), electronic funds transfers (19.3%), and credit cards (9%) (Graph 3.20).

The total value of monthly payments for food, beverages, clothing, transportation, housing and public utilities does not exceed the minimum monthly wage for 43.1% of the population. For 35.1%, these payments are between one and two times the SMLV; for 9.0%, they are between two and three times the SMLV.

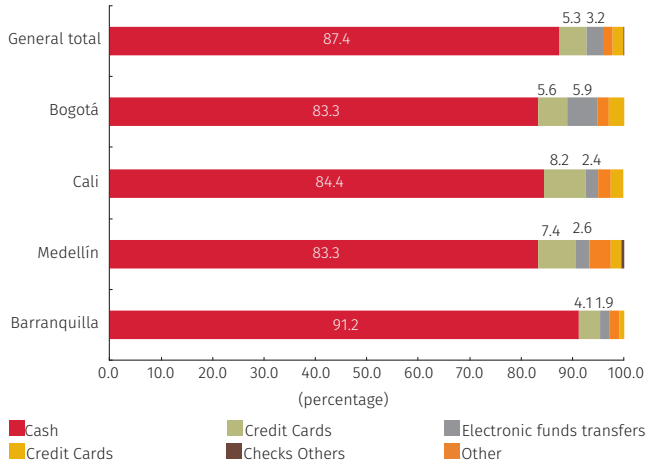
Graph 3.20
Preferred Payment Instrument
(Number of transactions, by socio-economic level)



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

The largest sum of monthly payments made in cash is in the range between six hundred thousand and one million pesos (23.2%), followed by the range from three hundred to six hundred thousand pesos (19.9%), and between one hundred thousand and three hundred thousand pesos (15.3%). Moreover, 3.9% of the population indicated they do not pay in cash.

Graph 3.21
Preferred Form of Payment
(Value)



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

As illustrated in Graph 3.21, the largest proportion of the sum of the value of monthly payments in the national total corresponds to cash (87.4%). Lesser proportions were met with debit cards (5.3%), electronic transfers of fundss (3.2%), credit cards (2.0%), checks (0.1%) and other payment instruments (2.0%). In general, the use of cash is considerable in every city surveyed, being the highest in Barranquilla (91.2%) and lowest in Medellín and Bogotá (83.3%). Debit cards are the second most preferred option in cities such as Cali (8.2%) and Medellín (7.4%), while electronic funds transfers are the second most preferred option in Bogotá (5.9%).

In the national total and by city, cash is the payment instrument preferred by the population, both in number (88.1%) and in value (87.4%). Debit cards are the second most important in terms of both the number (5.1%) and value of transactions (5.3%).

d. Reasons Why the Public Prefers to Pay with Cash

Since cash is the instrument most used by the population, the study looked at several alternatives that could explain this preference. The options for answers are not exclusive and, therefore, give the interviewee the possibility of choosing more than one and establishing an order of preference.

In the national total, the predominant preference for cash is attributed to a lack of deposit accounts (savings or checking) or credit cards (30.3%), the ease and speed of paying with cash (19.9%), the habit of using cash (12.7%), and being able to reuse it immediately (10.1%). Among other reasons, a lesser percentage of those surveyed said their purchases are small (6.8%), paying in cash is cheaper or leads to a discount (4.3%), it is considered less risky (3.5%), it is used when paying for purchases made on the street (2.6%), they use nothing but cash (2.3%), they fear having debit or credit cards cloned (2.2%), and they want to be sure the payment was received (1.4%) (Table 3.9 and Graph 3.22).

The findings by city are similar to those registered for the national total, with the lack of savings or checking accounts and credit cards being the main reason for using cash in Medellín (36.4%), Cali (33.4%) and Bogotá (25.3%).

Table 3.9
Reasons for Using Cash in Monthly Payments
(Percentage)

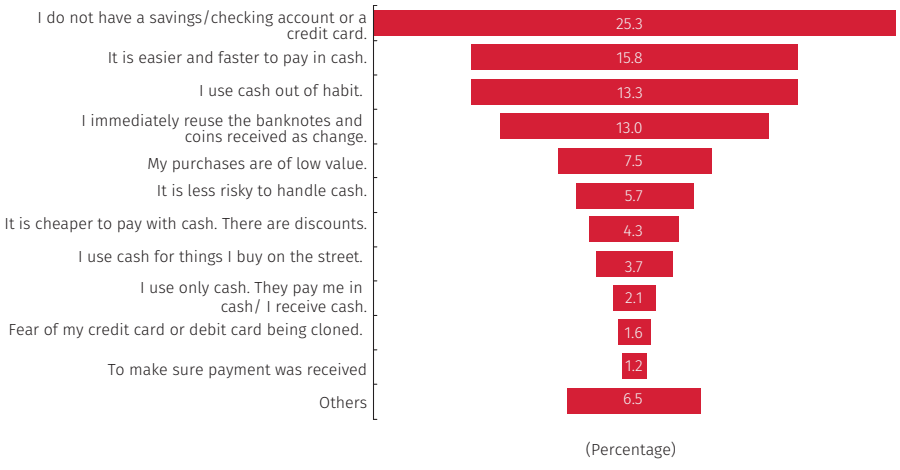
	I do not have a savings account, checking account or credit card	It is easier and faster to pay in cash	I use cash out of habit	I immediately reuse the banknotes and coins I receive as change	My purchases are of low value	It is cheaper to pay in cash. There are discounts
Bogotá	25.3	15.8	13.3	13.0	7.5	4.3
Barranquilla	21.6	43.9	8.1	3.2	3.7	3.4
Cali	33.4	17.5	12.0	8.0	10.5	3.8
Medellín	36.4	18.0	22.1	5.4	5.1	2.0
Nationwide total (46 cities)	30.3	19.9	12.7	10.1	6.8	4.3

	It is less risky to use cash	I use cash for things I buy on the street	I use only cash. They pay me in cash/ I receive cash.	Fear of my credit card or debit card being cloned	To be sure payment was received	Others
Bogotá	5.7	3.7	2.1	1.6	1.2	6.5
Barranquilla	3.8	3.6		3.0	2.4	3.5
Cali	3.0	1.6	1.4	4.1	2.6	2.1
Medellín	1.6	2.2	3.6	1.5	0.6	1.6
Nationwide total (46 cities)	3.5	2.6	2.3	2.2	1.4	4.0

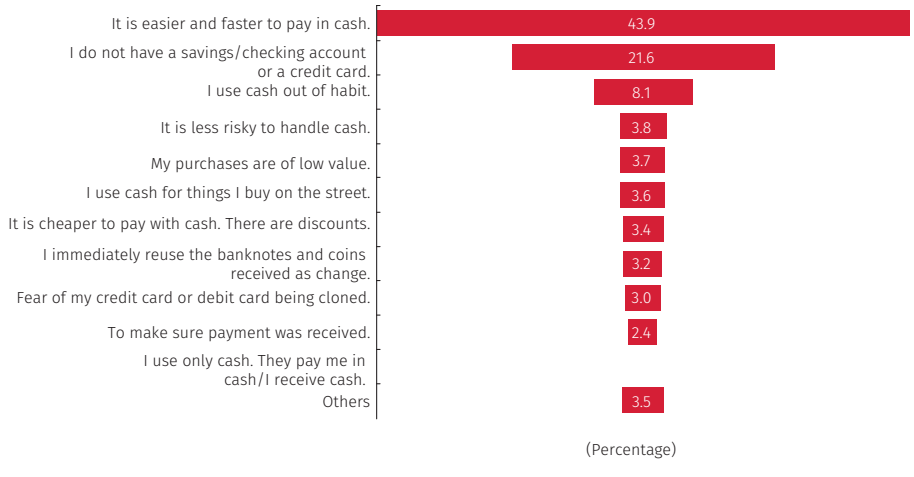
Source: *Banco de la República* (Epbmip).

Graph 3.22
Reasons for Using Cash in Monthly Payments
(Percentage)

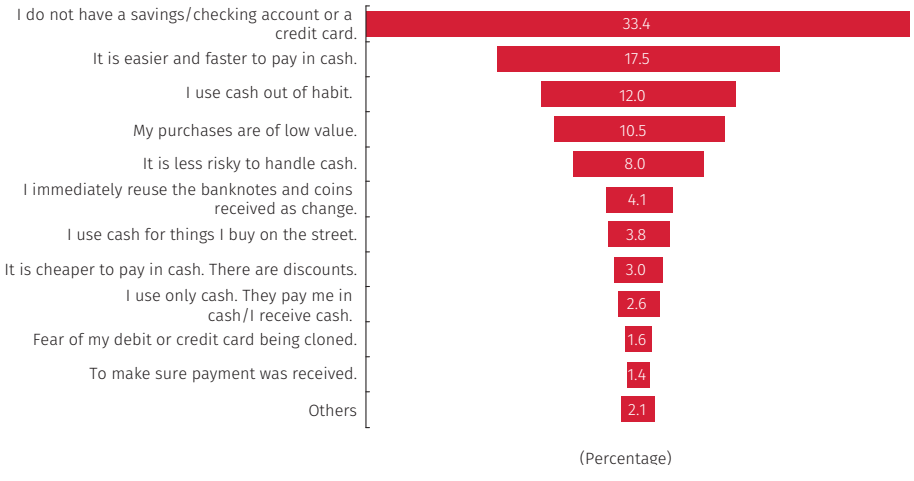
A. Bogotá



B. Barranquilla

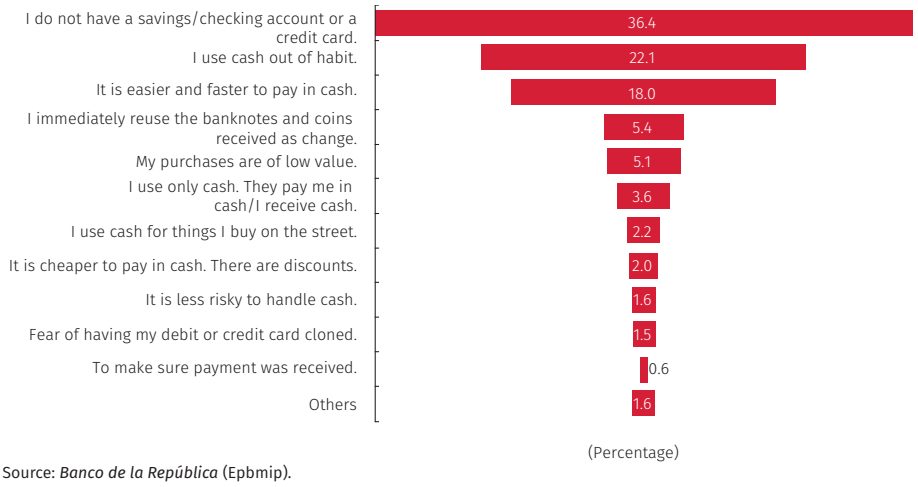


C. Cali



Graph 3.22 (continued)
Reasons for Using Cash in Monthly Payments
(Percentage)

D. Medellín



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

3.3.3.2. Findings from the Merchant Survey

The merchant survey offers a complementary perspective to that of the general public regarding the acceptance and use of payment instruments, since the unit interviewed (business owners or managers) represents the other party in each payment transaction.

a. Socio-economic Level and Commercial Registry of the Business Establishment

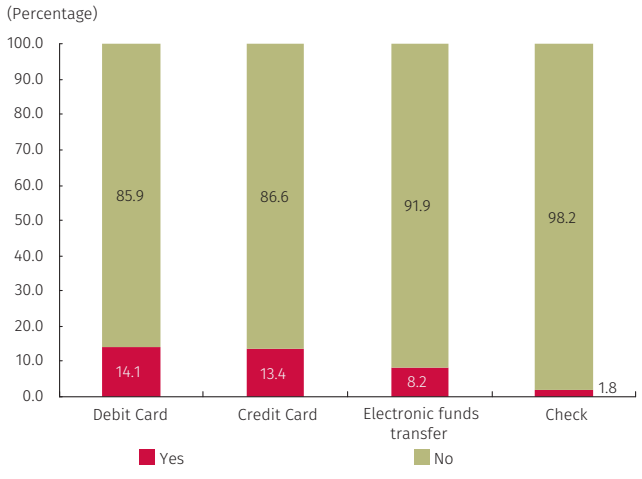
The commercial establishments considered in the EPBMIP are representative of all retail trade in the country's major cities. The survey includes the commercial channels in which the population makes its routine payments, as represented by hypermarkets, mini-markets and neighborhood supermarkets, neighborhood shops, other stores (ice-cream parlors, butcher shops, dairy stores), neighborhood bakeries, hardware stores, hairdressers, restaurants and cafeterias, service stations, drugstores, stationary and variety stores, and transportation services (taxis and buses).

The findings from the EPBMIP show 37.3% of the businesses interviewed pertain to socio-economic levels 1 and 2; 35.7%, to levels 3 and 4, and 3.8%, to levels 5 and 6, while 5.7% of these businesses are at the commercial level. The proportion of merchants who were registered with the Chamber of Commerce was 76.0%.

b. Acceptability of Payment Instruments

As to acceptance, cash is the only instrument accepted at all commercial establishments. It is followed, to a lesser extent, by debit cards

Graph 3.23
Acceptance of Payment Instruments



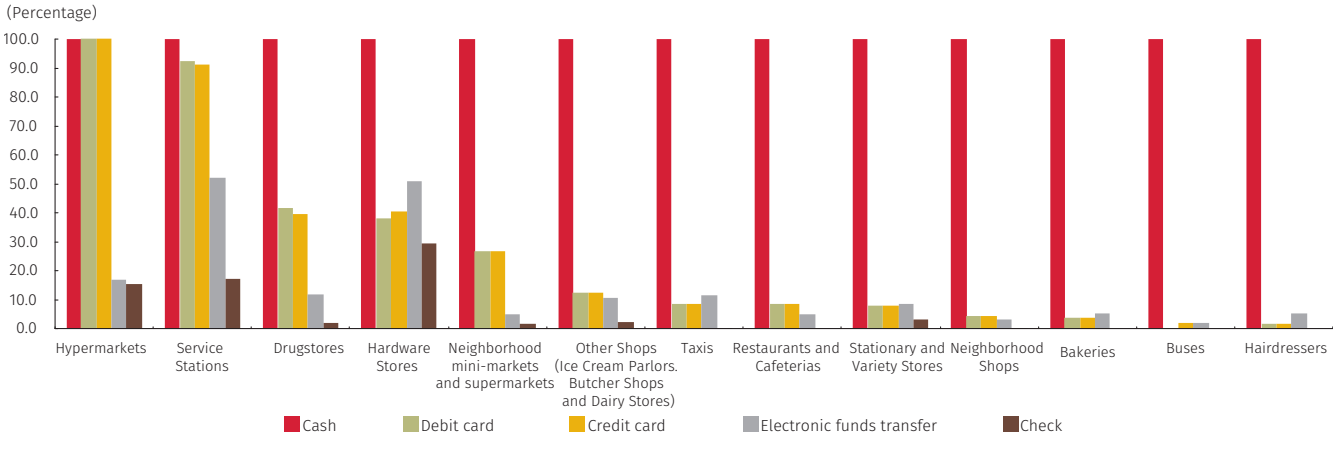
Source: *Banco de la República* (Epbmip).

(14.1%), credit cards (13.4%), electronic funds transfers (8.2%) and checks (1.8%) (Graph 3.23).

The degree of acceptance of payment instruments differs from one commercial channel to another (Graph 3.24). At hypermarkets, for example, the acceptance of cards (debit and credit) is 100%, as is the acceptance of cash. At service stations, the acceptability of debit cards is 92.5% and credit cards, 91.1%. Drugstores and hardware stores have an acceptance rate of nearly 40.0% for cards, while the degree of acceptance in other commercial channels is lower.

On the other hand, transfers were found to be accepted mainly at service stations (52.1%) and hardware stores (51.1%). In the other commercial channels, their acceptance is below 20.0%.

Graph 3.24
Acceptance of Payment Instruments
(By commercial channels)



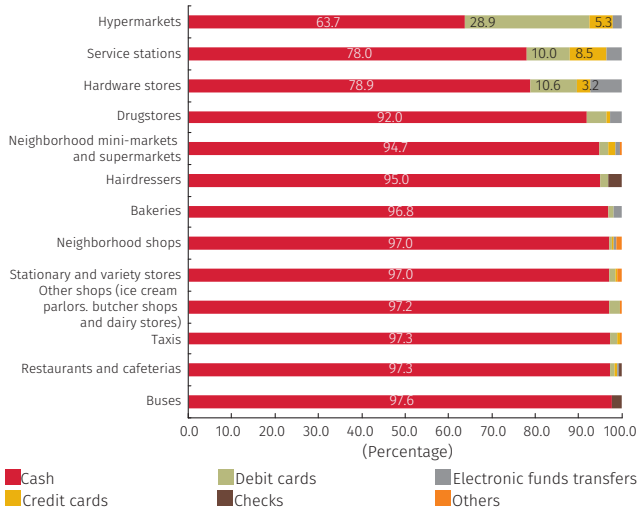
Source: *Banco de la República* (Epbmip).

The acceptability of checks was 29.5% at hardware stores, followed by service stations, with 17.2%, and hypermarkets, with 15.3%. In the other channels, the acceptance of checks is low.

c. The Consumer's Use of Payment Instruments, According to Merchants

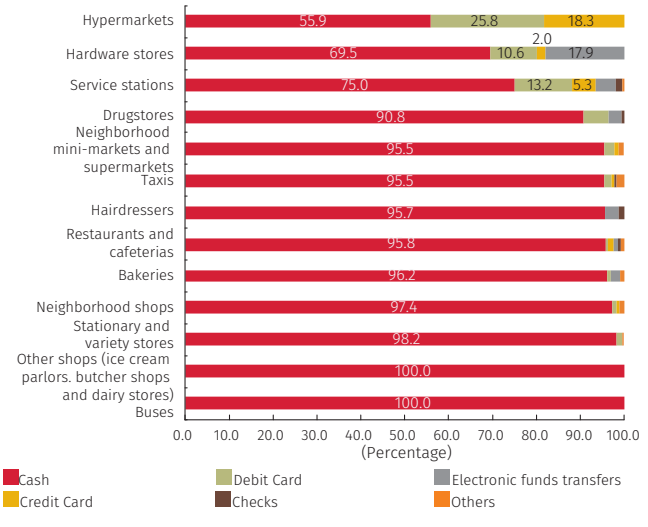
Based on the number of monthly sales, merchants identified cash as the instrument most used by their customers (Graph 3.25). Following, in order of importance, are debit cards, with a particularly prominent share of monthly payments at hypermarkets (28.9%), hardware stores (10.6%) and service stations (10.0%); and credit cards, with a much smaller share (8.5% at service stations, 5.3% at hypermarkets and 3.2% at hardware stores). Other forms of payment, which were identified in the findings with the option *other*, are to those made with coupons and vouchers, as registered at neighborhood shops, stationery and variety stores, and neighborhood mini-markets and supermarkets.

Graph 3.25
Payment Instrument Most Used by Customers
(Number)



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

Graph 3.26
Payment Instrument Most Used by Customers
(Value)



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

A look at the monthly value of sales shows similar findings. According to merchants, their customers pay for most purchases with cash, and use cards (debit and credit) to a far lesser extent. This is especially evident at ice-cream parlors, butcher shops and dairy stores, stationery and variety stores, convenience stores, bakeries, restaurants, hairdressers, mini-markets and supermarkets, and drugstores, where the receipt of cash payments accounts for more than 90% of the value of sales (Graph 3.26). Hypermarkets, hardware stores, and service stations again show the highest share of payments with non-cash payment instruments. Debit cards represent about 26% of sales at hypermarkets, and about 10% of those registered at service stations and hardware stores. Payments with a credit card account for 18.3% at hypermarkets and 5.3% at service stations. Electronic funds transfers represent a significant share at hardware stores (17.9%), exceeded by the proportion pertaining to the use of debit and credit cards. This type of instrument is of relative importance at service stations (4.7%) and at hairdressers and drugstores, accounting for nearly 3.0% of their monthly sales.

d. Reasons for Receiving Payment in Cash

Based on the answers provided by the merchants who identified cash as the payment instrument preferred by their customers, the reasons behind that finding were examined and suggest a set of alternatives, which are not mutually exclusive. The findings outlined below correspond to the first alternative that was selected (Table 3.10).

Generally speaking, not having a point-of-sale terminal (POS terminals) was identified as the main reason for receiving more cash payments, particularly in the case of hairdressers (43.6%), bakeries (41.2%), taxis (35.1%), restaurants and cafeterias (34, 4%), mini-markets and neighborhood supermarkets (33.5%), stationery and variety stores (31.5%), hardware stores (31.0%), neighborhood shops (28.3%), drugstores (28.2%), other stores such as ice-cream parlors, butcher shops and dairy stores (28.0%), buses (15.9%), and service stations (5.7%) (Table 3. 10 and Graph 3.27). The absence of POS terminals in these commercial channels indirectly indicates the degree of acceptance of payment cards (debit and credit), which affects the decisions of the entire population. Those who have payment cards and are willing to use them are unable to do so, simply because they are not accepted. Likewise, those who do not have payment cards may see their payment decisions affected to the extent that their decision to adopt cards (to have them or not) may

Table 3.10
Main Reasons for Receiving Cash from Customers
(Percentage)

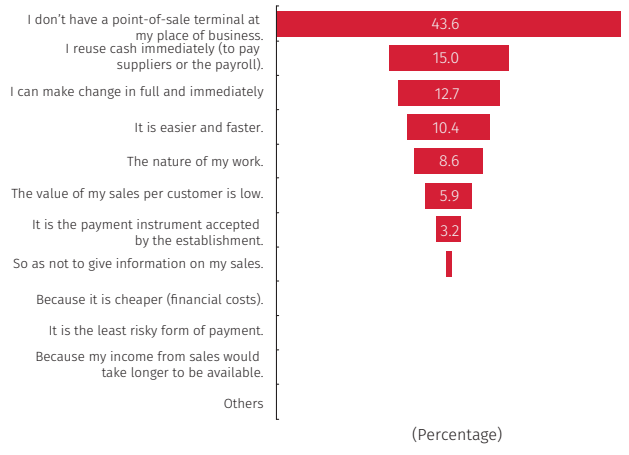
	I don't have a point-of-sale terminal at my place of business	It is easier and faster	I reuse cash immediately (to pay suppliers or the payroll)	The nature of my work	I can make change in full and immediately	The value of my sales per customer is low
Hairdressers	43.6	10.4	15.0	8.6	12.7	5.9
Bakeries	41.2	16.0	21.1	9.6	4.7	3.1
Taxis	35.1	18.9	15.6	16.5	9.2	0.9
Restaurants and cafeterias	34.4	14.6	18.9	10.1	6.4	7.9
Neighborhood mini-markets and supermarkets	33.5	15.2	18.5	10.8	4.8	8.9
Stationary and variety stores	31.5	16.8	15.2	5.1	11.9	15.3
Hardware stores	31.0	14.7	15.2	6.6	6.2	2.0
Neighborhoods shops	28.3	18.7	22.3	8.2	5.0	8.9
Drugstores	28.2	21.2	19.3	10.5	6.8	5.3
Ice cream parlors, butcher shops and dairy stores	28.0	20.5	18.5	11.7	2.8	7.6
Buses	15.9	19.5	18.6	15.6	13.3	1.2
Service stations	5.7	27.6	9.8	15.0	16.6	8.1
Hypermarkets		53.4	12.8	10.7	2.1	
Total	28.9	19.0	18.0	11.8	8.2	5.3

	It is the payment instrument accepted by the establishment	Because it is cheaper (financial costs)	It is the least risky form of payment	So as not to give information on my sales	Because my income from sales would take longer to be available	Others
Hairdressers	3.2			0.5		
Bakeries	2.9	1.1	0.3			
Taxis	2.0		0.7	0.8		0.4
Restaurants and cafeterias	1.9	1.8	1.6	0.9	0.5	1.1
Neighborhood mini-markets and supermarkets	4.0	0.7	1.5	0.7	0.3	1.2
Stationary and variety stores	1.0	1.2	1.0	1.0		
Hardware stores	19.1	1.9		3.4		
Neighborhood shops	1.8	3.5	3.2			0.1
Drugstores	2.7	3.2	0.2	0.5		2.1
Ice cream parlors, butcher shops and dairy stores	5.8	0.9	4.3			
Buses	14.3	0.9	0.8			
Service stations	13.0	2.8			1.4	
Hypermarkets	17.3	1.5				2.1
Total	5.0	1.4	1.3	0.5	0.1	0.5

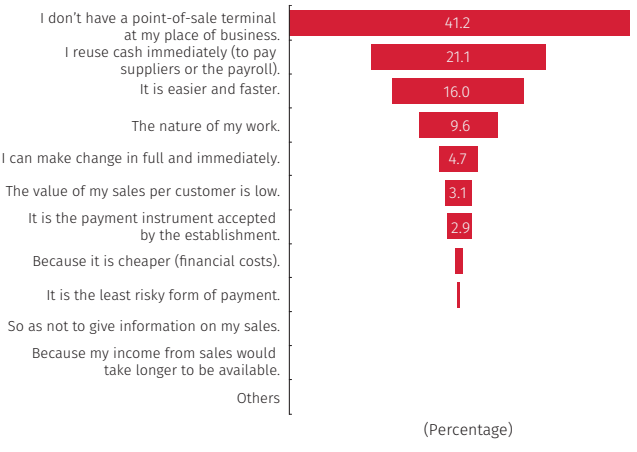
Source: *Banco de la República* (Epbmip).

Graph 3.27
Reasons for Receiving Cash from Customers

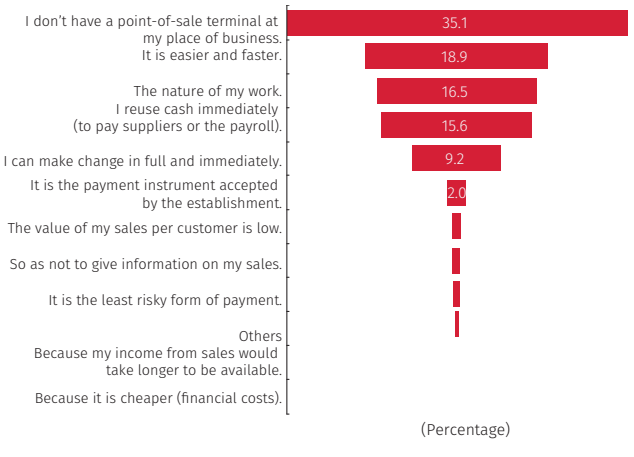
A. Hairdressers



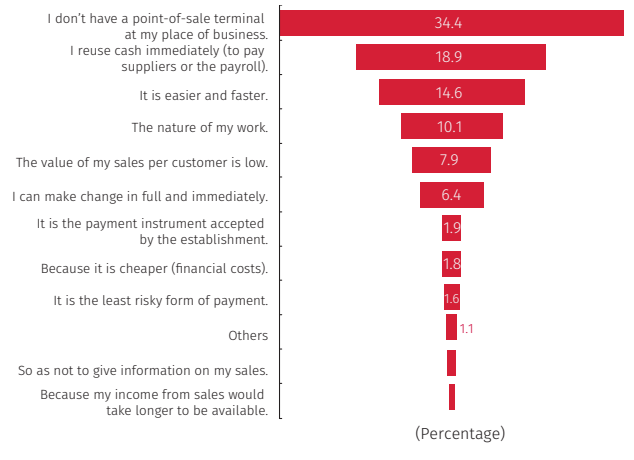
B. Bakeries



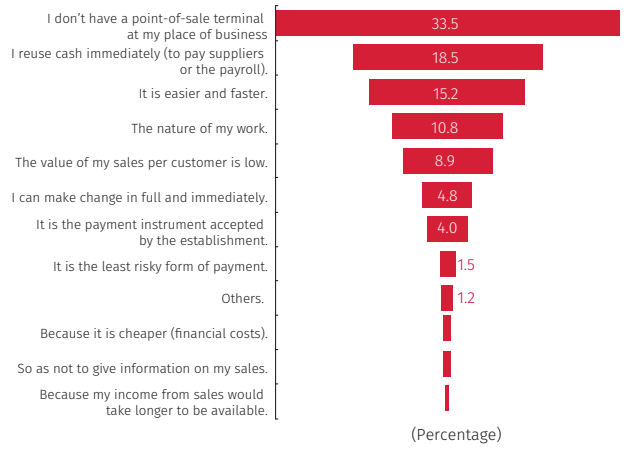
C. Taxis



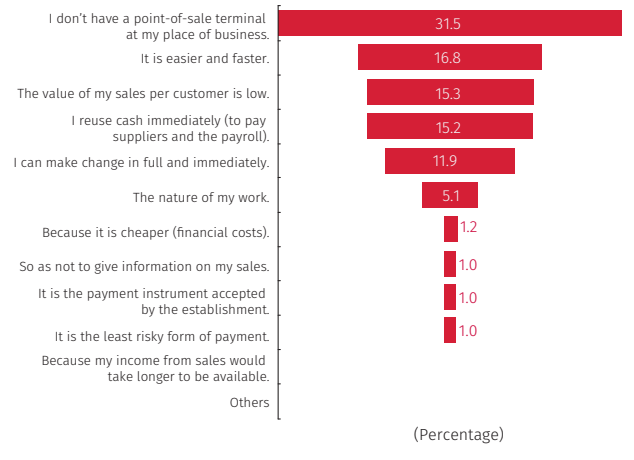
D. Restaurants and cafeterias



E. Neighborhood mini-markets and supermarkets



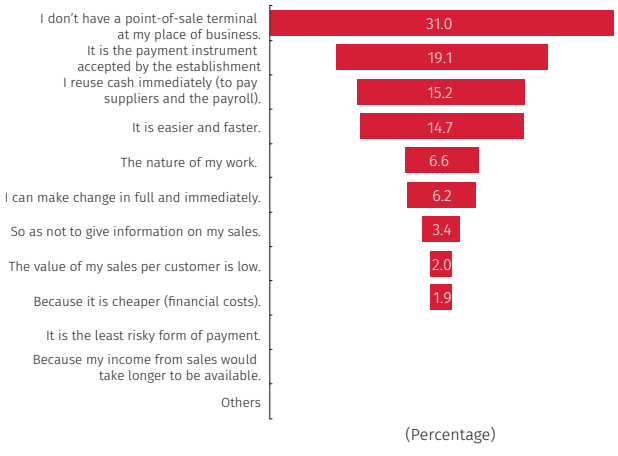
F. Stationary and variety stores



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

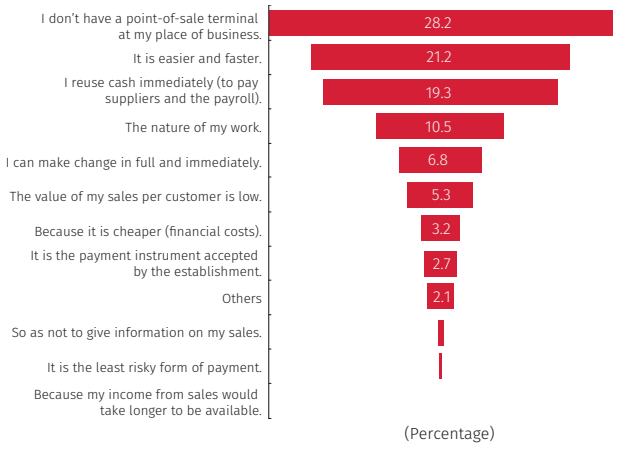
Graph 3.27 (continued)
Reasons for Receiving Cash from Customers

G. Hardware stores

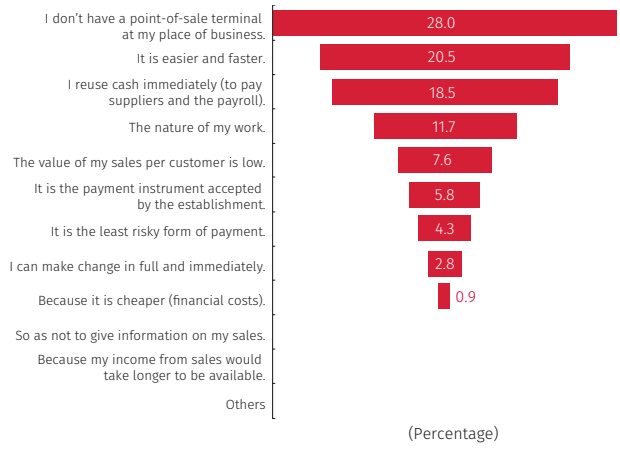


H. Neighborhood shops

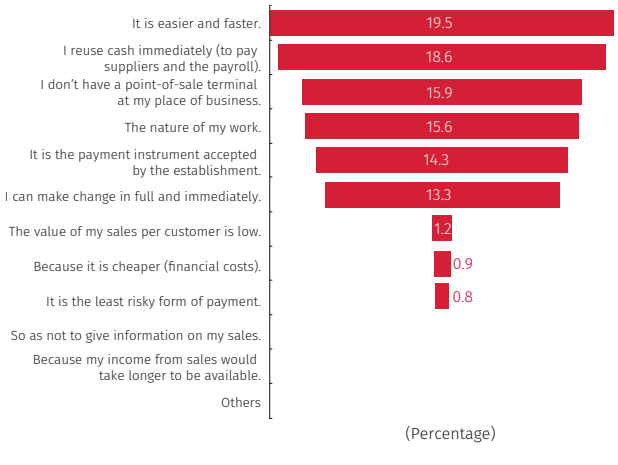
I. Drug stores



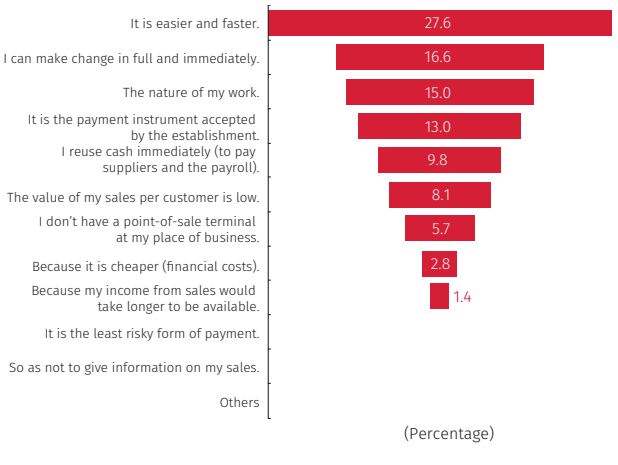
J. Ice cream parlors, butcher shops and dairy stores



K. Buses



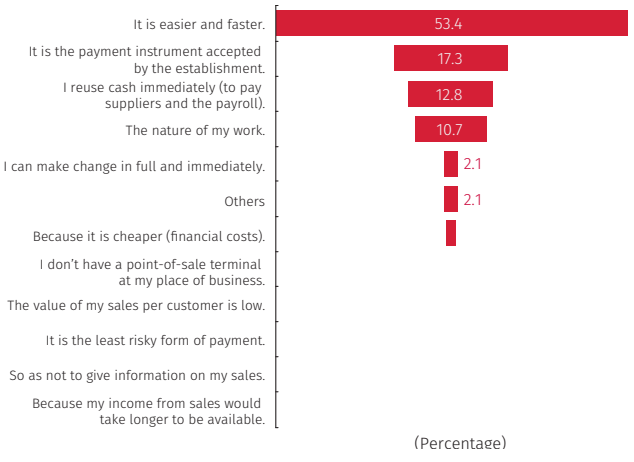
L. Service stations



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

Graph 3.27 (continued)
Reasons for Receiving Cash from Customers

M. Hypermarkets



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

depend on their acceptance of payment cards at the businesses where they shop regularly.

Among the responses registered, the ease and speed of receiving cash payments also accounts for a considerable share, suggesting these are highly appreciated attributes, mainly at hypermarkets (53.4%), service stations (27.6%), other stores such as ice-cream parlors, butcher shops and dairy stores (20.5%), and on buses (19.5%). In this respect, the relationship between the speed of payment and the value of the transaction is evident.

Other explanations, such as the possibility of reusing cash immediately, the nature of the work, and being able to make change in transactions, are also relevant findings based on the merchants' responses.

3.3.4 Conclusions

Cash continues to be the instrument most used by the population for its regular monthly payments (88.1% in terms of the number of payments and 87.4% in value). For the most part, the amount paid by the population for such goods and services does not exceed two times the minimum monthly wage (78.1%). The population with some type of financial product comes to 47.7%, and not having financial products is cited as the main reason for using cash. In turn, the extent to which merchants accept payment instruments other than cash is 14.1% for debit cards, 13.4% for credit cards, 8.2% for transfers and 1.8% for checks. The channel with the highest acceptance of non-cash payment instruments is the one comprised of hypermarkets, with debit and credit card acceptance similar to the acceptance of cash (100%). Acceptability at service stations is 92.5% for debit cards and 91.1% for credit cards. Drugstores and hardware stores have an acceptance rate of nearly 40.0% for cards, while the degree of acceptance in other retail channels is less. The main reason for using cash is the lack of POS terminals in commercial establishments.

In focus 3

How do Colombians make their usual payments?

The Public

87% pay in cash.

5% pay with a debit card.

3% pay with an electronic funds transfer.

For the general public, the main reason to pay with cash is not to have a savings / checking account or a credit card.

Some Population Features:

48% have some type of financial product.

74% earn up to twice the minimum monthly wage.

47% contribute to social security.

Commerce

More than **90%** of the hypermarkets and service stations accept forms of payment other than cash (debit and credit cards)

Cash is used in **64%** of the payments made at hypermarkets and **78%**, at service stations.

Drugstores and hardware stores have a card acceptance rate close to **40%**, while other retail channels have a lower acceptance rate.

The main reason why merchants claim to receive cash is because they do not have point-of-sale terminals at their places of business.

04

Changes in Technology and Innovation in Retail Payments

The word *fintech* is an abbreviation of two English words: *financial* and *technology.*[33] The Financial Stability Board (FSB) formally defines *fintech* as technology-based innovation in financial services, which may result in new business models, applications, processes or products associated with the provision of such services (FSB, 2017). More simply, Arner *et al*. (2016) refer to *fintech* as using technology to deliver financial solutions. Also associated with these definitions is the use of the term *fintechs* (plural), which refers to the companies or individuals that engage in this activity (Hochstein, 2015).

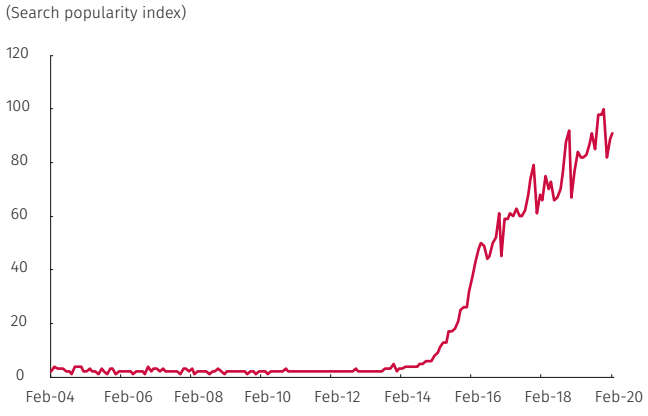
Regardless of its definition, the term's popularity has skyrocketed since midway through the second decade of the 21st century (Graph 4.1) and its use is now commonplace. However, although there is no consensus on when the term *fintech* was first used, its origin dates back to the 20th century.[34]

The term articulates three main elements: technology, innovation, and financial services. Since the expression of these three elements predates the first mention of the term or its recent popularity, it is possible to study its evolution from the very origins of financial services.

33 There is currently a discussion on the use of the terms *fintech* and *techfin* (see Marous, 2018). The first has to do with organizations that seek to provide better financial services through a better technological experience. The second concerns technology companies that are finding ways to improve the delivery of financial services as part of a broader supply of products and services. In this section, the term *fintech* is used in a general way (as it usually is), without distinguishing between the two; however, indication is given when the term *techfin* applies.

34 There is no consensus on when the term was first used. The Merriam-Webster dictionary reports it was used initially in 1971. Arner et al. (2016) say its use dates back to the early 1990s, when Citigroup initiated a project on financial technology services.

Graph 4.1
Popularity of the Term Fintech in Google Searches (Google trends)



Notes: The popularity of the term *fintech* in Google searches is measured with an index in a range of zero to one hundred, where zero corresponds to no popularity and one hundred, to maximum popularity achieved in the period available (January 2004 to February 2020).
Source: Google Trends, accessed on February 13, 2020.

In general terms, financial services can be classified into six broad categories (see Dermine, 2016): payments, intermediation, portfolio management, information, risk sharing, and consulting. This section looks at how the term *fintech* has evolved with respect to the provision of payment services, which includes services related to the registration and transfer of wealth between individuals. Diagram 4.1 serves as a guide to that evolution.

4.1 Three *Fintech* Moments in Payment Services[35]

There are two main elements in the provision of payment service: the mechanisms for a transfer of wealth between individuals, and the registration of individual wealth. Changes in technology have led to innovation in the way payment services are delivered, either through changes in the way wealth is transferred or in the way wealth is registered (or both).Three phases or moments in the development of *fintech* are examined herein, following Arner et at. (2016).

4.1.1 *Fintech* 1.0: The First Payment Services

It is difficult to identify unequivocally the first example of innovation in the provision of payment services. The minting of metal and leather coins, which dates back to ancient China (approximately 118 B.C.), as well as the use of paper money in China and checks among Muslim merchants since the ninth century (see Thornton, 2016, and Allison, 2019), can be considered as innovations with some technological component.[36]

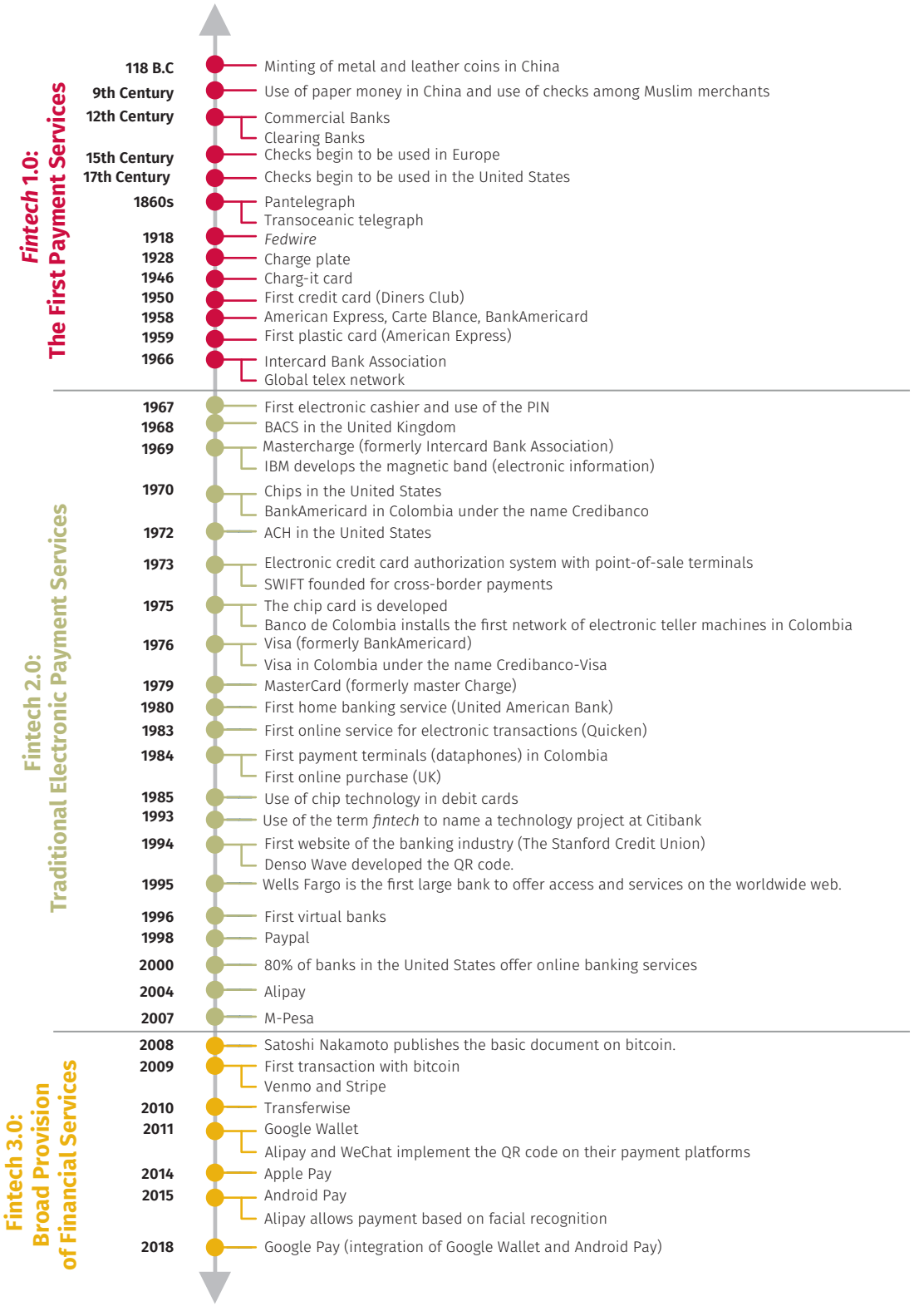
The origins of commercial banking (in the 16th and 17th centuries) are often mentioned as an early example of *fintech*. The first banks were responsible for issuing receipts in exchange for deposits from their customers, who delivered goods (e.g., gold, grain) for safekeeping. Those receipts were used to make payments between individuals, without physical delivery of the deposited goods, and those payments resulted in changes in the banks' registers.

Later, clearing banks were created to allow individuals to accept payments with receipts from banks other than their own. These provided banks with a service for depositing and registering their assets to avoid the potentially

35 This section is based on Arner et al. (2016). Other sources used extensively include Evans and Schmalensee (2005), Ali et al. (2014), Zimmerman (2016), Fabry (2016), MacDonald and Tompkins (2017), FSB (2017), Hutton (2019), ICD (2020) and Frost (2020). In some instances, the sources are omitted to preserve readability. However, all the sources used are mentioned at the end of the section.

36 The use of early forms of money (e.g., livestock, seashells, and cocoa beans, salt) can also be an example of innovation, but perhaps not technology.

Diagram 4.1
Fintech Timeline



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

cumbersome physical delivery of assets in exchange for receipts. In this case, the manner in which wealth was transferred evolved into a receipt that could be negotiated freely between individuals and banks, while registration developed into a centralized system that allowed for clearing receipts between banks, without the physical delivery of assets.

Several authors agree the invention and massification of long-distance communication is a key point in development of the *fintech* industry. Use of the pantograph to verify signatures in banking transactions in France since 1865, as well as transoceanic telegraphy since 1866, made it possible to extend an infrastructure network that facilitated long-distance financial transactions and brought about an initial period of financial globalization. At the same time, during the 19th century, the use of railways and waterways became more widespread, which also contributed to faster transmission of financial information.

At the start of the 20th century, in 1918, the United States Federal Reserve Banks established a dedicated interbank funds transmission service, which connected the twelve Federal Reserve Banks, their Board, and the United States Department of the Treasury. Known as the Fedwire Funds Service (Fedwire), it was based on a closed network of Morse code telegraphy and allowed securities to be transferred between its participants in a secure way and without involving the physical delivery of gold or cash to participants.

From the standpoint of retail-value payments, a number of innovative payment instruments, although limited in scope and use, were made available to the public in the 1920s.[37] The best known is the charge plate, which dates from 1928. It was a metal plate issued by department stores in the United States to their customers, enabling them to purchase at the store with a commitment to pay the following month. In fact, beginning in the 1920s, some department stores (e.g., Sears) and gas stations were already offering cards that allowed customers to buy with a commitment to pay the following month. In 1946, Flatbush National Bank of Brooklyn offered its customers a bank card called Charg-it, which could be used at affiliated stores near the bank's headquarters.

A key point in the provision of payment services to the public was the creation of the credit card in 1950. This payment instrument, widely used today, originated with the founding of Diners Club.[38] Diners Club started as a cardboard card used to make payments at affiliated restaurants, with the

37 See Evans and Schmalensee (2005), Vaccaro (2017), MacDonald and Tompkins (2017).

38 One of the most widely accepted stories about the idea behind the Diners Club card involves Frank McNamara, who was unable to pay for a business dinner at a restaurant in New York because he had forgotten his wallet. He and several partners founded Diners Club when they saw an opportunity to provide an alternative payment instrument that would avoid having to rely on cash at restaurants. However, a science fiction novel first published in 1888 (Bellamy, 1888) had referred already to the use of a credit card for easy and extensive payment.

customer agreeing to pay the balance at the end of the month.[39] Initially, the cards were given to a select group of people, who could use them to pay at fourteen restaurants in New York.

A year later, approximately 42,000 people paid $18 dollars per year for Diners Club membership, while members paid an average of $7 dollars per transaction. The 330 affiliated businesses, including restaurants, hotels and nightclubs, registered nearly $3 million dollars in customer payments to affiliated restaurants. Six years after the card was created, the amount of transactions had already reached $290 million dollars, and it could be used at nearly nine thousand affiliated establishments, which by then also included car rentals and other travel and entertainment related services in North America, Europe, Asia, and the Middle East. Within a few years, the Diners Club card became a widely accepted payment instrument, as it still is. A few years later, competition appeared with similar cards and business models, including commercial banks and hotel chains among those issuing such cards (see the shaded section below).

In focus 4
1958 and 1966: Key Years for the Credit Card Industry

The year 1958 is recognized as key to the credit card industry (Evans and Schmalensee, 2005). In that year, the Hilton hotel chain launched Carte Blanche. American Express, founded in 1850, launched its card of the same name. In 1959, American Express began to manufacture plastic cards, which allowed the data registered on the plastic to be transferred mechanically to receipts that used carbon paper (instead of manually registering the data on the cardboard card). Bank of America, then the largest bank in the United States, launched BankAmericard, which introduced the possibility of deferring payment for purchases. In 1976, Bank of America joined other banks, and the BankAmericard became what is now known as Visa. Another key year is 1966. It witnessed the appearance of the Interbank Card Association, which became Master Charge in 1969, and MasterCard in 1979.

Both MasterCard and Visa differ from Diners Club, American Express and Carte Blanche in that they are based on bank associations and are directly linked to banking products. Many other cards were created; some survive to this day; others have disappeared or been absorbed.

In the case of Colombia (see *El Tiempo*, 1991, CredibanCo, 2020), around 1970, Bank of Bogotá began to operate the BankAmericard under the name Credibanco. Later, in about 1976, after the creation of Ascredibanco (a partnership between a number of banks: Bogotá, Cafetero, Colombia, Ganadero, Latin America, Caldas, Costa, Nacional, Occidente, Santander, and Grancolombiano), the Visa franchise (formerly BankAmericard) was adopted under the Credibanco-Visa brand. In 1981, Ascredibanco redefined its role to become a technology, marketing and operations company in charge of developing the consumer credit and payment systems businesses. In 1984, Ascredibanco installed the first point-of-sale payment terminals, which initially accepted Visa franchise cards only.

39 Initially, the Diners Club card required customers to pay the balance of their consumption in full at the end of the month, without interest. Therefore, strictly speaking, Diners Club was a charge card (not a credit card); in that sense, it is commonly accepted that the first credit card was the BankAmericard, in 1958.

4.1.2 *Fintech* 2.0: Traditional Electronic Payment Services

Another key point in the history of the provision of payment services concerns the availability of cash at automated teller machines (ATMs). The impact of ATMs has been such that Paul Volker, a former Secretary of the United States Federal Reserve, noted in 2009 that ATMs were the most important financial innovation in the last twenty years (Hutton, 2019).

The first electronic teller (or ATM) was put into service in 1967 by Barclays bank in the United Kingdom.[40, 41] Then, along with electronic tellers, came ATM cards. With an ATM card and a password, users can withdraw cash, at an ATM, from their balances with a financial institution.[42] The importance of ATMs lies with the fact that, today, they are the point at which users of the financial system can convert their electronic money into physical money, doing so quickly, easily, and practically anywhere and at any time.

Technological advances have made electronic payments increasingly simple. A global telex network allowing payment messages and instructions to be transmitted across borders existed as early as 1966; this telex network was replaced by the use of the telephone network and fax machines in the 1980s. In 1968, what is now commonly known as the Bank Automated Clearing Service (BACS) was established in the United Kingdom.[43] It permits the clearing and settlement of interbank electronic transfers, through which payments are made to suppliers and for pensions, payrolls and public utilities. These same services have been provided in the United States since 1972, with implementation of the first automated clearing house (ACH) by the Federal Reserve Bank of San Francisco. In 1970, the Interbank Clearinghouse System (CHIPS) was established. Together with Fedwire[44], it provides the infrastructure for large-value electronic payments in the United States. In 1973, 293 banks in fifteen countries founded the Society for Worldwide Interbank Financial Telecommunication (Swift) to make cross-border payments.

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40 The first ATM did not use cards. It allowed cash withdrawals when depositing a special check issued by the same bank. The check had a slightly radioactive mark and a fixed denomination of ten pounds sterling. With invention of the ATM came the use of the four-digit identification key (or PIN: personal identification number) (Milligan, 2007).

41 In Colombia, the first ATM network was installed in 1975 by *Banco de Colombia*, and the card became known as the 7-24 ATM, which was renamed Llavebanco in 1980 (see *El Tiempo*, 1992).

42 At that time, however, paying with an ATM card at stores was not as easy as paying with a debit card.

43 These inter-bank electronic transfer clearing and settlement services are provided in Colombia by ACH Colombia and ACH Cenit. ACH Colombia was created in 1997 by institutions in the financial system, which are shareholders of the company with the same name. ACH Cenit, operated by the *Banco de la República* since 1999, primarily serves to channel drafts and payments from the nation to territorial entities (see Ortega and León, 2018).

44 As mentioned, Fedwire was created at the beginning of the 20th century as a system for the transmission of interbank payments based on a closed telegraphic network. In the early 1970s, Fedwire was converted from a system operated by telegraph to an electronic one.

In the 1970s, with the rapid growth of the credit card market, the possibility of a cashless society began to emerge (Evans and Schmalensee, 2005). The tremendous success of Visa and MasterCard credit cards came with three technological advances. First, in 1969, magnetic strips developed by IBM allowed cards to carry information electronically for the first time. Secondly, in the late 1960s, the development of point-of-sale terminals allowed the electronic information contained in the magnetic strips to be read. Thirdly, in the early seventies, the development of computer and communication systems allowed point-of-sale terminals to communicate with information centers so transactions could be authorized electronically, with greater security and speed. Based on these three developments, Visa and MasterCard implemented systems in 1973 that reduced the time needed to authorize a credit card transaction from minutes to a few seconds, while curbing fraud as well [45] Yet, it was only as of the late 1970s that electronic payment terminals based on the Visa and MasterCard networks became popular (Sorensen, 2019). The chip card, also known as the smart card, was invented in 1975. It offered security advantages compared with magnetic strips, but only was used in the mid-1980s for debit cards in Europe.[46]

New players appeared in the credit card market in the 1980s. Large non-financial companies such as AT&T, General Electric, and General Motors decided to enter the business through the MasterCard and Visa brands, for which they acquired or partnered with banks. Credit cards linked to loyalty programs, such as airline mileage programs, appeared as well. This gave further impetus to the credit card market and the use of electronic payment instruments.

The eighties also are recognized as a test period for using the internet and the World Wide Web for banking and online payments.[47] As an example, in 1980, United American Bank, a community bank in Knoxville, Tennessee (USA), offered its customers what is recognized as the first home banking service. It required a monthly subscription, a computer, a modem and a television, and allowed customers to pay bills, check balances and transactions, and apply for loans. Other banks around the world soon followed suit, most notably Nottingham Building Society (UK), with its HomeLink

45 In the case of Visa, this new system reduced the average authorization time for a transaction from four minutes to 40 seconds (Evans and Schmalensee, 2005). In terms of security, electronic authorization avoids the use of paper receipts onto which the card data is transferred mechanically; processing those receipts took days and facilitated fraud.

46 Chip technology allows the user's password to be stored more securely than with magnetic strips and, as such, does not require electronic confirmation with a central information facility. For that reason, debit cards with chips became the preferred option in Europe in the mid-1980s, when the cost of electronic communication was high, and reliability was low. In contrast, the low cost and high reliability of electronic communication in the United States made the use of chip technology unattractive until the beginning of the twenty-first century (Evans and Schmalensee, 2005 and Sorensen, 2019).

47 The internet refers to the network of physical infrastructure for an exchange of data, while the worldwide web refers to the information system through which different kinds of data are exchanged. Viewed differently, the internet is the physical infrastructure through which the worldwide web allows data to be exchanged. In general, this section uses the term online to refer to use of the internet and the worldwide web.

service, which also allowed retail purchases.[48] In 1983, Intuit Inc. launched Quicken, a program that allowed its users in the United States to keep track of their bank accounts, manage budgets, print checks, and perform certain transactions electronically. In 1984, Prodigy was launched, an online service that offered its subscribers a variety of products, including the ability to connect with their banks to access their information and to make payments, transfers, and purchases; however, unfriendly interfaces, as well as the collection of monthly subscriptions and other charges by the banks, led to a reduction in its use.

In the late 1980s and early 1990s, banks in the United States began to offer their own online banking platforms. These platforms, which had to be installed from a floppy disk, made it possible to consult historical account information, download spreadsheet data, and make and schedule payments and transfers (among other services). Then came the world wide web-based platforms, which initially contained business information, but without access to account information or transactional capabilities. Wells Fargo is recognized as the first large bank to allow customers access to their account information via the World Wide Web (in May 1995).[49] Shortly thereafter, Wells Fargo made it possible to make and schedule payments and transfers. The first virtual banks (without physical branches) appeared in 1996.

Access to banking services through the World Wide Web began to displace access based on platforms such as Prodigy, Quicken, and Microsoft Money. By the end of the 1990s, most banks in the United States were offering worldwide online banking services.[50] The 1990s also are recognized as the decade when the internet and the World Wide Web changed the way financial payment services are provided. With the turn of the century, online banking ushered in the new benefits of virtual banking and the possibility of conducting transactions without personal interaction between customers and banks (FSB, 2017).

Along with the internet and the World Wide Web, another type of card emerged in the 1990s: the debit card. These cards not only permitted withdrawals from ATMs, but also allowed payments to be made in shops from the customer's balance with a financial institution. Although this type of card had existed since the 1970s, its use was not particularly common; in fact, its issuance and use were important only in Europe.[51] The

48 The first recognized online purchase occurred in 1984. It was an order for groceries from a supermarket in the United Kingdom.

49 Months earlier, in October 1994, The Stanford Credit Union launched what is acknowledged as the first website in the banking industry.

50 By 2000, it was estimated that 80% of banks in the United States offered online banking services (Sarreal, 2017). Also, in 2000, an estimated 41 million people in the United States purchased a product over the internet and 14 million people used online banking services. According to surveys at that time, convenience and saving time are the determining factors in the use of online banking (Fox, 2002).

51 U.S. banks were not initially interested in debit cards because, unlike credit cards, it was not clear that debit cards would be a profitable business for them. Visa and MasterCard offered to charge a lower fee for debit cards to encourage their use. However, there was now a preference in Europe for using debit cards rather than credit cards (Evans and Schmalensee, 2005).

use of debit cards became more widespread because ATM cards were transformed into debit cards in the 1990s (which serve both purposes). Another factor was the installation of terminals that allowed the entry of PINs to make purchases, and enabled the use of credit and debit cards in shops. Consequently, as of the 1990s, debit cards began to be an electronic payment instrument on a par with credit cards. Moreover, since the 1990s and into the first decade of the 21st century, a synergy has developed between the internet and the use of cards, thanks to which credit and debit cards have facilitated online payments by users of the World Wide Web and have gained importance among the payment options available to the public.

4.1.3 *Fintech* 3.0: Wide-ranging Provision of Financial Services

The global financial crisis that began in 2007 marked an important point in the development of payment services. A cyberpunk trend of thought, which emerged as a result of discontent with the traditional financial system and national governments, is confident that computers and cryptography can free and protect people (*The Economist*, 2018; Cross, 2018). As part of this trend, bitcoin was launched in 2009 by Satoshi Nakamoto, which is the pseudo name of the person or group of persons who developed it.

Bitcoin has two fundamental features. First, it is a new digital asset that is independent of any central bank or government, is of limited issue, and its value is determined by the free play of supply and demand. Secondly, it is a technology capable of keeping a distributed, encrypted, permanent and growing register of all transactions, which serves to verify the availability of bitcoin and prevents the asset from being spent more than once by users.[52] Such technology is known as blockchain and represents a fundamental difference in the way transactions and wealth are registered.[53]

Initially, the motivation behind bitcoin was to offer an electronic cash system independent of central banks and governments. It would be possible to pay online with bitcoin, in a peer-to-peer network, without financial system intermediaries (Nakamoto, 2008). However, bitcoin's acceptance and use as a payment instrument is limited, as is the case with other similar systems that came later[54] (Meiklejohn *et al.*, 2013; Ali *et al.*, 2014; DNB, 2018; Surowiecki, 2018; JP Morgan, 2018; Cross, 2018; Wood, 2018; Kharif, 2018). In time, the vision of bitcoin and altcoins not as new payment instruments but as a new type

52 Before bitcoin, there were others that resembled its intent on being an electronic cash system based on cryptography. However, the great contribution of bitcoin is its recording technology (i.e., blockchain), which prevents the asset from being spent more than once (i.e.: double spending).

53 The payment recording process did not change with the switch from analogue to digital technology (in Fintech phases 1.0 and 2.0). Traditional payment registration is done centrally, with participants relying on a central agent that debits the sender's balance and credits the receiver's balance. The emergence of blockchain and distributed registration technology represents a significant change in the way payment systems can operate, as it is no longer necessary to have a central entity that agents must rely on to register their wealth.

54 The systems that came after bitcoin are commonly known as altcoins. There are about two thousand altcoins, such as etherum, litecoin, monero, and zcash.

of asset has gained ground. This is the reason why the term *cryptoassets* is preferred to *cryptocurrencies* (BCE, 2015; Arango *et al*., 2018; Parra *et al*., 2019).

Although bitcoin and altcoins have not managed to position themselves as digital currencies, the idea has gained strength among governments, central banks, technology companies and financial institutions. Some proposals for digital coins include the use of a public distributed registration system (i.e., without entry clearance[55]), such as blockchain for bitcoin. Others initiatives seek for a distributed registration system, but one that is private. The initiatives come from many directions, including central banks, financial institutions and fintech companies. Box 3 in this section of the report looks at digital currencies.

Besides the novelty of bitcoin as an independent, blockchain-registered digital asset, its creation coincided with the emergence of new players in the provision of services that were previously limited to financial institutions, such as payment services. Like bitcoin, these new players found an environment conducive to competing with financial entities. Public distrust, greater demands placed on financial institutions by regulators, who also encouraged more competition in the provision of financial services, and higher expectations from consumers with experience in online shopping, led to the arrival of new players seeking to compete with financial institutions (Desai, 2015a; Arslanian and Fischer, 2019). The bad times for the financial system were then compounded by the availability of free software and the huge capacity offered by cloud computing[56], which made it easier than ever to start up a technology-related business (Robinson and Verhage, 2018). In that environment, the first non-financial payment-related technology companies were born. Their aspiration was to compete with the business model that had prevailed for several decades, and they sought to make any payment as easy as an online purchase.

The contribution non-financial companies have made to the development of payment services differs geographically. In countries where access to and use of payment banking services (e.g., debit cards, credit cards, inter- and intra-bank electronic transfers) is massive, non-financial firms have offered services that complement or enhance the experience of users, be they payment originators or recipients. These are known as *wrappers*, and they improve the user interface and accessibility of existing systems (Ali et al. 2014). Companies such as Paypal, Venmo, Apple Pay, Google Pay, Transferwise and Stripe are an example. Some of these systems belong to large technology firms such as Amazon, Apple and Google (RSP, 2019). In that sense, it is not only new technology companies that contribute to the provision of financial services, but also those already positioned in fields as

55 In a public distributed registration system, anyone can access the network, read, write, and participate in the registration system. In a private one, participation is limited, based on permission granted by those who control the system.

56 Cloud computing refers to the distribution of technological resources on demand over the internet, on a pay-per-use basis. Accordingly, access, computing capacity, storage and databases can be obtained according to the customer's needs, without owning or maintaining physical servers and data centers (AWS, 2020). Cloud computing allows for combining computing power with connectivity and data availability in a flexible manner, which is particularly important to fast-growing, digitally focused startups (Arslanian and Fischer, 2019).

diverse as e-commerce, design, the manufacture and sale of computer-related products and services, and internet-related services and products (known as *techfins*).[57]

On the other hand, in countries with limited access to banking services, non-financial firms have sought to supply the market that is not served by the financial sector. In that respect, the determining factor in the growth of virtual financial services does not appear to be the effect of the mistrust in the financial system that was generated in the wake of the global financial crisis, but rather the failure of the financial system to provide payment services, as well as private and public-sector support to enterprises that try to improve the population's access to such services. Accordingly, in emerging markets, especially in Asia and Africa, there are several celebrated cases of non-financial companies successfully providing payment service.

In focus 5
Some examples of Wrappers

Paypal: Founded in 1998, it operates a system that allows for online transfers and payments.

Venmo: Available since 2009, this is an electronic wallet that allows payments to be made from the balances in that wallet, or from debit or credit cards. It has been a Paypal subsidiary since 2013. Initially, it served to distribute payments (e.g., pay a restaurant bill) among users.

Apple Pay, since 2014, and Google Pay, since 2018 (the year Google Wallet and Android Pay combined), allow P2B (people to business) and P2P payments from mobile phones, with contactless technology (i.e., NFC: near-field communication).

Transferwise: Founded in 2010, it executes electronic fund transfers between banks in different countries, doing so at a fraction of the cost of a bank and, in some cases, in just a few minutes.

Stripe: Founded in 2009, this is a platform that facilitates online commerce, allowing for the receipt of payments, billing processes and management of subscriptions, among other transactions.

In Asia, the best-known case is Alipay in China, which is a virtual payment platform founded in 2004. It is owned by the Alibaba Group, the Chinese e-commerce giant (see the following shaded section).

Alipay allows the initiation of payments and transfers linked to credit and debit cards, while providing payment services for Ant Financial, the financial services entity also owned by the Alibaba Group. It is important to point out that Alipay allows payments to be made from computers and mobile devices, with different access mechanisms such as facial recognition (from March 2015) or QR codes (see the following shaded section).

57 Techfins are technology companies that find ways to improve the provision of financial services as part of a broad range of products and services (Marous, 2018). It is common for these firms to develop new ways to initiate payments, but with the use of traditional payment instruments. Such is the case with Apple Pay, which uses traditional credit cards or the Apple Card.

In focus 6
How Alipay Developed

Alipay was created in 2004 as the payment department of Taobao, the online trading platform of the Alibaba Group. Alipay acted as a third party in the sense that it temporarily held the buyer's payment to the seller until the product arrived to the buyer's hands, in the condition as advertised. Taobao and Alipay were so successful that investing those resources in the Alibaba Group's money market investment fund (Yu'e Bao, which translates as "treasure of the leftovers") helped the latter to grow tremendously (i.e., it was the largest in the world by 2017, with 588 million investors and over 200 billion dollars in assets).

Yu'e Bao's success, as well as the high yields it offered compared to those to be earned on a traditional bank deposit account, made it a virtual wallet alternative in Asia. Users can make their payments through Alipay, in person or online, from their balances deposited with Yu'e Bao, which have a competitive rate of return.

Alipay became Ant Financial Services in 2014, but the payment platform retains its name. Ant Financial Services currently is recognized as the fintech company with the highest market value in the world. Today, Alipay allows for a wide variety of retail, online and face-to-face payments, as well as interbank transfers, payments of bills, and mobile top-ups, in addition to serving Taobao.

In 2015, Alibaba created MyBank, an online bank designed to provide inclusive and innovative solutions for individuals and businesses that lack adequate access to banking products. The granting of low-cost credit is free of human intervention, takes only a few minutes, and uses Alibaba's broad customer base, as well as Alipay's vast database.

In focus 7
The QR Code[1]

The QR code (quick response code) was developed in 1994 by Denso Wave, a technology subsidiary of the Japanese automaker Toyota. It was created as an improvement over the barcodes that existed at the time (i.e., one dimensional). Denso Wave addressed the limitations of existing barcodes, which did not allow for efficient management of the process used to manufacture its products. Through the use of two dimensions, it was able to include up to 200 times more information, in less space, with processing that was up to ten times faster.

Other advantages have allowed QR codes to be used in a variety of fields, including payments. First, they can be read by a special reader or by any device that has a camera (e.g., a mobile

1 Based on Hartung (2014), Tiwari (2016) and Denso Wave (2020).

phone). Second, the codes can be read under various conditions, including different angles and different surfaces (including various types of screens). They even can be read if they are not in perfect condition. Third, the information can be encrypted. Fourth, the codes are easily generated by merchants or users; for example, the QR code below allows access to *Banco de la República*'s website where all the Payment System Reports are stored.

QR codes, as part of existing payment services, became popular around 2011 when they began to be implemented by Alipay (of Alibaba) and WeChat (of Tencent) in China. However, a few years earlier, Starbucks and other merchants had begun using them to initiate payments. Later, MasterCard (MasterPass QR) and Visa (mVisa) started to use this technology in several countries in Asia and Africa.

In Africa, access to banking services is particularly limited and less than in Asia. Telecommunication companies in Africa have spearheaded the development of products that seek to provide the population with basic services such as payments and deposits (which the financial sector been unable to supply). These products have been developed around the creation of e-money deposits that can be managed from mobile phones, with text messages (SMS: short message service), and allow payments, transfers and conversion to cash to be done easily and at low cost. The best-known case is M-Pesa in Kenya. It has been available since 2007 and is offered by Safaricom, a subsidiary of Vodafone (in the United Kingdom). The success of M-Pesa has allowed other services to be added, such as the overdraft service offered by M-Pesa through Fuliza, and interoperability with similar products supplied by other Kenyan telecommunications companies (e.g., Airtel Money, Equitel Money).

Other countries in Africa have replicated Kenya's e-money model, which is internationally recognized for its results in providing access to financial services.[58] Latin America and Southeast Asia are also examples of how unmet demand for basic payment and transfer services is a key factor in the growth of fintechs (Frost, 2020).

58 Despite being a recurring example of financial inclusion, the M-Pesa e-money model has had unintended effects in Kenya and other countries. Among others, these include the existence of credit under extremely unfavorable terms for the borrower (i.e., at usury rates); credit being granted to those with no capacity to pay, who easily default and whose credit and employment history are negatively affected as a result; and considerable growth in the gambling industry (Kimani, 2020, Taylor, 2020).

4.2 Prospects

Innovation in technology-based financial payment services is not new but it has changed, particularly in terms of its origin and aim. Today, there are high expectations about what fintechs can achieve with respect to access to financial products and services, and financial inclusion (Frost, 2020). The three kinds of payment-service innovations witnessed in the fintech 3.0 stage; i.e., digital currencies, wrappers and e-money (Ali et al., 2014), are new players and new services that need to be studied and addressed by financial authorities in an effort to promote more and better payment alternatives for the general public. Other technology-based alternatives, such as open banking, also have the potential for innovation in the provision of payment services (see Box 2 in this section).

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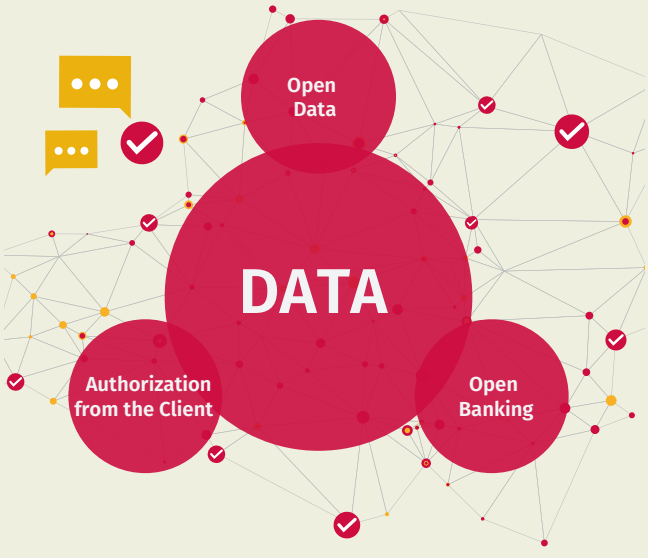
Box 2
Several Payment Aspects of Open Banking: the International Experience

The ease of using data on financial consumers, thanks to its storage, processing and analysis, has generated know-how and encouraged a number of innovations in areas such as payment services. Supported by digital technology, these innovations currently offer new value-added services to the owners of data (the customers of financial institutions). Therefore, the synergy between financial information and the participation of new actors (third parties) requires incorporating the custodians of that information (financial entities). This has given rise to open banking, which is protected in various countries by the necessary regulatory frameworks.[1]

According to the BIS, the concept of open banking originates with authorization from the customers of financial institutions to allow an exchange of their data[2] (Diagram B2.1). Although such authorization from third parties has been permitted for some time (e.g., automatic debit), the current situation is characterized by greater use of technology (broad coverage of digital devices, development of techniques such as data aggregation, and connectivity). This has generated a trend towards the creation of new applications[3] and products that have led to innovations in payment services, loans and mortgages, investments and account services.[4]

In general, the concept of open banking can be framed by the development of the data economy, which can be defined as the set of initiatives, activities or projects whose business model is based on the exploration and exploitation of existing database structures

Diagram B2.1
Customer Authorization: A Requirement for Open Banking



Source: *Banco de la República.*

(traditional and from new sources) to identify opportunities for creating products and services.[5] The data economy, as it applies to the financial sector, has several dimensions. These include (1) open payments, which deal with the opening up of financial data and competition exclusively for payment services; (2) open banking, which considers not only payment services, but also other banking services such as financing and savings; and (3) open finance, a dimension that extends the opening up of data and competition not only to the provision of services by the banking sector, but also to other types of financial institutions, such as investment funds and insurance companies.[6]

Accordingly, this box focuses on the first of those dimensions: open payments, which are understood as an initial service of what is known as open banking. The innovation in payment services (those that allow the transfer of money) has been reflected in a broader perception of transparency with respect to payment accounts and access to information and data transmission.[7]

Specifically, in terms of regulatory progress towards access to information on the customers of financial institutions and the transmission of data to third

1 Minsait. *IX Informe Tendencias de Pago*. 2019. AFI, Ariel & Telefónica.

2 BIS and the Basel Committee on Banking Supervision (2019). *Report on Open Banking and Application Programming Interfaces.*

3 Known as an application programming interface (API), this allows data to be transmitted from one user to another. In the case of payment services, data is transmitted from the payer to the merchant.

4 BIS and the Basel Committee on Banking Supervision (2019). *Report on Open Banking and Application Programming Interfaces.*

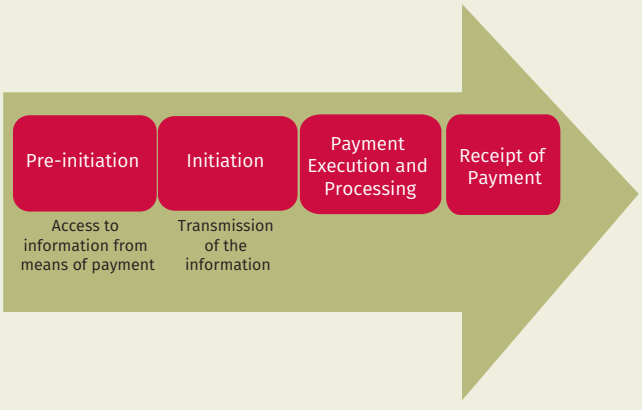
5 Fundación la Carolina (2017). *Economía de los datos*, Barcelona, Spain. Editorial Ariel.

6 Minsait. *IX Informe Tendencias de Pago*. 2019. AFI, Ariel & Telefónica.

7 BIS and the Basel Committee on Banking Supervision (2019). *Report on Open Banking and Application Programming Interfaces*

parties, Diagram B2.2 shows the first two stages of the payment process where the two activities mentioned are carried out. It then refers to international experience, the reasons that have so far led countries such as Canada to study the relevance of such regulations, and the progress made by the European Union and the United Kingdom.

Diagram B2.2
The Activities Involved in the Payment Process



Source: Committee on Payment and Settlement Systems, Innovations in Retail Payments (2012); adaptation by *Banco de la República*.

1. Canada

The government of Canada created the Open Banking Advisory Committee, spearheaded by the Ministry of Finance. In January 2019, it released for comment "A Review of the Merits of Open Banking," a document that initiated the debate on the need for open banking in Canada. With the conclusions from that debate, a second phase is expected in which the Committee will evaluate considerations regarding implementation.[8]

This document outlines the benefits and risks of open banking and presents case studies on countries where it has been implemented. Open banking is defined as reliable authorization from consumers and businesses to third parties (financial service providers) to access their financial transaction data, using secure online channels. These providers are expected to meet standards of privacy, security and operational stability, doing so through the use of secure data sharing mechanisms or application programming interfaces (APIs).

The expectation with open banking is that costs will be reduced and the capacity of individuals and companies to manage financial services and a wide range of products will be improved, all under protection of the consumer. The document establishes that some jurisdictions include payment initiation, whereby third-party financial service providers can make payments on behalf of consumers and small businesses, doing so directly from their bank accounts. Accordingly, the suggestion is that, in Canada, the company known as Payments Canada should work on modernizing the infrastructure for retail and large-value payment systems, so that, if open banking is implemented, an alignment with payment modernization would be expected.

It is implied that open banking can expand the number of customers for large, medium, and small banks. In the first case, this would be accomplished by forging partnerships with companies that combine other services with banking. For medium and small banks, it would mean easier account switching processes or less friction from having accounts with different providers.

For new financial service providers, such as *fintech* companies, open banking would drive their growth quickly and independently by providing them with access to data. With the consumer's consent, *fintech* companies would be able to access the necessary financial transaction data and provide independent services to the customer's bank. This access can also improve the extent to which customers rely on *fintech* companies by optimizing interoperability between different systems.

According to the roadmap, once the feedback stage has been completed, it would be possible to proceed with the implementation of open banking.

2. European Union

The second Payment Services Directive (PSD2) is European legislation that took effect at the beginning of 2018.[9] It allows regulated third parties, with the consent of the customer, to access information on the customer's account with a financial institution or to initiate payments. The aim is to attract new payment service providers and technology companies to enter the market and to create more innovative services for customers.[10]

The development of the financial and digital sectors incorporates the existence of third parties that provide payment services. They are allowed to access the data and products of the customers of financial institutions, with authorization from the owners and according to the principle that the personal and financial information on bank customers belongs exclusively to

8 See https://www.canada.ca/en/department-finance/programs/consultations/2019/open-banking.html, y https://www.payments.ca/industry-info/our-research/payments-perspectives/open-banking-common-good

9 January 13.

10 See https://www.openbanking.org.uk/about-us/

them and not to the financial institutions or companies that may offer new services. Therefore, it is the customers who decide on the use of their data.[11]

The European Union's PSD2 authorizes third parties to consult account information and to initiate payments, guided by the principles of transparency, relevance and security, among others. The intention behind these principles is to make sure the payment process functions properly.

The PSD2 regulations regarding access to and use of payment account information and access to payment accounts in the case of payment initiation services are detailed as follows.[12]

2.1. Payment Account Information Services and Rules on Access to Information and Its Use

a. Member States of the European Union shall ensure the payment service user has the right to use services that allow access to account information. Said right shall not apply if the respective payment account cannot be accessed online.

b. The account information service provider:[13]

- shall provide its services only with the explicit consent of the payment service user.
- shall ensure the payment service user's personalized security credentials are not accessible to third parties, apart from the payment service user and the issuer of those credentials, and when they are transmitted by the account information service provider, transmission shall be done through secure and efficient channels.
- shall identify itself, in each communication, to the payment service provider(s) managing the payment service user's account and shall do so in a secure manner. [14]
- shall access only the information on the designated payment accounts and the respective payment transactions.
- shall not request sensitive payment data linked to the payment accounts.
- shall not use, store or access any data for purposes other than to render the account information service expressly requested by the payment service user, in accordance the rules on data protection.

c. With regard to payment accounts, the payment service provider managing the account:

- shall establish secure communication with account information service providers.
- shall handle requests for data transmitted through the services of an account information service provider without discrimination, except for objective reasons.

d. The provision of account information services shall not be conditioned to the existence of a contractual relationship to that effect between the account information service provider and the payment service provider managing the account.

2.2 Regarding the Rules for Access to the Payment Account in the Case of Payment Initiation Services

a. Member States shall ensure a payer has the right to use a payment initiation service provider. That right shall not apply if the relevant payment account cannot be accessed online.

b. If the payer expressly consents to a payment being made, the payment service provider managing the account shall ensure the payer is able to exercise his/her right to use the payment initiation service.

c. The payment initiation service provider:

- shall, at no time, hold the payer's funds in connection with provision of the payment initiation service.
- shall ensure the payment service user's personalized security credentials are not accessible to third parties, with the exception of the payment service user and the issuer of the personalized security credentials and are transmitted through secure and efficient channels.
- shall ensure any other information about the payment service user that is obtained in the course of providing payment initiation services is supplied exclusively to the beneficiary and only with the payment service user's expressed consent.
- shall identify itself to the payment service provider managing the account of the account

11 See https://bbvaopen4u.com/es/actualidad/la-psd-la-normativa-que-abrio-camino-la-psd2, March 18, 2020.

12 European Parliament and Council of the European Union (2015). Directive 2366.

13 The account information service is offered online, and the purpose is to provide aggregated data on one or more payment accounts held by the payment service user with either another service or payment provider or with several payment service providers. This service is rendered by individuals or legal entities.

14 Payment service providers include credit institutions, electronic money institutions, money order institutions, payment institutions and central banks. The account manager (e.g., the credit institution) is responsible for the accounts of the payment users.

holder each time a payment is initiated, doing so in a secure manner.
- shall not store sensitive payment data on the payment service user.
- shall not ask the payment service user for any data other than that which is necessary to provide the payment initiation service.
- shall not use, store or access any data for purposes other than to render the payment initiation service expressly requested by the payer.
- shall not modify the value, the recipient or any other element of the transaction.

d. The payment service provider managing the account:

   - shall establish secure communication with payment initiation service providers
   - shall immediately, upon receiving a payment order from a payment initiation service provider, supply or make available to the payment initiation service provider all information on initiation of the payment transaction to which it has access in relation to execution of the payment transaction.
   - shall treat payment orders transmitted through the services of a payment initiation service provider without any discrimination whatsoever with respect to payment orders transmitted directly by the payer, except for objective reasons, particularly with regard to timing, priority or applicable charges.

e. The provision of payment initiation services shall not be subject to the existence of a contractual relationship to that effect between the providers of payment initiation services and the payment service providers managing accounts.

3. United Kingdom

Open banking was established in the United Kingdom in 2018 by the Competition and Markets Authority (CMA)[15], so as to provide for the regulation of data management in financial entities.

The nine largest banks in the United Kingdom[16] were requested to manage data openly, thereby allowing new *fintech* companies access to information.[17]

In 2016, the CMA created an independent entity for the implementation of open banking (OBIE).[18] Its commercial name is Open Banking, and the country's large banks participate in it to define a standard for implementing open banking services.[19] This entity is regulated by the CMA and financed by the nine largest banks and building societies[20] in the United Kingdom.[21]

The purpose of Open Banking Limited[22], among other objectives, is to design specifications for the application program interfaces (APIs) banks and construction companies use to provide open banking securely; to support third-party regulated providers, banks and construction companies in applying the standards for open banking; to create security and messaging standards; and to manage an open banking directory that allows regulated participants, such as banks, construction companies and third-party providers, to register for open banking.

With the adoption of API technology, financial providers have enrolled in this UK open banking scheme (which is regulated by the Financial Conduct Authority)[23], creating a transparent network of banking data in the United Kingdom.

The services being provided include, among others, publicly available information on branches and ATMs (opening hours and locations), and banking products and fees, in addition to allowing third parties access to account information, transaction information and payment initiation.[24] There are specifications as to how banks allow a regulated third party, with the customer's consent, to securely access the customer's account and request account information or payment initiation.

With the foregoing, payments can be made directly from banks' payment accounts, such as personal and business checking accounts, credit cards and e-money accounts, through online or mobile banking, and with regulated third parties (applications and websites, with requirements such as read/write, security, and

15 Competition and Markets Authority.

16 HSBC, Lloyds, Nationwide, Barclays, RBS, Santander, Bank of Ireland, Allied Irish Bank and Danske Bank.

17 Fintech companies (financial technology) https://www.businesscloud.co.uk/news/the-explainer-open-banking-and-apis

18 Open Banking Implementation Entity.

19 See https://bbvaopen4u.com/es/actualidad/el-open-banking-mas-alla-de-las-fronteras-europeas

20 A financial institution that specializes in offering savings accounts and mortgage loans.

21 See https://www.openbanking.org.uk/about-us/

22 See https://www.openbanking.org.uk/about-us/

23 See https://www.businesscloud.co.uk/news/the-explainer-open-banking-and-apis

24 BIS and the Basel Committee on Banking Supervision (2019). *Report on Open Banking and Application Programming Interfaces*

operational and customer management profiles).[25, 26] The security of open banking is the same as it is at the bank level, with proven software and security systems. It is the users who choose when and for how long to allow access to their data. In addition, there are data protection and financial consumer protection laws.[27]

In conclusion, open banking gives financial clients sovereignty over their data, allowing them, under conditions of transparency and security, to authorize a third party to request information on their accounts with financial entities, thereby enabling the third party to offer various financial services or to initiate payments. This new trend (the data economy) is based on a technological parameter for an exchange of information on data, through a joint effort between financial entities (payment accounts) and the different companies offering financial services, which is why it requires adequate regulatory support.

25 See https://www.openbanking.org.uk/customers/faqs/

26 https://standards.openbanking.org.uk/

27 See https://www.openbanking.org.uk/customers/faqs/

Box 3
Central Bank Digital Currencies

1. Introduction

The recent interest in digital currencies expressed by international organizations, central banks, and research groups has led to numerous discussions, forums and surveys intended to find out more about the topic.[1] A digital currency issued by a central bank (or CBDC) is a form of currency that resembles what is known as fiat money and, therefore, must comply with all the attributes of this type of currency.[2] According to Boar, Holden and Wadsworth (2020), publicly issued digital currencies can be for use by the general public and merchants (i.e., retail or general-purpose CBDC), or for use by financial institutions to settle wholesale payments (interbank and other transactions) in the large-value payment system (i.e., wholesale CBDC). This box focuses on retail or general-purpose CBDC, given the impact their potential issue could have on the circuit of payments between individuals and companies.

2. General-Purpose Digital Currencies

According to the Committee on Payments and Market Infrastructures (CPMI-MC, 2018), a general-purpose CBDC could be defined as an electronic obligation of the central bank, denominated in the existing unit of account, which would serve as a payment instrument and a store of value. A digital currency of this sort could complement or replace cash (banknotes and coins) in circulation and could be available for much broader use than just retail payments (Boar et al., 2020). With general-purpose CBDCs, transactions could be conducted with wide acceptance (person-to-person, person-to-business, and business-to-business) and without any network restrictions (Mancini-Griffoli et al., 2018).

Transfer technologies for this type of currency can be based on accounts, or on securities or tokens. With account-based CBDC, both individuals and businesses must open an account with the central bank to make payments using digital currency. With value-based Central Bank Digital Currencies (token-based CBDC), users must deposit CBDC units in their electronic wallets in order to conduct their transactions (CDBC WG, 2019). An important difference between these technologies is that access with the first (account-based CBDC) depends on an identification system, with the second (value-based CBDC or token-based CBDC), it depends on cryptographic schemes that do not require its users to be identified (Auer and Böhme, 2020). To better understand how payments are transferred through each technology, Diagram B3.1 reproduces the example proposed by Mancini-Griffoli et al. (2018).

With account-based technology (top of Diagram B3.1), user A logs into his/her central bank account via a web page or an application on his/her mobile device (smartphone or tablet) to send a payment to user B. Before transferring the funds, the central bank verifies the authority of the participant ordering the payment from that account, whether or not there are sufficient funds in the account, and the authenticity of the user receiving the payment. If positive, the amount being transferred is credited to user B's account and this information will be used by the central bank to update its master ledger.

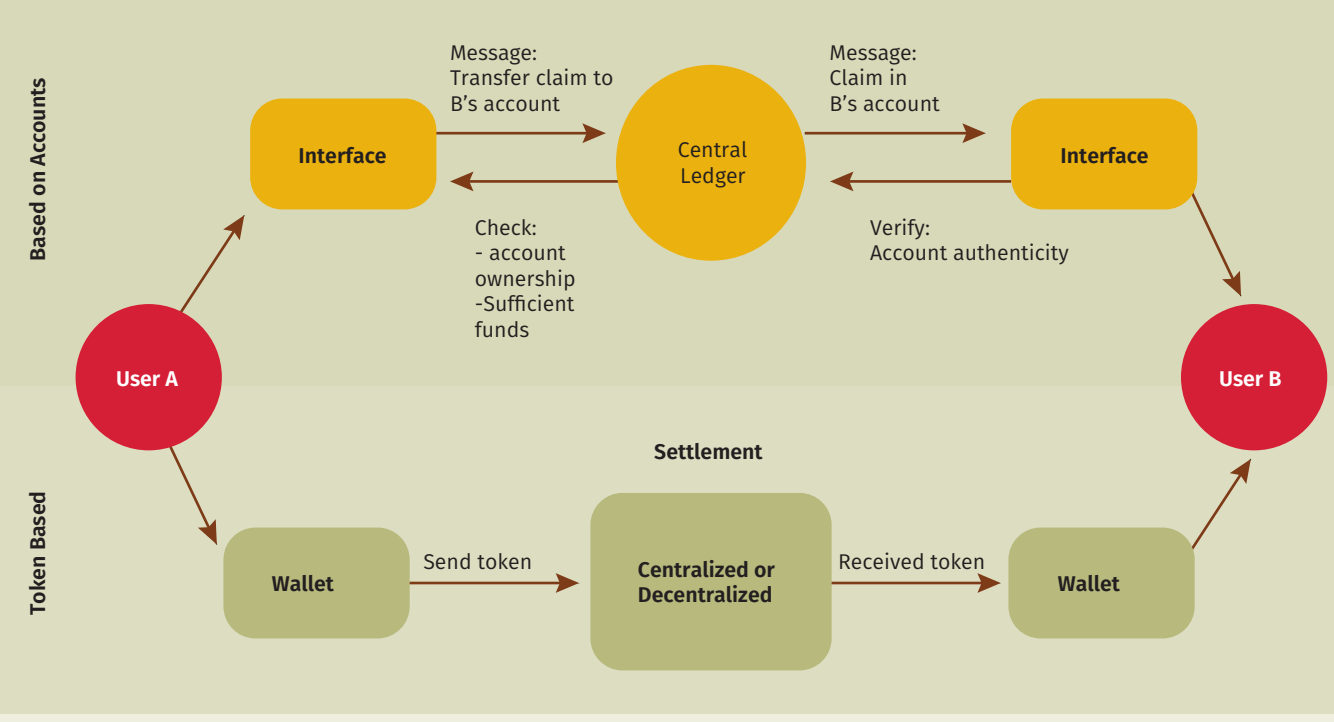
With token-based technology (bottom of Diagram B3.1), the funds are transferred between electronic wallets, and the transfer is subject to external verification through a transmission mechanism that can be centralized or decentralized. With a decentralized transmission mechanism, settlement depends on distributed ledger technology (DLT), which can be used in a closed network operated by the central bank. A centralized transmission mechanism depends on a centrally controlled infrastructure (Auer and Böhme, 2020), which consists of checking the validity of token serial numbers in order to reassign them once the tokens change hands. The degree of anonymity surrounding the transaction will depend on external verification of the tokens, or on registers kept on the movement between wallets and the transaction information (Mancini-Griffoli et al., 2018).

The design of a general-purpose CBDC may embody some flexible features, such as the degree of anonymity its users would have, the protection it would provide against loss and theft, its scalability, and the possibility of earning interest (Mancini-Griffoli et al., 2018). The first of these features depends on the transfer technology and, as mentioned, token-based CBDC allow for a higher degree of anonymity than account-based technology, since the latter requires identification of the

1 These research groups include the Cemla and Fintech working group in CBDC (CDBC WG), and the Fintech Advisory Group for Central Banks of the Caribbean Community (Caricom), among others.

2 According to Rollins (1917), fiat money is defined as money issued by the government. Therefore, it is legal tender and must be accepted at face value.

Diagram B3.1
General-Purpose CBDC Transfer Technologies



Source: Mancini-Griffoli *et al.* (2018).

user who holds the money (CDBC WG, 2019). However, the greater the degree of anonymity, the more difficult it is to reverse fraudulent transactions. Scalability refers to the possibility of increasing the amount of transactions allowed. Considering that central banks may be much more willing to offer a greater degree of anonymity to participants in a transaction for small holdings of CBDC, it is clear the scalability of this digital currency may be limited by the degree of anonymity established in its design. Another flexible feature of a general-purpose CDBC would be to allow it to earn interest, in which case monetary-policy transmission would be affected (strengthened) (Mancini-Griffoli et al., 2018). According to the Payments and Market Infrastructure Committee (CPMI MC, 2018), technically it would be possible to pay interest on general-purpose CBDC based on accounts and values (tokens), which could generate changes (incentives or disincentives) in the demand for digital currency, depending on the difference between the rate on CBDC and the rate banks pay on deposits.

The main purpose of retail CBDCs would be to enable the population to make payments more quickly and at lower cost. These digital currencies would differ from electronic payments made through bank cards and electronic funds transfers in that individuals and businesses using such payment services could hold money virtually, without involving a bank or other financial institution (World Economic Forum, 2020). They also would be different from those offered by the private sector, since they would be issued exclusively by the central bank and would be stable currencies, because they are the only ones that could be redeemed in central bank money (Cartsens, 2019).[3]

3. Reasons for Studying the Possible Issuance of a General-Purpose CBDC

As mentioned at the World Economic Forum on the creation of digital currencies, one of the reasons for central banks to consider issuing a general-purpose CBDC is to promote financial inclusion; more specifically, to increase access for the poorest population to modern payment services.[4] In the particular case of the European Union, current legislation seeks to

3 The digital currencies offered by the private sector are crypto-currencies (or crypto-assets) and stable digital currencies. Crypto currencies are symbols with no issuer or symbols that do not represent any underlying asset or obligation (Barontini and Holden, 2019). Stable digital currencies are referred to as such because their value is tied to a set of assets that guarantee their price stability (G7, 2019). Stable digital currencies are issued by non-bank payment service providers or fintech firms (Amamiya, 2019), while crypto currencies have no specific issuer.

4 Most of the poor in developed economies such as the United States and the European Union are immigrants and undocumented migrants who, because they are invisible to the system, cannot access formal banking services (World Economic Forum, 2020).

ensure commercial banks provide basic banking services to the entire EU population. However, recent regulatory changes related to capital requirements and measures to prevent money laundering have caused a phenomenon that banks refer to as risk reduction (or de-risking), which often ends up increasing financial exclusion. Other reasons to consider issuing this type of digital currency are; namely, to stop money laundering, to counteract the financing of terrorism, to reduce tax evasion, and to provide fast and low-cost cross-border payment services (World Economic Forum, 2020).

4. Advantages and Disadvantages of this Initiative

There is a relative consensus that the study on the possible issuance of a general-purpose CBDC is still in early stages. However, some likely advantages and disadvantages this initiative could represent for its users and issuers have been identified. One of the main advantages is that a general-purpose digital payment instrument would facilitate an expansion in the supply of payment services to the unbanked and underserved population. Unofficial figures on these aspects at a global level show the unattended population is 1 billion, while the unbanked population is 1.7 billion (World Economic Forum, 2020). Another advantage of a general-purpose CBDC is to ensure compliance with payments. Experts on the subject say other digital currencies (such as bitcoin) may not guarantee payment compliance since, as systems whose operation depends on a decentralized consensus, they may be susceptible to changes in the payment registers agreed by consensus (Cartsens, 2019).[5]

Among the disadvantages of this type of digital currency is the possible increase in operating costs it could represent for the central bank. This would happen, for example, with an account-based CBDC. In that particular case, the central bank would have to provide general-purpose accounts to all agents, making it the banker of all participants in the economy and, thus, increasing its operating costs (Cartsens, 2019). Another disadvantage of a general-purpose CBDC relates to cyber-attacks, and particularly to computer threats such as malware and cyber-fraud.[6] These last aspects can pose major challenges to central banks; with digital currencies that would be available to many participants, they could be susceptible to multiple points of attack (CPMI MC, 2018).

5. Cases of Interest

The BIS has conducted three surveys so far to determine how central banks have progressed in their work on general-purpose digital currencies. The results show the proportion of central banks working on this issue is on the rise, having increased from 65 per cent in 2017 to 70 per cent in 2018 and 80 per cent in 2019 (Barontini and Holden, 2019; Boar et al., 2020). However, the figures indicate most of the on-going effort is theoretical and conceptual. Of the 66 central banks included in the last survey, the proportion that considers digital currency issuance likely in the short term is 10%, and in the medium term, 20%. The reasons why central banks are working on this issue vary from country to country. For emerging economies, the main motivation is to increase financial inclusion and the efficiency and security of domestic payments; for advanced economies, the main motivation is to ensure payment security (Boar et al., 2020).[7]

Some central banks are conducting pilot tests to measure the scope of issuance of a general-purpose digital currency. The reasons for considering this initiative are due largely to idiosyncratic factors. The following is a description of several cases involving countries that plan to implement or are currently advancing initiatives in this area.

5.1 Sweden

The technological developments witnessed in Sweden in recent decades have brought about important changes in the payment patterns of the country's population, making the digital payment alternatives offered by the private sector more convenient and efficient than the cash provided by the central bank (CPMI MC, 2018).[8] As a result, cash use has declined at an unprecedented rate, from 50% of GDP in 2008 to 1.0% of GDP in 2018 (Sveriges Riskbank, 2018). Mobile payments are now being used by most of the population, but a small group (the elderly and other vulnerable populations who are highly dependent on cash) has been excluded from the system, because some businesses do not receive cash. To serve that population, Sveriges Riskbank began its e-krona digital currency project in 2017, and is currently developing a pilot project for this digital currency, which will not earn

5 In decentralized systems, transactions are verified through distributed ledger technology (DLT).

6 The cyber-attacks on immediate payment systems in Mexico and Chile in 2018 are evidence of how this type of problem could affect central banks that decide to issue digital currency (Minsait, 2018).

7 The journal *Central Banking* (2020) released the results of its survey on CBDCs. These concur with the BIS in noting that few central banks plan to issue retail CBDCs in the short term, and issuance of this type of digital currency would improve financial inclusion and payment efficiency, in addition to reducing reliance on cash.

8 The mobile payment system for the population in Sweden to make electronic payments is known as Swish and is provided by the private sector (Barontini and Holden, 2019).

interest, will not be of anonymous use, and will be available permanently (Boar et al., 2020).

5.2 Ecuador

Ecuador's central bank launched its general-purpose digital currency "(Dinero Electrónico") project in early 2015, but closed it in March 2018 because the currency was not widely used by the country's population (White, 2018). One of the main reasons for issuing that digital currency was to reduce the use of cash, as the economy has been dollarized since January 2000. A general-purpose CBDC (dollar-based) would reduce the cost of keeping foreign currency in circulation. In this case, "Dinero Electrónico" was accessed through accounts provided by the central bank, via an electronic wallet the user could download directly from the central bank or from financial institutions authorized by the central bank (CDBC WG, 2019).

5.3 Uruguay

In November 2017, the Central Bank of Uruguay launched a six-month pilot project to evaluate the issue of its digital currency (e-peso), as part of a broad program for financial inclusion advanced by the government of that country (Barontini and Holden, 2019). The project was a public-private initiative. The currency was accessed through an electronic wallet, and third parties were responsible for data validation, storage, dispersal, and operational aspects. In October 2018, Uruguay's central bank revealed that the operational process applied in the pilot project was successful, and the most widely used type of transfer was person-to-person. Another relevant aspect mentioned in that statement concerns the start of a rigorous study by the central bank on the results of the pilot project, from an operational standpoint (technological, security and market) and from a payment-systems point of view (Banco Central de Uruguay, 2018). One of the reasons why the central bank considered issuing e-pesos was to expand financial inclusion; another was to reduce the use of cash (CDBC WG, 2019). In December 2019, the central bank revealed it was evaluating its digital currency pilot project from a payment-systems perspective and in terms of its effects on the industry, and was conducting an in-depth analysis of the legal framework, the impact on monetary policy and financial stability, and the use of digital payment methods in the market (de los Heros, 2019).

5.4 China

The People's Bank of China began pilot testing its general-purpose CBDC in four cities in China during May 2020: Shenzhen, Suzhou, Chengdu, and Xiong'an (*The Wall Street Journal*, 2020).[9] The tests are focused on specific population groups (government employees), and will not affect the current issue of sovereign and circulating currency (*International Digital News Media*, 2020). To distribute digital currency to users, the central bank will consider a two-tiered system that will make use of existing commercial banks (Central Banking, 2020).

According to the Digital Currency Research Institute of the Central Bank of China, no internet connection will be required to conduct transactions with this CBDC; mobile phones (smartphones) will be placed close to each other, since the transfer of funds will be carried out between electronic wallet applications through QR codes (*International Digital News Media*, 2020).[10] With the issue of this CBDC, the central bank aims to reduce the cost of handling cash, decrease counterfeiting, prevent money laundering, and counteract the financing of terrorism (Amamiya, 2020).

5.5 The Bahamas and the Eastern Caribbean[11]

The Bahamas and the islands of the Eastern Caribbean Currency Union are piloting the issue of general-purpose CBDCs. The pilot project at the Central Bank of the Bahamas (Project Sand Dollar), which began in December 2019, consists of an account-based CBDC, and would not earn interest. The pilot project at the Eastern Caribbean Central Bank (DXCD) will enter its initial phase in the second quarter of 2020. The main reasons for advancing this type of initiative are to increase financial inclusion and to improve payment efficiency (Boar et al., 2020).

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9 China's digital currency still lacks a formal name, but it appears in the media as DC/EP (digital currency/electronic payment), e-RBM or the digital Yuan.

10 The mobile payment platforms offered by the private sector (Alipay and WeChat Pay) depend on an internet connection (*International Digital News Media*, 2020). They are stored value facilities that allow users to conduct e-money transactions using e-wallets installed on their mobile devices but are restricted to participants in the same network (Mancini-Griffoli et al. 2018).

11 The Eastern Caribbean Currency Union includes Anguilla, Antigua and Barbuda, Dominica, Grenada, Montserrat, Saint Kitts and Nevis, Saint Lucia, and Saint Vincent and the Grenadines.

6. Several Considerations Regarding the Study or Issue of a General-purpose CBDC

One of the aspects central banks are studying regarding general-purpose CBDCs concerns the possible effect the issue of digital currencies would have on the payment system, financial intermediation, and monetary policy.

With respect to the payment system, the belief is that an efficient model for introducing a general-purpose CBDC would consist of a scheme in which commercial banks and other payment service providers act with the central bank in a complementary way. Accordingly, the central bank would issue its general-purpose digital currency and distribute it through commercial banks and payment service providers, which would compete with each other by offering transaction services for this currency and would be responsible for distributing it to end users through retail channels. The operational resilience and robustness of the payment system could be increased under this CBDC scheme (CDBC WG, 2019).

Financial intermediation also could be affected by the introduction of a general-purpose CBDC into the payments market, because of its huge potential to replace bank deposits. This situation could make commercial banks much more dependent on sources of liquidity other than bank deposits. Such sources could be far more costly and, therefore, could reduce spreads and affect the provision of credit and the sustainability of the banking business (CDBC WG, 2019).

In addition to the anticipated impact on the payment system and financial intermediation, it is believed a general-purpose CBDC would have a limited effect on the implementation of monetary policy, and particularly on the control of short-term interest rates (CPMI MC, 2018).[12] However, unpredictable changes are expected in both the demand for money and its composition, as well as in the sensitivity of demand for money in light of changes in interest rates (Cartsens, 2019).

12 The central bank will continue to forecast demand for liquidity to inject or drain bank reserves (see CPMI MC, 2018).

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05

Applied Research Documents

5.1 Central Counterparties in Mitigating Counterparty and Liquidity Risk: the Case of Exchange Derivatives in Colombia

Central Counterparties in the Mitigation of Counterparty and Liquidity Risk: The Case of Exchange Rate Derivatives in Colombia, a document that looks at how the CRCC has helped to mitigate such risks (Mariño et al., 2020), is summarized in this section.

The international financial crisis that began in 2007-2008 prompted several changes in financial regulation. One of the reforms focuses on encouraging the centralized clearing and settlement of derivatives transactions through a central counterparty (CCP), particularly for derivatives traded in the over-the-counter (OTC) market (FSB, 2010). In general, clearing and settlement through a CCP seeks to mitigate counterparty risk[59] between financial institutions, besides providing more transparency by maintaining a centralized and detailed register of exposures (Ripatti, 2004; Bliss and Steigerwald, 2006; Manning et al., 2009; IMF, 2010; Yellen, 2013; Wendt, 2015), coupled with the reduced complexity implicit in exposure between them.

Clearing and settlement through the CRCC involves a mechanism known as novation, which means the CRCC interposes itself between the buyer and seller, thereby eliminating their bilateral obligations and replacing them with CRCC obligations. This does away with the links created in the original transaction, and the CRCC becomes the buyer to every seller and the seller to every buyer. The purpose of this interposition is to allow financial institutions to maintain

59 Counterparty risk is defined as the risk that a transaction will not deliver what is expected (e.g. delivery, payment).

a sole exposure to counterparty risk with a financial infrastructure[60] designed, regulated and supervised especially for that purpose.[61]

Interposition by a CCP can be expected to affect the way financial institutions interact in the market. If bilateral obligations are replaced by obligations with the CCP, financial institutions will be able to operate in the market with less exposure to counterparty risk in the clearing and settlement phase. In other words, interposition by a CCP reduces information costs for market participants and facilitates trading among them, which increases market liquidity (Ripatti, 2004; Bliss and Steigerwald, 2006; Wendt, 2015). In this regard, as Ripatti (2004) notes, the use of a CCP encourages trading and improves the way markets function.[62] As a result, the number of counterparties willing to trade in markets where a CCP is interposed can be expected to increase, which results in a more interconnected network of transactions among financial institutions and, consequently, less liquidity risk.[63]

The purpose of this section is to visualize and quantify the effect interposition by the Central Counterparty of Colombia S.A.[64] has on the way financial institutions interact with each other. The CRCC is the only CCP in the Colombian market. The information used refers to the Colombian market for non-delivery peso-dollar forward exchange operations (i.e., COP/USD FX-non delivery forwards). This is done for two reasons. The first is because financial institutions in that market have the power to decide whether to clear and settle operations through the CRCC or bilaterally.[65] The second is because of their contribution to the value of operations cleared and to the total open position of the CRCC, which accounted for 13.5% and 42.0%, respectively, by 2018. In addition, the average daily volume of peso - dollar exchange operations between financial institutions during 2018 came to USD 397.2 million, with 90.1% (USD 358.3 million) cleared and settled through the CRCC.

From the standpoint of network structure optimization (Ferrer, Cancho and Solé, 2003; Newman, 2010; León and Sarmiento, 2016), interposition by a CCP makes it possible to mitigate liquidity and counterparty risk.

60 Financial infrastructures are legal or functional entities that are established to conduct centralized and multilateral payment, clearing, settlement or registration activities (BIS-IOSCO, 2012).

61 Decree 2555 of 2010 defines the rules applicable to central counterparty clearing houses in Colombia.

62 According to Ripatti (2004), for example, the introduction of a CCP contributed to significant increases in the amounts traded on the European repo market.

63 Liquidity risk is defined as risk related to the difficulty of finding counterparties willing to trade in the market; that is, the difficulty a participant has in finding a counterparty with which to transform its position into another.

64 The first section of this report offers statistics on how the CRCC has evolved and considers several internal regulatory aspects developed during 2019. In addition, previous reports contain boxes describing the CRCC's risk model and offering some comparisons with CCPs in other jurisdictions.

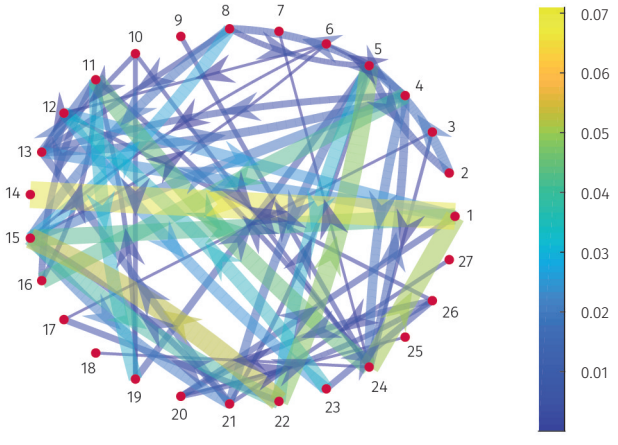
65 Interest rate swaps (OIS IBR) are another product in which participants can decide whether or not to clear and settle through the CRCC. However, the information necessary to carry out this exercise is not available for this market.

First, it manages to mitigate liquidity risk in the market by facilitating access to counterparties at the trading stage, as evidenced by a more interconnected network with less distance between participants. Second, it mitigates counterparty risk at the clearing and settlement stage because exposure to counterparty risk is concentrated in the CCP after novation, as reflected in reduced connectivity and greater distance in the exposure network.

5.1.1 Information and Constructing Networks

Based on the information available to *Banco de la República* and the CRCC between May 2010 and December 2018, three databases were constructed on the financial institutions participating in the Colombian market for term peso-dollar exchange operations, from either a proprietary or non-proprietary position. The first pertains to the sum of transactions for bilateral clearing and settlement between market participants (without interposition by the CRCC); it serves as a database on exposure between market participants for bilateral clearing and settlement.[66] The second corresponds to the sum of transactions between market participants for subsequent clearing and settlement through the CRCC. The third concerns exposure after interposition by the CRCC.[67]

Graph 5.1
Network of Transactions between Financial Institutions for Bilateral Settlement (without the CRCC, December 2018)



Notes: The connections between each node illustrate the transactions or exposure between participating financial institutions: Their thickness and color represent the percent contribution to the total value of all transactions during the month (see the scale to the right). Only the nodes with connections in that period are shown.
Source: *Banco de la República.*

The databases were constructed in dollars, aggregated on a monthly basis because, in some cases, there are not many transactions during a short period of time (e.g., one day, one week). In fact, the months when the number of relationships in any of the networks was less than ten were eliminated. This results in series covering 87 months, from October 2011 to December 2018.

Graph 5.1 shows the first type of network, which pertains to transactions between financial institutions during December 2018 that were to be settled bilaterally (without interposition by the CRCC). Each financial institution is represented by a node, which is assigned a number (for confidentiality reasons). To facilitate visualization, the nodes are organized in a circular pattern. The connections between each node represent the transactions between the participating financial institutions, while their thickness and color correspond to the percentage contribution to the total value of the transactions during the month.

66 This implies that bilateral obligations are settled gross (i.e., without calculating net bilateral exposure). As illustrated later, the results using gross or net exposures are robust.

67 These exposures pertain to the sum of those at the end of each day of the month. Those existing at the end of the previous month are not considered, nor is their term. They can be considered as an approximation to the typical exposure during the period.

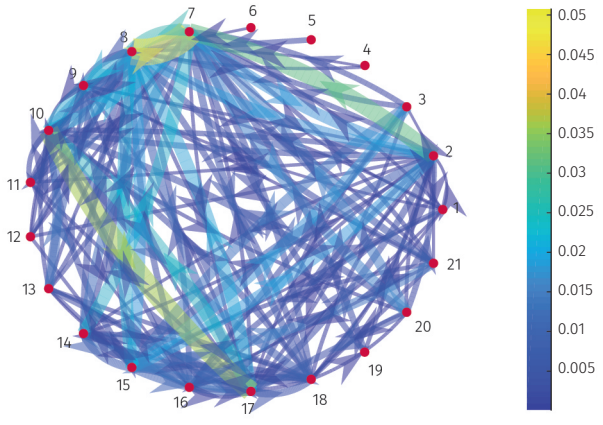
Graph 5.2 shows the second type of network for the same period. It pertains to bilateral transactions between financial institutions that are to be cleared and settled through the CRCC, by agreement between the parties. As in the previous network, each financial institution is represented by a node, and the connections represent the transactions between the participating financial institutions. The number assigned to a financial institution in Graph 5.2 does not necessarily correspond to the number assigned in Graph 5.1.

The network in Graph 5.2 only represents transactions between financial institutions. The exposure resulting from CRCC interposition is shown in Graph 5.3. The nodes are organized around the CRCC.

In general, the network for transactions to be settled bilaterally (Graph 5.1) is less interconnected than the one for transactions to be cleared and settled through the CRCC (Graph 5.2). This suggests financial institutions that agree to clear and settle their transactions through the CRCC are more willing to trade with each other, thereby reducing liquidity risk in the market. Accordingly, it also suggests financial institutions are more willing to assume counterparty risk; however, it will be temporary, since the CRCC will interpose itself later (Graph 5.3). Network analysis will make it possible to quantify this.

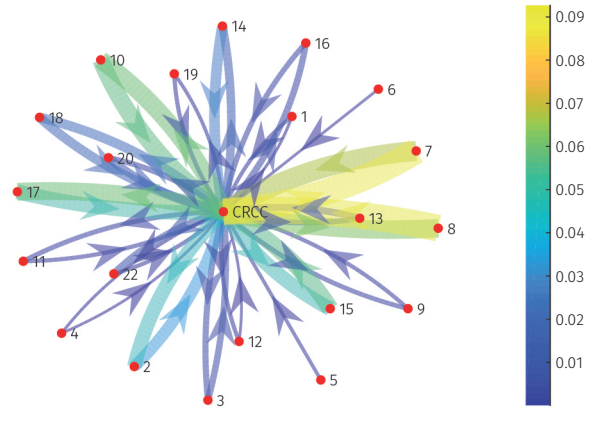
Similarly, a comparison between the network of transactions to be settled through the CRCC (Graph 5.2) and one of the transaction networks when the CRCC was not available (Graph 5.4) shows the former is more interconnected. This confirms the fact that interposition by the CRCC has afforded more liquidity to the market.

Graph 5.2
Network of Transactions between Financial Institutions for Clearing and Settlement through the CRCC
(December 2018)



Notes: The connections between each node illustrate the transactions or exposure between participating financial institutions: Their thickness and color represent the percent contribution to the total value of all transactions during the month (see the scale to the right). Only the nodes with connections in that period are shown.
Source: *Banco de la República.*

Graph 5.3
Exposure Network of Financial Institutions and the CRCC
(December 2018)



Notes: The connections between each node illustrate the transactions or exposure between participating financial institutions: Their thickness and color represent the percent contribution to the total value of exposure during the month (see the scale to the right). Only the nodes with connections in that period are shown.
Source: *Banco de la República.*

5.1.2 Analysis of the Networks

Network analysis is intended to describe and explain a system. It encompasses many concepts and metrics that make it possible to characterize a system by the way connections between its elements are organized and to identify elements or groups of elements that are important to the system.

In this case, network analysis is used only to compare the connective structure of two systems: one resulting from transactions between

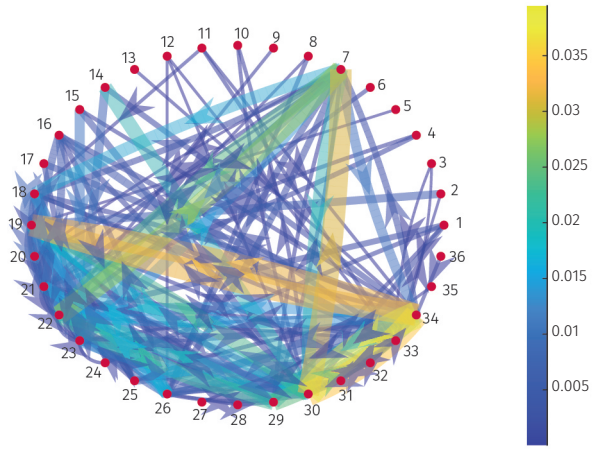
financial institutions that agree to clear and settle through the CRCC and another resulting from an agreement on bilateral clearing and settlement. Specifically, from the standpoint of optimizing the structure of a network (Ferrer, Cancho and Solé, 2003; Newman, 2010; León and Sarmiento, 2016), the aim is to study how both systems differ in terms of the counterparty and liquidity risk financial institutions face.

From that perspective, the participants of a system seek to minimize the costs related to the existence of connections, which results in the joint objective of minimizing the density of the network. Density measures the level of network cohesion; that is, how interconnected the nodes in the network are, and it is calculated as the ratio of the number of connections in the network to the number of possible connections in a network of the same size.

On the other hand, the participants also try to minimize the barriers to accessing the network, which results in the joint objective of minimizing the average geodesic distance within the network. The average geodesic distance reflects the structure of the network, which depends not only on the number of connections, but also on how those connections are organized among the network participants. It is calculated as the average of the shortest distance between all pairs of nodes in a network.

So, from this standpoint, there are two extreme cases with respect to network structure (Graph 5.5). The first consists of a complete network (Graph 5.5, Panel A), one in which all the participants are interconnected to one another. The cost of the existence of connections is the maximum, and the barriers for participants to access the network are minimal. The second case involves a star-type network (Graph 5.5, Panel B). In this instance, all the participants maintain only one connection, except for the participant who serves as an intermediary for all the others. The cost of the existence of connections is minimal, and access to and the existence of the network depend on a central node (León and Sarmiento, 2016).

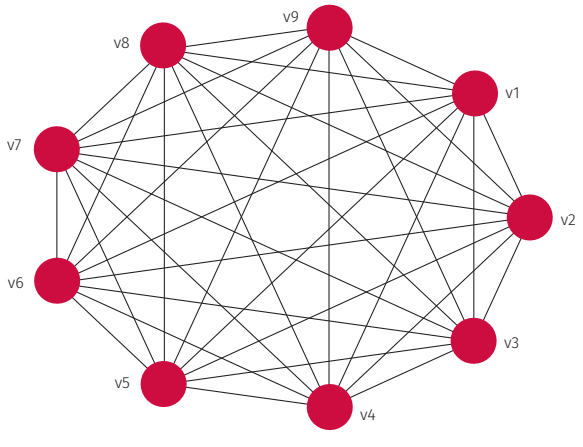
Graph 5.4
Network of Transactions between Financial Institutions for Bilateral Settlement (CRCC not available, April 2010)



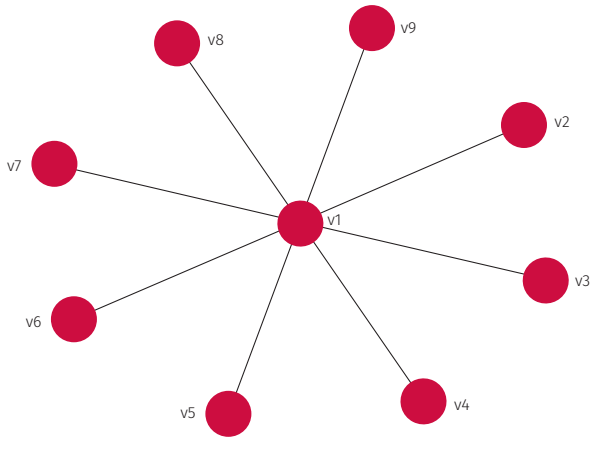
Notes: The connections between each node illustrate the transactions or exposure between participating financial institutions: Their thickness and color represent the percent contribution to the total value of the month's transactions (see the scale to the right). Only the nodes with connections in that period are shown.
Source: *Banco de la República.*

Graph 5.5

A. Entire network



B. Star-type network



Source: León and Sarmiento (2016).

5.1.3 Findings

According to the objectives of CCPs, as outlined in Mariño et al. (2020), interposition by the CRCC in the Colombian market for peso-dollar forward transactions (i.e., COP/USD FX non-delivery forwards) results in visually and quantitatively different transaction and exposure networks. Trading networks in which it is agreed that operations are to be cleared and settled through the CRCC exhibit more connectivity, which is represented by a higher density of relationships among the participating financial institutions. The added connectivity is accompanied by a shorter distance between the financial institutions. Once the CRCC is interposed, the connectivity declines and the distance increases.[68]

The differences in the structure of the transaction networks coincide with what is expected, according to the literature on market liquidity. For example, they are consistent with Ripatti (2004), who notes the CCPs have a clear influence on the functioning of financial markets, which have an incentive to trade. They also agree with Bliss and Steigerwald (2006), who suggest the work of CCPs increases market liquidity. The differences with the exposure network are consistent with expectations of reduced counterparty risk.

From the standpoint of network structure optimization (Ferrer, Cancho and Solé, 2003; Newman, 2010; León and Sarmiento, 2016), the greater connectivity and shorter distance in the network at the transaction stage suggest CRCC interposition manages to mitigate liquidity risk. The reduction in connectivity and the increase in distance after interposition by the CRCC suggest it manages to mitigate counterparty risk. In principle, mitigation of both these risks has benefits for the market as a whole.

The findings are relevant to the study of financial markets and to the work of financial market infrastructures in mitigating risk. They also provide tools to help understand, analyze and corroborate the work of CCPs in financial markets and that of the CRCC in the Colombian market for non-delivery peso-dollar forward transactions. The findings also provide empirical support to the different theoretical models developed to study the effect of CCPs on financial markets.

Given the findings, it is possible to envision certain extensions to work and applications. Because this study is limited to a single product and to financial institutions, it is advisable to visualize and quantify the effects when adding different products that are available in the market and participants other than financial institutions. Ultimately, the findings suggest tracking the connectivity and distance in financial market networks can be useful as a tool for monitoring the financial system.

68 Mariño et al. (2020) use tests of equality in the distribution of network statistics (i.e.: Kolmogorov-Smirnov). The conclusion, based on these tests, it that the differences in network structures are significant and of the expected sign.

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5.2 Using Machine Learning for Anomaly Detection in the Large-value Payment Network

Payments made by agents in the market are input for analyzing and monitoring the economy. Instead of using lagging and low frequency data, such as that contained in accounting reports or surveys, payments are available with only a minor lag, at high frequency, and with a good level of detail and accuracy.

Payments can be represented as a network. In it, the agents appear as nodes that interconnect with each other and those interconnections correspond to payments. This representation is widely used today for financial market monitoring purposes, as well as to oversee the performance of financial institutions. However, it has one problem: because of the large amount of data contained in each network, it is difficult to make comparisons over time to find those that deviate from what can be considered a typical or normal network.

Based on the payments financial institutions make to one other in the large-value payment system, León's article (2020) introduces a methodology that makes it possible to compare different payment networks and determine which ones can be regarded as anomalous. In other words, it gives signals that indicate when a network moves away from that observed in the historical series and warrants study as part of the monitoring tasks of payment systems. To make this comparison, a methodology similar to the one applied to classify images is used. It is designed to extract the main characteristics of the networks and use them as parameters for comparison.

5.2.1 Anomaly Detection

Anomaly detection is intended to identify observations that do not correspond to what can be considered typical or normal. A generic approach to anomaly detection consists of finding observations that can be considered as having a low probability of occurrence, usually establishing a maximum distance with respect to a representative group of observations or with respect to a frequency distribution chosen for those observations.

Generally, this generic approach to anomaly detection is easily implemented in low dimensional systems, such as a price vector (i.e., a time series). Distribution can be estimated relatively easily for the price series of a financial asset, and limits can be determined beyond which the probability of occurrence of an observation can be considered as low. In that case, under the assumption of normal distribution, it is common to define as anomalies those observations that are two standard deviations away from the mean. With that assumption, those observations have a 5.0% probability of occurrence, which means they can be regarded as being far from what is expected.

However, this easy implementation is not possible when systems contain more than one dimension. For example, if instead of a series of numbers in a vector you have a series of matrices from which you want to identify those that can be considered atypical, this approach is not directly possible.

One alternative is to study each element within the matrix as a time series; that is, to convert the series of matrices into a collection or set of vectors to be analyzed individually. However, this approach has two disadvantages. First, the number of vectors to be analyzed grows rapidly, as the extent of participants in the matrix increases. Second, an individual analysis of vectors can ignore structural anomalies in the matrix; in other words, finding structural anomalies in a matrix through an individual analysis of its components is inconvenient (Lakhina et al. 2004; Huang et al., 2006; Han and Kamber, 2006; Ding and Tian, 2016). The other alternative is to use dimension reduction methodologies. Based on quantitative methods, these seek to represent multidimensional data in a smaller space (i.e., fewer dimensions), doing so in such a way that it is possible to reduce the number of variables to be analyzed, while minimizing the loss of information that results.

One of the simplest methods to reduce the dimension is based on principal component analysis (PCA). For the most part, PCA makes it possible

to take any matrix of d×t dimensions and, through a procedure based on matrix mathematics (Leon, 2020), obtain a matrix of d×k dimensions, where k it is much smaller than t (k << t). Since the data contained in the original matrix are not random, preserving a small number of dimensions (i.e., setting a small k *number*) results in an acceptable loss of information. In that sense, this smaller version retains the essential characteristics of the original matrix; that is, it filters the signals and avoids the noise in the data.

Furthermore, as it is possible to reconstruct the original matrix from its compressed version, it also is possible to quantify the error caused by the reduction in dimensions (this is called a reconstruction error). And, it is precisely this error that serves as a measure to determine whether or not a matrix is anomalous. By applying PCA to a series of matrices that can be considered typical, it is possible to obtain a series of reconstruction errors that also are considered typical, from which one can obtain a distribution of the expected reconstruction errors. This distribution of errors can be used to characterize how difficult it was for the methodology to capture the essential characteristics of the evaluated matrix. If the error is far from a level regarded as normal, the matrix can be catalogued as anomalous.

5.2.2 Large-value Payment System Matrices

The payment matrices between large-value payment system participants are good examples of multidimensional systems. If there are n participating financial institutions, each observation (i.e., each matrix) consists of around n^2 elements to be analyzed. Reducing dimensionality for the purpose of anomaly detection is an approach that has already been implemented in the case of the Dutch large-value payment system (Triepels et al., 2017). In that instance, the authors applied a methodology known as auto-encoder, which consists of using a neural network to encode the most important information in a data set.[69]

In the Colombian case, León (2020) uses payment matrices constructed from CUD data on the period from January 2, 2017 to December 28, 2018. There are 484 days and 125 participants during that time. This implies a series of 484 matrices, each with dimensions of 125 by 125. Each of the elements in these matrices corresponds to the percentage contribution to the sum of payments on each day from one financial institution to another.

After excluding the matrices corresponding to days easily classified as atypical (i.e., those days with unusually low or high amounts of transactions), the PCA methodology was applied to one thousand sets of twenty matrices chosen at random (with replacement) from the sample. As a result, a thousand observations of reconstruction errors are available to determine what is atypical and what is not.

69 There is a connection between approximation through PCA and auto-encoders. The PCA approach can be considered as the simplest auto-encoder model possible, in which non-linear relationships between data are not considered.

Unfortunately, there are no observations in the sample that can be catalogued as abnormal and serve to corroborate the model's ability to identify anomalies. This is a common problem in this type of exercises (Alpaydin, 2014; Triepels et al., 2017). With that in mind and in keeping with the literature on the subject, synthetic data are used to recreate the conditions of an event that can be catalogued as abnormal. These synthetic matrices are mixed with the observed matrices to identify or distinguish them from those that can be considered normal or expected.

Two approaches are used to create synthetic anomalous data. The first calls for using the data in the described sample (i.e., from within the sample) to modify it and recreate anomalous matrices. The second approach uses new data (i.e., from outside the sample) to modify it and recreate anomalous matrices; in this case, the data used was from the large-value payment system between February 1 and March 29, 2019.

The modification process consists of introducing high-impact shocks into the sequence of payments made during a trading day. Two high-impact shocks were chosen: the first was to force a selected financial institution to start the day with no funds in its accounts with the central bank; the second was not to allow a selected financial institution to make payments during the day. The second of these two high-impact shocks is expected to have more potential to generate changes in the structure of payment matrices. This is because the first shock enables the selected financial institution to make payments to the extent that it receives liquidity from other participants in the system, while the second shock excludes the possibility of the selected financial institution making any payments during the day. The selection of financial institutions was made on the basis of their relative importance (i.e., centrality) in the large-value payment networks. This results in events that can be considered relevant from the standpoint of payment-system monitoring and have the potential to cause changes in the structure of the payment matrix.

5.2.3 Major Findings

Reconstruction errors in synthetic matrices do, in fact, serve to classify them as anomalous or not. In the case of synthetic matrices within the sample, León (2020) shows the reconstruction errors in synthetic matrices are higher and differ significantly from those obtained by reconstructing observed matrices. In other words, matrices that include structural changes can be identified by the divergence of their reconstruction error from the distribution of reconstruction errors in typical sample matrices.

In the case of out-of-sample synthetic matrices, it was possible to determine, based on the errors that a classification model founded on machine learning manages to identify anomalous matrices based on their reconstruction errors. As expected, the ability to identify anomalous matrices depends on the severity of the selected shock and the importance of the selected financial institution. Accordingly, the greater the severity of the shock and the greater the importance of the selected financial institution, the greater the ability of the machine learning model to classify the payment matrix as anomalous. At best, the methodology successfully classified around 80% of a set of anomalous networks. This suggests it has the potential to generate alerts based on data on payments between financial institutions or a set of market agents.

5.2.4 Contribution

Having the ability to identify payment networks that differ from those observed in historical series is important to financial authorities. It gives them additional tools to detect relevant changes in the way financial institutions interact with one another, be it as a result of changes in individual behavior or changes in the market. The methodology developed in León (2020) offers an easy-to-implement, low-computing-cost approach that can be useful to financial authorities who want to monitor the interaction between financial institutions or a set of agents in the market. It is important to note this methodology is not limited to the matrices resulting from transactions in value payment systems; it also is possible and advisable to use it to monitor clearing and settlement systems for financial assets.

In the future, the findings obtained with approximations of this type to identify networks with anomalous payments should be complemented with those designed to identify individual anomalies. This would allow for a more complete interpretation of the dynamics of payments between financial entities, as well as more and better tools to monitor financial infrastructures.

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Documents Produced Recently by the Financial Infrastructure Oversight Department

Banks in Colombia: How homogeneous are they?[1] (Bancos en Colombia: ¿qué tan homogéneos son?)

Carlos León

Homogeneity refers to the absence of diversity among the elements of a system. In the case of financial systems, homogeneity manifests itself in several ways, such as the adoption of similar strategies, highly correlated positions, and highly similar financial structures, among others. In this paper, the Euclidean distance and the clustering methodology were used to measure the similarity of commercial banks in Colombia, according to the structure of their average financial statements for 2016, and to visualize the hierarchical structure of the banking system. The results suggest there is some degree of homogeneity in the financial structure of commercial banks in Colombia, particularly among some of the largest banks.

1 Accepted for publication in *Revista de Economía del Rosario*, with a preliminary version in *Borradores de Economía*, no. 1022, *Banco de la República*, 2017 (http://repositorio.banrep.gov.co/bitstream/handle/20.500.12134/6335/be_1022.pdf).

Cryptoassets: Analysis and Review of the Literature [2]

Julián Parra, Carlos Arango, Joaquín Bernal, José Gómez, Javier Gómez, Carlos León, Clara Machado, Daniel Osorio, Daniel Rojas, Nicolás Suárez, Eduardo Yanquen

Cryptoassets are digital units issued in their own unit of account, by private agents, and are intended to become an alternative to traditional currencies and the traditional payment system. These units are transferred electronically, and registration and control of the transactions carried out with cryptoassets is to be done in a distributed manner in the network where they operate. The best known cryptoasset is the bitcoin. There are now more than 2,800 cryptoassets and their current worth or market capitalization is equivalent to approximately one hundredth of the market capitalization of the New York Stock Exchange. Although this is a relatively small phenomenon at present, it has sparked the curiosity of agents the world over, including different institutions and academics who have published a number of papers on the subject. That literature is reviewed in this article, with an emphasis on five topics about cryptoassets; namely, the structure of the cryptoasset system and its relation to the financial system, the determinants of its prices, the implications for monetary policy, the effects on financial stability, and the regulation of cryptoassets.

2 Published in *Revista Ensayos Sobre Política Económica*, no. 92, 2019 (https://investiga.banrep.gov.co/es/espe92).

Detecting Anomalous Payments Networks: A Dimensionality Reduction Approach[3] (Detección de redes de pagos anómalas: una aproximación desde la reducción de dimensiones)

Carlos León

Methods to detect anomalies are intended to identify observations that deviate significantly from what is expected. These methods are often used with low-dimensional data, such as time series. However, the growing importance of payment networks and exposure series (high dimensionality series) in monitoring financial markets requires methods that can detect anomalous networks. For that purpose, reducing dimensions makes it possible to quantify how different the connective characteristics of a network are (i.e.: its structure) with respect to those that can be considered normal. This is achieved because dimension reduction allows data to be reconstructed with an error, which serves as a parameter to determine how different the connective characteristics of the networks are. Decomposition or breakdown by principal components is used as a method to reduce the dimension, and a grouping algorithm classifies the reconstruction errors into normal or anomalous. Based on data from the Colombian large-value payment system and a set of anomalous payment networks artificially created with intraday payment simulation methods, the results reported in this paper suggest the detection of anomalous payment networks is possible and promising for financial market monitoring purposes.

Central Counterparties in the Mitigation of Counterparty and Liquidity Risk: The Case of Exchange Rate Derivatives in Colombia [4]

Ricardo Mariño, Carlos León, Carlos Cadena

Central counterparties (CCPs) interpose themselves between buyers and sellers to eliminate their bilateral obligations and, thus, mitigate counterparty risk. This interposition can be expected to affect the way in which financial market participants interact. Based on transaction data for non-delivery peso-dollar forward exchange transactions and network analysis, this article compares transactions where clearing and settlement is agreed through the Colombian Central Counterparty (CRCC) with those where bilateral clearing and settlement is agreed (i.e., without the CRCC). The effect of interposition by the CRCC is as expected. The transaction network in which interposition by the CRCC is agreed shows a significant increase in connectivity (i.e., greater density, reciprocity and grouping) and a significant decline in the distance between participants. This suggests agreeing on interposition by the CRCC allows for mitigating liquidity risk. With interposition, the resulting network of exposures has less connectivity and greater distance, which is consistent with the mitigation of counterparty risk. The differences in the structure of the networks are significant. The results are relevant because they make it possible to visualize and quantify the effect of the CRCC on risk management.

3 Published in *Borradores de Economía*, no. 1098, *Banco de la República*, 2019 (http://repositorio.banrep.gov.co/bitstream/handle/20.500.12134/9774/be_1098.pdf).

4 Published in *Borradores de Economía*, no. 1101, *Banco de la República*, 2020 (http://repositorio.banrep.gov.co/bitstream/handle/20.500.12134/9806/be_1101.pdf).

Annex 1
Financial Infrastructures and Markets

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

Fixed Income

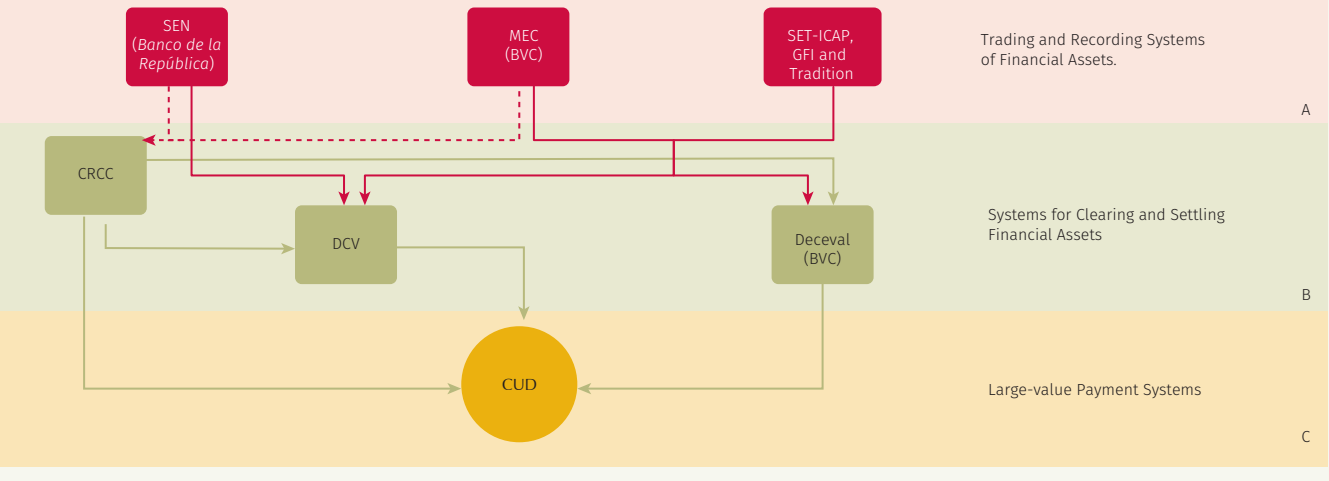
Diagram A1.1 shows the infrastructures that provide trading, clearing, and settlement services for operations in this market. The flow starts at the top with the trading and registration systems, where the participants make trades through automatic matching mechanisms (SEN and MEC) and hybrid voice and data systems (SET-ICAP Securities, GFI and Tradition). In each of these trades, the seller must inform the system manager of the deposit account where it has the securities that are to be delivered, so the latter can send them and, therefore, the process and settlement can take place. The securities leg is met with an entry in the securities deposit account, noting the change of ownership in favor of the buyer, and the cash leg is met with the transfer of funds to the seller, through the CUD large-value payment system.

Forward operations (TES sell/buy-backs) are sent by the SEN and MEC systems to the Central Counterparty (CRCC) for respective risk management (dotted lines in Diagram A1.1); while gross clearing and settlement are done in the DCV-CUD (continuous lines in the same diagram).

Equity Income

The BVC manages the value chain of the spot equity market in Colombia, from trading to clearing and settlement. In the case of forward transactions (equity repos), it also manages trading, but clearing and settlement have been done through the CRCC since August 2017.[1]

Diagram A1.1
Flow of Operations in the Fixed-income Market



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

1 See Decree 2219 issued on December 27, 2017 by the Ministry of Finance and Public Credit. It amends Decree 2555 of 2010 with respect to certain provisions applicable to operations that are cleared and settled through a central counterparty clearing house and the establishment of a protocol for crisis or contingency situations in the securities market.

As shown in Diagram A1.2, the flow starts in the trading system, where participants compete with offers for available securities. In the spot market, after closing, these operations are confirmed and complemented for clearing and settlement. For the securities leg, the BVC uses Deceval; for the cash leg, it uses the CUD large-value payment system. In the forward market, the BVC sends the operations to the CRCC for risk management, clearing and settlement. As in the spot market, 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 registration systems in the Colombian foreign exchange market. The first does so through a matching system whereby participants voluntarily decide which offers to accept; the second, through voice and data systems, with foreign exchange offers received privately from each participant and then circulated to the rest of the market. The CRCC and the Foreign Exchange Clearing House of Colombia S.A. (CCDC) are in charge of the processes for clearing and settling operations that can be accepted pursuant to the conditions established in their respective regulations. The CCDC clears and settles only spot foreign exchange operations (pesos-dollars) between its participating financial institutions.[2] The CRCC, on the other hand, clears and settles cash-settled NDF forwards (peso/dollar) between its members on proprietary or non-proprietary basis (Diagram A1.3).

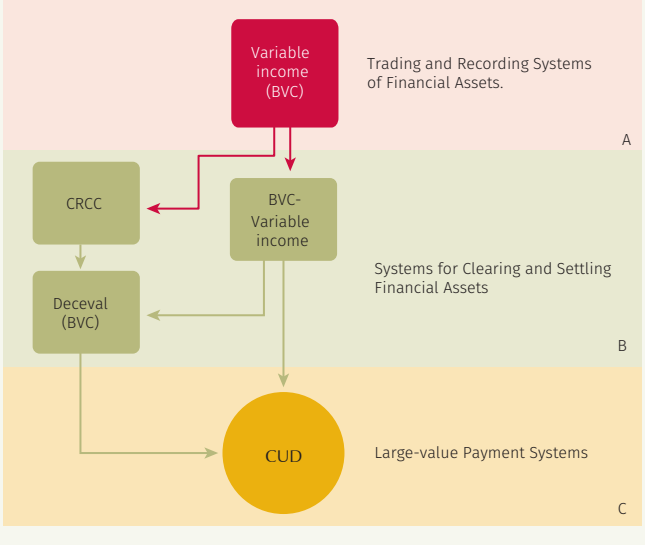
Currently, the CCDC processes spot and next day transactions from SET-ICAP-FX. Similarly, the CRCC, as a central counterparty, clears and settles NDF peso/dollar transactions from all authorized systems. However, all those transactions now come from SET-ICAP-FX.

Standardized Derivatives

The BVC and Derivex manage the trading and registration systems for the standardized derivatives market. Diagram A1.4 shows the transactions conducted through those systems are sent to the CRCC for clearing and settlement.

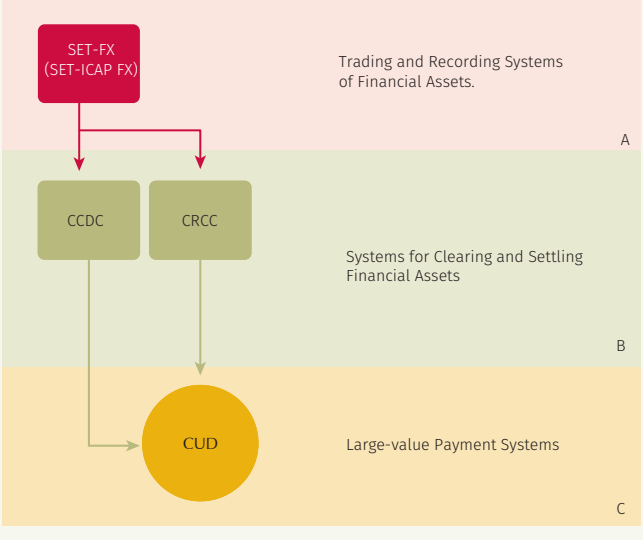
From that moment onward, the CRCC, as the central counterparty, does the novation for the operations, thereby becoming every buyer's seller and every seller's buyer. It then generates the obligations or liabilities of its participants (clearing) and proceeds to settle them in the CUD large-value payment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

Diagram A1.2
Flow of Operations in the Equity Market



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

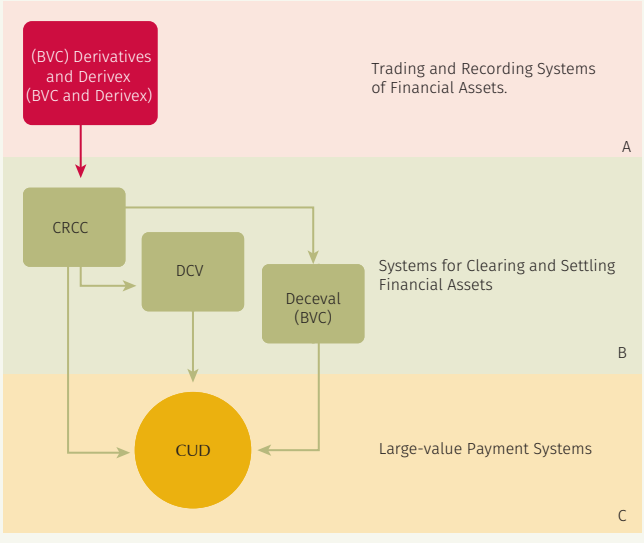
Diagram A1.3
Flow of Operations in the Foreign Exchange Market



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

2 External Resolution 4 adopted in 2006 by the Board of Directors of *Banco de la República* states that entities overseen by the Office of the Superintendent of Financial Institutions in Colombia, the Ministry of Finance and Public Credit (General Directorate of Public Credit and the National Treasury) and *Banco de la República* may act as direct participants, subject to the regime that regulates their activities and to all other applicable provisions.

Diagram A1.4
Flow of Operations in the Market for Standardized Derivatives



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

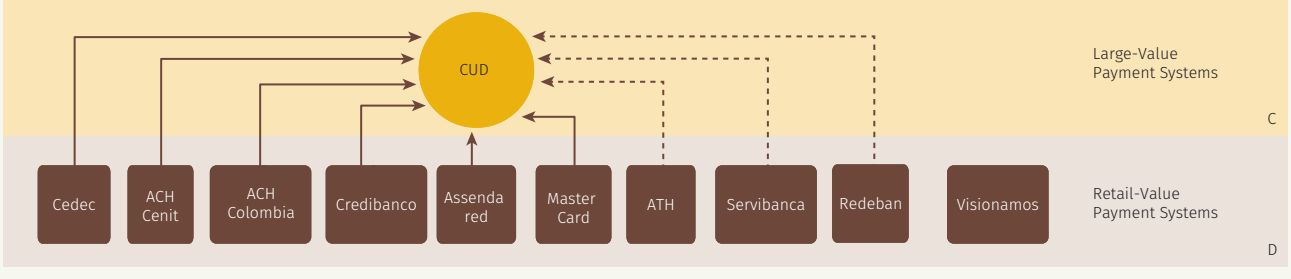
Retail-Value Payment Systems

The retail-value payment systems are represented in Diagram A1.5. The Electronic Check Clearing House (Cedec), managed by *Banco de la República*, clears checks and other payment instruments at the national level. 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 transfers of funds or collections that come from associated entities, on behalf of their clients, be they 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 their own deposit account with the large-value payment system and, therefore, are able to clear and settle their operations directly, using the resources in those accounts. The other networks do not have an account in the central bank system;[3] as a result, they only clear operations, which are then settled by a commercial bank through the deposit account opened in its name with *Banco de la República*. There is also the Visionamos network, which belongs to the solidarity sector of the economy and processes credit card transactions that are covered by participating cooperatives or international franchises.

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

Diagram A1.5
Flow of Operations in the Retail-value Payment System



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

3 The dotted lines in Diagram A1.5 indicate these ATM and card networks do not have their own deposit account in the CUD system, which is managed by *Banco de la República*. Visionamos is a retail-value payment system but does not settle multilateral clearing through the CUD. It does so through Banco Coopcentral, which settles, in turn, through CENIT.

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