

The Test of Confidence: An Interrupted Time Series Analysis of the Liquidity Effects of the VIBER ISO 20022 Migration

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ABSTRACT: This study examines the liquidity effects of the migration of the Hungarian Real-Time Gross Settlement (RTGS) system (VIBER) operated by the Central Bank of Hungary (MNB) to the ISO 20022 messaging standard. The objective is to determine whether the 27 October 2025 go-live resulted in a detectable structural break or a persistent change in the trend of VIBER's aggregate closing balance. The empirical analysis is based on interrupted time series (ITS) segmented regression, complemented by robustness checks using ARIMA models. The initial regression results indicated a temporary decline in balances and a post-migration change in the trend. However, after controlling for VAT payment periods, the temporary effect was no longer statistically significant. In the ARIMA models accounting for the autoregressive structure of the time series, neither the shock associated with the migration, nor the post-migration change in trend proved to be robust. The findings suggest that a substantial proportion of the observed balance movements can be explained by the internal dynamics of the time series and by liquidity reallocations associated with tax payment periods. Interviews conducted with a bank liquidity management specialist further confirmed that the migration did not require any extraordinary liquidity-management adjustments. Overall, the results indicate that the VIBER ISO 20022 migration was implemented without significant liquidity disruptions, which points to the successful preparation of the project, as well as the high level of market confidence in the central bank.

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Introduction

One of the fundamental prerequisites for the functioning of financial markets is the efficient and reliable operation of payment systems. Real-time gross settlement (RTGS) systems operated by central banks play a key role in financial market infrastructure, as economically critical high-value payments are processed through these systems. Alongside the evolution of payment systems, there has been a continuous need to modernise the underlying messaging standards. One of the most significant developments in global payments of recent years has been the adoption of the ISO 20022 standard, which has by now become a defining element of the modernisation of financial market infrastructures.

The aim of ISO 20022 is to standardise financial messaging, to enrich data content, and to improve interoperability across financial systems. The adoption of the standard represents not only a technological upgrade but also a complex organisational and business transformation affecting the operation of financial institutions. Consequently, central banks, financial market infrastructures, and credit institutions worldwide have implemented phased migration programmes to adopt the new standard. The TARGET services of the European Central Bank (ECB), the SWIFT global financial messaging network, and numerous national RTGS systems already operate based on the ISO 20022 messaging standard.

In Hungary, following several years of preparation, the Real-Time Gross Settlement system (VIBER) operated by the Central Bank of Hungary (MNB) migrated to the ISO 20022 messaging standard in October 2025. In the case of an infrastructure development of such significance, it is natural to ask how the migration affected the liquidity management practices of the participating credit institutions, and whether it resulted in any material changes in the banking system's central bank money holdings. This question is particularly relevant because balances held in VIBER are one of the most important indicators of the liquidity position of the banking system and also play an important role in the operation of the reserve requirement system.

Numerous studies have used interrupted time series (ITS) analysis to examine the effects of regulatory, technological, and institutional interventions. This study adopts this methodological approach to analyse the liquidity effects of the VIBER ISO 20022 migration.

The main research question of this study is whether the VIBER ISO 20022 migration resulted in a detectable structural break and whether it led to a persistent change in the trend of VIBER's aggregate closing balance. The

empirical analysis is based on interrupted time series (ITS) segmented regression, complemented by robustness checks using ARIMA models. The study also pays particular attention to the insights gained from interviews with banking experts, which provide a practical perspective for interpreting the statistical findings. The study therefore offers both an empirical assessment of the liquidity effects of the VIBER ISO 20022 migration, as well as insights into the institutional and trust-related factors underlying the successful modernisation of financial market infrastructures.

Literature review

The economic role of payment and settlement systems and the importance of central bank RTGS systems

The reliable and efficient operation of payment and settlement systems is essential for the smooth functioning of the financial sector and, through its intermediary role, the economy as a whole. It is also fundamental for maintaining the stability of the financial system. The primary function of payment systems is to ensure that payments are executed safely and efficiently throughout the economy. Payments may be made in cash or, through various payment methods, in commercial bank money. Settlement of non-cash payments requires central infrastructures that provide clearing and settlement services, together with the communication mechanisms necessary to support these processes.

The Bank for International Settlements (BIS) highlights the importance of payment and settlement systems and identifies systemic risk as the principal policy concern in this context (BIS, 1994). According to the BIS, the fundamental policy concern relating to payment and settlement systems is not primarily the risks borne by individual institutions or those confined to specific market segments, but rather systemic risk. The latter refers to the risk that the failure of a participant to meet its contractual obligations may in turn cause other participants to default, with the resulting chain reaction leading to broader financial difficulties and potentially having repercussions throughout the economy. The reliable operation of payment and settlement systems, as core components of financial market infrastructure, is therefore essential for preventing systemic risk and, should it materialise, limiting the spread of financial contagion. Settlement problems at one or more institutions, or even concerns that they may fail to settle their obligations, can trigger financial disturbances that may spread to other institutions and, ultimately, to their customers. Disruptions to the payment system may also have repercussions throughout the economy, as virtually all economic activity depends on the execution of financial transactions and on the confidence that contractual

obligations will be fulfilled by all parties. The central components of modern financial market infrastructures are the real-time gross settlement (RTGS) systems operated by central banks. These are payment systems that provide immediate and final settlement in central bank money for large-value, time-critical and systemically important payments, primarily, but not exclusively, interbank transfers. In doing so, they support the efficient functioning of the two-tier banking system while substantially reducing settlement and systemic risks arising from interbank and other financial market transactions, including foreign exchange and securities transactions. According to analyses published by the BIS and the International Monetary Fund (IMF) in the 1990s, the main driver behind the widespread adoption of RTGS systems was the reduction of systemic risk. These institutions already regarded RTGS systems and their reliable operation as a key element of financial stability (BIS, 1997; IMF, 1996).

RTGS systems reduce systemic risk primarily by settling transactions individually and in real time on a gross basis, rather than on a net basis, through accounts held with the central bank. Unlike deferred net settlement systems (DNS), the accumulation of unsecured positions is prevented, immediate settlement finality is achieved, and transactions are settled in central bank money. RTGS systems are also used by securities settlement systems, other post-trade infrastructures, and retail payment systems for the settlement of transactions, making them an indispensable component of the financial market infrastructure. RTGS systems also enable the widespread use of payment-versus-payment (PvP) mechanisms in foreign exchange markets and delivery-versus-payment (DvP) arrangements in securities settlement.

Beyond their role in payment processing, RTGS systems also play a central role in the implementation of monetary policy. In this role, they enable central banks to monitor liquidity conditions in real time and to conduct open market and other monetary policy operations, including the provision of overnight lending and deposit facilities and the operation of the reserve requirement system. They thereby contribute directly to the effective transmission of monetary policy. To perform these functions properly, RTGS systems also provide a range of tools to support the liquidity management of credit institutions. Central banks typically offer intraday credit, queue management, and other liquidity-saving mechanisms to account-holding financial institutions, thereby reducing both liquidity risks and liquidity costs. Kollár (2024), in a study examining the effects of changes in the monetary policy toolkit on payment system liquidity, finds that certain elements of the central bank's monetary policy toolkit – particularly changes in the reserve requirement ratio and liquidity management measures – can have a direct impact on the central bank money balances held in VIBER. At the same time, the study concludes that the Hungarian payment systems could operate safely even with a lower level of liquidity than currently available, suggesting that the domestic payment infrastructure has substantial liquidity buffers and is highly resilient. Kollár also argues that VIBER's aggregate closing balance provides a suitable indicator for analysing liquidity conditions

in the banking system. Accordingly, this study uses this measure to assess the potential liquidity effects of the VIBER ISO 20022 migration.

Several studies have examined the macroeconomic consequences of operational disruptions affecting critical financial market infrastructures, as well as the potential effects of bank failures. Bedford et al. (2004) used a simulation model to assess the operational risks of the CHAPS Sterling system under various scenarios involving bank failures and infrastructure disruptions. Their results indicate that the system remains resilient even when several participants experience operational failures, with no significant accumulation of unsettled transactions under prevailing liquidity conditions. Using a simulation approach, Mazars and Woelfel (2005) found that the PNS payment system operates reliably even at lower liquidity levels under normal conditions. However, the technical default by a major participant may prevent the settlement of nearly 10% of the transactions of otherwise unaffected participants. The authors conclude that contagion effects can be effectively mitigated by rapidly reducing bilateral limits with the defaulting participant. Using simulation based on real transaction data from the Austrian ARTIS system, Schmitz et al. (2006) examined the impact of the default of the most active participant(s), measured in terms of liquidity usage and payment concentration. They found that the risk of contagion remained low as long as business continuity measures functioned effectively; however, once these measures ceased to function effectively, significant contagion effects emerged. Dimitrijevic et al. (2012) examined the payment system of the National Bank of Serbia using simulations based on real transaction data, in which they analysed the effect of operational outage affecting one or two key participants. Their findings indicate that effective liquidity management and the application of the *stop-sending* rule can substantially mitigate contagion effects arising from operational disruptions. Analysing global payment data, Soramäki and Cook (2012) demonstrated, using a Barabási-Albert scale-free network, that the metric they developed can identify which individual banks would be most severely affected by the default of a given bank. They also showed that the measure is capable of accurately predicting the extent of disruption caused by the default of a bank within a payment system in a simulated environment. Borges et al. (2020) examined the resilience of the Angolan payment system (APS) to systemic risk under payment default scenarios. In the system, only five banks exhibit a high degree of interconnectedness. As these five institutions process nearly half of the total payment volume, they have the potential to amplify contagion. Nevertheless, the failure of a single participant poses only limited systemic risk. The authors also conclude that the existing risk mitigation mechanisms effectively protect the APS against systemic risk.

Overall, the findings of these studies suggest that, given the network structure of payment systems, any operational disruption or irregularity affecting the payment infrastructure may destabilise the system as a whole through contagion effects. It is therefore essential that payment and settlement

systems be protected against such systemic risks through all available risk mitigation measures. Likewise, infrastructure upgrades and technological migrations should be implemented while ensuring the continuous operation of the system.

Upcoming trends in the development of RTGS systems

In recent years, the extension of the operating hours of central bank RTGS systems has become one of the most important structural trends in the international financial infrastructure. The process is closely linked to the G20 programme targeting the development of cross-border payments, coordinated by the Committee on Payments and Market Infrastructures (CPMI) operated by the Bank for International Settlements (BIS). According to the analyses of the BIS, the limited daily opening hours of traditional RTGS systems and the operational differences between the various time zones cause unnecessary friction in the international financial system, resulting, among other things, in increased liquidity costs and delays in the execution of payments. The related CPMI reports therefore identify three possible directions of development, namely, extending the operating hours of current business days; introducing weekend and public holiday operation; and, finally, providing 24/7⁴ availability (BIS, 2022; BIS, 2023). The trend is further reinforced by the global expansion of instant payment systems, as retail and corporate customers, on a global level, increasingly expect instant payment services. At the same time, the underlying settlement in central bank money takes place through RTGS systems mostly, however, those settlements are still carried out within limited time frames.

In 2003, the Federal Reserve's Fedwire Funds system already moved to a long, practically 22-hour weekday operation; the system currently opens at 9:00 pm Eastern Time on the previous day and closes at 7:00 pm on the current day, significantly increasing the overlap with the European and Asian markets. Starting from 2028, The Federal Reserve will also examine the possibility of moving towards weekend operation. The eurozone RTGS system, T2⁵, has likewise gradually expanded its operating hours and currently operates – in Central European Time (CET and CEST) – with a settlement window between 2:30 am and 6:00 pm. In February 2026, the Bank of England announced that, from September 2027, the CHAPS system will open at 1:30 am instead of the previous 6:00 am, so that the current 12-hour daily operating time will be extended to 16.5 hours. The Bank of England has also envisaged Sunday and public-holiday operation after 2029, and near-non-stop operation from the

4 24/7 availability means a continual, non-stop service of a system, operating 24 hours a day, 7 days a week.

5 The new name of the system created following the consolidation of the former TARGET2 and TARGET2-Securities EU systems.

early 2030s. In Switzerland, the Swiss Interbank Clearing (SIC) system already operates almost continuously, with a short daily maintenance break. The BIS often cites this as one of the examples to follow for near-non-stop operating hours. In India, the RTGS system operated by the Reserve Bank of India (RBI) was, in December 2020, the first among the world's largest systems to move to full 24/7 operation, primarily in order to support the digital economy and instant payments. According to the BIS's 2025 analysis, most of the central banks are not yet striving to achieve full 24/7 operating hours but following a gradual, transitional strategy by first extending weekday operating hours, after which weekend and public-holiday opening may follow, and finally near-continuous operation (BIS, 2025).

The primary goal of the early RTGS systems was to reduce systemic risk, that is, to ensure the immediate and final settlement of payment transactions in central bank money, considered as risk-free⁶. In recent years, however, increasing emphasis has been placed on further improving liquidity-management efficiency and the interoperability between individual payment infrastructures, which can be identified as another important direction of development. One of the best and most relevant international examples of this change is the ECB's RTGS system, which underwent a major structural transformation in 2023 with the introduction of the new T2 platform. The most important elements of the reform were the creation of a central liquidity-management module, the migration to the ISO 20022 standard, and the technical consolidation with the ECB's securities settlement platform, T2S and the ECB's instant payment platform, TIPS. Behind the expansion of the range of services technological modernisation was the main driver: modular architecture, real-time data processing and a universal messaging standard. The introduction of the technological innovations served a business purpose, namely, to enable optimised liquidity management and more efficient intraday collateral management for banks (ECB, 2023; ECB, 2024).

Regarding the efforts to develop the interoperability and interconnectivity of systems, it is also worth mentioning that, whereas RTGS systems were previously closed and highly centralised systems, in recent years an increasing number of systems have begun to provide Application Programming Interface (API) based access. Among other things, this enables real-time data provision and report handling, as well as automated connection with external systems.

Significant developments in recent years have also been linked to the objective of improving the cyber-resilience and operational robustness of RTGS systems. As digitalisation advances continue to accelerate, the probability of cyberattacks – and the level of the cyberattack threats in general – increases, which must be taken particularly seriously in the case of RTGS systems that

6 In the case of central bank money, the central bank guarantees the fulfilment of all the classic functions of money, so it can be considered as risk-free in all cases, except the country is hit by a shock (for example, war).

count as critical infrastructure. Accordingly, following the guidance of the BIS CPMI (BIS, 2012), RTGS systems have made significant investments, for example by creating redundant data centres, real-time incident monitoring, or the introduction of segmented network architectures. In these cases, the services of RTGS systems were enhanced not with new functions but with a higher level of reliability.

Finally, one of the most important directions of RTGS development is the migration to the ISO 20022 messaging standard. This process has had, and continues to have, a significant impact on virtually every financial institution in the world, as well as on numerous non-financial institutions. The introduction of the ISO 20022 messaging standard therefore represents, compared with the previous standard, not merely a technical update but a fundamental change in the entire structure and data fields of business communication. It follows that the change in the standard enables a complete shift in the service paradigm. In what follows, we present its background and the path leading to it in more detail.

The evolution of international payment messaging

The harmonisation of the business communication of financial transfers had already become a general need by the 1960s, as it was increasingly difficult – relative to the needs and possibilities of the time – to deliver international transfers quickly and accurately from originators to beneficiaries. The telex-based communication then in widespread use was slow and required continuous human intervention. Moreover, the partly paper-based transmission of messages frequently resulted in physical damage to the medium carrying the information physically, as well as data-transmission errors arising from the telecommunication technology used. For this reason, every financial instruction had to be checked manually, involving human labour, while those whose content was damaged during transmission often had to be repeated. The increasingly complex processes of the world economy, however, required business communication to take place through standardised message exchange, interpreted and applied in the same way by all parties. It was to meet this need that, in 1973 in Brussels, the Society for Worldwide Interbank Financial Telecommunication (SWIFT) was created at the initiative of 239 founding banks from 15 countries, with the primary aim of facilitating the development of a modern business communication platform to replace telex (Scott & Markos, 2012). The first SWIFT message was sent four years later, on 9 May 1977, by King Albert II of Belgium. Thereafter, the new mode of financial transacting quickly became popular: by the end of the 1980s the community numbered close to 2,800 institutions, which together executed 300 million financial transactions annually with the help of the system. In the 1990s the growth of the community's membership remained uninterrupted, while several technological developments had to be carried out to maintain reliability. Prioritising the business needs of the rapidly growing membership

and the considerations of maintaining operational security, communication was standardised in 1984 with the publication of the ISO 7775 standard. Barely a decade and a half later, in 1997, SWIFT introduced the ISO 15022 standard, which covered the business needs of the full range of financial institutions through a new set of fixed-content messages that fully met the needs of the time (SWIFT, 2026a). This was made possible by the fact that the International Organization for Standardization⁷ had earlier authorised SWIFT to take over control of the standard on behalf of the community. In developing the standard containing the so-called MT⁸ message types, SWIFT carried out thorough professional work, as the standard served the needs of the world's financial intermediary system well for more than two decades, across 11,500 institutions in 220 countries.

More than two decades later, in 2018, SWIFT announced that it would launch a programme to modernise the business communication of financial-sector actors across all segments, encompassing domestic, cross-border, interbank and other retail-institution messages, as well as central bank messages. With this, compared with earlier solutions, they set the goal of introducing a comprehensive messaging standard that would bring all message and institution types into a unified framework. This became the ISO 20022 standard built on modern XML-based encoding, which enables a more structured and more data-rich communication, among other things in the clearing and settlement of payment orders, payment initiation, cash management, securities settlement, the management of financial instruments, account keeping, and the handling of reference data.

The significance of the change in standards and the use of the new messaging standard for financial infrastructures

Why is standardisation crucial in financial messaging? The foundation of the global financial system is structured electronic messaging, which includes every type of electronic transaction: payments, money market, foreign exchange, and securities market transactions including clearing and settlement processes, as well as reporting. In the past, the various incompatible, often proprietary or historically evolved and entrenched legacy formats caused significant interoperability problems, limited the richness of data content, and increased operational risks.

The standardisation of message formats ensures a universal structure, conceptual clarity, interoperability and automation in the financial ecosystem. Financial messages contain not only amounts but countless other important pieces of information: for example, transaction and customer identification data, timestamps, regulatory references, and settlement instructions. Their

⁷ International Organization for Standardization

⁸ Message Type

divergent application carries significant operational and legal risk. A common standard reduces translation errors, data loss and the need for manual intervention, thereby increasing the stability and efficiency of the system.

ISO 20022: the main business advantages of the modern, global financial messaging standard

ISO 20022 is an international electronic financial messaging standard that is fully suitable for serving the business needs of credit transfers, payment cards, securities and foreign exchange market infrastructures. The standard was developed by the TC68 technical committee of the International Organization for Standardization (ISO) under the name Universal Financial Industry Message Scheme. The basis of ISO 20022 is a metamodel and a central data dictionary, from which the specific message types relating to individual business processes can be derived. Messages are typically implemented with XML-based syntax, which enables machine-readable, structured and extensible data handling (ISO, 2022). It has advantages that are leading to its rapid spread worldwide in financial infrastructures, gradually replacing the earlier standards. In what follows, we briefly present these advantages, primarily from an economic and business perspective.

On the one hand, the XML-based structure enables the transmission of detailed and structured data, for example longer and thus more complex information, special data fields with – potentially freely defined functions, and unique identifiers. This significantly expands the range of value-added services that can be offered, gives greater scope to business innovation, and increases data-analysis possibilities, which as a result can improve customer service and risk management.

ISO 20022, furthermore, provides a kind of common language for financial infrastructures. This reduces the need to convert between divergent national or institutional formats, thereby facilitating, for example, the more efficient processing of cross-border payments. Universal, structured messages also increase the proportion of transactions that can be processed fully automatically between endpoints (straight-through processing, STP). This reduces the need for manual intervention, lowers the error rate, and improves the efficiency of liquidity management. Beyond all this, the detailed data fields also support efficient compliance with sanctions-screening and anti-money-laundering requirements.

In the case of ISO 20022, future-proofing is also an important factor. Its modular structure enables the integration of new business models, for example, instant payment systems, tokenised assets, or central bank digital currencies. The flexible extensibility of the standard ensures that financial infrastructures can also adapt to technological development over the long term.

Implementations of the ISO 20022 standard in the most important financial infrastructures

The global introduction of ISO 20022 took place in several phases across a wide range of financial institutions and infrastructures in recent years. The process was often supported by regulatory or infrastructure-operator expectations and requirements. For example, the action plan defined within the framework of the BIS by the CPMI and the Financial Stability Board, and adopted by the G20 countries, aimed at increasing the efficiency of cross-border payments, explicitly supports the harmonised application of ISO 20022 (FSB, 2025). Generally speaking, in most large financial infrastructures the transition took place or is taking place on the basis of a central bank or infrastructure-operator decision, with a defined deadline. The standard is thus gradually becoming the new, universal communication basis of the global financial system.

As previously mentioned, the T2 payment system operated by the European Central Bank migrated to ISO 20022-based messaging in 2023, simultaneously with the consolidation of the earlier systems. The Bank of England likewise introduced the ISO 20022 standard in 2023 in the CHAPS, the RTGS infrastructure of the United Kingdom. In the United States, the RTGS system operated by the Federal Reserve, the Fedwire Funds Service, migrated to the ISO 20022 message format in 2025. For the credit institutions and other financial institutions connected to the aforementioned systems, the transition also entailed a mandatory technical migration.

It is undeniable that the introduction of the new messaging standard represents one of the most significant developments in the history of financial messaging. SWIFT took a major step towards modernisation and security when it announced the adoption of the new ISO 20022 standard in March 2023. The migration period closed on 22 November 2025, by which date all SWIFT partners – excluding RTGS systems – were required to carry out necessary developments for the transition. From spring 2023 – during the announced transition period, operation under the old and the new standard could be maintained in parallel. SWIFT supported the transition with in-house translation software that ensured interoperability between the two standards and enabled the back-and-forth translation of individual messages, thereby ensuring that the operation of all member institutions – and consequently, global payments – remained continuous and uninterrupted. At predefined dates, the various market areas gradually migrated to the new operation according to a time-staggered schedule. As a result, within a few years, the vast majority of institutions worldwide had migrated to conducting business communications under the new standard. This included domestic and international payments, and the participants operating the financial infrastructures – typically central banks, or the clearing houses and institutions owned by them – including large-value payment systems (SWIFT, 2026b).

This therefore meant an industry-wide, quasi-mandatory transition affecting institutions on the order of tens of thousands, after which the use of

the ISO 2022 standard became almost exclusive in cross-border payments as well. In what follows, we present in greater detail the effects of the Hungarian transition, which forms part of this global migration process.

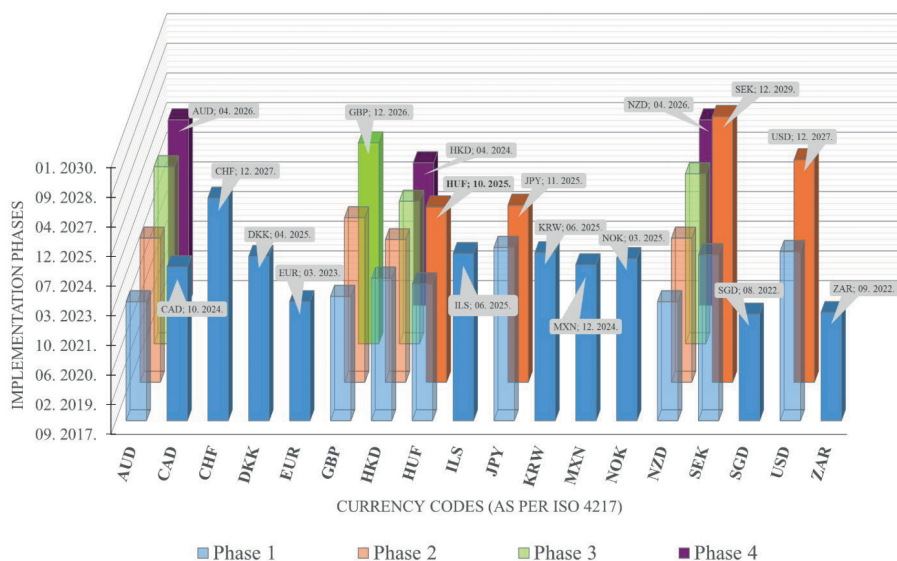
Preparing for the renewal of large-value electronic forint payments

The members of the SWIFT community had to become capable of receiving, sending and processing messages conforming to the ISO 2022 messaging standard by November 2025 at the latest. Although no mandatory transition deadline was set for the central banks operated RTGS systems⁹, the widespread introduction of the new standard in other areas of payment nevertheless also provided a strong incentive for central banks to adapt as soon as possible. The main reason for this is the turnover of commercial banks and other financial institutions appear in aggregate in the central infrastructures, therefore the adoption of the new standard also became indispensable in these systems. The content shown in Figure 1 presents the preparation timeline according to which the central banks of the currencies accepted for settlement by the Continuous Linked Settlement Bank (CLS)¹⁰ – a system of which the MNB has also been a member since 2015 – carried out the preparation of their own national systems for operation under the new messaging standard. These systems are not only complex, but their operation also has a significant impact on the entire electronic payments of a given country, so every change requires special care and thorough preparation.

9 RTGS systems typically settle large-value transactions; a relatively small number of transactions, a few thousand to tens of thousands, are executed daily, but the value of each individual transaction is itself significant.

10 The greatest benefit provided by the CLS system is, that eliminates the settlement risk of international foreign exchange transactions, since it waits for full delivery by both contracting parties and only then settles for both sides. This eliminates settlement risks, which previously arose because the parties of a transaction, operating geographically far from one another, could even fall into default.

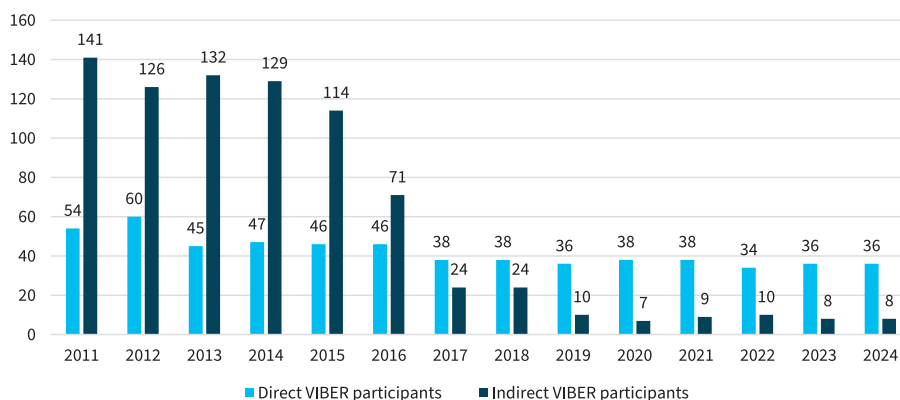
Figure 1: ISO 2022 implementation phases of CLS-eligible currencies as of 20 May 2026



Source: own compilation based on data published by CLS

VIBER is the domestic RTGS system operated by the MNB, which became operational on 3 September 1999. In the system, the settlement of large-value, urgent payments takes place in real time, with payment messages transmitted via the SWIFT network. The introduction of VIBER reflected the MNB's strategic objective of mitigating financial risks, including credit, liquidity, and operational risks. Furthermore, the system was designed to enhance the safety and operational efficiency of interbank payment settlement processes (MNB, 1999). Payments are settled only when sufficient funds are available. These funds may consist of a positive balance on the participant's settlement account or access to the intraday interest-free credit facility provided by the MNB. Settlement transactions include interbank transfers, customer-initiated payment orders, the Hungarian forint leg of delivery-versus-payment (DvP) securities transactions, and central bank operations. Participants of VIBER include domestic credit institutions, GIRO Ltd., KELER Central Depository Ltd., the MNB, the Hungarian State Treasury, the Hungarian Post, and several international fintech companies (MNB, 2026a).

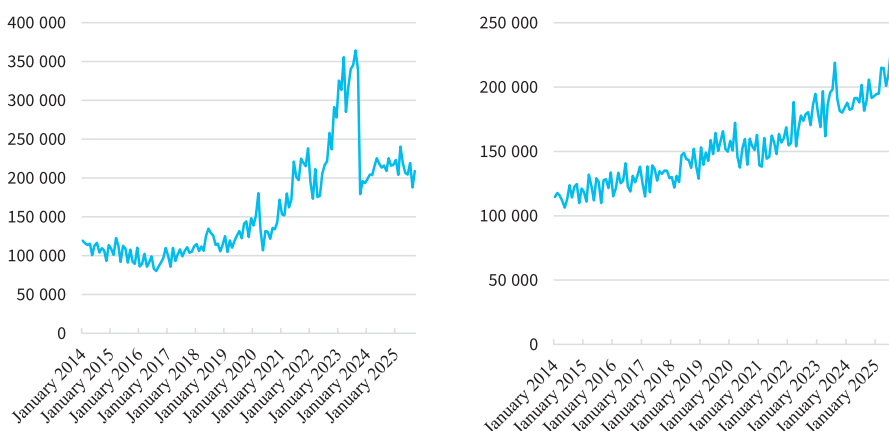
Figure 2: Number of direct and indirect VIBER participants



Source: own compilation based on MNB (2026d) data

Figure 2 illustrates the number of direct and indirect participants in VIBER. A clear downward trend can be observed after 2011 onwards, followed by a period of relative stability from 2019 onwards, with only minor fluctuations. This substantial decline can be attributed primarily to the integration of savings cooperatives, as well as to bank mergers and acquisitions. The consolidation of the Hungarian banking sector was largely completed by 2017.

Figure 3: VIBER transaction value (HUF billion) (left) and number of transactions (right), January 2014 – September 2025



Source: own compilation based on MNB (2026d) data

The data presented in the left panel of Figure 3 indicate that the upward trend in the value of transactions settled through VIBER came to an end in September 2023 and was followed by a marked decline. This decrease was primarily attributable to the phase-out of the deposit quick tender facility in October 2023 (MNB, 2025).

Prior to the preparation for the VIBER ISO 20022 migration, the MNB successfully participated in the migration project of the TARGET2 system operated by the European Central Bank (ECB). The MNB used TARGET2 to provide foreign currency payment services to its account holders and to process a substantial share of its own foreign currency transactions. Building on the experience gained from the TARGET2 migration project, planning for the modernisation of VIBER and the domestic adaptation of international best practices commenced in March 2023 following the approval of the MNB's Board of Directors. The implementation of the new VIBER messaging standard was organised as a dedicated programme comprising separate planning and implementation projects.

Methods and sampling

The aim of the study is to examine the changes in VIBER's aggregate closing balance, with particular emphasis on the go-live of the VIBER ISO 20022 migration programme on 27 October 2025. The VIBER aggregate closing balance, defined as the end-of-day balance recorded in participants' accounts held with the Central Bank of Hungary (MNB), serves as the basis for the calculation of mandatory reserves in accordance with MNB Decree No. 10/2005 (VI. 11.).

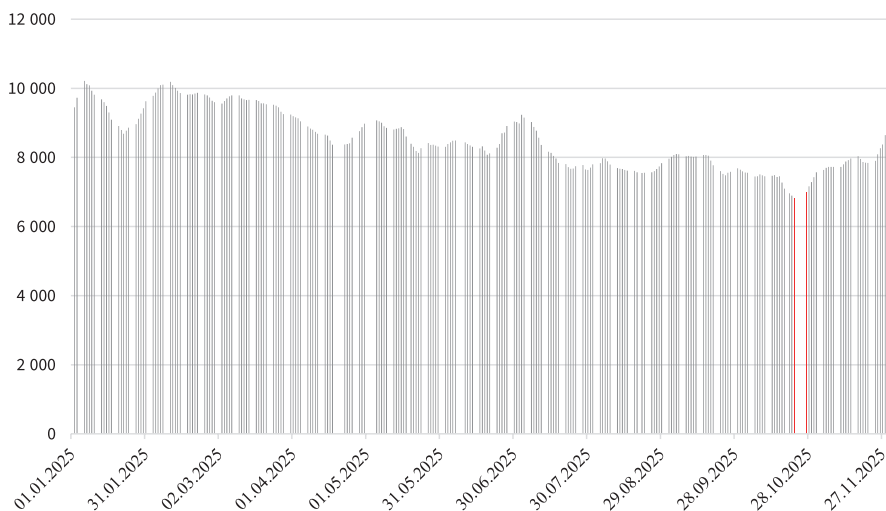
To evaluate the impact of the ISO 20022 go-live, we employ segmented regression analysis, a well-established statistical method for estimating intervention effects in Interrupted Time Series (ITS) studies. In this study, the time series consists of the aggregate closing balance, measured at regular intervals over time. A time series may be divided into distinct segments by one or more breakpoints. Breakpoints are predefined points in time at which the observed values of the time series deviate from the preceding pattern as a result of an identifiable event, such as a policy, regulatory, or technological intervention. The beginning and end of each segment are determined by these breakpoints. Each segment is characterised by two parameters: the level and the trend. The level represents the value of the outcome measured at a given point in time, whereas the trend is represented by the slope of the outcome over the corresponding time interval. Segmented regression analysis allows different segments to exhibit distinct levels and trends, making it well suited to identifying changes in both level and trend following an intervention. A level change refers to an immediate increase or decrease in the outcome, whereas a trend change reflects a difference in the slope of the post-intervention period relative to the pre-intervention period.

The main research question of this study is whether the VIBER ISO 20022 migration resulted in a detectable structural break and whether it led to a persistent change in the trend of VIBER's aggregate closing balance. Specifically, the analysis examines whether the ISO 20022 go-live led to statistically significant temporary or persistent changes in the time series, or whether the observed movements are better explained by other liquidity-related factors. The null hypothesis of the study is that the ISO 20022 migration, in itself, did not result in a persistent structural break in banking system liquidity, although the transition period may have been associated with minor fluctuations in balances. Segmented regression analysis has been widely applied to evaluate the effects of policy and regulatory interventions. Wagner et al. (2002) applied segmented regression analysis to evaluate the effects of a prescription reimbursement restriction introduced in the New Hampshire Medicaid programme and its subsequent replacement with a copayment programme. They found that the interventions resulted in an immediate and significant reduction in medication use and demonstrated that segmented regression analysis is a powerful statistical method for estimating intervention effects and assessing changes in level and trend following policy interventions. Nistal-Nuño (2017) also applied segmented regression analysis of interrupted time series data to assess the outcomes of the stricter blood alcohol concentration (BAC) limit introduced in Chile in 2012. The results indicated that the policy was associated with a statistically significant reduction in alcohol-related road traffic crashes. However, no clear effect was found on the overall number of injuries and fatalities.

Results

The present study uses VIBER's aggregate closing balances made available by the MNB for research purposes. The analysis covers the period from 1 January 2025 to 31 December 2025. The evolution of VIBER's aggregate closing balance over time is illustrated in Figure 4, with the ISO 20022 go-live date and the preceding day highlighted in red.

Figure 4: VIBER's aggregate closing balance between 1 January 2025 and 31 December 2025 (HUF billion)



Source: own compilation based on MNB (2026b) data

The dependent variable in the model is VIBER's daily aggregate closing balance ($\ln_viber$). The natural logarithm of the variable is used because the logarithmic transformation reduces the influence of extreme values, stabilises the variance, helps satisfy the homoscedasticity assumption, and facilitates a more straightforward interpretation of the estimated coefficients. The explanatory variables in the model are the time trend (t), a dummy variable indicating the short transitional period surrounding the migration ($transition_period$), and a post-intervention trend variable ($posttrend$). Formally, the time trend (t) variable is defined as follows:

$$t = 1, 2, 3, \dots, 365$$

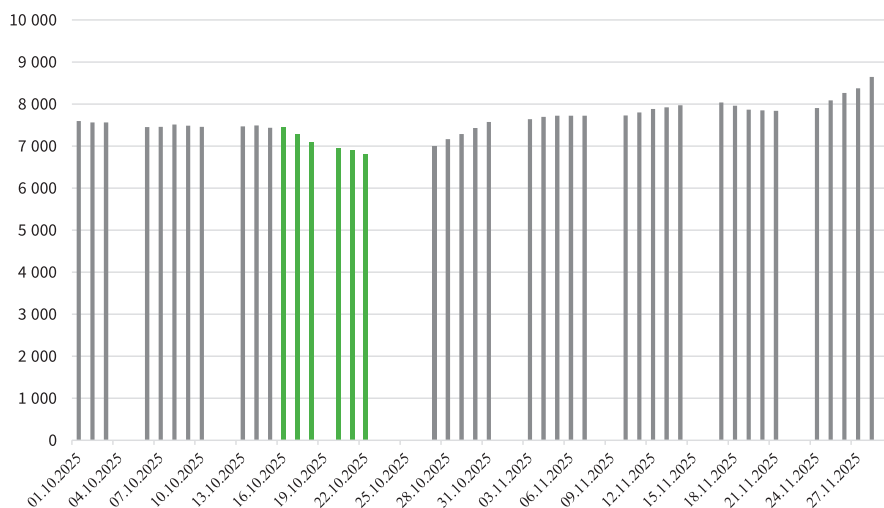
where t = number of days from 1 January 2025 to 31 December 2025

The post-intervention trend variable is formally defined as follows:

$$posttrend_t = \begin{cases} 0, & t < 300 \\ t - 299, & t \geq 300 \end{cases}$$

as the VIBER ISO 20022 migration went live on 27 October 2025, the time trend variable takes the value $t = 300$ on that date. As the primary focus of the analysis is the VIBER ISO 20022 go-live, the implementation period is highlighted in Figure 4. Figure 5 presents VIBER's aggregate closing balance during the go-live period and over the subsequent month.

Figure 5: VIBER's aggregate closing balance between 1 October 2025 and 30 November 2025 (HUF billion)



Source: own compilation based on MNB (2026b) data

It is evident that VIBER's aggregate closing balance exhibited a downward trend prior to the go-live and began to increase immediately following the go-live on 27 October 2025. The classical ITS assumes an immediate level change following an intervention. In many cases, however, interventions are characterised by a transition period, gradual implementation, or anticipatory effects. To assess the impact of the VIBER ISO 20022 migration, we employ a segmented regression model. The classical ITS approach typically estimates changes in level and trend before and after a pre-defined breakpoint. However, a visual inspection of the VIBER data suggests that the dynamics of VIBER's aggregate closing balance cannot be adequately characterised by a single instantaneous breakpoint around the time of the ISO 20022 migration. During the weeks preceding the go-live, a gradual decline in balances was observed, followed by a reversal in trend after the migration.

Accordingly, instead of including a variable representing an immediate level change, the model specification incorporates a dummy variable representing a transition period (*transition_period*) to capture the potentially gradual effects of the migration. The literature suggests that the effects of interventions are often not immediate but rather emerge through a transitional adjustment period. Zhang et al. (2023) pointed out that traditional segmented regression models may produce biased estimates when intervention effects emerge gradually or occur over a transition period. The authors therefore proposed an optimized ITS specification that explicitly accounts for the transition period of intervention effects.

In the present study, the `transition_period` variable denotes the short period between 16 October 2025 and 22 October 2025, highlighted in green in Figure 5. The objective of the model is to examine whether the evolution of VIBER's aggregate closing balance can be explained by a distinct transition period and whether a change in trend can be identified following the ISO 20022 migration.

The analysed time series consists of daily observations of VIBER's aggregate closing balance. An important characteristic of the data is that VIBER operates only on business days, consequently, no observations are available for weekends and public holidays. Accordingly, the dataset covers the complete calendar period, with the dependent variable recorded as missing for weekends and public holidays. These missing observations were not imputed, since this would result in artificial autocorrelation and biased variance estimates. Rather than explicitly modelling weekends, the analysis captures the adjustment behaviour associated with holiday periods. To this end, the model includes control variables: indicator variables for the days preceding (`pre_holiday`) and following (`post_holiday`) public holidays, a dummy variable identifying extended holiday periods (`long_break`), and the `month_end` variable capturing month-end liquidity effects. This approach enables a more accurate identification of the timing of liquidity adjustments than would be achieved by explicitly modelling unobserved weekend days. The variables included in the analysis are summarised in Table 1.

Table 1: Description of the variables in the model

Variable name	Meaning
<code>ln_viber</code>	Logarithm of the VIBER's aggregate closing balance
<code>t</code>	Time trend (1, 2, 3, ...)
<code>posttrend</code>	Time trend after go-live (1, 2, 3, ...)
<code>transition_period</code>	Dummy: 1 between 16 October 2025 and 22 October 2025, 0 otherwise
<code>pre_holiday</code>	Dummy: 1 before a public holiday, 0 otherwise
<code>post_holiday</code>	Dummy: 1 after a public holiday, 0 otherwise
<code>month_end</code>	Dummy: 1 on the last day of the month, 0 otherwise
<code>long_break</code>	Dummy: 1 before more than two consecutive non-working days, 0 otherwise

Source: own compilation

The model is specified as follows:

$$\ln(viber_t) = \beta_0 + \beta_1 t + \beta_2 posttrend + \beta_3 transition_period_t + \sum \beta_k X_{kt} + \varepsilon_t \quad (1)$$

where X_{kt} denotes the k -th control variables.

The regression coefficients are interpreted as follows. The coefficient β_1 represents the underlying trend in VIBER's aggregate closing balance; the parameter β_2 measures whether the slope of the time trend changed following the migration, while β_3 captures the effect of the transition period shock on aggregate liquidity. The remaining coefficients, β_k , represent the effects of the control variables, including month_end, pre_holiday, post_holiday, and long_break.

Table 2: Results of the first model

First model	B	Std. Error	Beta	t	Sig.
(Constant)	31.628	0.073		434.217	0.000
t	-0.001	0.000	-1.043	-25.383	0.000
posttrend	0.003	0.000	0.507	12.473	0.000
transition_period	-0.046	0.020	-0.078	-2.352	0.019
month_end	-0.007	0.017	-0.013	-0.413	0.680
pre_holiday	-0.009	0.008	-0.036	-1.045	0.297
post_holiday	-0.010	0.008	-0.042	-1.274	0.204
long_break	-0.036	0.023	-0.052	-1.554	0.121

Source: own compilation

Based on the results of the first ITS regression model (Table 2), the estimated specification explains the variation in VIBER's aggregate closing balance significantly ($F = 108,266$; $p < 0,001$), with a high explanatory power ($R^2 = 0,756$). The time trend variable (t) in the model has a negative and statistically significant coefficient ($B = -0,001$; $p < 0,001$), indicating a slight underlying downward trend in VIBER's aggregate closing balance over the sample period. In contrast, the posttrend variable, which captures the post-migration change in trend, has a positive and statistically significant coefficient ($B = 0,003$; $p < 0,001$). This suggests that following the ISO 20022 migration, the previous downward trend reversed, and VIBER's aggregate closing balance embarked on an upward trajectory. The transition_period variable, representing the transitional period surrounding the go-live, has a negative coefficient and is statistically significant at the 5% level ($B = -0,046$; $p = 0,019$), indicating a short-term decline in VIBER's aggregate closing balance in the immediate vicinity of the migration. This corresponds to an approximate 4.6% temporary decline. At the same time, none of the control variables, including the month-end effect (month_end), the pre-holiday (pre_holiday) and post-holiday (post_holiday) periods, or extended holiday periods (long_break) proved to be statistically significant.

To assess multicollinearity, the Variance Inflation Factor (VIF) was employed, which measures the extent to which the correlation among the explanatory

variables increases the variance of the estimated regression coefficients. The literature generally considers VIF values below 5 as indicating the absence of serious multicollinearity. Therefore, the model can be regarded as stable, as all VIF values remained below 2. However, the Durbin–Watson statistic indicates substantial positive autocorrelation ($DW = 0,134$), suggesting that the OLS regression results should be interpreted with caution.

From a liquidity management perspective, precautionary liquidity accumulation and, consequently, an increase in aggregate central bank money holdings would have been expected prior to the ISO 20022 go-live. This made it necessary to investigate the factors underlying the temporary decline identified by the regression models. Such precautionary behaviour appeared particularly plausible because the migration affected not only the central VIBER system but also the payment and back-office systems of all participating credit institutions. Any migration-related issue could have disrupted the processing or transmission of payment messages, thereby creating liquidity risk not only for the institution concerned but also for its counterparties. To explain these empirical findings, which were contrary to the initial expectations, qualitative data were also collected to gain insight into banking practice. As part of this process, short interviews were conducted with liquidity management specialists from four institutions in the Hungarian banking sector. The respondents unanimously stated that the VIBER ISO 20022 migration did not materially affect their daily liquidity-management practice, and that the observed decline in balances was primarily attributable to the VAT payment obligation. During VAT payment periods, part of the banking-system liquidity is transferred to the account of the Hungarian State Treasury held at the MNB, resulting in a temporary decline in VIBER's aggregate closing balance.

Based on the interviews, the `vat_period` dummy variable was introduced into the model. This variable identifies the ± 3 business-day period around the VAT payment deadline, which falls on the 20th day of each month. Its purpose is to examine whether VAT payment periods contributed in a statistically significant manner to the temporary decline in VIBER's aggregate closing balance.

Accordingly, the equation of the second model is as follows:

$$\ln(viber_t) = \beta_0 + \beta_1 t + \beta_2 posttrend + \beta_3 transition_period_t + \beta_4 vat_period_t + \sum \beta_k X_{kt} + \varepsilon_t \quad (2)$$

where X_{kt} denotes the control variables.

Table 3: Results of the second model

Second model	B	Std. Error	Beta	t	Sig.
(Constant)	31.657	0.070		450.319	0.000
t	-0.001	0.000	-1.055	-26.651	0.000
posttrend	0.003	0.000	0.523	13.325	0.000
transition_period	-0.027	0.019	-0.046	-1.412	0.159
vat_period	-0.031	0.007	-0.145	-4.587	0.000
month_end	-0.017	0.016	-0.033	-1.045	0.297
pre_holiday	-0.007	0.008	-0.031	-0.936	0.350
post_holiday	-0.007	0.008	-0.030	-0.936	0.350
long_break	-0.028	0.022	-0.041	-1.270	0.205

Source: own compilation

Based on the results of the second model (Table 3), the model still has high explanatory power ($R^2 = 0,776$), and the explanatory variables are jointly statistically significant ($p < 0,001$). As in the first model, the time trend variable (t) had a negative and statistically significant coefficient in this specification ($B = -0,001$; $p < 0,001$), while the posttrend variable remained positive and statistically significant ($B = 0,003$; $p < 0,001$).

The transition_period variable, which showed a significant negative effect in the first model, lost its significance after the vat_period variable was included ($B = -0,027$; $p = 0,159$). At the same time, the vat_period variable had a negative and highly significant coefficient ($B = -0,031$; $p < 0,001$), suggesting that the decline in VIBER's aggregate closing balance was more likely related to the VAT payment periods than to the ISO 20022 migration itself. Owing to the log-transformed dependent variable, the estimated coefficient can be interpreted as an approximately 3.1% temporary decline in VIBER's aggregate closing balance during the VAT payment periods.

The control variables – including month_end, pre_holiday, post_holiday, and long_break – did not prove statistically significant. Overall, the results suggest that the temporary decline in balances around the migration was primarily attributable to fiscal rather than technological or operational factors.

However, the Durbin-Watson statistic continues to indicate strong positive autocorrelation ($DW = 0,170$), suggesting that the residuals are not independent.

Therefore, to assess the robustness of the OLS regression results, ARIMA models were employed based on the second model specification, which are able to account for time-series autocorrelation. Specifically, ARIMA(1,0,0), ARIMA(1,0,1), and ARIMA(2,0,0) models were tested. In all cases, the autoregressive components were highly significant, confirming that the liquidity

time series exhibited substantial internal dynamics. In the ARIMA(1,0,0) model, the estimated AR(1) parameter was 0.982 ($p < 0,001$), indicating extremely strong temporal dependence.

According to the results of the ARIMA(1,0,0) model (Table 4), the transition_period and the posttrend variables both lost their statistical significance, whereas the vat_period variable remained negative and significant ($p = 0,014$). Thus the significance of the posttrend variable was most likely attributable to the strong autoregressive structure of the time series rather than to a genuine structural change in trend.

Table 4: Results of the ARIMA(1,0,0) model

	Estimate	SE	t	Sig.
Constant	31.509	0.518	60.796	0.000
AR (1)	0.982	0.012	79.105	0.000
trend	-0.001	0.000	-3.345	0.001
posttrend	0.001	0.001	0.613	0.541
transition_period	-0.008	0.010	-0.786	0.433
vat_period	-0.006	0.003	-2.477	0.014
month_end	0.004	0.003	1.297	0.196
pre_holiday	-0.001	0.002	-0.798	0.426
post_holiday	0.000	0.001	-0.271	0.786
long_break	-0.006	0.005	-1.308	0.192

Source: own compilation

These findings suggest that much of the structural break observed in the initial OLS models was more likely attributable to other liquidity-related factors than to the direct effect of the migration. The ARIMA(1,0,0) model shows a good fit (Stationary $R^2 = 0.981$; RMSE = 0.014; Normalized BIC = -8.370). However, the Ljung–Box test remained significant ($p < 0.001$), indicating that autocorrelation is still present in the residuals (Table 5). Nevertheless, the model fit improved substantially compared with the OLS regression, confirming the need for a time-series modelling approach.

Table 5: Presentation of the ARIMA(1,0,0) model

Model statistic	Value
Stationary R2	0.9809
RMSE	0.0136
Normalized BIC	-8.3702
Ljung–Box p-value	<0.001

Source: own compilation

As a further robustness check, the ARIMA(2,0,0) model showed an even better fit, as reflected by a lower normalized Bayesian Information Criterion (BIC) value and improved goodness-of-fit measures. In this specification, however, the *transition_period*, the *posttrend*, and *vat_period* variables were not found to be significant. This indicates that the dynamic structure of the time series alone was able to reproduce the temporary movements observed earlier. The ARIMA(1,0,1) model yielded similar results, although in this case the *transition_period* variable remained weakly significant. Comparing the alternative specifications, the ARIMA(1,0,0) model provided the most economically interpretable compromise, as it accounted for the autoregressive structure of the time series more effectively than the OLS regression while preserving the role of alternative liquidity-related explanations.

The interpretation of the results was supported by interviews with liquidity management specialists from several Hungarian banks. The interviewees unanimously agreed that the VIBER ISO 20022 migration did not materially affect daily liquidity management practices and did not require any extraordinary adjustment measures. Several respondents also emphasised that the migration was implemented smoothly from both a technological and an operational perspective. According to the interviewees, the banking sector had a high level of confidence in the transition coordinated by the National Bank of Hungary, meaning that the market accepted both the development solutions implemented for VIBER and the closely integrated InFoRex system, as well as the programme management methodology applied throughout the migration. However, the successful migration cannot be attributed solely to effective project management. Carrying out such a transition also requires the adaptation of payment processing systems to the new messaging standard, as well as the technological modernisation of the supporting infrastructure. This is particularly true for systems that have been in operation for several decades, as providing stable, high-performance, and flexible support for the ISO 20022 standard requires significant development efforts and resources. The infrastructure investments carried out in recent years and the available development resources created the technological conditions necessary for the migration to be implemented safely.

The interviews also highlighted that substantial VAT payments took place during the study period, resulting in liquidity outflows to the account of the Hungarian State Treasury held at the National Bank of Hungary. This is consistent with the finding that the `vat_period` variable remained negative and significant in the ARIMA(1,0,0) model.

Overall, based on the results of the analysis, we did not find robust empirical evidence that the VIBER ISO 20022 migration, in itself, resulted in a structural break in liquidity within the Hungarian banking system. Much of the temporary structural break initially observed can instead be explained by the strong autoregressive structure of the time series and by alternative liquidity-related factors. Rather, the results suggest that the migration was carried out successfully from an operational perspective and without significant market disruptions, which can also be interpreted as an indirect indicator of confidence in the Hungarian financial infrastructure and the banking system's adaptive capacity.

Summary and discussion

The functioning of the financial system relies on the standardized exchange of payment messages. As financial infrastructures evolve, these standards are periodically updated to support more efficient data management, broader interoperability between systems, and the changing needs of financial markets. One of the most significant developments in payment systems in recent years has been the global adoption of the ISO 20022 messaging standard, affecting the world's major financial market infrastructures, including central bank RTGS systems and the SWIFT network.

In line with these international developments, Hungary also completed the migration of the VIBER system to the ISO 20022 standard. Given the scale of such a technological transition, an important question was how it affected the liquidity management practices of financial institutions and the evolution of central bank money holdings. This study examined this question by analysing VIBER's aggregate closing balance using interrupted time series analysis and ARIMA models.

Although the initial estimates indicated a temporary decline in balances and a post-migration trend change, the robustness analyses showed that these effects were not persistent. The results suggest that much of the observed variation can be explained by the internal autoregressive structure of the time series and liquidity reallocations associated with VAT payment periods. We found no robust empirical evidence that the ISO 20022 migration, in itself, caused a structural break in liquidity within the Hungarian banking system.

The quantitative results were also supported by short interviews conducted with bank liquidity-management experts: the respondents unanimously agreed that the migration did not materially affect daily liquidity management practices

and did not require any extraordinary adjustment measures. This suggests that market participants had a high level of confidence in the migration coordinated by the Central Bank of Hungary and considered the project's preparation, testing, and implementation to be adequate.

One of the main lessons of the analysis is that the success of complex central bank infrastructure developments depends on more than technological capabilities. Equally important are early preparation, the involvement of all relevant stakeholders throughout the process, transparent and consistent communication, extensive testing, and the maintenance of market confidence. The experience of the VIBER ISO 20022 migration demonstrates that, with appropriate project management and effective cooperation, even major technological changes affecting critical financial infrastructure can be implemented without significant market disruption. In this sense, the project can be regarded not only as a technological modernisation but also as evidence of the institutional maturity and adaptability of the Hungarian financial system.

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