Box 4: Automatic Debit Mechanisms in Retail-Value Payment Systems and their Contribution to Risk Mitigation: The Case of ACH Colombia

As the administrator of the Deposit Accounts System (CUD), since 2010, *Banco de la Republica* (*Banrep*) has offered automatic debit services for deposit accounts. This allows an external system[1] to send a series of debits to one or more deposit accounts of its linked participants automatically.

In 2023, ACH Colombia began a process to obtain authorizations from its affiliates to enable a more efficient allocation of resources within the framework of interbank transfer settlements through this operational facility. As a result, the institution has reduced the time taken to complete the settlement cycles.

This is crucial since the quicker ACH receives the funds, the faster it can distribute them to the receiving institutions. This, in turn, allows institutions to access resources more promptly to meet other intraday payment obligations (e.g., settlement of securities market transactions). In this regard, anticipating the settlement of transactions generates lower liquidity pressures for the system participants towards the end of the day.

In this context, this box seeks to analyze the contribution of the automatic debit functionality to the times taken by ACH Colombia to complete its settlement cycles. This is particularly relevant considering that this institution is the third most important financial infrastructure as a global liquidity distributor in the Colombian large-value payment system (León & Pérez, 2014). Therefore, it is necessary to quantify the benefits in terms of intraday liquidity needs for participants in the CUD. This analysis is based on a methodological approach proposed by the Bank for International Settlements (BIS).

This box is organized into five sections. The first provides context on the operation of ACHs, emphasizing the settlement process. Subsequently, sections two and three describe key elements of the functioning of ACH Colombia, its stages, and the time taken for payment order settlements. Sections four and five present the methodological approach and analysis of results regarding the effects that the reduction in settlement cycle times may have had on the intraday liquidity needs of the institutions. The last section contains the conclusions.

1. Lifecycle of an ACH Transaction

BIS-CPSS (2003) defines Automated Clearing Houses (ACH) as electronic clearing systems where payment orders are exchanged between financial institutions, primarily through magnetic means or telecommunications networks. McAndrews (1994) defines them as electronic systems that allow the transfer of funds between accounts at different banks, particularly for recurring retail-value payments, such as payroll, insurance premiums, and utility payments.

1 It refers to any clearing and settlement system for securities transactions, foreign exchange clearing and settlement system, clearing and settlement system for futures, options, and other financial assets, central counterparty clearing house, or payment system other than the CUD, duly authorized by the competent authority to operate in Colombia.

This funds transfer occurs through electronic transfers of two types: credit and debit transfers. The difference between the two lies in who originates the transaction. Thus, credit transfers are initiated by the payer, while debit transfers are initiated by the payment recipient (payee). For example, credit transactions occur when an individual pays a utility bill, a company pays an invoice from a supplier or pays employee salaries, or where a securities issuer pays dividends. Debit transactions, on the other hand, include, for example, instructions initiated by a company to collect co-ownership management fees, insurance premiums, or loan repayments from banking institutions whose clients hold deposit products with another entity.

The processing of these transactions results in what is known as clearing and settlement. Clearing corresponds to the definition of obligations among participants, where an ACH uses a net multilateral scheme that establishes a debit (against) or credit (in favor) position for each institution in the face of the ACH, where the total sum of positions equals zero. Thus, the total for debit positions equals the total for credit positions.

To illustrate this, Table B4.1 presents the total number of credit transfer orders to be cleared in a settlement cycle. Thus, bank B has an obligation to A for COP 300 and to D for COP 400. At the same time, institutions A and C have obligations to B for COP 100 and COP 400, respectively. Instead of each institution settling its obligations bilaterally with its counterparties, a net clearing balance is generated with a debit obligation for institutions B, C, and D. In contrast, a credit obligation arises in favor of institution A (Table B4.2).

Table B4.1
Transactions to be Processed by ACH in a Settlement Cycle

Transaction	Originator	Recipient	Type of transfer	Gross value (COP)
1	A	B	Credit	100
2	B	A	Credit	300
3	C	B	Credit	400
4	D	C	Credit	200
5	B	D	Credit	400
6	D	A	Credit	600
Total amount of orders to be processed				2,000

Source: *Banco de la República*; DSIF calculations.

Table B4.2
Result of the Multilateral Net Clearing Process

Entity	Type of transfer	Position	Resulting net value (COP)
A	Credit	In favor	800
B	Debit	Against	-200
C	Debit	Against	-200
D	Debit	Against	-400

Source: *Banco de la República*; DSIF calculations.

The second process (i.e., settlement) consists of extinguishing the obligations in Table B4.2; that is, when institutions B, C, and D effectively transfer the resources to the ACH, which then re-transfers them to institution A. Once this is complete, the transactions in the Table are processed, and each institution proceeds to make the corresponding credits in the savings/checking accounts of its own ledger or core banking system. Thus, institution B credits COP 100 from transaction 1, which was initiated by a customer of institution A, and COP 400 from transaction 2, which was initiated by a customer of institution C, and so forth. As a result of multilateral netting, a 60% savings in participants' liquidity needs was achieved since pro-

cessing payment orders for COP 2,000 required only a fund transfer of COP 800 (i.e., 1-[800/2000]).

Regarding how often the settlement process occurs (i.e., cycles), the World Bank (2023) indicates that about 63% of the ACH surveyed worldwide have multiple settlement cycles within a single day. Locally, ACH Colombia conducts five settlement cycles during the day on business days.

As for how these net resources are transferred, there are various operational arrangements. According to the World Bank (2023), the model used by 89% of ACHs globally is characterized by performing the final settlement of positions in a large-value payment system (LVPS). This is the case of ACH Colombia, where, through its own settlement account in the CUD, it receives funds from debit-position institutions and then transfers them to credit-position institutions. It is important to note that in the case of Colombia, the institutions participating in the ACH Colombia also have a deposit account in the CUD.

In this final settlement stage, the use of automatic debit facilities becomes relevant. As debit-position institutions collect funds more efficiently, credit-position institutions experience shorter wait times for the receipt of funds.

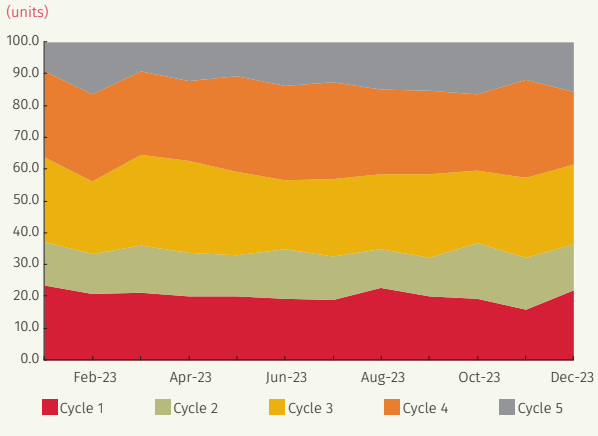
2. Settlement Process of ACH Colombia

As outlined in the previous section, transactions processed by ACH Colombia are cleared and settled under a multilateral netting arrangement in the LVPS. This results in the movements of funds in the CUD being lower than the gross value of the transactions, thus generating savings in the liquidity needs of the institutions. Particularly, in 2023, the average daily gross value processed by ACH was COP 7,690 billion (b), while the value of the movement resulting from multilateral netting in the CUD was COP 1,736 b. This equates to a savings in the liquidity needs of ACH participants of approximately 78% (i.e., [1 - [1 - [1,736/7,690]), which has remained at similar values in recent years.[2]

Regarding the amounts settled in the CUD, in line with its operational regulations, ACH Colombia performs five daily settlement cycles. Graph B4.1 exhibits the contribution of each cycle to the fund transfer process from ACH Colombia's account to the institutions. Notably, cycles three and four have the largest shares, at 24% and 28%, respectively.[3]

The cycles consist of a series of stages that can be classified as follows: 1) the transfer of resources from debtor institutions to ACH Colombia's account in the CUD; 2) internal validation processes during which ACH Colombia holds the resources in its CUD account for a short period, and 3) the transfer of resources from ACH Colombia's account to the institutions with credit positions (see Diagram B4.1). The analysis presented here focuses on this fund transfer stage (stage 3) under the premise that these times are shortened as stage 1 times are also reduced as

Graph B4.1
Percentage Distribution of the Settlement Conducted by the CUD (Contribution by cycle)



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

2 Section 2.2 of this Report outlines the recent transactional evolution of the institution.

3 Transactions processed by financial institutions in these cycles were requested by their customers between 11:30 a.m. and 4:00 p. m. This is consistent with the regular cash management hours of companies, which represent more than 85% of the transfers processed by ACH Colombia.

Diagram B4.1
Stages of an ACH Colombia Settlement Cycle

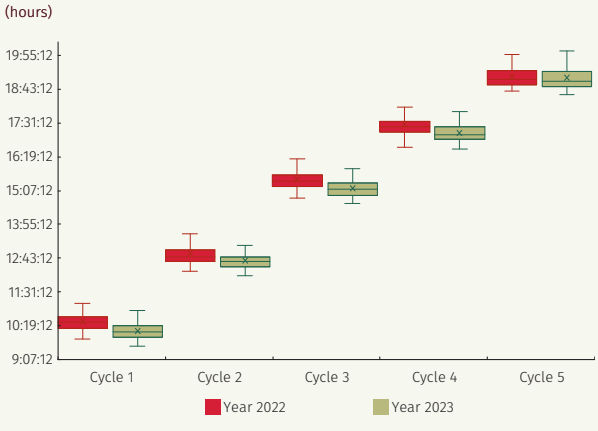
Source: *Banco de la República*, prepared by authors.

a result of the automatic debit process, while stage 2 times remain unchanged.

3. Evolution of Settlement Times

Considering what was explained in the previous section, Graph B4.2, and Table B4.3 exhibit the observed times when ACH Colombia transferred the resources to the institutions with credit positions. In general, it is observed that the transfer times decreased in all cycles between 2022 and 2023, although some cycles showed a more pronounced reduction than others.[4]

Graph B4.2
Distribution of Hours of Occurrence of the ACH Colombia Payment Dispersion



Source: *Banco de la República* (CUD); DSIF calculations.

It should be noted that these transfer times are associated with the time slots that the institution has established according to its operating regulations. That is, ACH Colombia can carry out the settlement for cycle 1 between 10:00 a.m. and 10:30 a.m., for cycle 2 between 12:30 p.m. and 1:00 p.m., and so forth. Thus, ACH Colombia went from transferring resources from the end of the established time slot to the beginning.

This is relevant in terms of operational management and risk mitigation because, on the one hand, it allows the ACH to have greater flexibility in addressing operational incidents. On the other hand, the participants receiving the resources can access them earlier and thus meet other intraday payment obligations (e.g., tax transfers and compliance with securities market operations).

4. Reduction of Intraday Liquidity Risk as a Result of Earlier Settlement of Transactions

Intraday liquidity risk arises from an institution's inability to manage its intraday payments effectively. Consequently, an uncompleted payment situation is created, affecting not only its liquidity position but also that of other participants in the LVPS.

To meet its intraday payment obligations, an institution generally has three sources of liquidity: 1) balance at the beginning of the day, 2) incoming payments (e.g., resources received by an institution with a credit position from ACH Colombia), and 3) liquidity facilities obtained through the central bank (ECB, 2021; McAndrews and Rajan, 2000). This, together with the synchronization between fund inflows and

4 When applying a statistical t-test for equality of means, it is found that the average value of dispersion hours has decreased between 2022 and 2023, with a confidence level of 95%. The decrease is most robust in the first four cycles (99% confidence level).

Table B4.3
Changes in ACH Colombia's Funds Dispersion Times towards Institutions with a Credit Position

		2022	2023	Decrease	Dispersion band according to operating regulations
Cycle 1	Average	10:27:55	10:08:11	0:19:43	10:00 a. m. to 10:30 a. m.
	Median	10:26:04	10:05:07	0:20:58	
Cycle 2	Average	12:53:38	12:37:58	0:15:40	12:30 p. m. to 1:00 p. m.
	Median	12:46:17	12:35:35	0:10:42	
Cycle 3	Average	15:31:37	15:12:36	0:19:02	3:00 p. m. to 3:30 p. m.
	Median	15:26:48	15:09:31	0:17:17	
Cycle 4	Average	17:28:37	17:10:50	0:17:47	5:00 p. m. to 5:30 p. m.
	Median	17:23:03	17:06:35	0:16:29	
Cycle 5	Average	19:10:44	19:07:22	0:03:21	6:45 p. m. to 7:00 p. m.
	Median	19:04:48	19:01:08	0:03:40	

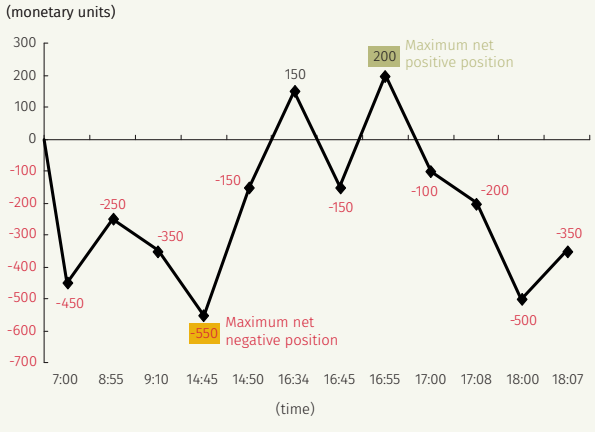
Source: *Banco de la República* (CUD); DSIF calculations.

outflows (i.e., the sequence and timing in which payments materialize), determine the daily liquidity needs.

To determine these needs, it is important to note that in 2013, the Basel Committee on Banking Supervision, together with the Committee on Payments and Market Infrastructures of the Bank for International Settlements (BCBS-CPSS, 2013), developed a set of tools to monitor and control intraday liquidity risk. One of these tools is the calculation of an indicator that includes the maximum daily liquidity use, which requires institutions to record the cumulative net value of payments they send and receive throughout the day. As seen in Graph B4.3 and Table B4.4, this is equivalent to constructing the movement in the deposit account, assuming an initial balance of zero, and recalculating the cumulative net balance as payments are received or made.

For example, one can see the maximum cumulative net positive position (highlighted in green in Table B4.4) is reached at a point in the day when the institution has received more payments, in terms of value, than it has sent (i.e., 16:55 hours). This situation may reflect the participant's strategy of funding outgoing payments with the liquidity received from incoming payments. The maximum cumulative net negative position is identified as well (highlighted in yellow in Table B4.4). It represents the maximum daily use of intraday liquidity. This occurs when the difference between the accumulated value of payments sent and received is at its peak (i.e., 14:45 hours). This value is interpreted as the minimum balance the institution needed to have on hand, at the start of the day, to ensure its daily payments could be made on time.

Graph B4.3
Evolution in the Cumulative Net Position



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

Table B4.4
Summary of Observed Payments

Time	Payments		Cumulative Net Position
	Sent	Received	
7:00	-450		-450
8:55		200	-250
9:10	-100		-350
14:45	-200		-550
14:50		400	-150
16:34		300	150
16:45	-300		-150
16:55		350	200
17:00	-300		-100
17:08	-100		-200
18:00	-300		-500
18:07		150	-350

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

5. Quantifying the Benefits Associated with Shortened Settlement Cycles

Based on the above, it is possible to quantify the benefits associated with a decrease in intraday liquidity risk due to earlier settlement of transactions through simulation exercises. In this case, the variable to analyze is the potential changes in the calculation of the daily minimum liquidity required by all institutions participating in ACH Colombia before and after the introduction of automatic debit.

For this purpose, all payments made in the CUD during 2023 are taken as a baseline simulation scenario. This includes both transactions made by ACH that benefit from automatic debit and other transactions made in CUD (e.g., purchases and sales of TES, tax transfers). The counterfactual scenario results from taking the same set of transactions of the baseline scenario and only modifying the settlement time of the transactions where ACH Colombia transferred resources towards institutions with credit positions, adding the average times found in Table B4.3. Thus, all settled transactions in cycle 1 would have an additional 19 minutes, while those in cycle 2 would have an additional 15 minutes, and so forth through the fifth cycle. In other words, the counterfactual scenario: i) supposes a delay in ACH Colombia's fund transfer transactions to isolate the benefits of automatic debit and ii) maintains the observed settlement times of the rest of the transactions that occurred in the CUD.

Table B4.5 presents the main statistics from the daily simulation of the payments observed during 2023, at the aggregate level. Particularly, compared to the counterfactual scenario: 1) liquidity needs decreased by 96% of the 242 days studied; 2) about 3.2 institutions reported benefits daily; 3) the benefits, understood as a reduction in liquidity needs, averaged COP 45.8 b, equivalent to 7.1%, and 4) 77% of the institutions experienced a decrease in their liquidity needs on at least one of the analyzed days.

Upon reviewing the decrease in liquidity needs experienced by participants in detail, the results are heterogeneous; that is, some institutions reflected greater benefits than others. Moreover, some institutions experienced decreases in their liquidity needs for a longer duration than others. This variation is reasonable given that the transactions involved are

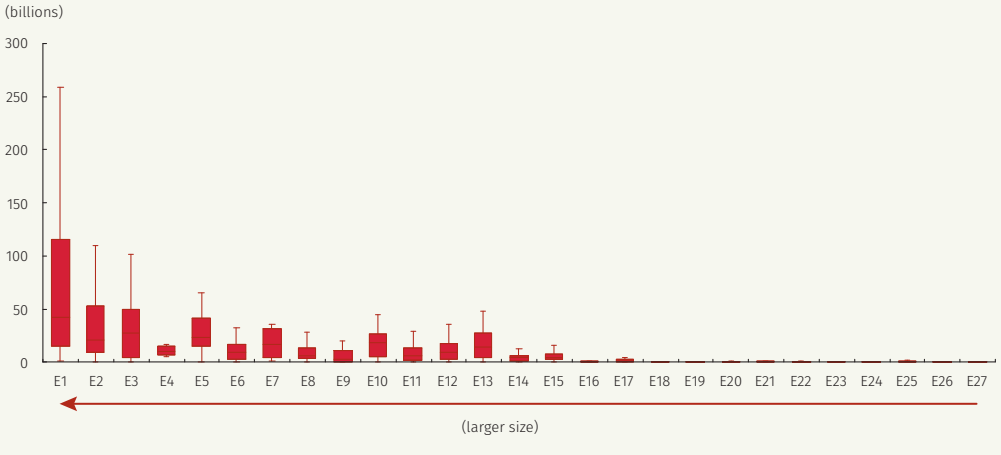
determined not by the institutions but by their customers. However, when ranking the entities according to their asset levels in the financial system, it is observed that larger entities experienced greater benefits (Graph B4.4).

Table B4.5
Main Simulation Results

Concept	Value
Operating days	242
Days when liquidity needs decreased	231
Days when liquidity needs increased	0
Days when liquidity needs remained stable	11
Participating entities	45
Entities benefited	35
Average	3.2
Maximum	9
Minimum	1
Median	3
Decrease in liquidity needs (amounts)	
Average	$ 45,864,432,822
25th percentile	$ 53,244,606,161
50th percentile	$ 25,901,195,978
75th percentile	$ 8,817,719,335
Decrease in liquidity needs (percentage)	
Average	7.1%
25th percentile	1.6%
50th percentile	3.3%
75th percentile	8.0%

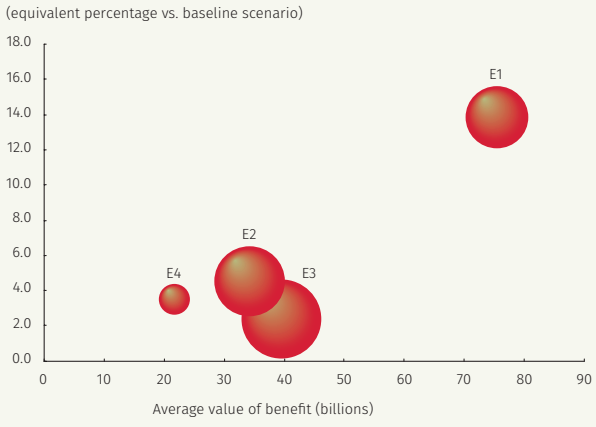
Source: *Banco de la República* (DSIF).

Graph B4.4
Decrease in Liquidity Needs by Entity



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

Graph B4.5
Results for Entities of Greater Importance in the CUD



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

Graph B4.5 exhibits an additional analysis of the results obtained by entities E1, E2, E3, and E4, which are the largest according to their asset value and were also the most relevant according to network centrality criteria.[5] The x and y axes represent the average decrease in liquidity needs and the equivalent percentage value of this decrease, while the bubble size represents the number of days in the year on which such a decrease was recorded. Thus, for entity E1, it is observed that, computing the results of the 29 days where benefits were experienced, it is found that, on average, the entity reduced its liquidity needs by 13%, compared to the calculation found in the counterfactual scenario, which is equivalent to COP 75 b.

Another interesting case is that of entity E3, which benefited for 36 days and during those days, due to the earlier receipt of resources from ACH Colombia, experienced a decrease in its intraday liquidity needs of about 4.5% (i.e., COP 34.2 b).

6. Final Comments

In order to provide new products for its customers and increase its operational efficiency[6], during 2023, ACH Colombia successfully implemented the automatic debit facility in its settlement processes affecting the deposit accounts of its participants. As a result of the monitoring activities conducted by *Banrep* on the financial infrastructure, it has been preliminary observed that in four of the five settlement cycles, their times have decreased on average by 18:03 minutes.

This reduction is significant as it benefits both ACH Colombia and its participants in two ways. First, it allows ACH to complete its settlement cycle earlier, providing greater flexibility to address any eventualities affecting the settlement process. Additionally, by closing the cycle earlier, the related entities increase the timeliness with which they accredit payment orders in their core banking systems, thus promoting the smooth functioning of the payment system within the economy. Second, upon receiving the funds earlier, entities can use them as a source of liquidity to meet other intraday payment obligations (e.g., collateral requirements in a clearing house, settlement of securities market transactions, tax transfers to the national government), thus contributing to a decrease in their daily liquidity needs.

In this regard, using simulation tools, this box aims to quantify how the decrease in settlement times of a payment infrastructure interconnected to the CUD system can reduce the overall intraday liquidity needs of institutions. Specifically, based on metrics proposed by the BIS, it was preliminarily determined that the time reductions achieved by ACH Colombia in 2023 resulted in an average decrease of 7.1%

5 In particular, the number of incoming and outgoing connections, the number of counterparties they interact with, and the hub and centrality indicators that measure an entity's capacity to be a distributor or receiver of liquidity were taken into account for each entity. More information in Newman (2010).

6 In approaches with the entity's product area, it was pointed out that the use of automatic debit was mainly motivated by: i) the need for a faster transfer of resources to financial institutions so that they could credit funds to users' checking/savings accounts; and ii) the goal of reducing some fees and charges associated with delays in settlement processes.

in the calculation of liquidity needs for the benefiting entities. Considering that at the end of 2023, six banks still did not allow the automatic debit of resources by ACH Colombia, the resulting benefits could be even higher. This is especially relevant since these entities represent 35% of the amount of payment orders processed by ACH.

From this case study, it is also evident that the use of the operational tools provided by *Banrep* as CUD administrator, for a more efficient management of the payment processes of other infrastructures, contributes to the effective management of intraday liquidity risk of financial institutions. In this regard, it is crucial that both entities and financial infrastructure work in a coordinated manner to ensure that the functional arrangements and settlement processes carried out in the CUD minimize potential liquidity pressures. In the specific case of retail-value payment infrastructures (such as ACH Colombia) this is of additional interest to financial authorities, as their proper functioning contributes to maintaining public confidence in the payment system and currency, while promoting an efficient economy (ECB, 2003; Cirasino and García, 2008; ECB, 2010; Hasan et al., 2013).

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