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Digital Payment Channels and Fintech Performance in Kosovo: An Econometric Analysis Using HAC-GMM

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Abstract:

This research paper analyzes the impact of digital payment channels on fintech performance in Kosovo using monthly data from the Central Bank of Kosovo for the period 2018–2024. The analysis covers several key categories of financial transactions, specifically Credit Transfers in Paper Form (CTPF) and in Electronic Form (CTEF), Electronic Funds Transfers at Point of Sale (EFTPOS), Automated Teller Machine (ATM) based operations, including ATM Cash Withdrawals (ATMW) and ATM Deposits (ATMD), Credit Transfers via ATMs (CTATMs), as well as Cash Withdrawals and Card Payments at POS terminals (CWPOS and CPPOS). The empirical methodology relies on Ordinary Least Squares (OLS) and Heteroskedasticity and Autocorrelation Consistent Generalized Method of Moments (HAC-GMM) estimators. Variables identified as I(1) were differenced before estimation, while structural breaks (COVID-19, post-pandemic) and regulatory milestones (2022 e-payment reforms) were incorporated into the model. The empirical findings indicate that electronic credit transfers, ATM deposits, and POS terminal card payments have a statistically significant positive effect on the volume of online transfers, which serves as a proxy for fintech performance. In contrast, paper-based credit transfers (CTPF), EFTPOS transactions, ATM cash withdrawals (ATMW), and cash withdrawals at POS terminals (CWPOS) have negative effects. In contrast, credit transfers conducted through ATMs (CTATMs) show no statistically significant impact. The results highlight the essential function of complete digital tools and transitional methods in facilitating financial inclusion, at the same time pointing out that such inclusion remains hindered by the structural and behavioral barriers associated with cash dependency. The study contributes to the academic literature in three main ways. First, it provides the most comprehensive transaction-level assessment of digital payments in Kosovo using official Central Bank of Kosovo data. Second, it employs advanced econometric techniques, particularly HAC GMM, to generate detailed and robust estimates of financial impacts. Third, it integrates the Technology

Acceptance Model and Diffusion of Innovations theory with empirical financial behavior, offering an innovative analytical framework for understanding the interaction, substitution, and complementarity among payment channels in emerging markets. Policy recommendations included the acceptance of cards and the use of electronic transfers, the linking of ATM deposits with mobile banking, and the decrease of cash reliance through pricing strategies and the implementation of financial literacy programs.

Keywords: Fintech, digital payments system, financial innovation.
JEL Classification: G23, G28, O33.

1. Introduction

Digitalizing financial products and services continues to fundamentally transform the fintech industry, driving operational efficiency, innovation, and wide-ranging financial inclusion. However, in emerging economies like Kosovo, digital payment systems are gaining a more central role in the financial sector, as they are much faster, easier to access, and cost-effective. Research shows that every percentage increment in the use of digital payments has the potential to increase GDP/capita by 0.04–0.10 percent, further demonstrating the macroeconomic advantage of digital finance (Moddy Analytics, 2016). Fintech in Kosovo is fast developing, and financial institutions and startups are adopting the use of digital technology to increase financial inclusion, enhance services, and improve profitability through progressive regulations by the Central Bank of Kosovo. Such changes are supported by the development of new financial platforms and smart service delivery mechanisms, driven by the improvement of technologies like blockchain, artificial intelligence (AI), and machine learning (ML). The use of fintech solutions has increased scholarly interest, primarily regarding the analysis of the factors that contribute to their distribution and their role in the economic performance. According to empirical studies (e.g., Avdullahi et al., 2025; Ozili, 2018; Ernst and Young, 2017; Schindler, 2017), the adoption of fintech has been researched and explored in terms of its causes and association with financial inclusion. Also, the change in consumer behavior because of the use of digital payments is indicative since it is vital to add a robust analytical framework that allows evaluating the consequences of digital payments on the economy (Zhang, Luximon, and Song, 2019).

Nevertheless, in spite of such tremendous opportunities posed by the current technological signals of invention, numerous obstacles exist that impede the successful application of fintech in less developed economies. Such limitations are infrastructural problems, like inconsistent supply of electricity, poor internet availability, insufficient levels

of financial literacy amongst the population, and regulatory issues that may slow innovation (Open Data Kosovo, 2022). The policymakers and stakeholders should understand these dynamics to get the maximum out of the potential of digital finance. The concept of digitalization has also transformed the behaviors of consumer transactions all around the world, including countries such as Kosovo. The electronic payment instrument has been used at an increased rate as digital infrastructure grows and consumer interests change. Such a change requires a more thorough investigation of usage trends and related ramifications of financial inclusion, the efficiency of the payment system, and the flexibility of financial infrastructure. The research presents an empirical study on trend analysis of digital transactions in Kosovo between January 2018 and December 2024. The analysis includes five primary transaction types: ATM cash withdrawals and deposits, credit transfers via ATMs, cash withdrawals at point-of-sale (POS) terminals, and card payments at POS terminals. These channels reflect both traditional and emerging digital payment behaviors.

Accordingly, to determine the multidimensional interaction between the research's aim and the changing landscape of payment channels in Kosovo, the research encompasses numerous key topics that serve as the backbone of the research. This research is guided by the following research questions:

RQ_1: How do traditional and fully digital credit transfer mechanisms influence the adoption of online transfers in Kosovo's banking system?

RQ_2: To what extent do semi-digital channels relying on physical infrastructure, such as EFTPOS transactions, ATM cash withdrawals, and ATM deposits, affect the growth of online transfers and digital financial inclusion?

RQ_3: What role do hybrid and complementary payment instruments, credit transfers via ATMs, cash withdrawals at POS terminals, and card payments at POS terminals play in shaping fintech performance and online transfer volumes?

The study intends to identify the core factors that influence online transactions through the use of an extensive transaction-based method that covers both traditional and digital channels. Earlier studies had different focuses, mostly one payment method at a time, or they had been based on aggregate factors of the digitalization of finance, but this study explicitly represents online transactions and is supported by a wide range of independent variables. The set of variables includes various transaction methods, such as paper and electronic credit transfers, transactions initiated through physical EFTPOS,

ATM withdrawals and deposits, ATM credit transfers, POS withdrawals, and POS card payments. This methodology makes it possible to analyze, with great detail, the interaction of different payment channels with online transfers, whether they are positively or negatively affecting each other. Through this multi-faceted approach, the research makes a scientific contribution by filling a gap in current research literature on this topic and also by employing sophisticated research techniques. Most previous studies used a static analysis and/or a limited number of payment indicators, which did not help in portraying the dynamics of the digital payments trend clearly. Furthermore, the study employs cutting-edge econometric techniques that consider both endogeneity and dynamic impacts, and the validity of the results is confident. The contributions of the research will be multidimensional. Firstly, the research conducted in the Kosovo setting is considered to be among the earliest ones employing official quantitative data from the Central Bank of Kosovo, which has been designated according to the International Monetary Fund requirements. Secondly, this research includes up-to-date time series data. Finally, using advanced statistical techniques, including the HAC-GMM estimator, the study aims to provide empirical insights into how different types of digital transactions affect the operational outcomes of fintech institutions in the country and the region. The structure of this study is organized by beginning with the introduction as the first section, followed by the second section, which presents the literature review. The third section explains the methodology, the fourth section discusses the findings, and the final section presents the conclusions.

2. Literature Review

Financial technology refers to the integration of technology into financial services companies' offerings to enhance their use and delivery to consumers. The global growth of digital payment systems and fintech solutions has significantly transformed the financial services industry, especially in developing economies. Fintech, as a recent innovation, has also found applicability in the financial industry by making it a combination of finance and technology, which promotes broader financial inclusion, improves transactions, and influences the development of new innovative products. This technology, including a wide range of tools or applications, includes mobile banking, peer-to-peer lending, blockchain technology, and digital payments. In this spirit, Gomber et al. (2017) define fintech as a group of innovations that effectively manage to transform banking and financial services through online channels, or in other words, the orientation towards customer-focused models and advanced analytics. The continuous advancement of fintech has radically changed the way financial services are accessed and delivered, especially in developing

economies, where traditional banking infrastructure is limited (Ozili, 2018). Recent developments in fintech are directly linked to the technological advancement and expansion of the global economy. Therefore, with the increase and adoption of the presence of digital technologies in everyday life, financial services have also evolved to meet the expectations of a more connected, mobile, and data-driven society (Ungratwar et al., 2025). This transformation is not only technological but also structural, reshaping the competitive landscape of the financial industry.

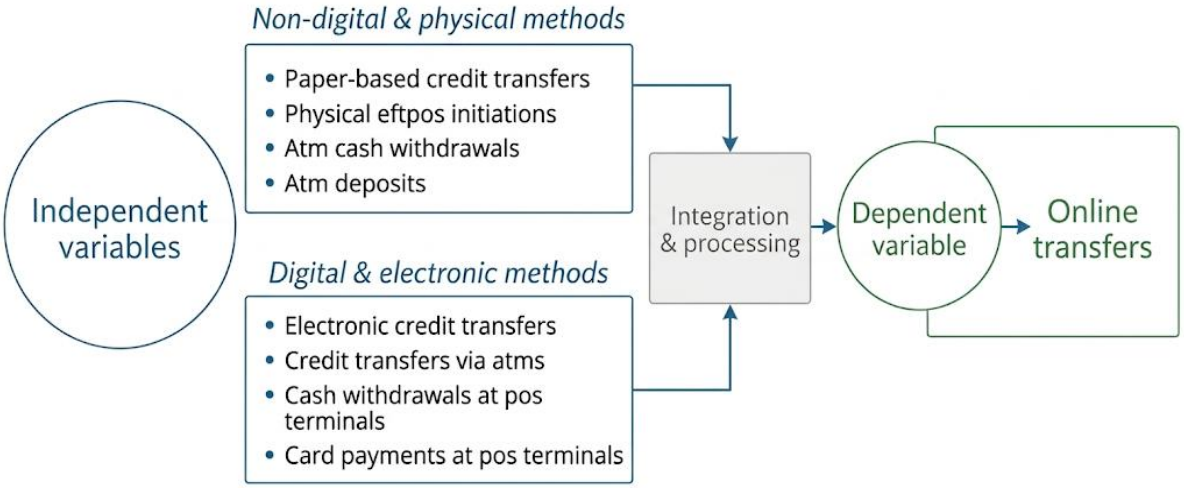
2.1 Fintech and its impact dimensions

According to Zhang, Luximon, and Song (2019), these systems enable users to conduct financial transactions electronically, reducing the need for physical cash and increasing the speed and security of transactions. However, it is essential to note that in developing countries, these digital payments have been a main catalyst in promoting financial inclusion, providing access to financial services for residents who previously lacked such opportunities (Sun, 2025). According to the World Bank (2022), digital financial services can reduce poverty and improve economic well-being by enabling people to save money safely, send and receive payments, and access credit and insurance. The application of Fintech also creates new paths in the formalization of the economy by increasingly shifting financial activity to digital channels, which improves tax collection and economic planning (Ernst and Young, 2017). Given Kosovo's commitment to Fintech implementation, it is worth emphasizing that Kosovo is in its early stages, but given the up-to-date development trend in the coming years, it is considered to have great potential. To accomplish this objective, from a regulatory outlook, the Central Bank of Kosovo has created and implemented progressive regulations based on EU directives to support digital finance, and financial institutions are increasingly adopting digital tools to develop service delivery and operational efficiency (Open Data Kosovo, 2022). This research relies on two fundamental theories: the Technology Acceptance Model (TAM) and the Diffusion of Innovations (DOI). TAM concentrates on the fact that adoption of technology is based on perceived usefulness and ease of use, which in the digital payment context is reflected in the efficiency, convenience, and simplicity variables that make electronic payment and card payments more attractive to users (Davis, 1989). DOI, on the other hand, explains adoption by attributes such as relative advantage, complexity, and compatibility, suggesting that payment methods that offer speed, security, and cost savings spread more rapidly, while those requiring physical presence or increasing cash reliance face obstacles (Rogers, 2003). Together, these theories create a framework for understanding why some payment channels speed up digital adoption, while others hinder it.

Beyond the benefits, the adoption of fintech faces various challenges. Briggs and Brooks (2021) have highlighted that infrastructure constraints, unstable electricity supply, and poor internet connectivity are considered among the biggest obstacles for developing countries. From a different outlook, Schindler (2017), referring to the matter of cybersecurity, notes that the study's findings suggest that regulatory frameworks often lag behind technological developments, creating gaps in consumer protection and data privacy. Hence, in line with this outlook, well-defined regulation is imperative in building a secure and inclusive fintech environment. The development of fintech is normally seen to occur faster in those markets where the regulatory environment is stronger and more supportive. Conversely, innovation can be suppressed by fragmentation of the regulatory system and lack of cross-linking institutions (Xu, 2025). Many factors influence acceptance of a digital payment, including convenience, cost, trust, and perceived usefulness. It has been found that consumers are interested in accessing digital payment services when they are convenient, safe, and helpful (Zhang et al., 2019).

Researchers have consistently examined the factors influencing and the consequences of fintech adoption in various areas. For example, Niankara and Traoret (2023) investigated the causal connection between digital payment systems and financial inclusion across 123 economies; their results provide substantial evidence of a beneficial impact, particularly in low-income economies. In terms of an operational cost perspective, Ong and Chong (2023) studied the bank usage impact of cashless payments and found that digital payments enhance customer engagement and reduce operational costs. Ouyang (2021) explored the influence of cashless payment on the credit access of underprivileged groups, revealing the mechanism of fintech in financial inclusiveness. Consequently, the conceptual framework of this analysis seeks to examine the influence of numerous variables on the utilization of online transfers in Kosovo. Diagram 1 illustrates the paradigm of the conceptual framework.

Figure 1. Conceptual Framework



Source: Author's compiling

2.2 Mapping payment channels for hypothesis development

To be conceptually clear, all hypotheses are introduced regarding the dependent variable, Online Transfers (OT), which is gauged in the total amount of transactions in millions of euros, not the quantity of transactions. This difference is essential as the purpose of the study is to obtain the economic size of digital adoption instead of the number of transactions, which does not entirely demonstrate the fintech performance. In this regard, the hypotheses have been re-formulated to investigate the effects of various forms of payment channels on the value of online transfers to make sure that the hypotheses are consistent with the operational definition of OT and the econometric model framework. In numerous emerging economies, the process of money transfers continues to rely predominantly on Credit Transfers in Paper Form (CTPFs), which necessitate the submission of physical documents to banks or formal institutions, thereby increasing both transaction time and cost. Although digital payment systems offer clear advantages, traditional methods remain prevalent due to outdated infrastructure, inadequate regulatory frameworks, and user hesitancy toward technological change (Briggs and Brooks, 2021). The persistence of paper-based systems constrains efficiency and inhibits innovation in financial services, particularly within fintech, which thrives on automation and real-time processing. According to Ramayanti et al. (2024), institutional reluctance toward digitalization and limited technological readiness in many communities contribute to this stagnation. Rogers (2003) attributes such delays to perceptions of complexity and unfamiliarity with innovation.

Further, Haddad and Hornuf (2019) and Ozili (2018) contend that transitioning to digital systems significantly improves financial inclusion and fintech advancement. Reliance on paper-based processes adds to expenses and time wastage, thus repelling the use of online channels. Consistent with the Diffusion of Innovations theory, the perceived benefits are limited, and the complexity is diffusing the adoption, whereas the current habits and infrastructure in Kosovo reinforce the effect and ensure CTPF is an obstacle to fintech development. Accordingly, this study advances the following hypothesis:

H_1: Credit transfers in paper form (CTPF) hinder online volumes.

Contrary to conventional mechanisms, Credit Transfers in Electronic Form (CTEFs) facilitate the digital transfer of funds through platforms such as online banking, mobile applications, and automated systems, thereby constituting a fundamental pillar of the fintech infrastructure. By eliminating the need for physical documentation, CTEFs enhance operational efficiency while simultaneously improving user experience. The prevailing spread of such systems can be eloquently described by the Technology Acceptance Model (TAM) and the Diffusion of Innovations model that inherently points out perceived usefulness and ease of use as major factors gauging technological adoption (Davis, 1989; Rogers, 2003). These theoretical assertions are supported by the empirical observations made by Haddad and Hornuf (2019) and Ozili (2018), demonstrating the positive effect of CTEFs on the financial processes occurring, as well as the level of financial inclusion. Conspicuously, as discovered by Van Dinh (2024), the introduction of CTEFs has greatly revolutionized service delivery in the fast-growing digital economy in Vietnam. Online credit transfers simplify processes by eliminating the need for paper records, making things less complicated, and making the user experience better, which encourages more people to utilize digital services. The Technology Acceptance Model asserts that how useful and easy to employ something is among the most important variables. Our hypothesis in this instance is:

H_2: Credit transfers in electronic form (CTEF) have a significant positive impact on online transfer volumes.

Electronic Funds Transfer at Point of Sale (EFTPOS) refers to card-based transactions conducted at physical retail locations using payment terminals. While these transactions are processed electronically, they require the customer's physical presence and are often seen as a transitional form of digital payment. Theoretically, EFTPOS adoption is influenced by factors such as convenience, infrastructure availability, and consumer trust, as explained by the Unified Theory of Acceptance and Use of Technology (Venkatesh et al.

2003). However, empirical studies suggest that EFTPOS may not significantly advance fintech performance. While it reduces cash dependency, its reliance on physical infrastructure limits scalability. Simatele and Mbedzi (2021) found that EFTPOS usage in Zimbabwe did not lead to long-term digital adoption, and Avdullahi et al. (2025) noted that fintech ecosystems relying on physical channels often lag in innovation. Electronic funds transfer (EFTPOS) operations depend on a physical presence and corresponding infrastructure, meaning they limit accessibility and potentially hinder the adoption of digital technology. Due to the Diffusion of Innovations theory, innovative technologies that are more complex and have fewer benefits are disseminated more slowly. As a consequence, EFTPOS remains less adaptable than entirely digital channels. Our hypothesis in this instance is:

H_3: Transactions initiated on a physical EFTPOS have a significant negative impact on the number of online transfers.

ATM cash withdrawals (ATMW) involve the use of automated teller machines to access physical currency. While ATMs are part of the digital banking infrastructure, the transactions they facilitate are inherently cash-based and do not directly support the goals of digital financial ecosystems. The continued reliance on ATMW can be understood through path dependency and consumer behavior theories, which suggest that historical preferences and institutional norms shape current financial habits. Empirical studies have shown that high levels of cash usage are negatively associated with fintech growth. For instance, Ong and Chong (2023) discovered that increased ATM withdrawals were associated with decreased mobile and internet banking, and Haddad and Hornuf (2019) pointed out that economies with more cash in circulation experience a higher level of obstacles to digital transformation. Moreover, according to the study by Suader et al. (2024), ATM withdrawals negatively affect online transfers by influencing the dependence on the use of cash, which is reflected in the slowdown of digital adoption. Based on this, our hypothesis here is:

H_4: ATM cash withdrawals (ATMW) have a statistically significant negative effect on the number of online transfers.

On the other hand, ATM deposits (ATMD) allow users to deposit physical cash or checks into their bank accounts via automated teller machines. Unlike ATM withdrawals, these transactions help digitize physical money, making it available for use in online and digital financial services. In theory, ATM deposits lead to financial intermediation as they enable the relocation of funds into the formal banking system. Its empirical analysis demonstrated that the adoption of digital finance is strongly correlated with ATMD usage.

For instance, Haddad and Hornuf (2019) and Impa et al. (2025) proved that ATM deposits provide access to digital platforms that cash-dependent clients could use, thus contributing to financial inclusion and increasing the performance of fintech. Furthermore, Mukherjee and Gaur (2024) conclude that ATMs play an important role in financial inclusion by converting physical money into digital form, as well as facilitating access to formal banking systems for individuals. Our hypothesis in this instance is:

H_5: ATM deposits (ATMD) positively impact the volume of online transfers.

Credit transfers over ATMs (CTATMs) entail the activation of inter-account fund transfers at the interface of ATMs. These are pure electronic banking transactions; however, not in the form of mobile or internet, but using physical terminals. The subscription to CTATMs can be explained by means of the channel substitution theory, according to which users prefer the use of financial service channels in terms of their convenience and familiarity. Although CTATMs allow clients to have an online alternative to perform transfers in branches, this mechanism usually competes with mobile and internet banking, which is more flexible and gives better customer satisfaction (Zhang et al. 2019). According to empirical studies, such as that by Haddad and Hornuf (2019), mobile and online platforms are greater growth drivers in fintech compared to the services accessed with the use of ATMs. In the same vein, authors Wu et al. (2023) point out that credit transfers via ATMs are considered an alternative to traditional transfers in branches, but often compete with mobile and online banking services, which offer greater flexibility and user satisfaction. Our hypothesis in this instance is:

H_6: Credit transfers via ATMs (CTATMs) usage positively affects the volume of online transfers.

Withdrawing cash at the point-of-sale terminals (CWPOS) enables the consumer to withdraw cash settlement, with the purchase of goods at retail outlets through the use of debit or credit cards. In spite of being processed electronically, such transactions lead to physical money in circulation, which might undermine the objectives of digital financial inclusion. CWPOS may be considered a theoretical approach based on the transaction cost theory, which purports that users embrace financial services that limit effort and cost. As convenient as CWPOS is, it promotes the continued use of cash and can result in a negative influence regarding the shift towards the establishment of all-digital financial habits. As empirical evidence presented by Simatele and Mbedzi (2021), Alkadi et al. (2023), and Impa et al. (2025) has indicated, the higher the dependency on cash-based services such as CWPOS, the slower the growth of the fintech sector and the deterioration of digital accessibility rates. Our hypothesis in this instance is:

H_7: Cash withdrawals at POS terminals (CWPOS) usage negatively affects digital financial adoption in the fintech sector.

Card payments at POS terminals (CPPOS) involve the use of debit or credit cards to make purchases at physical retail locations. These transactions are fully electronic and represent a key component of digital payment ecosystems. The adoption of CPPOS is well-supported by the Technology Acceptance Model (TAM) and network externalities theory. These frameworks suggest that users are more likely to adopt technologies that are easy to use and widely accepted (Davis, 1989; Haddad and Hornuf, 2019). Empirical studies consistently show that CPPOS promotes digital financial behavior, reduces reliance on cash, and enhances fintech performance. Zhang et al. (2019) found that card payments significantly influence consumer spending patterns and support financial inclusion. Our hypothesis in this instance is:

H_8: Card payments at POS terminals (CPPOS) usage positively influences the volume of online transfers.

In order to maintain a clear and coherent structure between the research questions and the hypotheses, the next section demonstrates the direct and explicit connection of each hypothesis with the respective research questions. RQ_1 is addressed through all eight hypotheses, as they jointly examine the connection between payment channels and fintech performance. RQ_2 is supported by hypotheses that focus on digital instruments that are expected to improve online transfers (H_2, H_5, H_8). Finally, RQ_3 is linked (H_8) to testing whether transaction volumes, both positive/negative, serve as reliable predictors of fintech growth in emerging economies.

3. Research Methodology

3.1 Data analysis approach

In our specific instance, online transfers were selected as the dependent variable, considering that they represent, fairly and comprehensively, the performance of Fintech in the Kosovo banking system. Unlike other indicators of electronic payments, OT exclusively captures transactions carried out through fully digital channels, reflecting both consumer adoption and institutional capacity to provide digital services. Therefore, this selection is consistent with previous literature that uses digital transaction volumes as a proxy for fintech growth, but improves on it by focusing on a pure digital metric instead of mixed or semi-digital instruments. The research explores numerous transfer forms by distin-

guishing between physical currency and digital transactions. The empirical analysis relies on a combined use of OLS and HAC GMM. Historically, research exploiting aggregated time series data has predominantly used the OLS methodology. Nonetheless, it is crucial to highlight that this strategy may, in some instances, produce erroneous or biased outcomes (Bai, Choi, and Liao, 2021). Some possible challenges connected with OLS prediction include the presence of autocorrelation, non-stationarity, heteroskedasticity, lagged data, and prediction constraints. Despite these constraints, OLS will be initially employed to evaluate whether its results significantly differ from those obtained via HAC GMM. Therefore, the full model specification is presented:

Equation (1):

$$Y_{it} = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon_t$$

Where: Y_{it} – denotes online transfer, α_0 – denotes intercept, $\beta_1, \ldots, \beta_n$ – coefficients in estimation, $X_1, \ldots, X_n$, and ε_t – error terms. Applying the above overall design and including the relevant variables associated with our instance, the operational model becomes:

Equation (2):

$$OT_{i,t} = \alpha_0 + \beta_1(CTPF_t) + \beta_2(CTEF_t) + \beta_3(EFTPOS_t) + \beta_4(ATMW_t) + \beta_5(ATMD_t) + \beta_6(CTATMs_t) + \beta_7(CWPOS_t) + \beta_8(CPPOS_t) + \varepsilon_t$$

Clarification: OT – denotes the dependent variable, β_1 till β_8 – represent the estimated coefficients, *t* – indicates the observed periods, and ε_t – captures the error terms. Given the theoretical and empirical limitations of OLS, especially regarding potential endogeneity and heteroskedasticity, the GMM approach is considered more appropriate for addressing such issues (Arellano and Bond, 1991). By differentiating the data (by placing them in the first difference), Arellano and Bond (1991) modify the OLS estimation to eliminate potential problems that may arise. These modifications allow the acquisition of control for individual effects and continue with the incorporation of internal instruments for predicting the correlated values, which addresses the issue of endogeneity. Lastly, the consistency that this approach provides for the presence of heteroscedasticity and serial correlation further validates it. The method described here is particularly successful in overcoming difficulties related to lagged values and structural errors that OLS could ignore (Roodman, 2009). Further motives for employing HAC GMM are to test for overidentification, verify the validity of instruments, and examine the consistency between standard and robust outcomes. Specifically, in the context of financial data, the usage of HAC GMM has gained broad consensus among researchers (Wooldridge, 2010; Cameron and Trivedi,

2005; Arellano, 2003). Therefore, drawing upon prior literature and the aforementioned shortcomings of OLS, HAC GMM is employed as a robust safeguard, ensuring the stability and credibility of the empirical results. The HAC GMM formula, expressed in our case, is presented as follows:

Equation 3:

$$\widehat{B}GMM = \arg\min_{B} \left[\left(\frac{1}{T} \sum_{t=1}^{T} z_t \left(y_t - (\beta_0 OT_t + \beta_1 CTPF_t + \beta_2 CTEF_t + \beta_3 EFTPOS_t + \beta_4 ATMW_t + \beta_5 ATMD_t + \beta_6 CTATMs_t + \beta_7 CWPOS_t + \beta_8 CPPOS_t) \right)' W_t \left(\frac{1}{T} \sum_{t=1}^{T} z_t \ (y_t - \beta_0 OT_t + \beta_1 CTPF_t + \beta_2 CTEF_t + \beta_3 EFTPOS_t + \beta_4 ATMW_t + \beta_5 ATMD_t + \beta_6 CTATMs_t + \beta_7 CWPOS_t + \beta_8 CPPOS_t) \right) \right]$$

Clarification: y_t – online transfers as the dependent variable, β_1 till β_8 – represents the estimation coefficients in the model, CTPF, CTEF, EFTPOS, ATMW, ATMD, CTATMs, CWPOS, and CPPOS – represents the independent variables treated, z_t – represents the instrument vector (including lagged values), and W_t – represents the weighting matrix (e.g., based on Newey-West covariance).

3.2 Study sample

The selected sample for investigation covers the period from January 2018 to December 2024, comprising a total of 84 observational periods, and includes data from all licensed financial institutions operating in Kosovo. The motivation for including this period in the investigation lies in the fact that from this period, the CBK has begun to publish data in official form based on the legal framework approved in accordance with EU directives. The research used transaction data that financial institutions operating under the Central Bank of Kosovo (CBK) licensing and regulation submitted to the institution. The CBK requires financial institutions to meet specific requirements for licensing, which include maintaining adequate capital levels, following anti-money laundering rules and consumer protection standards, and operating secure digital payment systems for reliable transaction reporting. The employed data are considered credible and accurate, as before their publication in the prescribed formats, they must undergo several regulatory validation filters imposed by the relevant authorities. Previous studies conducted in this domain

have employed various data collection techniques. The first cluster of researchers has relied on survey-based approaches, such as Avdullahi et al. (2024), who analyzed the digital economy and electronic payment behavior in the case of Southeast and Central European countries. Similarly, using data from the Global Findex Survey, the scholars Niankara and Traoret (2023) analyzed a sample covering 123 economies.

On the other side, the second cluster of researchers has employed time series data, such as Ong and Chong (2023), who examined the influence of cashless payments on the use of banking services. In the same line of thought, another study explored how cashless payments affect credit access for the underprivileged by using a BigTech platform, namely Alipay (Ouyang, 2021). Consequently, following this approach, our research is designed in alignment with the methodology applied by the second cluster, albeit with modifications in the analytical approach and the selection of variables for exploration. Based on the mindset of the previously conducted and highlighted studies, our research has selected a set of variables that are considered unique compared to the existing literature. These variables are presented in Table 1, which includes their abbreviations and data sources.

Table 1. Variables description

Description	Acronyms	Sources
Online transfers	OT	Central Bank of Kosova
Credit transfers in paper form	CTPF	Central Bank of Kosova
Credit transfers in electronic form	CTEF	Central Bank of Kosova
Initiated on a physical EFTPOS	EFTPOS	Central Bank of Kosova
ATM cash withdrawals	ATMW	Central Bank of Kosova
ATM deposits	ATMD	Central Bank of Kosova
Credit transfers via ATMs	CTATMs	Central Bank of Kosova
Cash withdrawals at POS terminals	CWPOS	Central Bank of Kosova
Card payments at POS terminals	CPPOS	Central Bank of Kosova

Author's compilation

4. Results and discussion

4.1 Descriptive statistics

Based on the initial descriptive perspective, Table 2 provides an overview of the examined variables, which exhibit considerable variability in online transfers (OT) values. The minimum recorded value during the observed period is €2.745 million; the mean value recorded during this period is €11.128 million, even though the maximum value reached is €34.523 million. These initial results indicate that the banking system in Kosovo has already implemented adequate technology to facilitate the execution of transactions without the need for physical cash (Schindler, 2017).

Table 2. Descriptive statistics

Var.	Obs	Mean	SD	Min	Max	Skewness	Kurtosis
OT	84	11,128	7,201	2,745	34,523	0.970	3.148
CTPF	84	564,618	114,147	303,096	861,157	0.254	3.048
CTEF	84	1,301,161	518,233	526,320	2,512,873	0.478	2.148
EFTPOS	84	48,657	26,093	20,046	118,235	1.083	2.962
ATMW	84	287,449	79,100	154,917	485,334	0.422	2.621
ATMD	84	157,963	57,481	56,519	312,510	0.555	2.518
CTATMs	84	134	75	19	270	−0.129	1.746
CWPOS	84	750	507	118	2,357	1.624	4.705
CPPOS	84	60,379	28,808	22,178	137,393	0.880	2.711

Source: Author's calculations

In contrast, credit transfers in paper and electronic form have a mean value of €564.62 thousand and €1.301 million, respectively. The maximum recorded values for these transfers are €961 thousand and €2.512 million, respectively. Transactions initiated on a physical EFTPOS during the observation period display a minimum value of €20.046 million, a mean value of €48.657 million, and a maximum value of €118.235 million. The results related to the use of ATMs for mutual withdrawals and deposits reveal significant varia-

tion, predominantly in favor of cash withdrawals. Specifically, the minimum value for ATM withdrawals (ATMW) is recorded at €154.517 million, whereas for ATM deposits (ATMD), the minimum value is €56.519 million. The mean values for these two parameters range between €157.963 million and €287.449 million, again in favor of withdrawals. Moreover, two variables associated with credit transfers via ATM and Point-of-Sale (POS) terminals display significantly lower usage compared to other transaction channels utilized by the residents in Kosovo. The mean value of credit transfers via ATM (CTATMs) is €19 thousand, with a maximum of €270 thousand. In comparison, credit transfers via POS (CTPOS) have a minimum recorded value of €118 thousand and a maximum of €2.357 million. Finally, card payments at POS (CPPOS) terminals have an average value of €60.379 million, while the maximum recorded value during the observed period is €137.393 million.

We additionally examined skewness and kurtosis measurements, which clarify to us how the data is shaped relatively to the normal distribution, in combination with the descriptive statistics already discussed, to learn more about the variables' distributional properties. Analysis results exhibit that CWPOS and EFTPOS are positively skewed to a higher degree than OT and CPPOS, which are to a moderate extent. Regarding CTPF, CTEF, ATMW, and ATMD, there is a moderate positive skewness. However, only CTATMs exhibit slightly negative skewness, making them nearly symmetric. As for kurtosis, CWPOS has the most significant score, indicating a leptokurtic distribution. Despite the remaining indicators displaying kurtosis values that are close to normal, OT and CTPF seemed to be close to a normal distribution. The kurtosis coefficient is less than 3 for just one measure, indicating a platykurtic distribution.

4.2 Correlation analysis

To extend the analysis of the study and determine if multicollinearity poses any problem, a correlation analysis was done, with the results provided in Table 3. Based on the data from this research, it is obvious that the degree of correlation among the variables stays at a moderate level, indicating insignificant multicollinearity difficulties.

Table 3. Correlation matrix

	OT	CTPF	CTEF	EFTPOS	ATMW	ATMD	CTATMs	CWPOS	CPPOS
OT	1.000								
CTPF	0.051	1.000							
CTEF	0.047	0.570	1.000						
EFTPOS	0.257	0.543	0.443	1.000					
ATMW	0.218	0.514	0.594	0.581	1.000				
ATMD	0.163	0.481	0.569	0.521	0.688	1.000			
CTATMs	−0.170	−0.208	−0.298	−0.313	−0.031	−0.110	1.000		
CWPOS	−0.073	0.484	0.514	0.326	0.598	0.597	−0.192	1.000	
CPPOS	0.258	0.553	0.461	0.641	0.698	0.667	−0.279	0.374	1.000

Source: Author's calculations

Specifically, none of the correlation coefficients exceeds or equals the criterion of 0.698. As highlighted by Wang et al. (2022), correlation coefficients of $r \geq 0.80$ are often considered symptomatic of potential multicollinearity issues, warranting further diagnostic testing. In the current investigation, the largest detected correlation is between ATMW and CPPOS, with a value of 0.698, which remains below the critical threshold. More formally, the correlation matrix reveals that all variables demonstrate weak to moderate positive relationships, except CTATMs and CWPOS, which show a negative link. As an overall conclusion, the results provide compelling evidence that multicollinearity is not a concern in this dataset. Instead of just designing and performing any econometric model, it is essential to conduct preliminary diagnostic tests based on the standard presumptions of econometric models, as detailed in Table 4.

Table 4. Preliminary tests

Some preliminary tests	Chi(1)	ρ-value
Durbin – Watson	(9,84)	2.083
Cameron and Trivedi's decomposition of the IM-test		
Heteroskedasticity	45.80	0.3975
Skewness	7.18	0.5172
Kurtosis	1.08	0.2977
Total IM-test	54.06	0.4336
Ramsey RESET Test	F(3, 72) = 1.32	0.2756

Source: Author's calculations

Accordingly, under this justification, we'll begin with the explanation of the Durbin--Watson statistic, which yielded a coefficient of 2.083. This indicates the absence of first-order autocorrelation in the residuals and simultaneously confirms the null hypothesis *(H_0)* of no disturbances, thereby reinforcing the model's stability. In addition to the preceding test, to examine any issues with heteroskedasticity, the pattern of distribution of residuals, or the omission of significant variables, we conducted Cameron and Trivedi's Decomposition of the IM-test. Consequently, the insights of this test concerning heteroskedasticity validate H_0, considering the computed probability value is ρ = 0.3975. Conversely, the results obtained from the asymmetric distribution perspective do not demonstrate that we have difficulties with distribution because ρ = 0.5172. Similarly, the results for kurtosis do not demonstrate that we have concerns about the "tails" of the distribution because ρ = 0.2977. In terms of the likelihood that the offered models passed the overall specification test, we performed the IM test, which resulted in ρ = 0.4336. Our result provides convincing evidence that the models are adequately defined. Lastly, to verify if any of the important variables have been left out of the model, we performed a Ramsey test which produced the results F (3,72) =1.32 with ρ = 0.2756, a result which does not reject H_0, meaning that we can conclude that in the setting of variables that are associated with electronic transfers, they were not left out of the specified model.

4.3 Unit root analysis

Given that the data employed in our specific instance consists of time series, it is essential to conduct the Augmented Dickey-Fuller (ADF) test to ascertain and validate the stationarity of the time series. Additionally, the deployment of HAC-GMM necessitates that the time series be stationary. As a result, GMM models frequently rely on moment estimates for measuring parameters.

Table 5. Augmented Dickey–Fuller

Variable	At level		1st difference	
	Statistic	ρ- value	Statistic	ρ- value
OT	–1.964	0.3027	–13.383	0.0000
CTPF	–5.020	0.0000	–12.422	0.0000
CTEF	–2.721	0.0705	–11.904	0.0000
EFTPOS	–2.308	0.1695	–9.943	0.0000
ATMW	–3.569	0.0064	–13.917	0.0000
ATMD	–2.566	0.1003	–10.682	0.0000
CTATMs	–2.307	0.1696	11.817	0.0000
CWPOS	–5.263	0.0000	–10.360	0.0000
CPPOS	–2.177	0.2147	–10.036	0.0000

Source: Author's calculations

In this scenario, non-stationary data can result in inaccurate or insufficient outcomes, as issues similar to autocorrelation and other related issues can fluctuate over time. In other words, the stationarity test is a crucial stage in guaranteeing that the HAC-GMM simulation generates reliable and precise results. The theoretical basis of this test is that if the data result in a p-value < 0.05, ultimately H_0 is rejected; otherwise, H_a is considered (Kwiatkowski, Phillips, Schmidt, and Shin, 1992). Looking at the results reported in Table 5, it is observed that the majority of the variables administered at the level are not stationary, as they exhibit a p-value > 0.05. Accordingly, to maintain stationarity of the data, they are placed under the I(1) rule of thumb, respectively, in the first

difference. Afterwards, the entire data are placed in the first difference; they become stationary, and as a consequence, we can proceed with the Phillips-Perron test.

Table 6. Phillips–Perron

Variable	At level		1st difference	
	Statistic	ρ- value	Statistic	ρ- value
OT	–5.461	0.4197	–117.124	0.0000
CTPF	–37.867	0.0000	–91.969	0.0000
CTEF	–10.425	0.1456	–92.514	0.0000
EFTPOS	–7.135	0.2533	–77.206	0.0000
ATMW	–18.863	0.0147	–106.825	0.0000
ATMD	–10.344	0.1430	–88.872	0.0000
CTATMs	–6.428	0.2784	–94.107	0.0000
CWPOS	41.140	0.0000	–78.383	0.0000
CPPOS	–6.683	0.3121	–79.369	0.0000

Source: Author's calculations

Building upon the considerations outlined in Table 5, to enhance the consistency of the integration of variables, the Phillips–Perron test was conducted, with the results displayed in Table 6. The obtained results confirm that the data at the level are non-stationary, and to fulfill this criterion, the data have been placed in first difference to achieve stationarity. Additionally, beginning with the value of (p-value), the results obtained from the placement in the first difference indicate that the data are integrated in the first order I(1), which is a crucial criterion during the deployment of models such as HAC-GMM.

4.4 Econometrics results

Before addressing the econometric results, the primary emphasis will be on the robustness of the selected model. The robustness and validity of the econometric approach to the HAC-GMM approach are studied in steps, respectively, in three iterations (Hall, 2005; Hayashi, 2000). Results that were provided exhibit that in the first step, the HAC-GMM

criterion function (Q(b)) has a considerable decline from 256.23 to only 0.0178 in iteration 2. Such a decrease is considered to be positive because it indicates that the algorithm has managed to converge quickly to a stable minimum of the function. Beyond this, this significant decrease in iterations indicates the instruments are efficiently measured, and the model has appropriate robustness. Furthermore, the outcomes of the second step, HAC-GMM, employ a specified weight to evaluate.

Additionally, in this lens, it is concluded that even in the second step, we have a decline in iteration Q(0) with a value of 0.3279, which reduces again in iteration 2, accordingly Q(b), to just 0.2827, which indicates further improvement of the model's adjustment to the moment conditions (Baum, Schaffer, and Stillman, 2003; Stock and Wright, 2000). The overall conclusion is that the model has converged swiftly in two steps, the values of Q(b) have become extremely insufficient, which approach the zero value (which indicates sufficient adaptation of the moment constraints), and it does not contain indicators of lack of convergence or numerical difficulties. To examine the adequacy of the instruments in the model, a Hansen J-test was performed, which has a value of 22.6214 (p=0.5422), resulting in a value higher than $\alpha = 0.05$ and indicating that the instruments are exogenous, are adequately fitted, and are not correlated with the error terms (Hansen, 1982). As a result of this, we can proceed in the following part to comment on the econometric results acquired.

The research has been guided by the outcomes of the HAC-GMM estimation, where each hypothesis was individually analyzed and interpreted in light of existing theoretical frameworks and empirical studies. The research outcomes establish the statistical significance of the main variables while situating them within broader discussions on financial inclusion, digitalization, and consumer behavior in the country's banking industry.

Table 7. Econometric estimation

	OLS		HAC GMM		HAC GMM Robust		Arellano-Bover/ Blundel-Bond		ARDL	
	β	***ρ ≥ [z]***	***β***	***ρ ≥ [z]***	***β***	***ρ ≥ [z]***	***β***	***ρ ≥ [z]***	***β***	***ρ ≥ [z]***
IR – L_1.	"–"	"–"	1.239	0.764	1.239	0.764	0.387	0.000	−0.285	0.024
CTPF	−0.321	0.175	−0.732	0.032	−0.731	0.032	−0.290	0.085	−0.064	0.013
CTEF	0.464	0.105	0.606	0.038	0.606	0.038	0.425	0.039	0.575	0.051
EFTPOS	−0.809	0.032	−1.375	0.001	−1.375	0.001	−0.129	0.020	−0.225	0.003
ATMW	−1.068	0.001	−0.914	0.004	−0.914	0.004	−0.527	0.034	−0.648	0.070
ATMD	1.224	0.001	1.220	0.000	1.220	0.000	1.101	0.000	0.792	0.043
CTATMs	−0.112	0.159	.0716	0.357	.0716	0.357	−0.076	0.175	−0.096	0.263
CWPOS	−0.153	0.007	−0.250	0.000	−0.251	0.000	−0.109	0.007	−1.468	0.016
CPPOS	1.339	0.009	2.152	0.000	2.152	0.000	2.063	0.001	1.393	0.008
Observation	84	"–"	84	"–"	84	"–"	84	"–"	84	"–"
F-test	79.93	0.000	"–"	"–"	"–"	"–"	"–"	"–"	41.68	0.000
R^2	0.8950	"–"	"–"	"–"	"–"	"–"	"–"	"–"	0.951	"–"
Wald chi2(8)	"–"	"–"	"–"	"–"	"–"		1231.77	0.000	"–"	"–"
Step 1: Interaction										
GMM criterion Q(b): 0	"–"	"–"	256.230	"–"	256.230	"–"	"–"	"–"	"–"	"–"
GMM criterion Q(b): 1	"–"	"–"	0.017	"–"	0.017	"–"	"–"	"–"	"–"	"–"
GMM criterion Q(b): 2	"–"	"–"	0.017	"–"	0.017	"–"	"–"	"–"	"–"	"–"
Step 2: Interaction										
GMM criterion Q(b): 0	"–"	"–"	0.327	"–"	0.327	"–"	"–"	"–"	"–"	"–"
GMM criterion Q(b): 1	"–"	"–"	0.282	"–"	0.282	"–"	"–"	"–"	"–"	"–"
GMM criterion Q(b): 2	"–"	"–"	0.282	"–"	0.282	"–"	"–"	"–"	"–"	"–"
Hansen's J-test	"–"	"–"	"–"	"–"	22.621	0.542	"–"	"–"	"–"	"–"
Sargan test	"–"	"–"	"–"	"–"	"–"	"–"	123.801	0.773	"–"	"–"

Source: Author's calculations

4.5 Robustness tests

Based on the reported results, the robustness tests indicate a high degree of consistency across all applied models. Overall, the sign of the coefficients for the key variables remains unchanged across OLS, HAC GMM, HAC GMM robust, Arellano Bover Blundell Bond, and ARDL, confirming that the main conclusions do not depend on the choice of econometric approach. However, the differences that were observed are primarily associated with the degree of statistical significance. These differences are to be anticipated because there are varying assumptions about endogeneity, dynamic structure, and variance estimation among the models. Particularly, all alternative specifications lead to the same direction of the estimated effects in the base model. The variables of CTPF, EFTPOS, and ATMW constantly have a negative and significant influence, and CTEF and ATMD have a positive and consistent influence in all models. All the specifications show that CTATMs are statistically insignificant, which proves that there is no strong effect of the economy. CWPOS and CPPOS are statistically significant with signs of consistency. Generally, even though there are differences in statistical significance, the behavioral indications and comparative scale of the coefficients make it clear that the findings are robust and sufficient.

4.6 Findings and interpretation

Empirical discoveries indicate that paper-based credit transfers (CPTFs) negatively affect the volumes of online transfers in a statistically significant manner, thereby confirming hypothesis H_1. The results reveal that the application of paper-based credit transfers greatly lowers the volume of online credit transfers. This implies that the conventional processes introduce expenses and time waste that put off the use of digital platforms by users. The negative impact ensures that the more the processes are dependent on paper, the less online services are used. Such a result complies with the literature used to develop this work, which focuses on the low efficiency and tardy response of traditional banking practices. Besides, the research conducted by Briggs and Brooks (2021) and Jain and Jain (2025) indicates that paper-based systems would be more widespread in developing economies because of infrastructural limitations and consumer behaviors, which are also obstacles to the vast expansion of the fintech sector. The negative coefficient derived from the HAC-GMM model used in this study further reinforces the idea that reliance on manual processes constrains the growth of digital financial transactions, as also suggested by Haddad and Hornuf (2019).

Contrary to the first hypothesis (H_1), credit transfers in electronic form (CTEFs) reveal a statistically significant positive relationship with online transfer volumes, thereby validating the second hypothesis (H_2). This means that online processes are more efficient and more convenient, which would push users towards online avenues. The beneficial impact underpins the notion that an increase in electronic transfers enhances the overall use of the digital system in finances. This finding is consistent with the Technology Acceptance Model (Davis, 1989) and the Diffusion of Innovations theory (Rogers, 2003), both of which emphasize perceived worth and ease of use as key drivers of digital implementation. Empirical studies by Ozili (2018) and Impa et al. (2025) further support this view, indicating that digital credit transfers improve operational efficiency and promote financial inclusion. The Kosovo case examined in this study also confirms that CTEFs serve as a foundation of fintech performance in emerging markets.

The analysis from the study shows that EFTPOS transactions negatively and significantly affect online transfer volumes, confirming hypothesis number three (H_3). According to the study, the volume of online transfers decreases due to EFTPOS transactions in a significant manner. This implies that cash payment systems that involve physical presence curb the transition to online systems. The reverse impact validates the fact that dependence on such transactions will delay the entire shift to electronic money in the financial sector. Although EFTPOS is an electronic method, its dependence on physical infrastructure limits the large-scale volume and digital transformation potential. This result is in line with the findings of Simatele and Mbedzi (2021), who found that the use of EFTPOS does not necessarily lead to extensive digital adoption. Similarly, Gomber et al. (2017) note that fintech ecosystems that rely on physical channels face innovation delays, strengthening the idea that EFTPOS may act as a transitional, but ultimately limiting, payment method. When analyzing the fourth hypothesis, we find that ATM cash withdrawals (ATMW) have a statistically significant negative effect on online transfers, thereby supporting hypothesis H_4. The results indicate that the high involvement in ATM cash withdrawals diminishes the amount of online transfers to a considerable extent. This trend indicates that increased use of cash is weakening the use of digital payment channels. The detrimental impact substantiates the fact that dependence on cash-based transactions makes the transition to electronic financial services slow. The outcomes are consistent with the path dependence theory, which indicates that historical reliance on cash-based systems has maintained a significant impact and an image defining consumer behavior. Both studies, Ong and Chong (2023) and Haddad and Hornuf (2019), emphasize that the prevalence of cash utilization is associated with a low extent of digital involvement. The fact that, in the case

of Kosovo, at the end of 2020, cash withdrawals persisted testifies not only to structural but also to behavioral constraints to implementing fintech that should be addressed by increasing financial literacy among those using financial services and investing in modernizing the country.

It is confirmed by the positive statistically significant effect of ATM deposits (ATMDs) on online transfers, validating hypothesis H_5. The outcome complies with the perception that ATMDs provide a midstream between cash-based handlers and more developed digital financial systems. Since ATM deposits allow depositing funds and making them formal, according to both Haddad and Hornuf (2019) and Ramayanti et al. (2024), users can engage in the provision of online financial services. As far as Kosovo is concerned, according to the findings of this research, it appears that ATMDs can be regarded as a strategic entry point in the expansion of digital financial inclusion, particularly among the inhabitants entering the realm of formal banking.

Surprisingly, the outcome of this research disclosed that the ATM transfers of credit (CTATMs) have no statistically significant influence on online transfers, which fails to support the hypothesis that online transfers occur due to the ATM transfers of credit (H_6). The findings indicate that credit transfers that occur via ATMs do not significantly affect the amount of online transfers. This implies that ATM activity does not influence the choice of users to use online channels. The lack of a considerable effect indicates the lack of support for the assumed connection that is suggested by the hypothesis. Technically, CTATMs are also digital, which gives rise to the possibility that their limited flexibility, as well as the need to use physical terminals, makes this form of distribution less appealing in productive terms during the workday as compared to mobile or internet channels. The present outcome is in line with Gomber et al. (2017), who state that a mobile-first approach is more effective in enhancing the implementation of fintech. Data from Kosovo further suggest that CTATMs show a minimal role in the digital transformation process, likely due to user preferences for more appropriate and available channels. Cash withdrawals at POS terminals (CWPOS) have a statistically significant negative impact on online transfers, confirming H_7. This affirms the theory of transaction costs, which states that although CWPOS is convenient, it allows adherence to cash reliance, hindering digitalization. The same conclusion has been made by Simatele and Mbedzi (2021) and Haddad and Hornuf (2019), who discovered that cash-based services retard the development of fintech. In Kosovo, this practice indicates consumer behavior and the existing infrastructural deficiencies that should be addressed in order to provide a more inclusive financial system.

Given the research outcomes, we observe that cash withdrawals at POS terminals (CWPOS) reduce the level of online transfers with a negative and significant difference, and hypothesis number seven (H_7) is confirmed. Exploring through the existing frame of literature regarding the profession, we found that such an outcome advanced the theory of transaction cost, which states that despite the level of comfort that CWPOS provides, it promotes the inertial effect of physical cash usage and discourages the use of digital services. To support this finding, we found that Simatele and Mbedzi (2021), as well as Haddad and Hornuf (2019), have reached similar conclusions, emphasizing that cash-based services slow down the progress of fintech. In the Kosovo case, the continuous use of CWPOS reflects static consumer habits and infrastructure insufficiencies, which need to be addressed by promoting a more inclusive and digital financial environment. Lastly, a positive statistically significant interplay was observed between Card payments at POS terminals (CPPOS) and online transfers, which also confirms H8. The current outcome stands in line with the Technology Acceptance Model and network externalities theory, which focus on the influence of perceived ease of use and externalities of adoption on digital behavior. According to Zhang et al. (2019), CPPOS increases spending and financial inclusion among the people, which is the case in Kosovo as well. The conclusions illustrate CPPOS as one of the central drivers of fintech performance, facilitating the involvement of users and the efficient flow of operations.

5. Conclusion

The present research combines a sophisticated methodological and econometric approach to conduct a comprehensive analysis of the causal connection between digital payment channels and the performance of financial technology (fintech) in Kosovo. The study employs monthly time-series data from 2018 to 2024, employing a combined approach of OLS and HAC-GMM. The econometric discoveries derived from the HAC-GMM approach provide compelling evidence that the adoption of digital financial instruments significantly contributes to the volume of online transfers, which serves as a core proxy for fintech performance. Specifically, the results underscore that credit transfers in electronic form (CTEF), ATM deposits (ATMD), and card payments at POS terminals (CPPOS) exert a statistically significant and positive effect on online transfers. Accordingly, these digital payment channels act as crucial catalysts for digital financial inclusion while also enhancing the operational efficiency of the sector. On the other hand, conventional instruments, particularly those reinforcing the use of physical cash, such as credit transfers in paper form (CTPF), EFTPOS transactions, ATM cash withdrawals (ATMW), and cash withdraw-

als at POS terminals (CWPOS), exhibit a negative relationship with online transfers. This indicates that ongoing dependence on these conventional channels may obstruct the advancement of a comprehensive digital financial ecosystem. The research additionally indicates that credit transfers via ATMs (CTATM) failed to have a statistically significant influence on online transfers, signifying their restricted contribution to improving fintech performance. The results presented here align with widespread empirical literature and underscore the necessity of shifting from cash-based and semi-digital systems to fully integrated digital platforms.

The findings provide a clear guiding path to policymakers and financial institutions on the way towards the process of digital transformation accelerated in Kosovo. To begin with, the fact that card payments at POS terminals (CPPOS) and credit transfers in electronic format (CTEF) are most strongly positively optimized indicates that the development of card acceptance systems and encouraging electronic transfers such as a reduction in fees or promotion, should be listed among the priorities of the policy. The effect of financial institutions on the economy can be further enhanced by financiers partnering with merchants by subsidizing the cost of the POS terminal and providing loyalty programs to encourage reward schemes on digital transactions. Contrarily, their negative coefficients would indicate the positive and meaningful influence of the reduction of cash dependency by specific interventions on ATM cash withdrawals (ATMW), EFTPOS transactions, and cash withdrawals at POS terminals. The policymakers can implement incremental caps on the cash withdrawals, introduce lower charges to make the cash-based services unattractive, and introduce financial literacy education on the advantages of digital payments. Moreover, ATM deposits have complementary potential as a cornerstone means that the banks ought to reinforce the deposit feature and combine it with the mobile banking systems to help the shift towards the digital world and ecosystems. These steps are a direct product of the approximated size and direction of impacts, and they represent a clear path that policy-makers may take to accelerate the speed of fintech adoption and enhanced financial inclusion in Kosovo.

It is also important to acknowledge certain econometric limitations of the study, notably the relatively short observation period of 84 months. Nevertheless, this limitation cannot affect the credibility or direction of the study's findings. As one of the first empirical investigations, notably via the HAC-GMM approach, focused on Kosovo's fintech context and applying official data from the Central Bank, this research provides vital insights for both regional and international discourse on digital finance. Future research could expand on the current research by applying additional econometric models, including

behavioral data, doing cross-country comparisons, or examining the long-term macroeconomic effects of digital payment adoption.

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