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CBDC Adoption as an Autonomous Factor: Monetary Policy Implementation Implications Across Floor and Corridor Operational Frameworks

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WORKING PAPER

CBDC Adoption as an Autonomous Factor: Monetary Policy Implementation Implications Across Floor and Corridor Operational Frameworks

A Cross-Jurisdictional Analysis: ECB, PBoC, Banco Central do Brasil

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Introduction

This paper examines the implications of CBDC adoption for monetary policy implementation across three distinct operational frameworks: the Eurosystem, the People's Bank of China (PBoC), and the Central Bank of Brazil (BCB). Rather than treating CBDC as a payment innovation, the paper approaches CBDC adoption as a new autonomous factor affecting the demand for reserves, the composition of bank liabilities, and the central bank's liquidity forecasting process.

The ECB serves as a benchmark case. Its floor system operates under conditions of abundant reserves and relies on a relatively compact policy toolkit, since the anchoring of the target rate removes much of the need for frequent fine-tuning operations. In such an environment, migration between commercial bank deposits and CBDC holdings are less likely to generate significant volatility in overnight money markets because the operational target rate remains anchored by standing facilities rather than by active reserve scarcity.

Brazil presents a case of larger regulator intervention in the target segment potentially crowding out private players and facing collateral "specialness" risks. The BCB operates a corridor-style framework in which liquidity management relies heavily on repo operations collateralized by government securities. While this structure has proven effective in steering the Selic rate, it creates a dependence on the availability and distribution of collateral within the financial system. Because government debt management is conducted by the National Treasury while liquidity management remains the responsibility of the central bank, rapid changes in liquidity conditions associated with CBDC adoption could require a higher degree of balance-sheet coordination between fiscal and monetary authorities. In this sense, CBDC may introduce a new source of operational complexity into an already collateral-intensive framework.

The Chinese case highlights a transitional operational framework with both short and long-term monetary implementation tools, while introducing a different dimension of CBDC design. Unlike many conceptual models of retail CBDC, the e-CNY framework largely preserves the role of commercial banks as intermediaries. Under the current architecture, e-CNY balances remain integrated into banks' balance-sheet management, reserve requirement calculations, and broader prudential arrangements. Consequently, the introduction of e-CNY does not fundamentally replace the existing monetary transmission framework but instead reinforces the importance of reserve requirements and quantitative liquidity management within the PBoC's operational toolkit.

The paper evaluates how these differing institutional arrangements may affect the capacity of central banks to absorb liquidity shocks generated by CBDC adoption. Particular attention is given to the interaction between CBDC-related deposit migration, liquidity forecasting, reserve management, and the operational mechanisms used to maintain control over short-term interest rates.

Beyond the floor-versus-corridor distinction, the paper also considers the settlement infrastructure through which CBDC-related flows would be processed. RTGS systems, Instant Payment systems, Central Securities Depositories, and CBDC ledgers determine where conversion touches reserves, whether liquidity movements are immediately visible to the central bank, and how participants can replenish prefunded positions. This settlement-layer perspective complements the operational-framework analysis and helps explain why similar CBDC designs may have different operational consequences across jurisdictions.

Section 1. Operational Frameworks and CBDC Transmission Channels

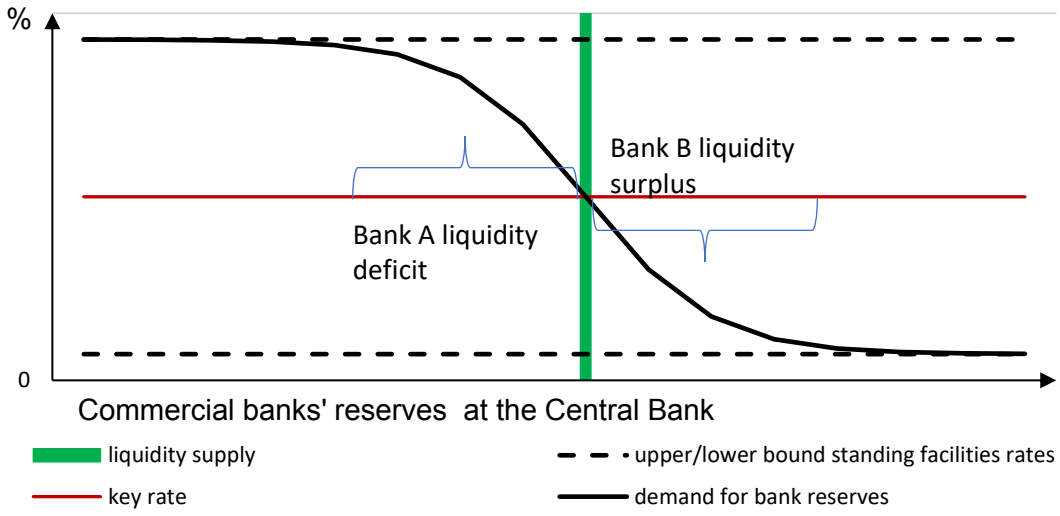
Central banks typically operate one of two canonical monetary policy implementation frameworks: the corridor system or the floor system. The distinction is not merely technical – it determines the sensitivity of overnight interest rates to liquidity shocks, including those potentially generated by CBDC adoption. The design of CBDC also affects the extent to which monetary policy implementation will need adapting.

1.1 The Corridor System

In a corridor system (e.g. ECB, Fed before 2009 recession), the central bank establishes an upper lending rate and a lower deposit rate, while the operational target rate – typically an overnight repo or interbank rate – is steered within these bounds through liquidity management operations. A key advantage of the corridor framework is its flexibility: it can operate effectively under both structural liquidity deficits and surpluses, with the direction of open market operations adjusting accordingly while the broader framework remains unchanged. Corridor systems also support activity in the interbank market, as institutions have incentives to both borrow and lend reserves before resorting to standing facilities.

Critically, the target rate in a corridor system lies on the most elastic segment of the reserve demand curve, where relatively small changes in reserve supply can produce significant movements in overnight rates. As a result, liquidity forecasting becomes a core operational task. Forecast errors that create reserve shortages or excesses may lead to rate volatility and require frequent fine-tuning operations. The introduction of CBDC adds an additional autonomous factor affecting reserve demand and deposit flows, potentially increasing forecasting uncertainty and making corridor systems somewhat more vulnerable to liquidity shocks than floor systems.

Figure 1 - A stylized mechanism of liquidity Demand and Supply in the Money Market: corridor system.

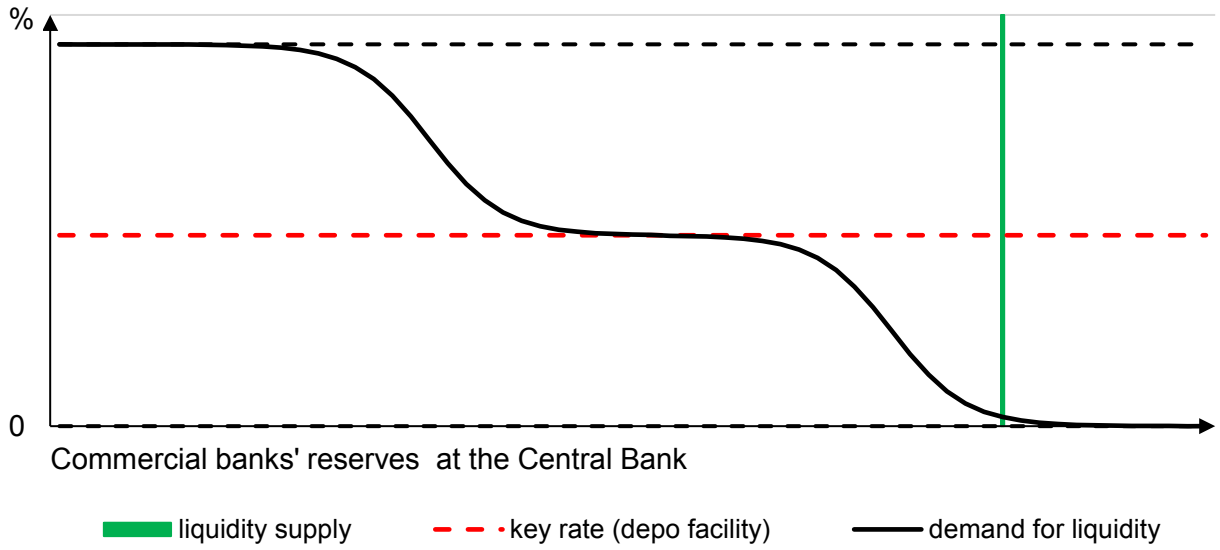


Source: Adrian, T., D. Laxton, and M. Obstfeld. 2018. Advancing the Frontiers of Monetary Policy. Washington, DC: International Monetary Fund.

1.2 The Floor System: Rate Insensitivity and the Bounded Drain Problem

In a floor system, the central bank supplies reserves in excess of the minimum reserve requirement on a sustained, structural basis. The aggregate excess reserve stock is large enough that the demand curve for reserves becomes inelastic at the deposit facility rate: all participants with access to the deposit facility are willing to place surplus reserves there rather than lend below that rate in the interbank market. The operational target rate therefore anchors at or near the deposit facility rate, regardless of moderate fluctuations in autonomous factors or CBDC-related reserve drains[1].The consequence for monetary policy implementation is a material reduction in the urgency of liquidity forecasting.

Figure 2 - Demand for bank reserves in a floor system.



Source: Adrian, T., D. Laxton, and M. Obstfeld. 2018. Advancing the Frontiers of Monetary Policy. Washington, DC: International Monetary Fund.

The downside of this insensitivity is structural: money market activity declines as the incentive for interbank lending disappears, market segmentation increases as non-bank participants cannot access the deposit facility, and the central bank's market intelligence about true liquidity demand deteriorates. Currently the ECB and the BCB are employing the floor system in the framework.

In this context, CBDC adoption has a more limited effect on overnight rate volatility in a floor system – provided the holding limit is set at a level where the aggregate drain does not exhaust the structural surplus. However, the floor system introduces a more subtle CBDC interaction: if the digital currency is remunerated, it creates a new rate floor in the retail financial system that competes with the deposit facility itself. Banks and money market funds will respond by raising retail deposit rates and wholesale lending rates to retain liquidity, effectively transmitting the CBDC remuneration rate upward through the financial system.

[1] Kunaratskul, T., A. Reslow, and M. Singh. 2024. Implications of Central Bank Digital Currency for Monetary Operations. IMF Working Paper. Washington, DC: International Monetary Fund, p. 5

1.3 Design of CBDC as a new autonomous factor

CBDC adoption introduces a new autonomous factor whose magnitude and volatility are partly determined by central bank policy choices. Traditional autonomous factors - currency in circulation, government deposits at the central bank, and net foreign assets - affect reserve supply independently of open market operations and constitute the main source of liquidity forecasting errors. Their fluctuations reflect payment behaviour, fiscal operations, and external transactions that are largely exogenous to monetary policy implementation. By contrast, demand for CBDC depends on design parameters established by the central bank itself, including remuneration, holding limits, accessibility, and institutional architecture. As a result, CBDC creates an autonomous factor that is both policy-sensitive and potentially more difficult to forecast than traditional sources of liquidity variation.

The impact of CBDC on banking system liquidity depends primarily on four design dimensions. First, remuneration determines the degree of competition between CBDC, commercial bank deposits, and money market instruments. A remunerated CBDC increases incentives to reallocate funds away from bank deposits, making reserve outflows larger and more sensitive to changes in interest rate differentials. Second, the distinction between retail and wholesale architectures affects the transmission channel. Retail CBDC directly competes with household and corporate deposits, whereas wholesale CBDC primarily changes settlement arrangements and reserve distribution within the financial system. Third, institutional architecture influences the extent of disintermediation. A one-tier model, under which households hold direct claims on the central bank, maximizes the substitution of commercial bank liabilities by central bank liabilities. A two-tier architecture mitigates, but does not eliminate, this effect by maintaining the role of intermediaries. Finally, holding limits place an upper bound on potential reserve outflows and therefore constrain the maximum liquidity shock that CBDC adoption can generate.

The balance-sheet implications of CBDC depend on the source of funds used to acquire digital currency. The simplest case arises when households exchange physical cash for CBDC[2]. In this scenario, the composition of central bank liabilities changes while the size of the balance sheet remains unchanged. Currency in circulation declines and CBDC liabilities increase by an equivalent amount, leaving reserve balances unaffected. Consequently, the operational implications for monetary policy implementation are generally limited.

A more consequential scenario emerges when households convert commercial bank deposits into CBDC. In this case, CBDC appears as a new central bank liability while reserve balances decline as banks settle customer conversions. Although the size of the central bank balance sheet remains unchanged, commercial bank balance sheets contract as deposits migrate toward CBDC holdings. The resulting reserve drain may increase competition for liquidity among banks and place upward pressure on short-term money market rates, particularly in operational frameworks where reserve scarcity remains relevant for price formation.

Persistent CBDC-induced reserve outflows may require central banks to expand their balance sheets to preserve operational control over short-term interest rates. If reserve balances decline below the level required for smooth functioning of payment and money markets, central banks may need to conduct reserve-management asset purchases or other liquidity-providing operations. Such interventions increase both assets and liabilities on the central bank balance sheet and may lead to a larger and more permanent central bank footprint in government bond and money markets. The likelihood of this outcome depends critically on the pre-existing liquidity regime, reserve demand, and the scale of CBDC adoption.

The operational significance of these scenarios varies across monetary policy frameworks. In floor systems operating with abundant reserves, moderate CBDC-induced shifts may be absorbed without materially affecting overnight interest rates. In corridor systems, where market rates are determined in a more reserve-sensitive environment, equivalent shifts in liquidity can generate greater volatility and increase the frequency of central bank interventions. CBDC therefore has the potential to alter not only the size and composition of central bank balance sheets but also the operational complexity of liquidity management itself.

[2] Malloy, M., F. Martinez, M.-F. Styczynski, and A. Thorp. 2024. Retail CBDC and U.S. Monetary Policy Implementation: A Stylized Balance Sheet Analysis. Washington, DC: Board of Governors of the Federal Reserve System, p. 7.

Section 2. Cross-Country Analysis of Monetary Policy Implementation in the Advent of CBDC

2.1 Comparative Operational Framework Overview

Table 1 summarises the key characteristics of the operational frameworks of the three jurisdictions examined. Rates are as of Q1 2025.

The comparison highlights that similar liquidity regimes may emerge from fundamentally different balance-sheet dynamics. Both the Eurosystem and the Central Bank of Brazil currently operate under conditions of persistent excess liquidity, yet the origins of these surpluses differ substantially. In the euro area, excess reserves are largely a legacy of large-scale asset purchase programmes and long-term refinancing operations implemented during the post-crisis period. In Brazil, excess liquidity is more closely linked to foreign reserve accumulation, sterilization operations, and the resulting expansion of central bank liabilities. Despite producing similar operational outcomes - overnight rates remaining close to policy targets with limited reserve scarcity - the implications for CBDC accommodation may differ because the underlying balance-sheet constraints are not the same.

Table 1 - Comparative Monetary Policy Operational Framework Characteristics. Sources: ECB, PBoC, BCB official publications; author's compilation.

Characteristic	ECB	PBoC	BCB
Policy Rate	DFR (2%)	7-day Reverse Repo (1.40%)	Selic Target (15%)
Upper Bound	MLF (2.4%)	SLF Lending Rate	Selic +35 bps (Standing Lending Facility)
Lower Bound	DFR (2.15%)	Excess Reserve / Deposit Facility	Selic –35 bps (Voluntary Deposits)
Operational Target	€STR	DR007	Overnight Selic
Target Segment	Unsecured O/N	Secured 7-day Repo	Secured O/N Repo
Framework	Floor	Corridor (hybrid)	Corridor
Rate Formation	Near floor rate	Managed around policy rate	Corridor anchored by BCB repos
Main Liquidity Tool	Reserve remuneration	RRR, OMOs, policy lending	Repos, deposits, standing facilities
Liquidity Regime	Ample reserves	Structural surplus	Persistent excess liquidity
Source of Surplus	QE / APP / PEPP	FX intervention sterilization	FX accumulation and fiscal factors
CBDC Project	Digital Euro	e-CNY	Drex
CBDC Design	Retail, 2-tier	Retail, 2-tier	Wholesale/tokenized platform
CBDC Remuneration	Under discussion	Non-remunerated	Non-remunerated (pilot)
Potential CBDC Challenge	Balance-sheet expansion	Reserve requirement calibration	Collateral availability and liquidity forecasting

The three jurisdictions have also chosen markedly different CBDC strategies, implying different channels through which CBDC adoption may affect monetary policy implementation. China's e-CNY is designed as a retail payment instrument embedded within a two-tier banking structure. Under the current framework, e-CNY balances distributed through commercial banks remain closely integrated with existing reserve requirements, balance-sheet management, and deposit insurance arrangements. As a result, the introduction of e-CNY primarily represents the creation of a new payment infrastructure layer rather than a fundamental change in the structure of monetary liabilities. Consequently, no major adjustment to the operational framework would be expected even under wider adoption.

The Digital Euro and Drex present a different set of operational considerations. Although both projects rely on intermediary-based architectures, they introduce the possibility of migration from traditional bank deposits toward new forms of central-bank-related digital money. In the euro area, the floor system and large stock of excess reserves provide a substantial buffer against such shifts, reducing the likelihood of immediate money-market disruptions. In Brazil, however, the reliance on collateralized liquidity operations introduces an additional dimension. A rapid increase in demand for central-bank digital liabilities could require expanded liquidity provision at a time when the availability of government securities collateral depends not only on central bank decisions but also on public debt management objectives. This interaction between liquidity management and sovereign debt issuance may make the Brazilian framework comparatively more sensitive to large-scale balance-sheet adjustments associated with CBDC adoption.

2.2 The ECB: Floor System Benchmark and the Digital Euro as Corridor Restoration Tool

2.2.1 Evolution of the ECB Operational Framework

The ECB began operations under a textbook symmetric corridor framework. The Main Refinancing Operation (MRO) served as the primary liquidity-providing instrument, while the deposit facility (DF) and marginal lending facility (MLF) established the corridor boundaries. With the banking sector operating close to a neutral liquidity position, interbank and repo markets played the central role in reserve redistribution and the ECB intervened only through regular refinancing operations.

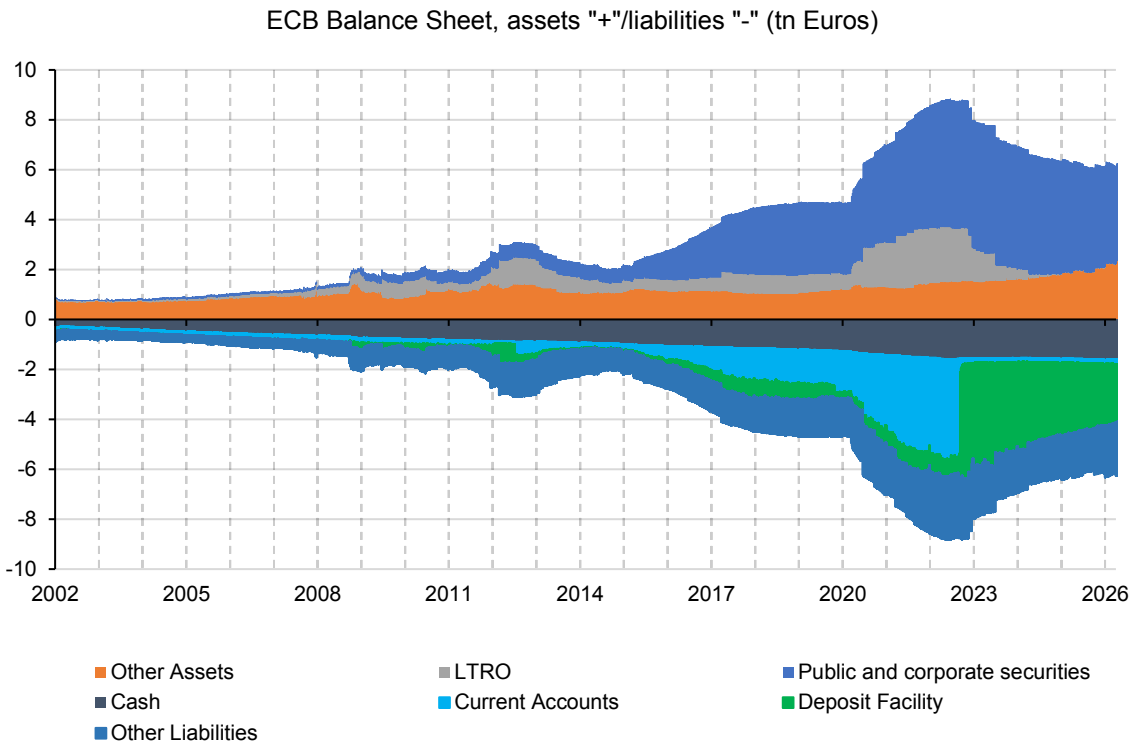
The transition to a de facto floor system began during the global financial crisis and accelerated during the period of unconventional monetary policy between 2009 and 2022. Fixed-rate full-allotment refinancing operations, LTROs, TLTROs, and large-scale asset purchases under the APP and PEPP generated a persistent structural liquidity surplus, causing overnight market rates to converge toward the deposit facility rate.

Under abundant liquidity conditions, reserve absorption shifted from active market operations toward remuneration of central bank liabilities. Until September 2022, the Eurosystem operated a two-tier floor system under which reserve balances within an exemption allowance – set at seven times minimum reserve requirements – were remunerated at 0 percent, while balances exceeding the allowance received the deposit facility rate of -0.50 percent. This structure created internal arbitrage incentives and moderated the impact of negative interest rates on bank profitability.

Following the return to positive interest rates in September 2022, the tiering mechanism was abolished and the framework effectively became a standard floor system anchored by the deposit facility rate. Banks subsequently concentrated excess liquidity in the deposit facility, reinforcing its role as the effective lower bound for money market rates.

Under the March 2024 operational framework review, the ECB retained the deposit facility rate as its primary policy rate while preparing for a gradual decline in excess reserves. The framework relies on weekly MROs and three-month LTROs to supply liquidity, supported by a narrower spread between the MRO and DFR rates (15 bps instead of 50 bps) to encourage participation in central bank refinancing operations. The ECB also retained the option to deploy structural refinancing operations or structural securities portfolios should additional reserve supply become necessary as the balance sheet normalises.

Figure 3

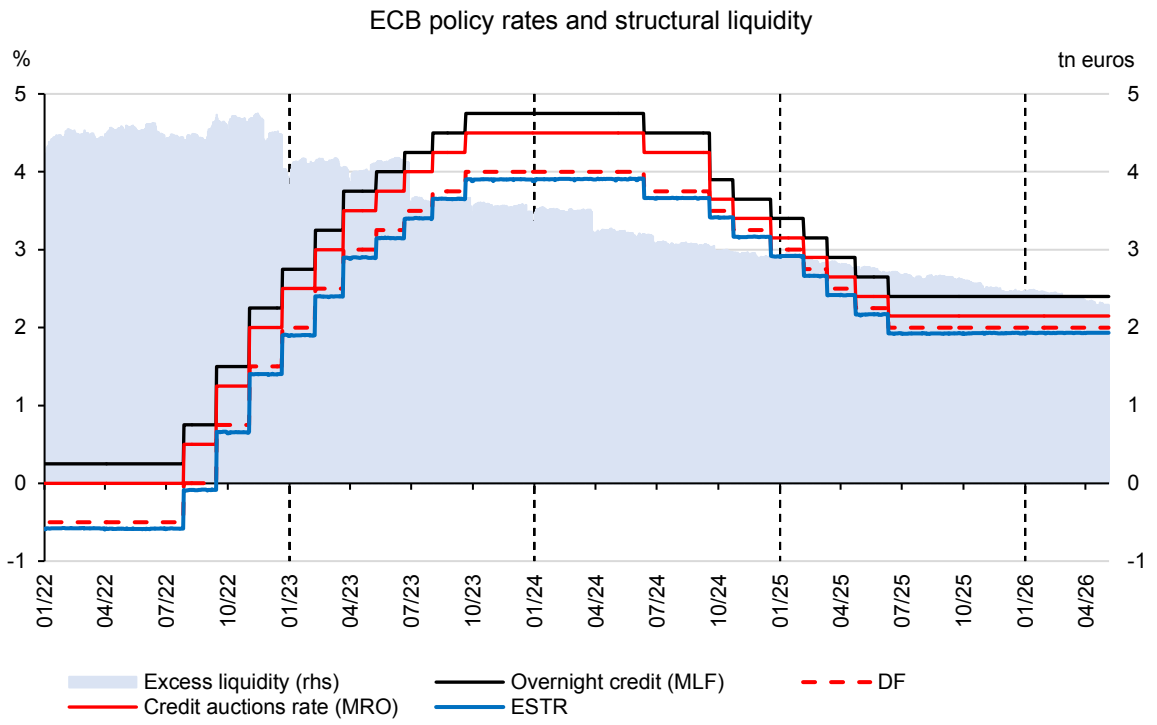


Source: ECB data portal, accessed via API. Retrieval code available via the link

With the transition to positive rates on 14 September 2022, the tiered remuneration system was discontinued and the framework moved to a single lower bound. Banks redistributed excess liquidity from reserve accounts to the deposit facility, effectively collapsing the two-tier structure into a standard floor system anchored at the DFR.

In the current period of monetary policy normalisation, the ECB retains the DFR as the primary policy rate. Seven-day repo auctions serve as the primary fine-tuning instrument, while structural longer-term operations are being phased in under the March 2024 operational framework review to manage reserve supply as the balance sheet normalises.

Figure 4



Source: ECB data portal, accessed via API. Retrieval code available via the link

2.2.2 Market Segmentation and the €STR Spread

The ECB's floor system has delivered effective interest-rate control, but its operation relies on a degree of market segmentation that prevents full convergence between policy and market rates. Although the deposit facility rate (DFR) functions as the primary policy rate, the €STR – the effective overnight market benchmark – has consistently traded below it. This spread reflects institutional segmentation between credit institutions with direct access to ECB standing facilities and non-bank participants, particularly money market funds (MMFs), which are excluded from direct access to central bank deposit facilities.

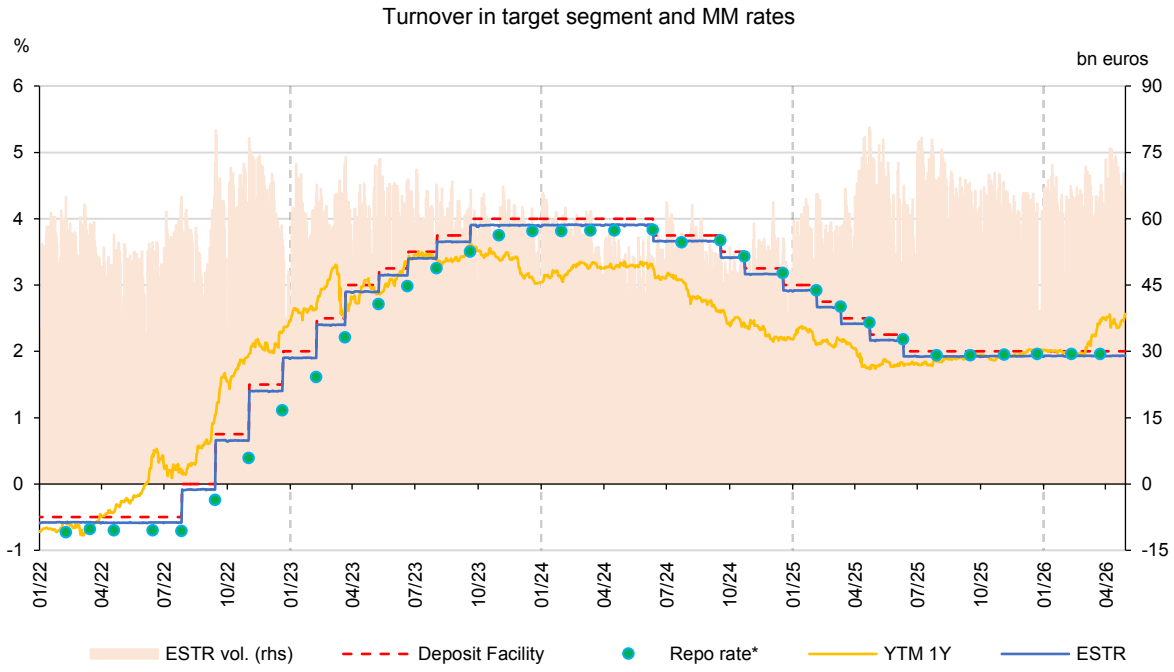
The resulting "leaky floor" is a structural feature of the Eurosystem's operational framework rather than a temporary market distortion. Because €STR incorporates transactions between banks and counterparties that cannot place funds directly at the ECB, market rates settle below the DFR. MMFs and other non-bank investors must therefore accept rates offered by commercial banks, even when those rates remain below the remuneration available through the deposit facility. The spread is further reinforced by prudential regulation, as additional short-term liabilities increase banks' leverage ratio exposure and raise the balance-sheet cost of intermediating non-bank liquidity.

The segmentation became particularly visible during the period of targeted long-term refinancing operations (TLTRO III). Between 2020 and 2022, exceptionally favourable TLTRO funding conditions created incentives for banks to expand balance sheets and intermediate liquidity at rates disconnected from the prevailing policy corridor. Although the subsequent normalization of monetary policy reduced these distortions, €STR continues to trade modestly below the DFR under normal market conditions and exhibits wider deviations around regulatory reporting dates.

As excess liquidity declines, the ECB may gradually transition from an environment of abundant reserves toward a more balanced liquidity position. Under the March 2024 operational framework review, the Eurosystem confirmed its intention to preserve a floor-system architecture while relying more heavily on refinancing operations to supply reserves. In such an environment, reserve demand is expected to become more relevant for operational implementation, increasing the importance of liquidity forecasting and reserve

management. The experience of the pre-crisis corridor framework suggests that money-market activity could recover as excess reserves decline, although the ECB has indicated its intention to maintain sufficient reserve supply to avoid a return to structural reserve scarcity.

Figure 5



Source: ECB data portal, accessed via API. Retrieval code available via the link

From a CBDC perspective, the key implication is that the Digital Euro would enter a framework already characterized by segmented access to central bank liabilities. To the extent that households and non-bank financial institutions substitute deposits for digital euro holdings, liquidity distribution within the financial system may change even if aggregate liquidity remains ample. The ECB's large balance sheet established refinancing infrastructure, and floor-system design provide significant capacity to absorb such shifts. Nevertheless, Digital Euro adoption could increase the importance of reserve-demand forecasting and reinforce existing segmentation between institutions with and without direct access to central bank balance-sheet facilities.

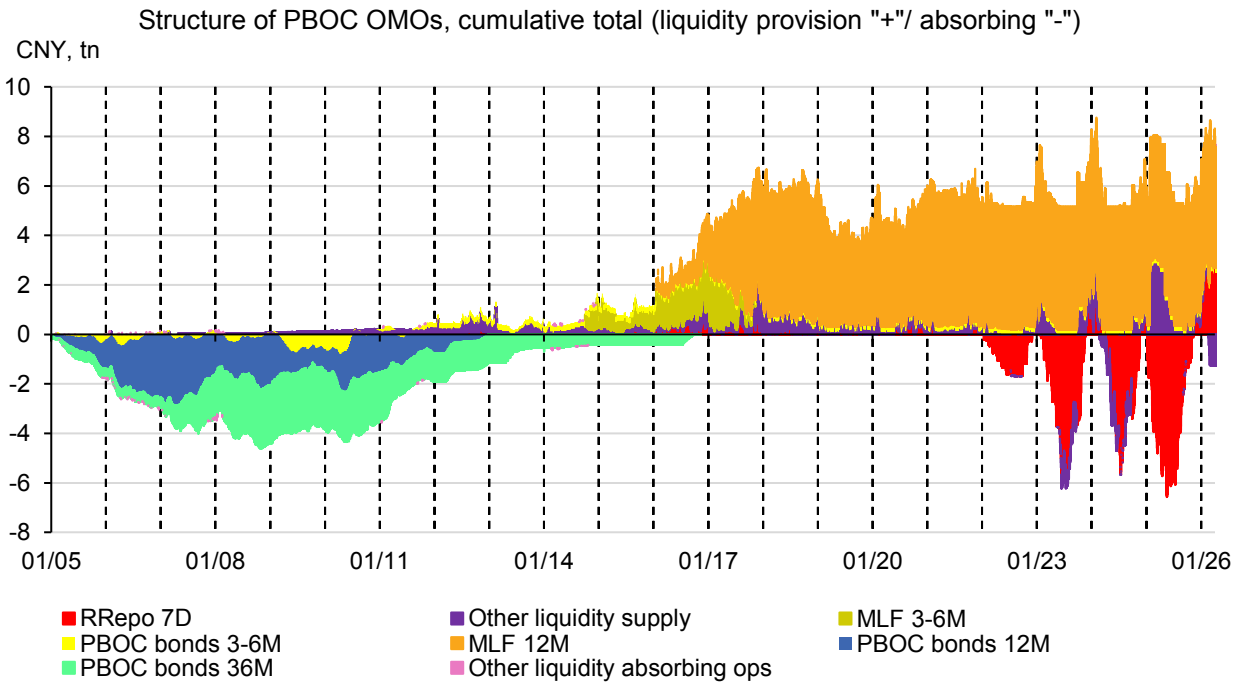
2.3 The PBoC: Transitional Corridor, Administrative Channels

The People's Bank of China's (PBoC) operational framework combines market-based liquidity management with administrative and balance-sheet instruments, resulting in a monetary policy architecture that differs fundamentally from the predominantly market-based frameworks of advanced economy central banks. In addition to pursuing price stability, the PBoC supports broader policy objectives, including financial stability, exchange-rate management, and economic development. Consequently, conventional money market instruments coexist with reserve requirement adjustments, targeted lending facilities, policy-bank financing, and various forms of credit guidance. While recent reforms have strengthened the role of interest rates in monetary transmission, administrative mechanisms continue to play a significant role in allocating liquidity and influencing credit conditions.

The PBoC formally operates an interest rate corridor, but its liquidity management framework relies heavily on medium-term funding instruments rather than the short-term reserve management characteristic of classical corridor systems. The Standing Lending Facility (SLF) provides the upper boundary of the corridor, while the excess reserve remuneration rate forms the lower bound. The 7-day reverse repo rate has emerged as the principal policy signal and serves as the benchmark for short-term liquidity

operations. Unlike the ECB or the BCB, however, the PBoC does not designate a specific overnight market rate as its operational target. Structural liquidity is managed through a combination of reserve requirement ratios (RRR), Medium-Term Lending Facility (MLF) operations, and open market operations (OMOs), with the MLF becoming the dominant source of medium-term central bank funding for the banking sector.

Figure 6



Source: Bloomberg “PBOC Open Market Operations database”.

The growing importance of the MLF has altered the incentives of market participants and weakened the role of the short-term money market in liquidity allocation. Since 2015, the PBoC has increasingly supplied liquidity through auction-based facilities with maturities ranging from several months to one year. While these instruments provide predictable funding conditions for banks, they reduce the need for active day-to-day liquidity redistribution through the interbank market. As a result, a larger share of liquidity management is effectively conducted through central bank balance-sheet operations rather than through market interactions among financial institutions.

This reliance on medium-term central bank funding may weaken the transmission of short-term policy signals. In a conventional corridor system, banks actively manage reserve positions in response to changes in overnight funding conditions, strengthening the link between the operational target and broader financial conditions. In China, by contrast, institutions that secure a substantial portion of their funding through MLF operations have a reduced need to adjust their overnight positions in response to fluctuations in short-term market rates. Consequently, changes in the 7-day reverse repo rate may exert a weaker influence on market pricing than would be expected in a framework where liquidity is distributed primarily through the interbank market.

Reserve requirement ratios remain a central pillar of China's liquidity management framework and continue to play a larger role than in most advanced economies. Historically, high reserve requirements absorbed structural liquidity generated by sustained foreign exchange inflows and contributed to the sterilisation of balance-of-payments surpluses. Following the slowdown of reserve accumulation after 2015, the PBoC increasingly relied on a combination of RRR reductions, MLF funding, and repo operations to maintain adequate liquidity conditions. Although RRR adjustments remain an important signalling device, the operational burden of day-to-day liquidity provision has shifted toward central bank lending facilities.

The coexistence of reserve requirements, medium-term lending facilities, and short-term market operations creates a more complex transmission mechanism than observed in the ECB or BCB frameworks. This complexity may reduce transparency regarding the relative importance of individual policy instruments and blur the distinction between structural liquidity provision and cyclical liquidity management. At the same time, it provides the PBoC with considerable flexibility to support specific sectors or policy objectives without relying exclusively on market-based channels.

From the perspective of CBDC implementation, the Chinese framework exhibits a distinctive feature: the e-CNY has largely been integrated into the existing banking and reserve management architecture rather than creating a separate monetary instrument. Under the current two-tier design, e-CNY wallets are distributed through commercial banks and remain embedded within banks' balance-sheet management processes. Consequently, the introduction of the digital yuan is unlikely to materially alter aggregate banking sector liquidity or require substantial changes to the existing operational framework. Instead, reserve requirements and central bank liquidity facilities are expected to remain the primary instruments through which the PBoC accommodates changes in money demand arising from CBDC adoption.

The table presents the main instruments currently employed by the PBoC, including reserve requirement ratios, reverse repos, the Medium-Term Lending Facility, Standing Lending Facility, and targeted lending programmes.

Table 2 – PBoC liquidity providing toolkit.

Instrument	Purpose	Counterparties	Tenor	Outstanding (CNY tn)	Rate (%)
SLF	Standing liquidity facility	Banks	O/N–1m	~0.01	2.25 – 2.75
PSL	Policy-bank refinancing	Policy banks	>3y	~3.3	1.75
MLF	Medium-term liquidity provision	Banks	3–12m	~4.8	2.0
TMLF	SME-targeted funding	Banks	Up to 3y	Phased out	–
TLF	Temporary liquidity support	Large state banks	28d	Limited use	–
CRA	Temporary reserve relief	Banks	30d	Limited use	–

Note: MLF is the dominant structural liquidity instrument. PSL provides long-term funding to policy banks. SLF serves as the corridor ceiling. TMLF, TLF and CRA have largely become supplementary or inactive facilities.

The introduction of e-CNY remuneration does not, in itself, imply a need for a fundamental redesign of the PBoC's operational framework. Given the existing two-tier structure, in which e-CNY is intermediated through commercial banks and embedded within their balance-sheet and reserve management processes, the aggregate impact on system-wide liquidity is likely to be gradual and largely endogenous. Any shift in deposit composition between bank deposits and e-CNY holdings would primarily manifest as a redistribution of liabilities within the banking system rather than an autonomous change in central bank balance-sheet size. In this context, the PBoC can accommodate changes in money demand through its existing toolkit without introducing new operational instruments.

At the margin, however, a higher degree of e-CNY adoption and remuneration could increase the sensitivity of retail and corporate liquidity preferences to short-term rate differentials, potentially raising the frequency of liquidity fluctuations at the bank level. This would argue for continued reliance on the reserve requirement ratio as a structural liquidity buffer, alongside active short-term liquidity smoothing through 7-day reverse repo operations. The RRR is therefore likely to retain its role as the primary structural instrument for absorbing or releasing liquidity shocks, while 7-day reverse repos remain the main marginal tool for day-to-day liquidity calibration.

Overall, the operational framework is best characterised as stable under CBDC adoption, with incremental adjustments in liquidity management rather than structural change. The coexistence of reserve requirements, auction-based medium-term funding, and short-term repo operations continues to

provide the PBoC with sufficient flexibility to accommodate evolving money demand dynamics without requiring a shift toward a fully corridor-based system or a redesign of its policy rate architecture.

2.4 The Banco Central do Brasil: Sterilised Surplus, Selic Moral Hazard, and DREX

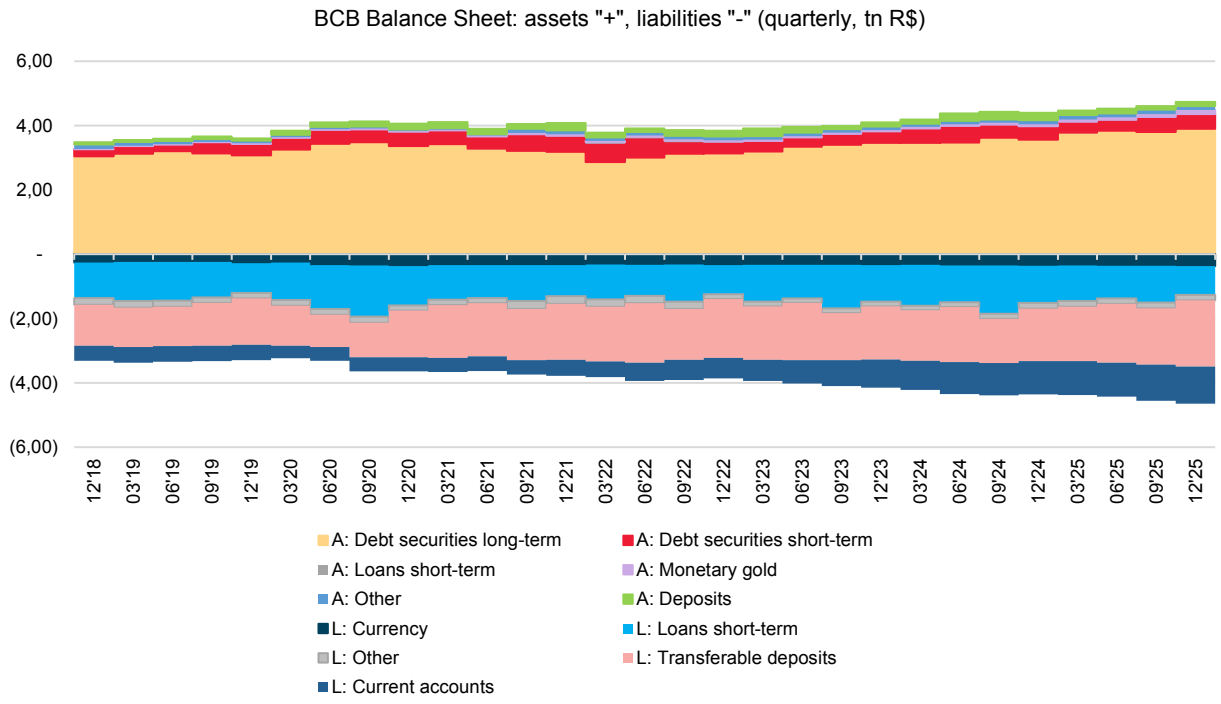
2.4.1 BCB Operational Framework: Historical Origins and Current Architecture

The Banco Central do Brasil's (BCB) operational framework is structurally shaped by its historical role as both monetary authority and residual financier of the sovereign, embedding government bond–collateralised repo operations at the core of its liquidity management system. This institutional configuration originates in Brazil's pre-1964 system, where monetary policy was conducted via Banco do Brasil under Treasury influence, with no centralized sovereign bond market and administratively capped yields (12%). The 1965 PAEG reform established the BCB and a national monetary council, while preserving government influence and mandating support for sovereign bond market functioning – anchoring government securities as the natural instrument for monetary operations.

This fiscal–monetary nexus was reinforced in 1987 when debt management was formally transferred to the Treasury, but legislation retained a clause allowing the BCB to purchase any unplaced government bonds, effectively positioning it as a residual buyer of sovereign debt. The 1990 debt crisis, during which 80% of financial assets were frozen and forcibly exchanged at below-market prices, exposed the risks of this arrangement and ultimately supported the transition toward central bank independence.

The resulting framework is characterised by a persistent structural liquidity surplus, driven by sustained foreign exchange inflows and their sterilisation through government bond issuance rather than by discretionary central bank balance sheet expansion. Unlike the ECB, where surplus liquidity has been policy-induced via asset purchases and is now actively unwound, Brazil's surplus is endogenous and linked to external sector dynamics. Since the adoption of inflation targeting in 1999 and the establishment of the Selic rate – defined through overnight repo transactions on the interbank settlement system – the BCB has combined a forward-looking policy rate path with active short-term liquidity management via repo auctions.

Figure 7



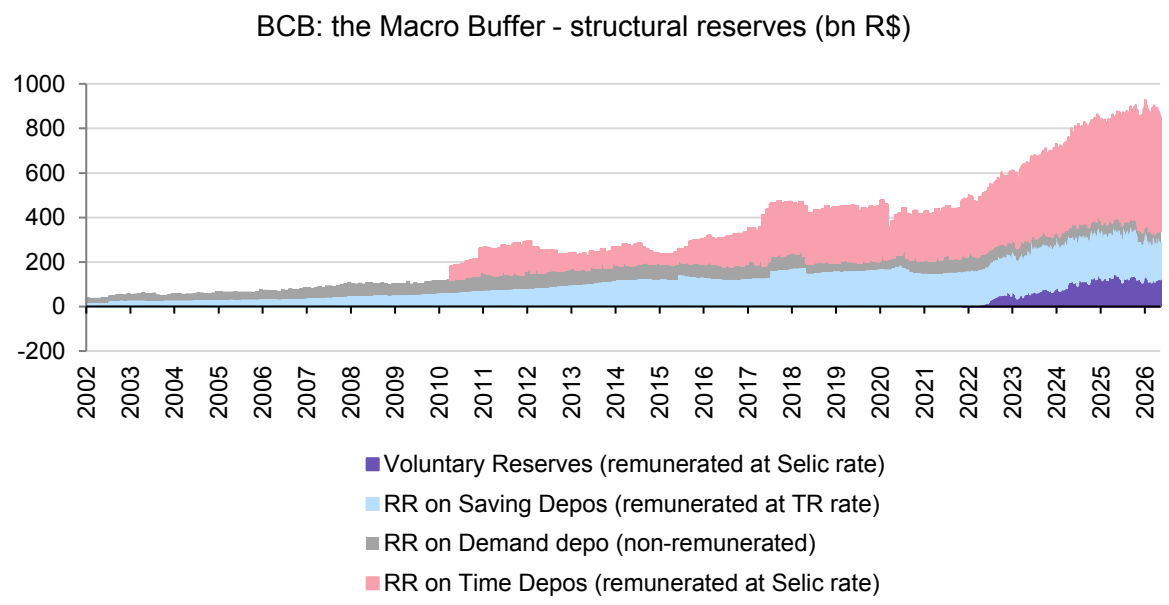
Source: Banco Central do Brasil (BCB), SGS (Sistema Gerenciador de Séries Temporais) and Open Data Portal. Authors' calculations based on BCB balance sheet accounts. Data retrieved via BCB API (SGS/Open Data interface)

Within this environment, required and voluntary reserves remunerated at differentiated rates constitute the primary structural instrument for absorbing excess liquidity and shaping interbank dynamics around the Selic target. These tiered remuneration mechanisms generate active reserve management behaviour among banks, effectively sustaining a distributed market for liquidity around the policy rate corridor.

However, BCB repo operations also play a disproportionately large role in price formation, accounting for roughly half of all rate-relevant transactions in the Selic-forming segment. This reduces the purely market-determined character of the policy rate relative to benchmarks such as €STR and introduces a degree of central bank dependency in liquidity redistribution. As a result, interbank incentives to develop bilateral liquidity management are partially displaced by reliance on the central bank as the marginal liquidity provider.

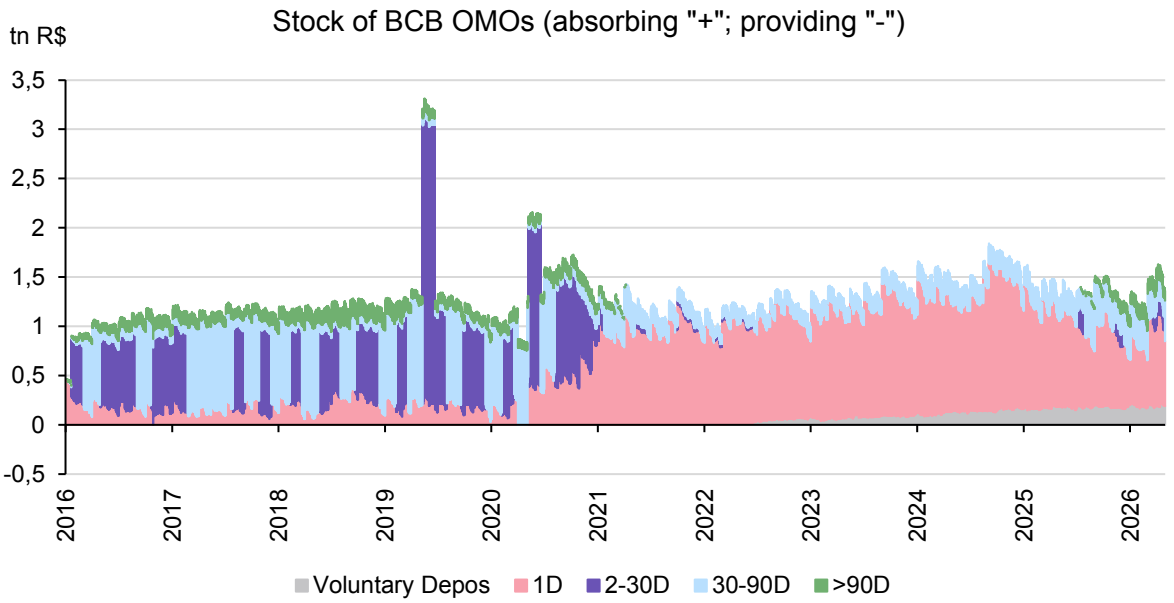
The accompanying charts illustrate these dynamics through the evolution of the BCB balance sheet, the term structure of outstanding open market operations, and the scale of structural commercial bank deposits held at the central bank (MacroBuffer).

Figure 8



Source: Banco Central do Brasil (BCB), SGS (Sistema Gerenciador de Séries Temporais) and Open Data Portal. Authors' calculations based on BCB balance sheet accounts. Data retrieved via BCB API (SGS/Open Data interface)

Figure 9



Source: Banco Central do Brasil (BCB), SGS (Sistema Gerenciador de Séries Temporais) and Open Data Portal. Authors' calculations based on BCB OMO reports. Data retrieved via BCB API (SGS/Open Data interface)

2.4.2 The Selic Rate: Structure, Informational Content, and Moral Hazard

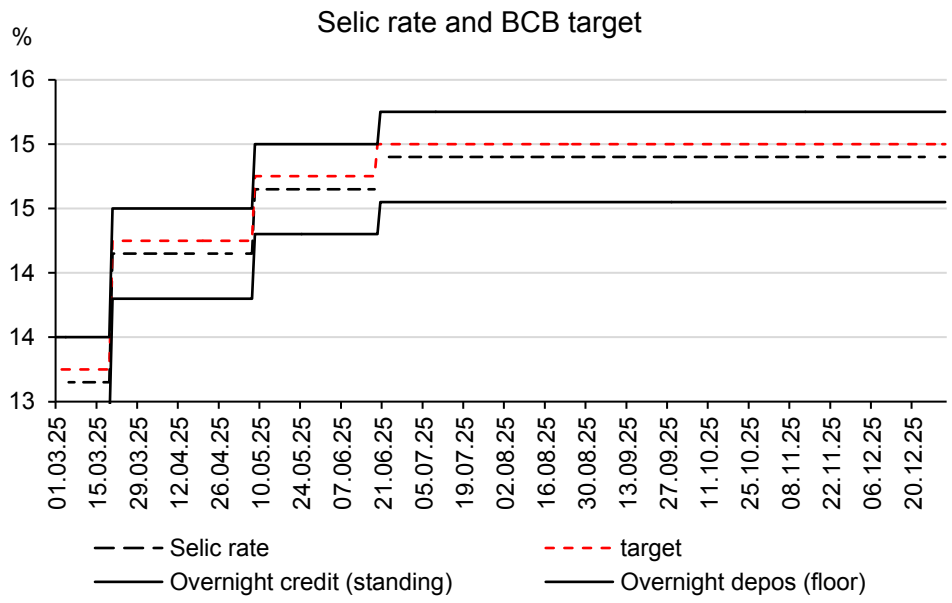
The Selic rate – Brazil's overnight repo rate – is the Banco Central do Brasil's (BCB) operational target and is jointly formed by market transactions and central bank operations rather than being a purely interbank-determined benchmark. Unlike €STR, which is computed exclusively from reported overnight unsecured transactions between financial institutions, Selic is derived from a transaction pool that includes both market repo operations and BCB liquidity-providing operations. Within this structure, BCB participation accounts for approximately half of all rate-relevant transactions, materially shaping the formation of the benchmark itself.

This hybrid structure reduces the informational content of the Selic rate as a pure signal of private-sector liquidity conditions, since the central bank is simultaneously a price setter and a major price participant in the underlying market. As a result, Selic reflects not only interbank funding pressures but also the operational stance of the BCB in supplying or absorbing liquidity. This dual role – where the policy instrument is also the main observable market outcome – limits the extent to which Selic can be interpreted as an independent measure of marginal liquidity conditions in the banking system.

The BCB's dominant operational presence in the Selic formation process creates structural reliance by market participants on central bank liquidity provision, weakening incentives for deep bilateral interbank repo markets and autonomous liquidity redistribution. In the absence of strong incentives to intermediate liquidity peer-to-peer, banks can rationally expect the BCB to remain the marginal counterparty at the policy rate, which reduces the development of private liquidity insurance mechanisms. No quantitative evidence beyond the stated share of BCB participation is provided here; further microstructure data would be required to assess the magnitude of this effect on market depth and pricing efficiency.

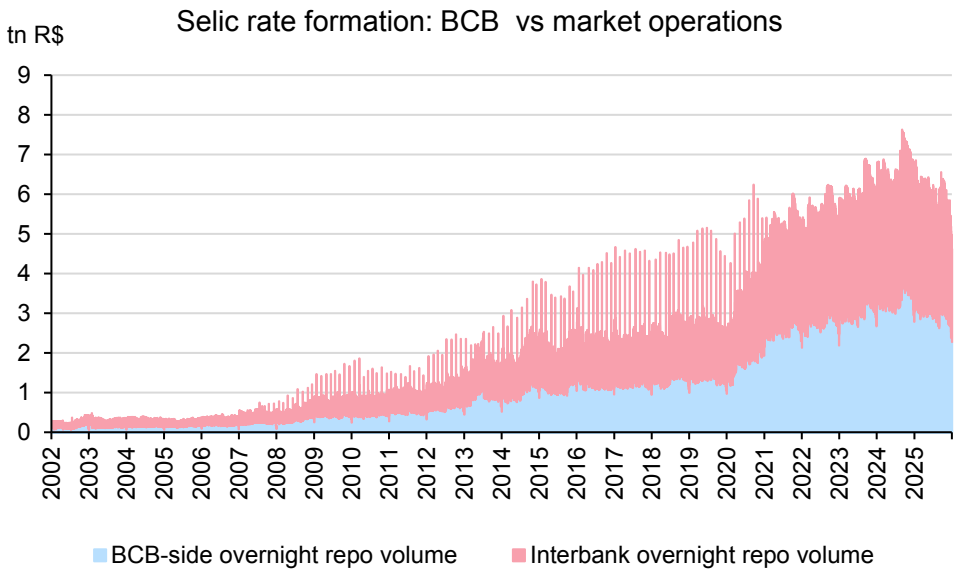
From a CBDC perspective, the existing Selic formation mechanism introduces a potential amplification channel for liquidity centralisation, but the direction and magnitude of the effect cannot yet be empirically established given the absence of post-e-CBDC microstructure data. If a retail CBDC increases the volatility or redistribution speed of deposits across institutions, the reliance on the BCB as a marginal liquidity provider could become more pronounced, reinforcing the existing structure in which central bank operations dominate rate formation. However, this remains a hypothesis rather than an observed outcome. The main structural vulnerability of the current framework is therefore its dependence on the central bank as both price setter and dominant liquidity counterparty, which may constrain the development of fully decentralised interbank liquidity markets under evolving monetary architectures.

Figure 10



Source: Banco Central do Brasil (BCB), SGS (Sistema Gerenciador de Séries Temporais) and Open Data Portal. Authors' calculations. Data retrieved via BCB API (SGS/Open Data interface)

Figure 11 - Selic rate formation.



Source: Banco Central do Brasil (BCB), SGS (Sistema Gerenciador de Séries Temporais) and Open Data Portal. Authors' calculations. Data retrieved via BCB API (SGS/Open Data interface)

The preceding jurisdictional analysis shows that floor, corridor, and hybrid operational frameworks condition the way central banks absorb CBDC-related shocks. This reserve-buffer perspective, however, does not fully explain where a CBDC-related liquidity shock enters the system, when it becomes visible to the central bank, or how participants replenish their positions. These questions depend on the settlement infrastructure. The next section therefore adds a settlement-layer dimension to the analysis.

Section 3. CBDC design and selected central banks' monetary policy response

CBDC adoption affects monetary policy implementation primarily through four design parameters – remuneration, holding limits, access criteria, and mechanisms that reduce the need for positive CBDC balances – which jointly determine equilibrium CBDC demand and the associated shift in bank reserve demand. These features are central to the transmission channel because they define whether CBDC behaves as a close substitute for deposits or remains a limited payment instrument, thereby shaping the magnitude and volatility of balance-sheet adjustments across the banking system.

Remuneration is the dominant determinant of CBDC attractiveness as a store of value and therefore a key driver of potential deposit substitution and reserve drain. If CBDC were remunerated at rates comparable to savings deposits, money market funds, or short-term sovereign instruments, large-scale portfolio reallocation toward CBDC would be expected. For this reason, most central banks have historically opted for zero remuneration to preserve CBDC's role as a means of payment rather than an investment asset. This includes the ECB, Bank of England, and Reserve Bank of India. The PBoC similarly maintained a non-interest-bearing e-CNY during its pilot phase (2020–2025), consistent with this design logic.

A structural break occurred in the PBoC framework on 1 January 2026, when e-CNY balances held via commercial bank wallets were reclassified as deposit liabilities and became interest-bearing under prevailing deposit rate regulations, fundamentally altering substitution dynamics with bank deposits. Under the new regime, commercial banks remunerate e-CNY wallet balances, which are fully integrated into balance-sheet management and covered by deposit insurance. This design preserves the two-tier architecture but transforms e-CNY into a close functional substitute for demand deposits, increasing sensitivity of CBDC demand to interest rate differentials and making reserve flows more elastic with respect to policy rates. This represents a material shift in the global CBDC design space, as it is the first documented case of a remunerated retail CBDC within a bank-intermediated framework. In contrast, Brazil's Drex is structured as tokenised commercial bank deposits rather than a central bank liability, implying that remuneration dynamics are fully internalised within the banking sector and do not directly affect the central bank balance sheet.

Holding limits are used by central banks as a quantitative backstop to prevent CBDC from evolving into a large-scale store of value, particularly under low interest rate conditions. The ECB's preparation phase analysis (2023–2025) shows that with a €3,000 holding limit, only 13 banks (0.3% of total banking assets) would experience liquidity stress, compared to earlier industry estimates suggesting significantly higher vulnerability (up to 56 institutions in German banking sector assessments). More recent ECB internal discussions indicate that higher thresholds – potentially up to €10,000 per individual – remain under consideration, although the final binding constraint is subject to the legislative process expected to conclude in 2026 following Eurogroup agreement (September 2025). For e-CNY, no explicit individual holding limit has been publicly specified post-2026 redesign, with constraint mechanisms instead embedded in the commercial bank deposit framework.

Access criteria define the perimeter of CBDC adoption and therefore determine the cross-border and sectoral transmission of liquidity effects. The ECB continues to design the digital euro as a domestically focused instrument, initially restricted to euro-area residents and natural persons, excluding non-residents, non-financial corporates, and financial institutions. This is particularly relevant given estimates that approximately 40% of euro banknotes are held outside the euro area (Zamora-Pérez, 2021; Devigne et al., 2023), implying that a significant portion of legacy cash demand would not migrate into CBDC. By contrast, e-CNY exhibits a materially broader access perimeter: the PBoC–HKMA cross-boundary pilot expansion (2024) enabled Hong Kong residents to open wallets using only a local mobile number, with funding via the Faster Payment System, representing one of the first direct integrations between a fast payment system and a CBDC infrastructure. This places e-CNY on a more internationalised trajectory relative to the digital euro design space.

Mechanisms that reduce the need to hold positive CBDC balances are critical in limiting steady-state CBDC stock and therefore constraining long-run reserve displacement. The ECB's "reverse waterfall" mechanism automatically replenishes insufficient CBDC balances by drawing funds from linked commercial bank accounts in real time, eliminating the need for pre-funding and structurally limiting persistent CBDC holdings. This feature was retained in the June 2025 interim scheme rulebook and remains central to ensuring

that CBDC does not disintermediate bank deposits at scale. In the case of e-CNY, the hybrid architecture combining account-based wallets, token-based components, and smart contracts preserves full convertibility with commercial bank deposits, while Drex relies entirely on existing real-time settlement infrastructure (STR), ensuring that tokenised deposits remain embedded within the banking system rather than creating a parallel liquidity pool.

Across the ECB, PBoC, and BCB frameworks, CBDC design choices converge on a common objective of limiting destabilising reserve shifts, but they do so through distinct institutional mechanisms reflecting their underlying monetary operating frameworks. The ECB relies primarily on quantitative caps and automated balancing mechanisms within a floor system; the PBoC (post-2026) introduces a remunerated CBDC embedded in the banking system, increasing substitution elasticity but maintaining intermediation; and Brazil's Drex avoids central bank balance-sheet expansion by design, delegating CBDC issuance to tokenised bank deposits. The common constraint across all three cases is that CBDC functions as an autonomous factor in reserve demand forecasting, requiring central banks to adjust liquidity management frameworks even when no fundamental change in operating targets is intended.

Table 3 - CBDC Design features.

Design feature	Digital Euro (ECB)	Drex (BCB)	e-CNY (PBoC)
Remuneration	Zero remuneration. ECB explicitly frames digital euro as cash-equivalent to avoid store-of-value substitution and bank deposit outflows.	No central bank remuneration. Drex is tokenised commercial bank deposits; remuneration is fully delegated to banks within the existing two-tier model.	**Interest-bearing since 1 January 2026.** Wallet balances (categories 1–3) earn deposit-rate remuneration with quarterly settlement; fourth-category anonymous wallets excluded. This represents a structural departure from the global zero-interest CBDC design consensus.
Architecture / tiering	Two-tier model. ECB issues CBDC; PSPs and banks provide retail access. ECB does not directly observe end-user holdings. Development of CBMT tokenised settlement layer underway (from Dec 2025) to integrate tokenised bank deposits and central bank money.	Two-tier wholesale tokenised model. BCB issues Drex to financial institutions; retail users hold tokenised bank deposits. Drex is not a direct retail central bank liability. Settlement integrates with STR infrastructure.	Hybrid system (accounts + token strings + smart contracts). Commercial banks distribute e-CNY; **post-2026 classification treats balances as bank deposits**, fully integrated into ALM and deposit insurance.
Holding limits	Not finalised (legislative process ongoing into 2026). ECB analysis: €3,000 cap → stress in 13 banks (0.3% of banking assets). Eurogroup discussions (Sept 2025) consider higher caps (up to €10,000). Waterfall mechanism enforces limits automatically.	No CBDC-specific cap. Constraints are indirect via existing bank deposit regulation and capital framework. Design remains wholesale/DvP-focused rather than retail balance accumulation.	No explicit CBDC cap post-2026 redesign. Constraints effectively governed by standard deposit regulation (incl. CNY 500,000 deposit insurance threshold).
Other monetary-policy-relevant features	Reverse waterfall prevents persistent CBDC balances by automatically funding payments from linked bank accounts. Offline NFC capability introduces partial opacity in liquidity tracking. Excludes non-residents and corporates, removing ~40% of euro banknote demand (Zamora-Pérez 2021; Devigne et al. 2023) from substitution pool.	Programmability and smart contracts enable atomic DvP settlement of tokenised assets (securities, receivables, real assets). Primary function is settlement efficiency rather than retail payment substitution. Integration with PIX reduces friction between bank money and tokenised settlement.	Deposit insurance coverage (post-2026) removes safety differential between CBDC and bank deposits. Large-scale adoption base (≈230m wallets; CNY 16.7tn cumulative transactions by end-2025) creates strong network effects. Cross-border access via HKMA–PBoC FPS linkage (2024) introduces non-resident CBDC holdings as a potential volatile liquidity component.

Section 4. Conclusions and Policy Recommendations

The impact of CBDC adoption is shaped by two interacting layers: the monetary policy operational framework and the settlement infrastructure stack. The first determines how sensitive rates are to reserve shocks; the second determines whether a shock reaches reserves, when it becomes visible to the central bank, and how participants can replenish liquidity. A CBDC design that appears identical on paper may therefore have different operational consequences depending on the legal form of the retail unit, the settlement model of the prefunded instant layer, and the operating hours of the scheduled RTGS system.

CBDC design should be evaluated primarily through its interaction with central bank operational frameworks rather than as a standalone payment innovation, since its monetary policy impact depends on how it reshapes reserve demand under either abundant- or scarce-reserve regimes. The central implication is that CBDC does not generate a uniform policy challenge: its effects are state-dependent and vary systematically with its position along two dimensions—retail versus wholesale usage and remunerated versus non-remunerated design—interacting with pre-existing liquidity management structures.

The magnitude and volatility of CBDC effects will be determined less by design parameters alone and more by adoption dynamics, institutional incentives, and policy-driven usage patterns that may compress or amplify deposit substitution. If CBDC adoption is actively promoted through public sector payments or transfer systems, uptake could be rapid and concentrated, improving short-run observability of money demand but increasing structural deposit displacement. This creates a trade-off between improved transparency in autonomous factor measurement and higher potential for unintended balance-sheet stress if adoption exceeds calibrated thresholds. Non-resident usage constitutes a further uncertainty: foreign CBDC holdings introduce autonomous factor dynamics driven by portfolio allocation and exchange rate expectations rather than domestic payment behaviour, making them structurally more volatile and less predictable than traditional currency demand. This channel is not analysed in detail in this paper but represents a first-order long-run uncertainty for reserve currency jurisdictions.

4.1 ECB / Digital Euro

The ECB is the best-positioned of the three cases to absorb CBDC-related autonomous factor shocks due to its deep financial market infrastructure and structurally abundant reserves, which provide a buffer against moderate CBDC-induced liquidity drains. In this environment, the digital euro primarily affects the distribution rather than the aggregate level of liquidity, reinforcing the importance of calibration at the level of operational parameters rather than instrument design. The holding limit should therefore be treated explicitly as a monetary policy implementation variable: if the objective is to preserve a floor system, limits should remain sufficiently restrictive to prevent meaningful depletion of structural surplus liquidity; if the objective is to reintroduce corridor-like dynamics, limits could be calibrated to allow a controlled and gradual drain of reserves consistent with multi-year balance-sheet normalisation.

4.2 PBoC / e-CNY

The PBoC's primary monetary policy challenge remains the transition toward more market-based price discovery, with e-CNY playing a secondary role relative to the broader reform of liquidity management and interest rate transmission mechanisms. The central priority is to reduce reliance on administrative liquidity instruments—reserve requirement adjustments, directed lending facilities, and window guidance—and to strengthen the role of the DR007 as a genuine marginal price of reserves. Within this framework, the current non-remunerated, two-tier structure of e-CNY is consistent with limiting autonomous factor volatility during the transition phase. The main vulnerability of the PBoC framework lies less in CBDC-induced deposit substitution and more in the coexistence of partial market signals with persistent expectations of non-market intervention, as illustrated by past episodes of credit stress

resolution. Resolving this institutional inconsistency is a prerequisite for CBDC to operate within a fully informative market-based liquidity regime.

4.3 BCB / Drex

Drex should be interpreted primarily as a wholesale tokenised settlement infrastructure rather than a retail CBDC, implying limited direct impact on autonomous factor dynamics but potential relevance for the structure of liquidity management if its scope evolves. In its current form, Drex functions as an extension of Brazil's existing RTGS architecture (STR), with liquidity effects concentrated at the interbank settlement layer rather than through retail deposit substitution. However, from an operational framework perspective, a remunerated form of tokenised bank liability linked to Drex could, in principle, serve as an additional liquidity absorption mechanism. Such an instrument could reduce the BCB's structural reliance on repo-based liquidity management and improve the informational content of the Selic rate by lowering the central bank's marginal dominance in the repo market. This remains conditional on further analytical work regarding inflation targeting consistency, the interaction with government bond yields, and the broader implications for collateral scarcity and fiscal–monetary separation.

For central banks and payment system operators, CBDC design should therefore be assessed jointly with the surrounding settlement infrastructure. This includes RTGS operating hours, instant payment settlement models, access to central bank accounts, the reserve eligibility of prefunded balances, and collateral availability across non-working periods. Each of these conditions determines where a CBDC-related shock enters the reserve circuit, how quickly it becomes visible, and how readily it can be absorbed.

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CBDC Adoption as an Autonomous Factor: Monetary Policy Implementation Implications

A Cross-Jurisdictional Analysis: ECB, PBoC, Banco Central do Brasil

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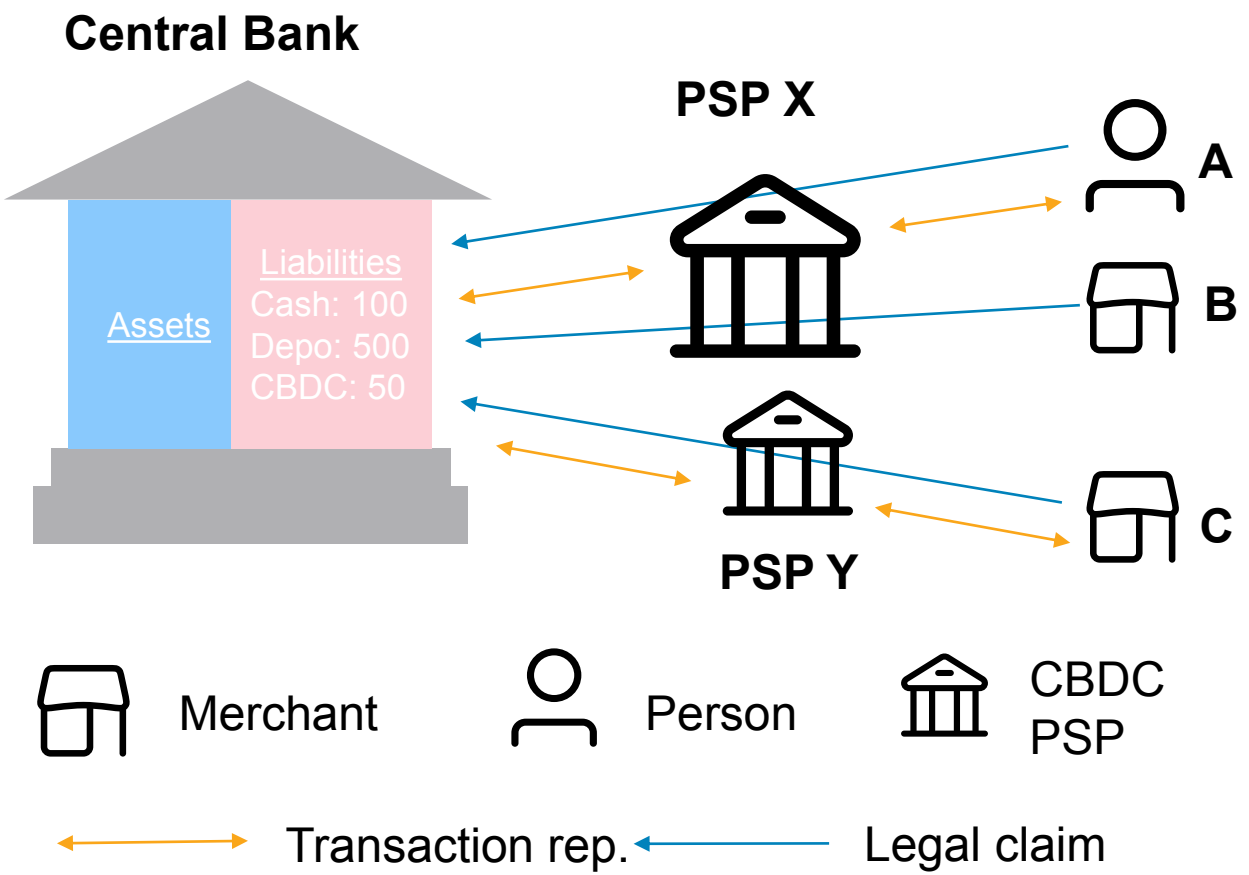
Motivation

CBDC is usually discussed as a payments innovation.

But for central banks, CBDC creates a new autonomous factor.

CBDC adoption can:

- alter reserve demand
- change bank liability composition
- affect liquidity forecasting
- influence money market rates



Source: BIS

Does CBDC adoption affect all central banks equally?

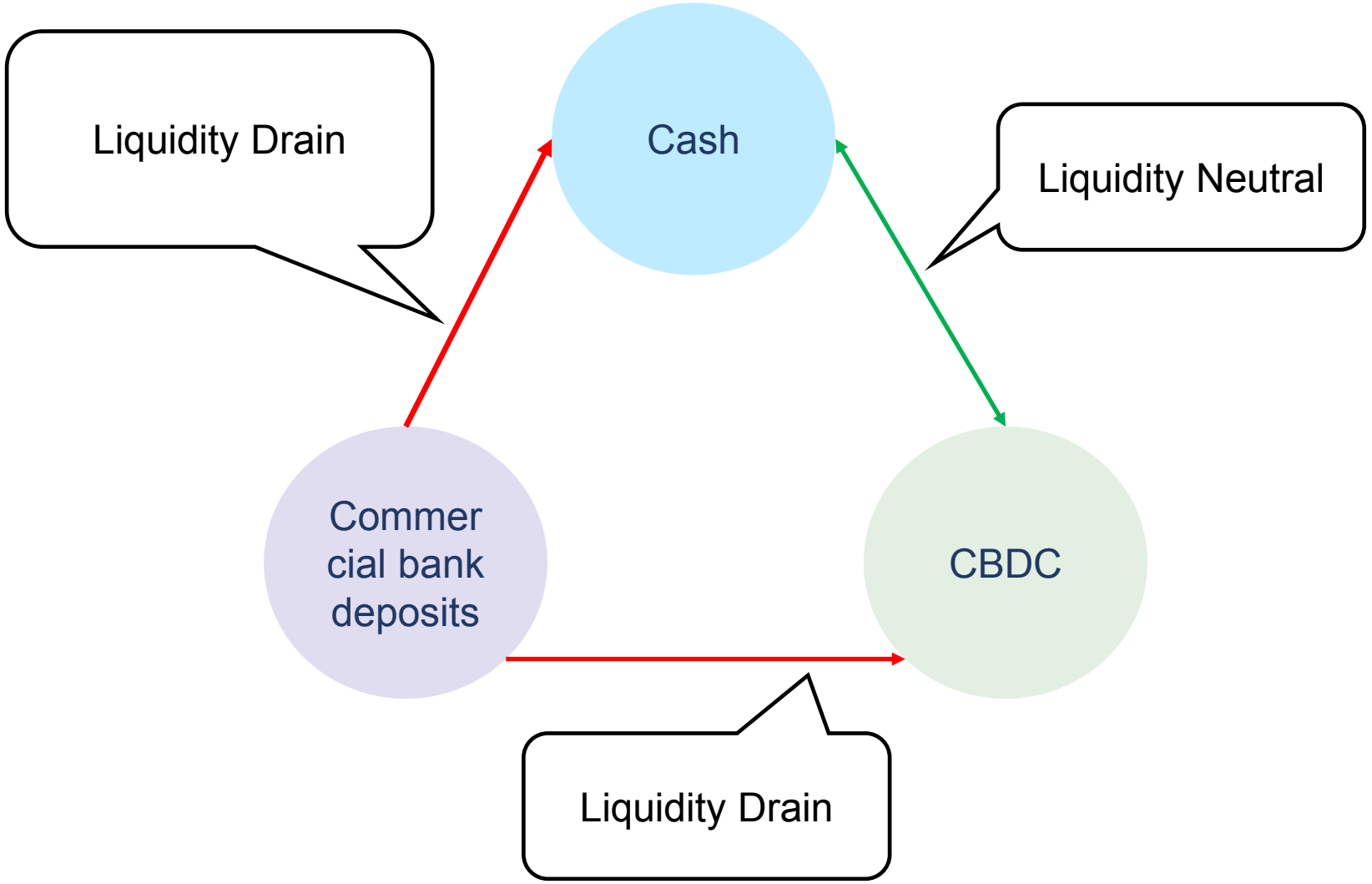
Short answer – No.
The impact depends on:

CBDC Design:
- Institutional architecture (1 or 2-Tier)
- Remuneration
- Holding limits

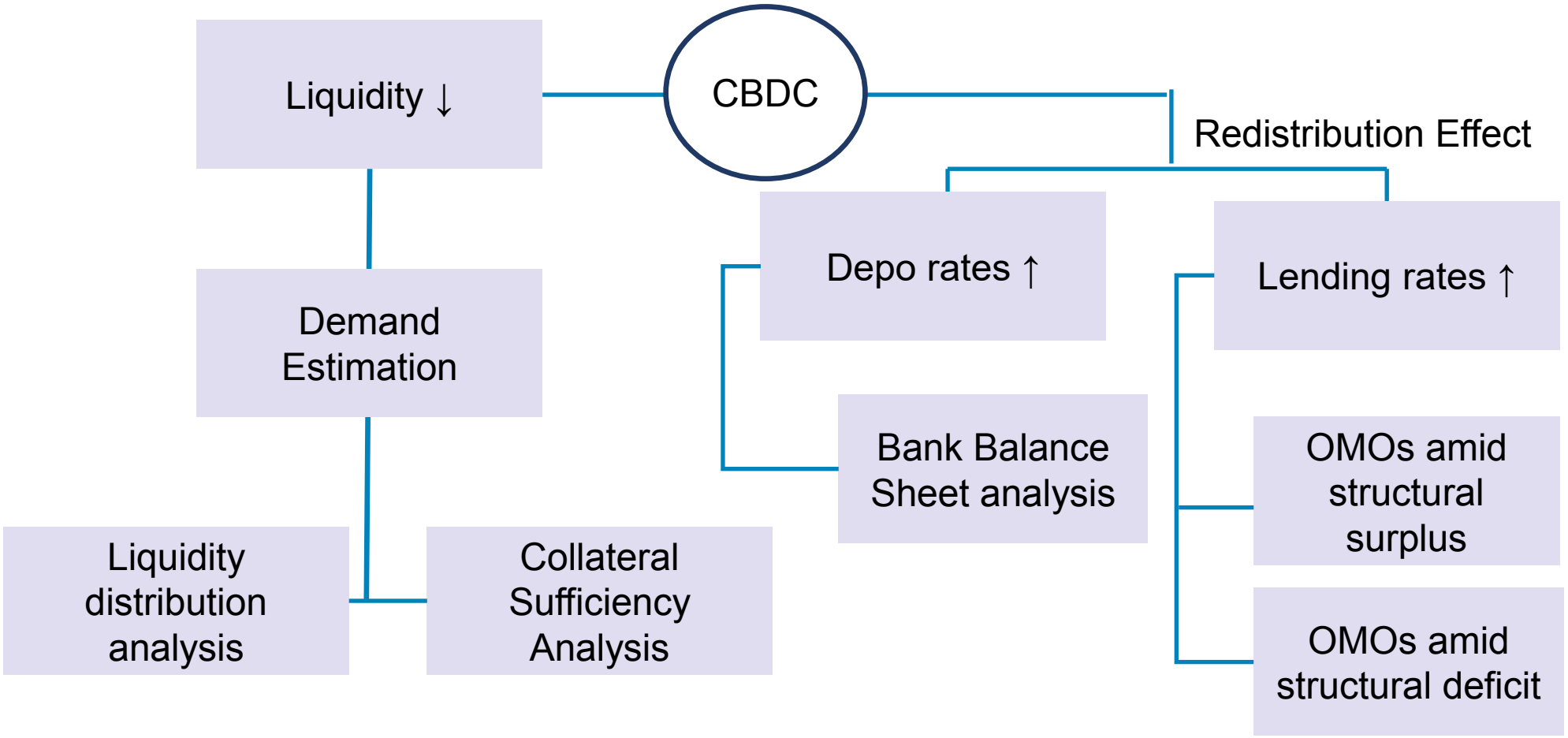
Operational Framework:
Interest rate system (floor vs corridor)
Liquidity position
Money Market activity and structure
Existing OMO toolkit

CBDC design and operational framework must be analysed together

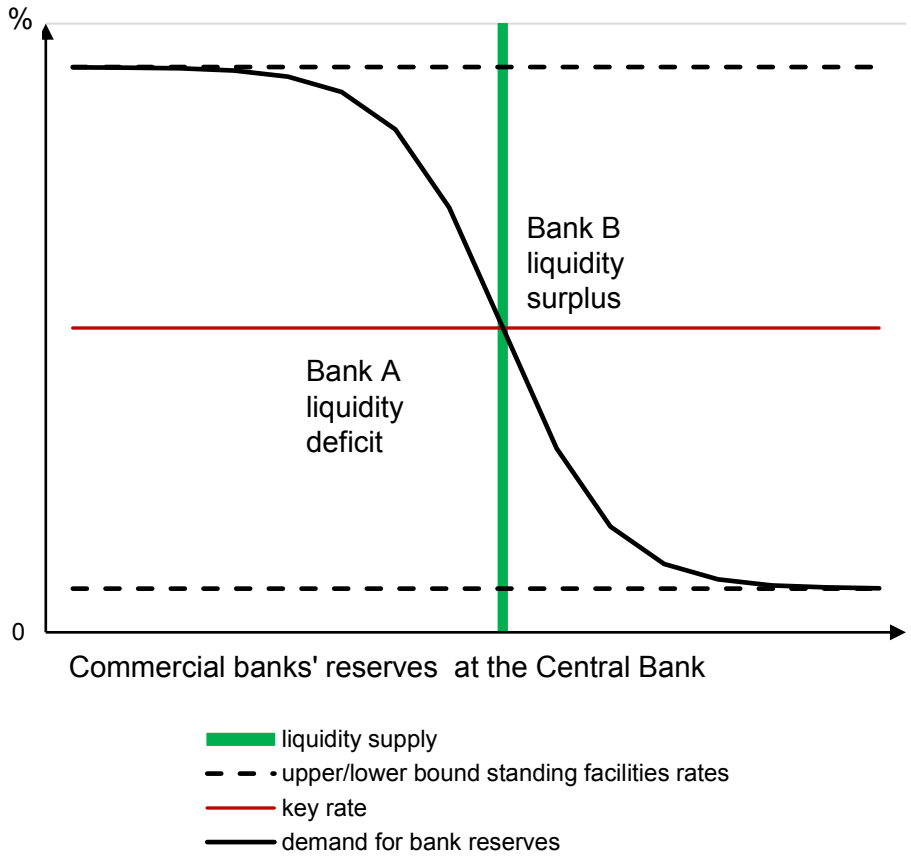
A Brief Recap: CBDC as Autonomous Factor

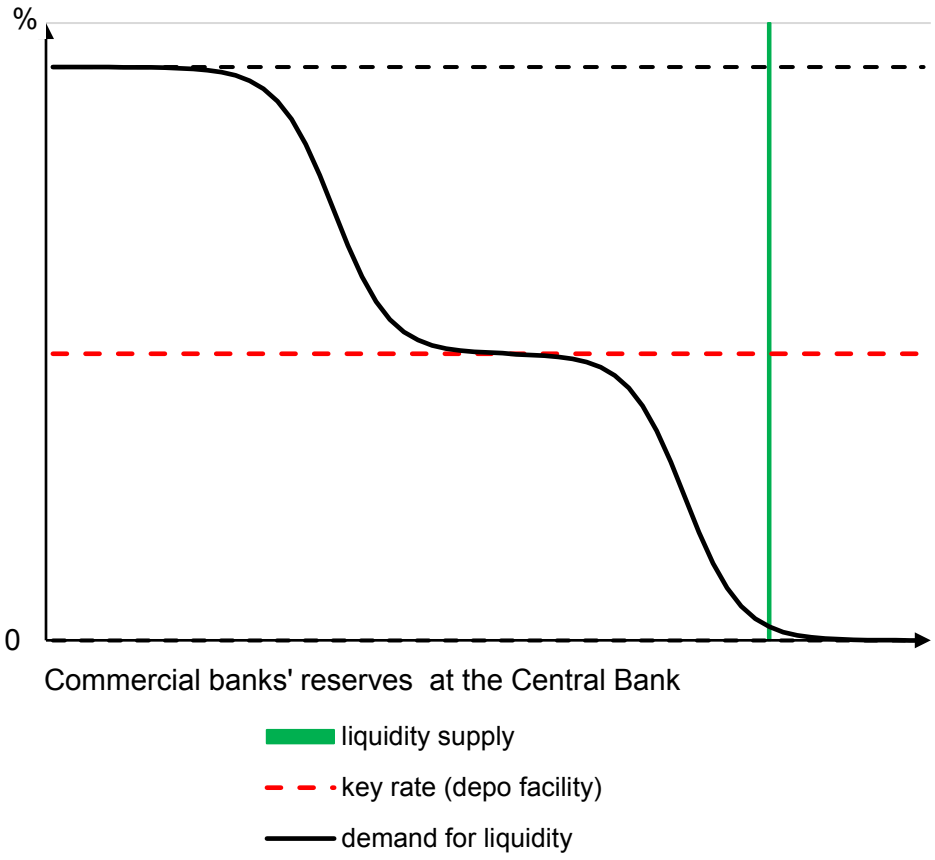


Brief Recap: Stylized Scheme of CBDC Impact on Bank Sector Liquidity



Operational Framework: Floor vs Corridor





Corridor System:

- Universal
- Less costly and risky for the CB

Floor System:

- Less sensitive to liquidity drains
- Requires larger CB Balance Sheet

Source: Adrian, T., D. Laxton, and M. Obstfeld. 2018. Advancing the Frontiers of Monetary Policy. Washington, DC: International Monetary Fund.

Cross-Country Analysis of Monetary Policy Implementation in the Advent of CBDC

Characteristic	ECB	PBoC	BCB
Policy Rate	DFR (2%)	7-day Reverse Repo (1.40%)	Selic Target (15%)
Upper Bound	MLF (2.4%)	SLF Lending Rate	Selic +35 bps (Standing Lending Facility)
Lower Bound	DFR (2.15%)	Excess Reserve / Deposit Facility	Selic –35 bps (Voluntary Deposits)
Operational Target	€STR	DR007	Overnight Selic
Target Segment	Unsecured O/N	Secured 7-day Repo	Secured O/N Repo
Framework	Floor	Corridor (hybrid)	Corridor
Rate Formation	Near floor rate	Managed around policy rate	Corridor anchored by BCB repos
Main Liquidity Tool	Reserve remuneration	RRR, OMOs, policy lending	Repos, deposits, standing facilities
Liquidity Regime	Ample reserves	Structural surplus	Persistent excess liquidity
Source of Surplus	QE / APP / PEPP	FX intervention sterilization	FX accumulation and fiscal factors
CBDC Project	Digital Euro	e-CNY	Drex
CBDC Design	Retail, 2-tier	Retail, 2-tier	Wholesale/tokenized platform
CBDC Remuneration	Under discussion	Non-remunerated	Non-remunerated (pilot)
Potential CBDC Challenge	Balance-sheet expansion	Reserve requirement calibration	Collateral availability and liquidity forecasting

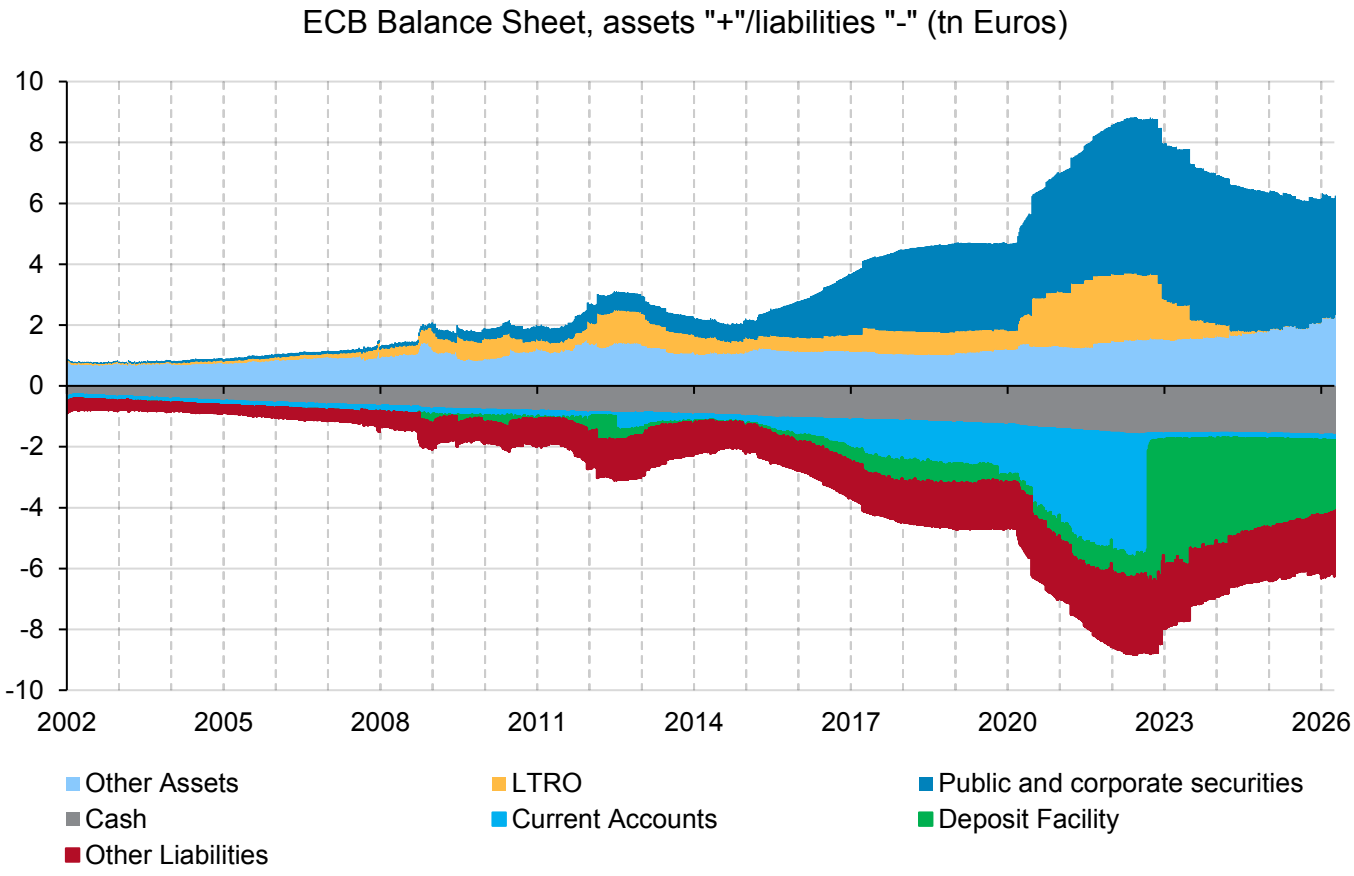
Source: ECB, PBoC, BCB, authors' analysis

ECB: Tracking OF Adjustment Through Balance Sheet

Pre-2009: Corridor system; balanced liquidity; active interbank market.

2010–2022: ZLB; LTRO/APP/PEPP; structural surplus; tiered floor.

2023–Present: Rate normalization; floor system; balance-sheet runoff; structural surplus.



2010–2022: *In response to the sovereign debt crisis, low inflation, and the pandemic, the ECB expanded its balance sheet through the Asset Purchase Programme (APP) and Pandemic Emergency Purchase Programme (PEPP). The largest component was the Public Sector Purchase Programme (PSPP), complemented by purchases of corporate bonds (CSPP), covered bonds (CBPP3), and asset-backed securities (ABSPP). At the same time, TLTRO III supplied approximately €2 trillion of long-term funding to banks at rates up to 100 basis points below the deposit facility rate. These measures generated a persistent structural liquidity surplus and transformed the operational framework from a corridor system into a tiered floor system.*

Source: ECB data portal, accessed via API. Retrieval code available via the link

ECB and the Money Market: a segmentation problem?

Floor system: DFR anchors short-term rates

Leaky floor: €STR persistently below DFR

Market segmentation: Banks vs. MMFs/non-banks

Access asymmetry: Non-banks lack ECB deposit facility access

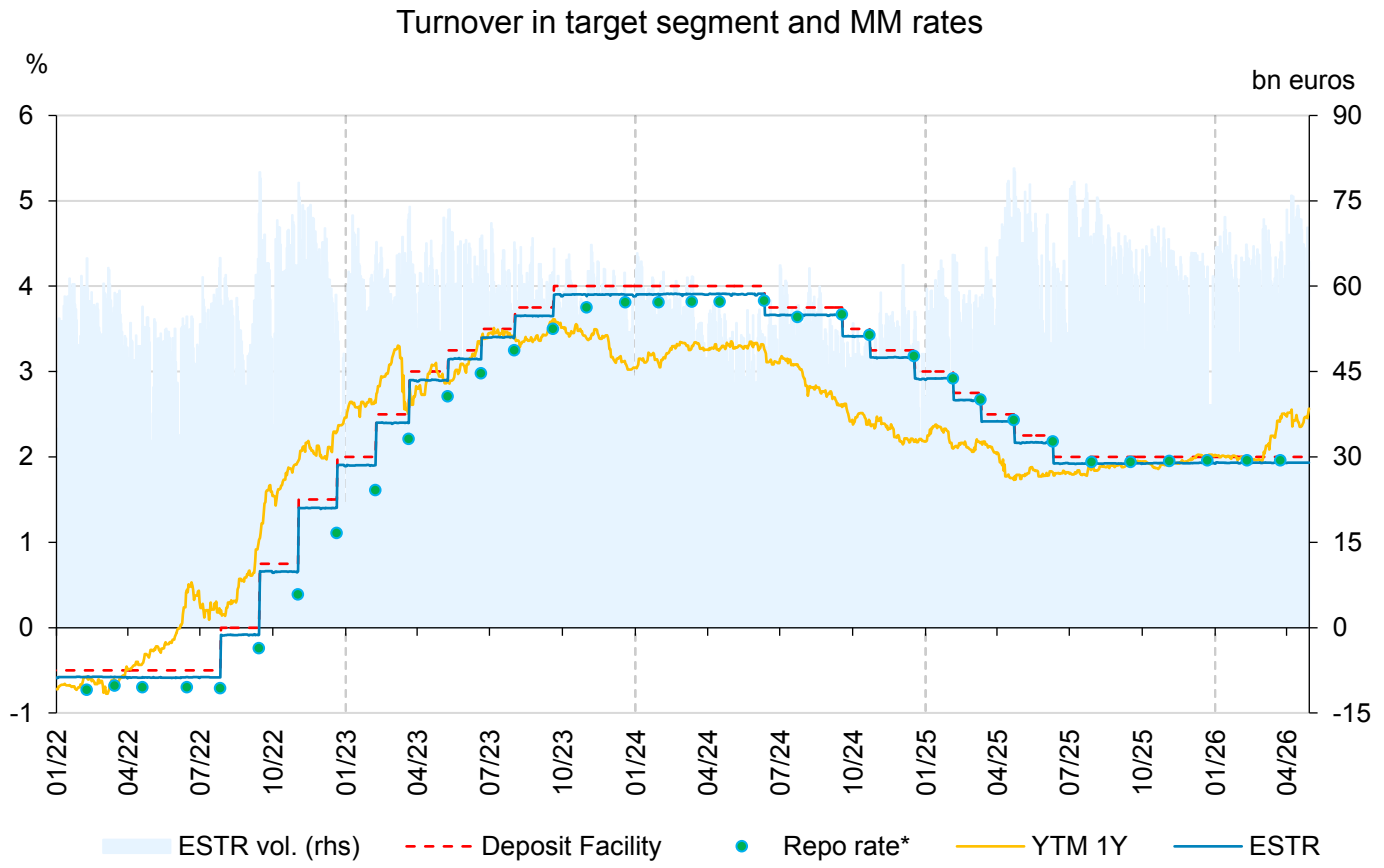
Regulatory frictions: Leverage ratio discourages intermediation

TLTRO III (2020–22): Distorted money market pricing

Normalization: Distortions largely reduced

Balance-sheet runoff: Excess liquidity gradually declining

2024 framework review: Floor system retained



€STR persistently trades below the deposit facility rate due to structural segmentation in the euro money market. The index includes unsecured overnight transactions between banks and non-bank financial institutions, particularly money market funds, which lack direct access to ECB standing facilities. As a result, banks intermediate liquidity at rates below the DFR, constrained by balance-sheet costs (notably leverage ratio impacts) and regulatory frictions. This creates a "leaky floor" whereby arbitrage is incomplete, and €STR reflects marginal non-bank liquidity conditions rather than the central bank policy rate.

Source: ECB data portal, accessed via API. Retrieval code available via the link

ECB in the Advent of Digital Euro

Structural strengths

- Floor system anchored by DFR
- Abundant reserves → rate stability
- Strong balance-sheet toolkit (APP, PEPP, TLTRO)
- Effective short-term rate control
- Crisis-tested flexibility (2008–2022)

Structural vulnerabilities

- Leaky floor": €STR < DFR
- Market segmentation (banks vs non-banks/MMFs)
- Limited arbitrage due to balance-sheet constraints
- Money market reduced informational content
- Dependence on excess liquidity conditions
- Transition risk as reserves decline (post-2024)

Implication for Digital Euro

- CBDC is **superimposed on an already segmented floor system**
- Main constraint: **how fast excess liquidity declines vs CBDC adoption speed**
- Policy challenge: **preserve rate control while managing new autonomous factor**

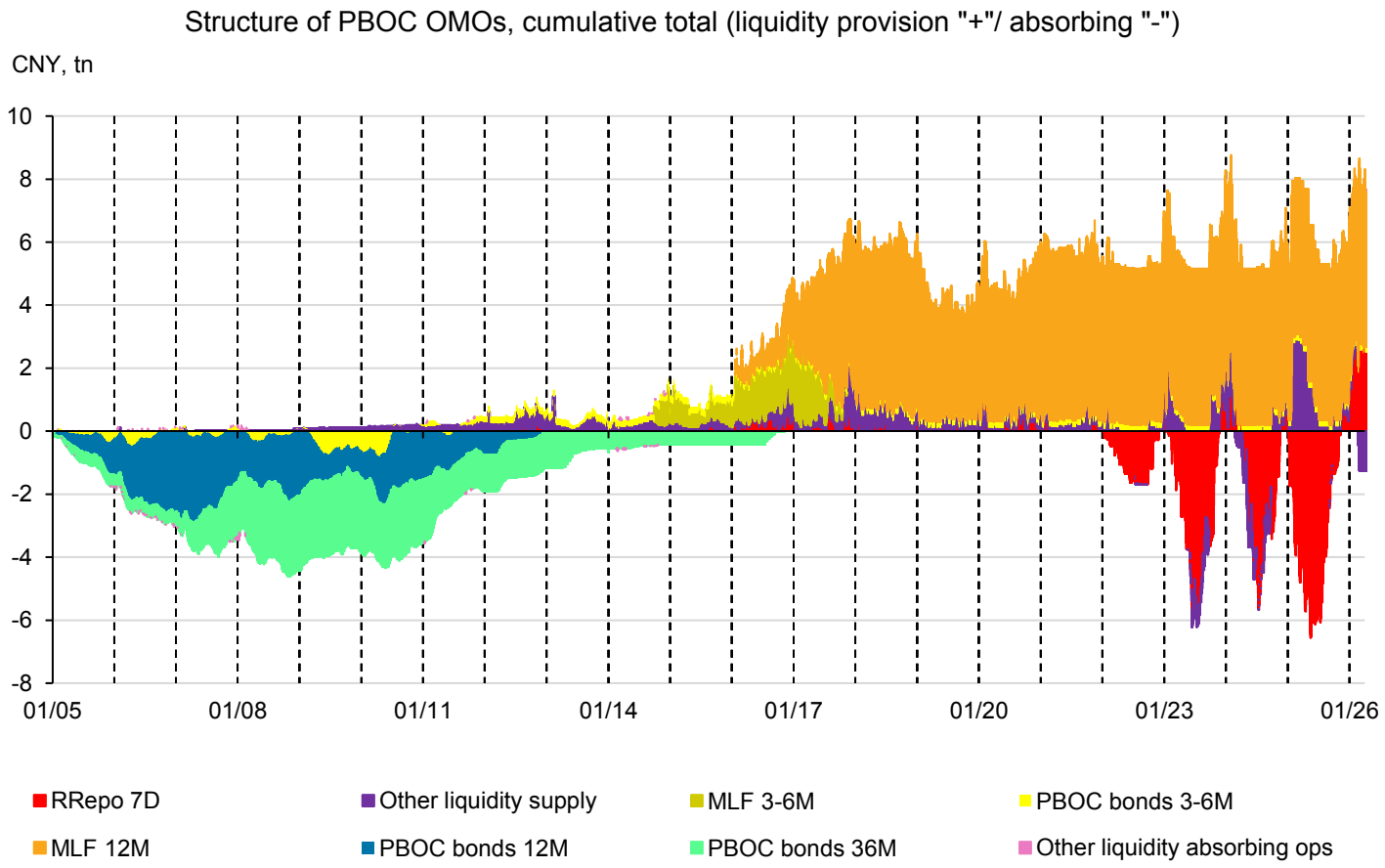
Preparing for Digital Euro: Engineering Drain Constraints

- **The Strategy:** The ECB explicitly frames the Digital Euro as a cash-equivalent to prevent store-of-value substitution. Design choices are heavily defensive to protect the structural surplus.
- **Holding Limits:** Used as a strict quantitative backstop. ECB modeling indicates a €3,000 cap causes stress in only 13 banks (0.3% of banking assets). Caps up to €10,000 remain under Eurogroup discussion for 2026.
- **The Reverse Waterfall:** Automatically funds CBDC payments from linked commercial accounts in real-time, eliminating the need to hold persistent positive CBDC balances.
- **Access Exclusions:** By excluding non-residents and corporates, the ECB removes approximately 40% of legacy euro banknote demand from the substitution pool.

Source: ECB press-release

PBoC: a Transitional Operational Framework

- PBoC liquidity management combines market-based OMOs with strong administrative tools (RRR), making reserve requirements an active policy instrument rather than a passive constraint.
- Unlike advanced economy central banks, liquidity is managed jointly through prices (rates) and quantities (reserves, guidance).



The growing importance of the MLF has altered the incentives of market participants and weakened the role of the short-term money market in liquidity allocation. Since 2015, the PBoC has increasingly supplied liquidity through auction-based facilities with maturities ranging from several months to one year. While these instruments provide predictable funding conditions for banks, they reduce the need for active day-to-day liquidity redistribution through the interbank market. As a result, a larger share of liquidity management is effectively conducted through central bank balance-sheet operations rather than through market interactions among financial institutions.

Source: Bloomberg "PBOC Open Market Operations database".

PBoC OF: possible vulnerabilities

Transmission channel

- MLF-dominant funding reduces banks' need to actively manage overnight liquidity
- Short-term rates play a weaker marginal role in pricing conditions
- Policy signal is partially absorbed by balance-sheet funding rather than interbank adjustment

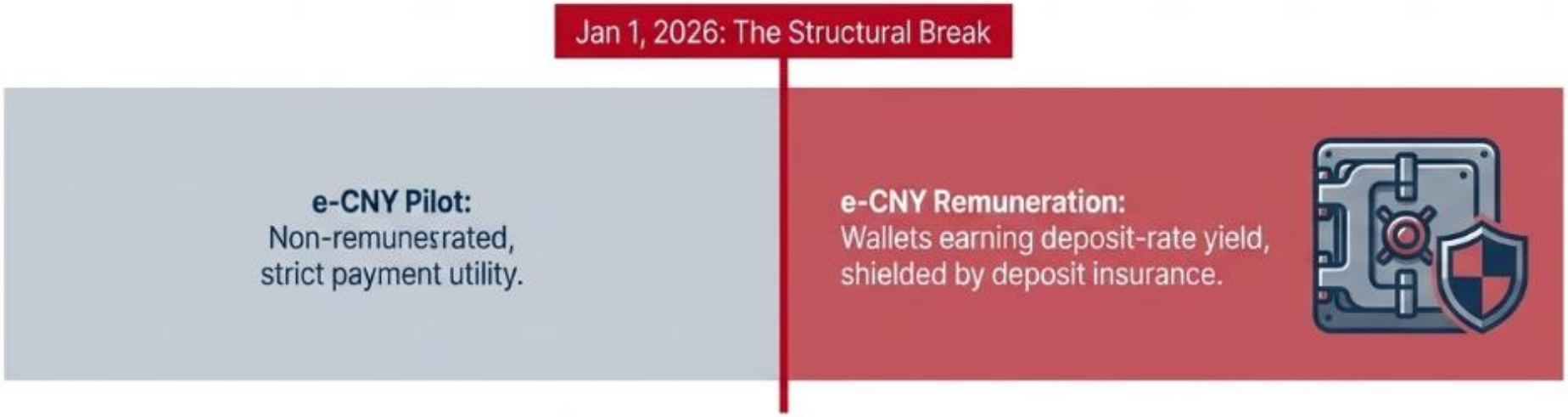
Structural liquidity management (center)

- RRR remains a key structural liquidity tool (sterilisation and adjustment of system-wide liquidity)
- Historically: FX inflows → high RRR (liquidity absorption)
- Post-2015: RRR reductions + MLF + OMOs → active liquidity provision mix
- Shift from reserve absorption → central bank balance-sheet provisioning

Instrument	Purpose	Counterparties	Tenor	Outstanding (CNY tn)	Rate (%)
SLF	Standing liquidity facility	Banks	O/N–1m	~0.01	1.60–2.10
PSL	Policy-bank refinancing	Policy banks	>3y	~3.3	~2.25–2.50
MLF	Medium-term liquidity provision	Banks	3–12m	~4.8	~1.50
TMLF	SME-targeted funding	Banks	Up to 3y	Phased out	–
TLF	Temporary liquidity support	Large state banks	28d	Limited use	–
CRA	Temporary reserve relief	Banks	30d	Limited use	–

Source: PBoC, authors' analysis

e-CNY Evolution: 2026 Paradigm Shift



1. The Break from Consensus: On Jan 1, 2026, the PBoC broke the global zero-interest CBDC consensus. e-CNY balances held in commercial wallets were reclassified as interest-bearing deposit liabilities

2. Substitution Elasticity: This transforms e-CNY into a highly elastic, functional substitute for demand deposits, increasing the sensitivity of CBDC demand to interest rate differentials

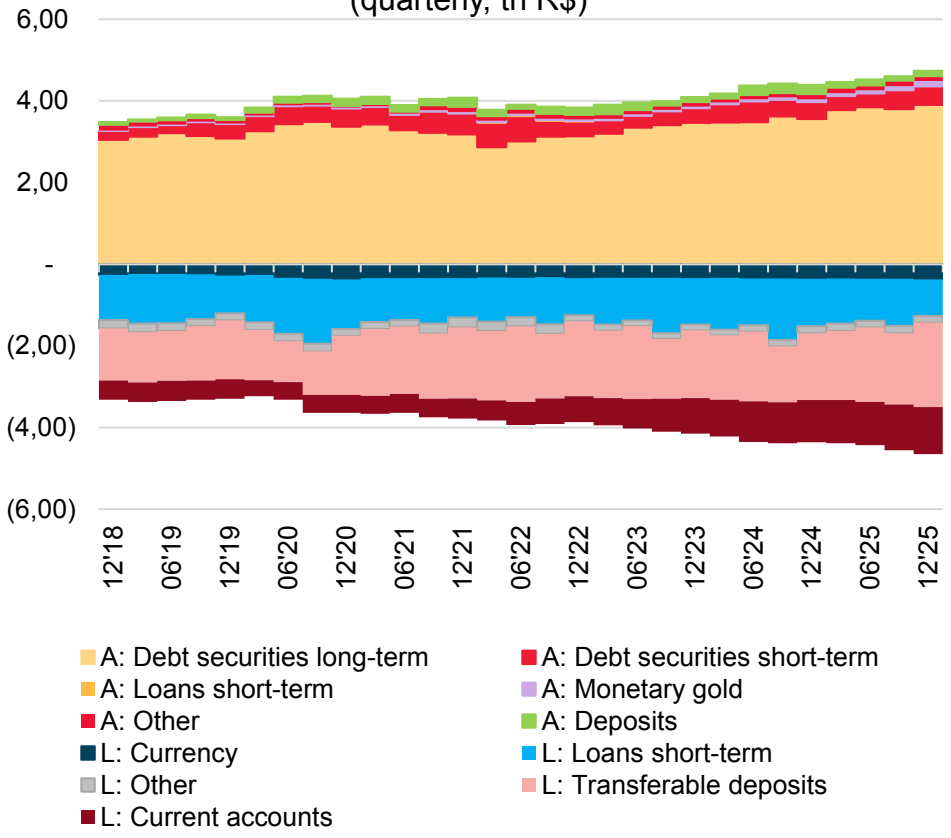
3. Integration over Disintermediation: Rather than causing a central bank reserve drain, the e-CNY remains fully embedded in bank balance-sheet management. Backed by scale: over 230m wallets & 230m wallets and CNY 16.7tn in cumulative transactions.

Source: PBoC press-release on e-CNY

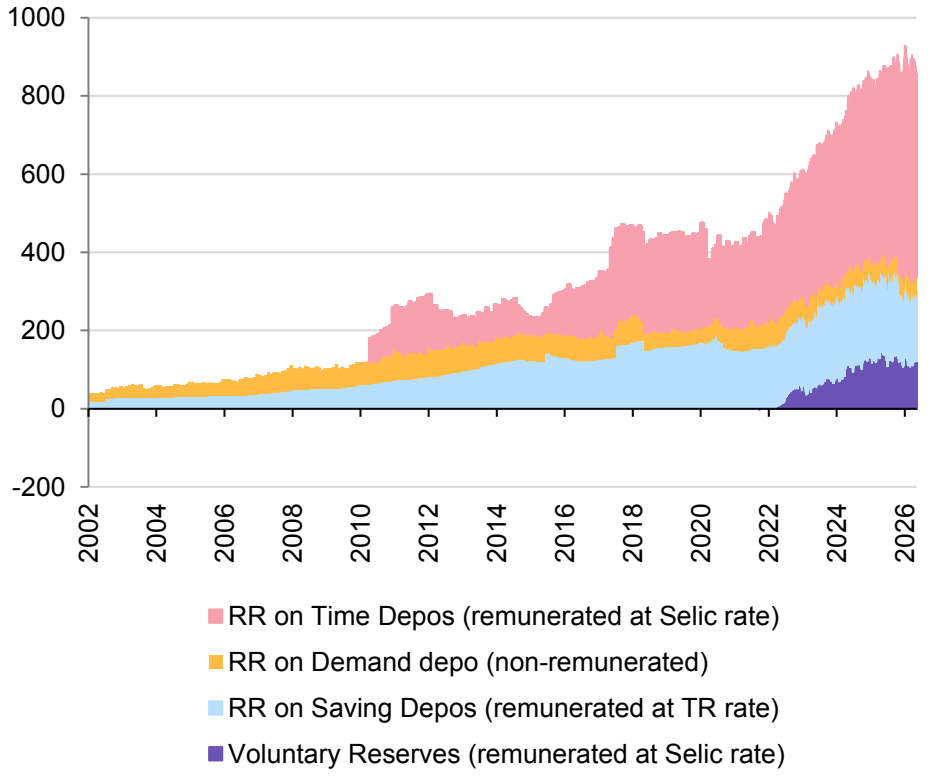
BCB: the Roots of the Current OF

- Repo operations collateralised by government bonds are the core liquidity tool of the BCB
- Structural liquidity surplus driven by FX inflows and sterilised via sovereign debt issuance
- Persistent fiscal–monetary linkage embedded in balance-sheet structure and Selic formation

BCB Balance Sheer: assets "+", liabilities "-"
(quarterly, tn R$)



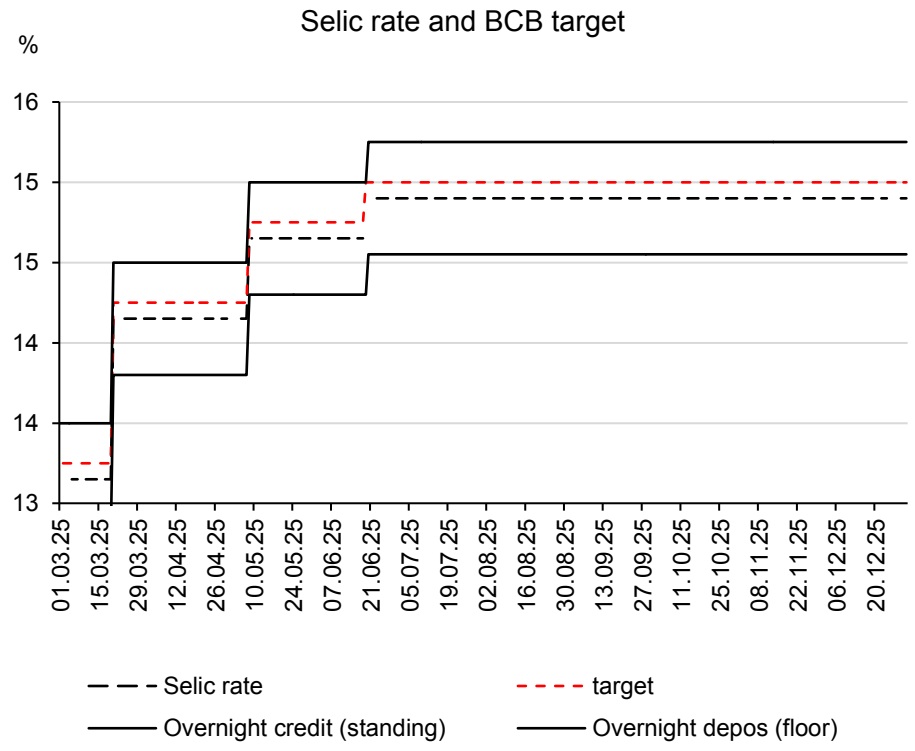
BCB: the Macro Buffer - structural reserves (bn R$)

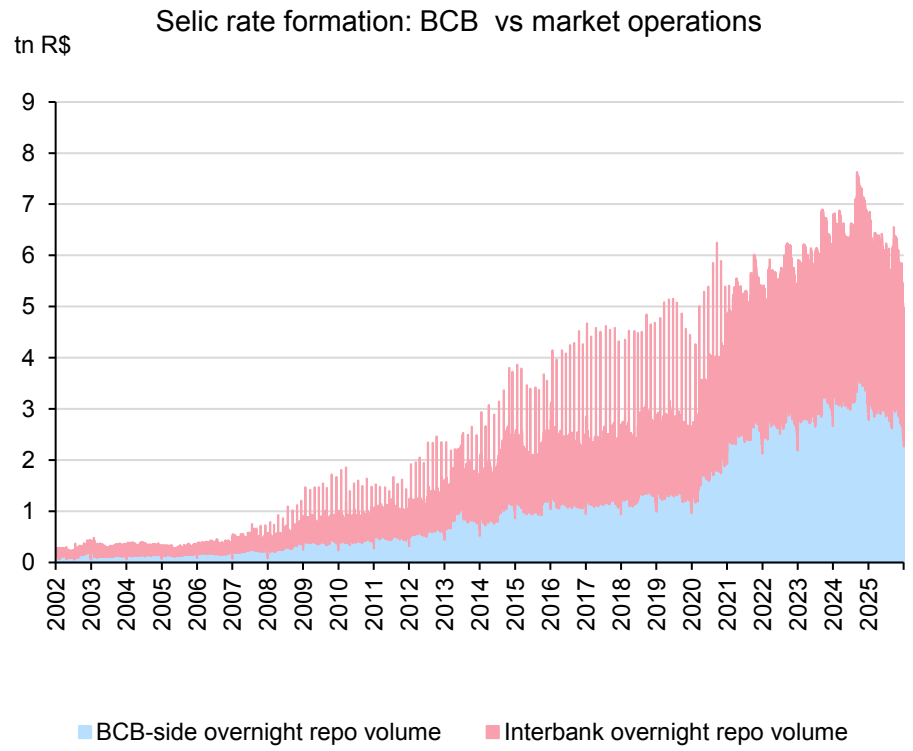


Source: Banco Central do Brasil (BCB), SGS (Sistema Gerenciador de Séries Temporais) and Open Data Portal. Authors' calculations based on BCB balance sheet accounts. Data retrieved via BCB API (SGS/Open Data interface)

BCB and the MM: SELIC rate formation

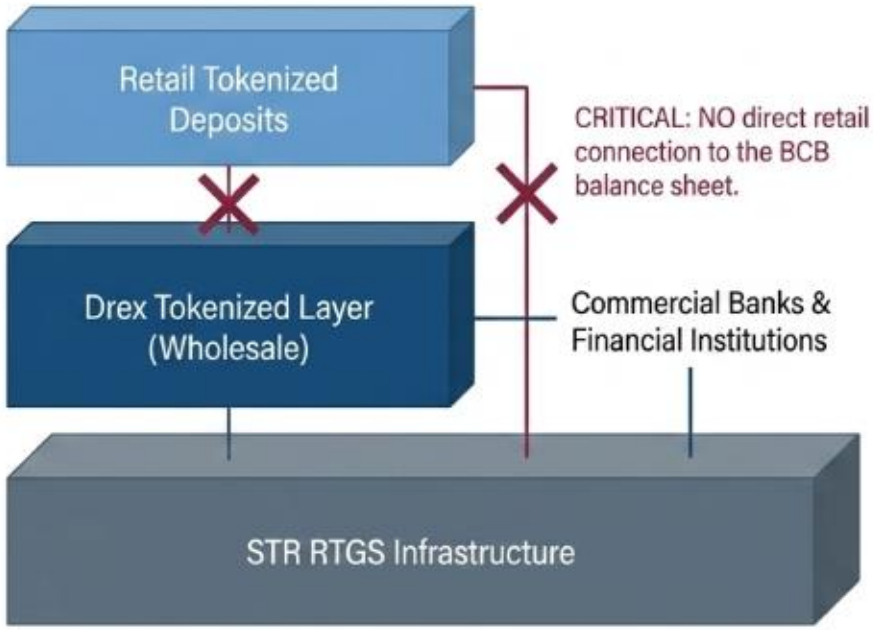
- BCB participates directly in Selic formation (~50% of transaction volume)
- Policy rate is simultaneously target, instrument, and market outcome
- Market pricing partly reflects central bank activity rather than private liquidity conditions
- Dependence on BCB liquidity may weaken bilateral interbank market incentives





Source: Banco Central do Brasil (BCB), SGS (Sistema Gerenciador de Séries Temporais) and Open Data Portal. Authors' calculations based on BCB balance sheet accounts. Data retrieved via BCB API (SGS/Open Data interface)

Drex: a wholesale CBDC model



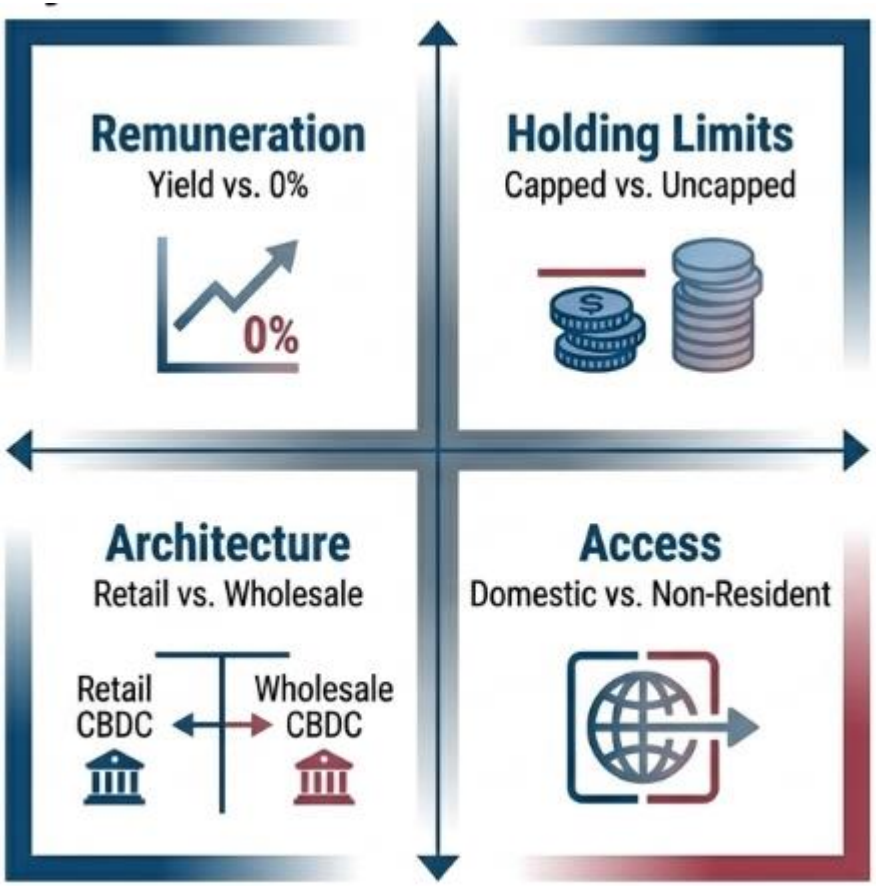
Bypassing the Drain: Drex is structured as a two-tier wholesale tokenized model. The BCB issues Drex only to financial institutions. Retail users hold tokenized commercial bank deposits, not direct central bank liabilities.

Delegated Remuneration: Because there is no retail CBDC, remuneration dynamics are entirely internalized within the banking sector. The central bank's balance sheet is insulated from retail deposit substitution.

Operational Goal: Drex's primary function is not retail payment substitution, but enabling atomic Delivery-versus-Payment (DvP) settlement through smart contracts integrated with existing PIX and STR infrastructure.

Source: BCB

The Four Dimensions of CBDC Design



- **Remuneration:** Determines CBDC attractiveness relative to bank deposits and other liquid assets. Higher remuneration increases deposit substitution and potential reserve outflows from the banking sector.
- **Architecture:** Defines whether CBDC circulates through commercial banks (two-tier) or directly with the central bank. Greater bank intermediation generally limits liquidity disruption and preserves existing transmission channels.
- **Holding Limits:** Quantitative caps constrain CBDC accumulation and limit large-scale migration of deposits into CBDC, reducing reserve drain risks.
- **Access:** Defines the eligible user base. Broader domestic and cross-border access expands potential CBDC demand and increases the scale and volatility of liquidity effects.

Source: BCB, PBOC, ECB press-releases

CBDC Design Matrix Across Jurisdictions

Implications for operational frameworks:

- Digital Euro design contains multiple safeguards (zero remuneration, holding limits, resident-only access), limiting reserve displacement.
- Drex generates minimal retail liquidity effects due to its wholesale architecture.
- e-CNY presents the largest potential operational impact, combining remuneration, absence of holding limits, and expanding cross-border accessibility.

Dimension	Digital Euro (ECB)	e-CNY (PBoC)	Drex (BCB)
Remuneration	0% (Cash equivalent)	Interest-bearing deposit rates (Post-2026)	Delegated to commercial banks
Limits	€3,000–€10k with automated reverse waterfall	Standard deposit limits (CNY 500k insurance cap)	Governed indirectly by standard capital frameworks
Architecture	2-Tier Retail	Hybrid 2-Tier (integrated ALM)	Wholesale tokenization (no retail CB liability)
Access	Domestic only (excludes ~40% of legacy cash demand)	Broad (Includes HKMA cross-border pilot)	Financial institutions via STR

Source: BCB, PBOC, ECB press-releases

Policy Recommendations

ECB / Digital Euro	PBoC / e-CNY	BCB / Drex
Main challenge	**Main challenge**	**Main challenge**
Managing reserve drain within a floor system	Strengthening market-based rate formation	Reducing reliance on repo-based liquidity management
Policy priority	**Policy priority**	**Policy priority**
Treat holding limits as a monetary policy parameter	Gradually shift from administrative tools toward market pricing (DR007)	Preserve wholesale focus while exploring liquidity-management applications
Calibrate limits to desired reserve regime (floor vs corridor)	Reduce reliance on RRR, directed lending and guidance	Assess remunerated tokenised liabilities as supplementary absorption tool
Maintain adequate structural surplus during adoption phase	Improve transparency of liquidity transmission	Reduce central bank dominance in Selic formation
Monitor cross-border adoption and reserve effects	Integrate CBDC within broader operational framework reform	Further analyse collateral scarcity and fiscal–monetary interactions

Source:

Abu Bakr F., Neshcheret M. Jun. 2026

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Thank you for attention!

We welcome your reviews:

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