“Effect of financial access on cashless economy: The case of Ukraine”

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EFFECT OF FINANCIAL ACCESS ON CASHLESS ECONOMY: THE CASE OF UKRAINE

Abstract

The pandemic and wartime in Ukraine confirmed the importance of cashless payments for financial stability. The purpose of the paper is to examine the effect of technological infrastructure and financial access factors on cashless economy development. The impact of the infrastructure factor is assessed in case of Ukraine, using NBU's data on payment infrastructure during 2001–2022. The hypothesis of the boosting effect of financial access towards a cashless economy has been tested using the method of correlation between M0/M3 and different indicators of financial access (usage of essential technologies, financial services) based on data of World Bank, IMF, and Triple-A in 2021.

The study's results show that globally there is an almost linear relationship between the number of open financial accounts and the increase in the level of cashless (0.954). It is also revealed that the rise of the share of the population making electronic payments decreases the share of cash in the economy. It is determined that the spread of the crypto-assets has a significant impact on the reduction of cash in the economy (an increase in the share of the population operating with cryptocurrencies by 1% reduces the share of cash by 0.5%). Regarding regulatory policies, it is proposed to stimulate the coverage of the population with open financial accounts, making mandatory payments with electronic payment systems and developing their infrastructure.

Keywords payment system, electronic money, banks, fintech, monetary policy

JEL Classification E42, E44, G21, O33

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INTRODUCTION

The transition to a cashless economy is a pressing task for developing economies. This is due to the prospect of increasing tax revenues, lowering the price of money circulation, and limiting the shadow economy, flight and illicit capital flows. Cashless services enhance financial literacy, use up-to-date financial instruments, simplify financial transactions, and increase the effectiveness of investments and savings (Yakean, 2020). At the same time, the challenges of the pandemic and wartime raised a question about the risks of cashless payments for the stability of banking systems and financial markets. Amidst concerns about the effectiveness of the economy's functioning during a pandemic or war is the reliability of the payment system. The case of Ukraine shows that the role of electronic payment systems is increasing during a pandemic or war. An electronic payment system enables the connectivity of economic entities and the banking system's solvency during these constraints (NBU, 2022). Meanwhile, developing an electronic payment system is a component of the transmission mechanism that makes monetary policy more effective (Durgun & Timur, 2015).

Formation of the institutional conditions of the cashless economy calls for assessing new digital financial technology penetration

of households and small entrepreneurs and identifying critical factors of their enhancement. Global trends demonstrate that the digital payment boom encourages financial inclusion. From 2011 to 2021, account ownership increased by 50%, reaching 76% of the worldwide adult population. World Bank reports that digital payments rapidly spread in developing economies. During 2014–2021, the share of digital payments increased from 35% to 57%. However, despite this growth, the population of developing economies does not exploit digital finance technologies to borrow or save. Only 25% use credit cards to save, and less than 50% to obtain a loan (Global Findex, 2022). The most common action is still to store cash from payment cards.

Transitioning to a cashless economy depends on access to digital payment services and as well crypto wallets. Central bank money available to the public can function as digital cash, such as wholesale and retail CBDCs, and through retail fast payment systems (BIS, 2022). In line with that, since 2016, the NBU has been working on the technological opportunities of the CBDC in the form of e-hryvnia, supplementing cash and non-cash forms of the hryvnia (NBU, 2022). Given the wide range of linkages between cashless payments and various aspects of the economy, there is an urgent need to identify the critical drivers of cashless payments.

1. LITERATURE REVIEW

The shift to a cashless economy is a significant tendency in developing financial markets. The cashless economy has been linked to the computerization of banking retail (Bátiz-Lazo et al., 2016). Researchers studying the cashless economy focus on factors that have a positive effect on limiting cash circulation. Specifically, it is defined as an economy in which all financial transactions are made through the transfer of digital information between the transacting parties by electronic money and without any share or minimal share of physical banknotes or coins (Kumari & Khanna, 2017; Choudhary, 2018). The spread of cashless transactions stimulates the accumulation of savings at financial institutions. This is confirmed by the practice of developing countries (Osakwe et al., 2020). Promoting cashless payments, in particular, facilitates access to the stock market (Gumport, 2015) and the use of derivatives (Slozko & Pelo, 2014).

At the same time, the leading factor of a cashless economy in developing economies at the initial stages is the spread of payment cards. In particular, Grzelczak and Pastusiak (2020) show that the largest share of non-cash payments in the countries of Central and Eastern Europe are payments using bank cards. In addition, socio-demographic factors influence the shift from cash to cashless payments, as education, income, and wealth positively affect the proportion of card expenses. The cashless economy enables access to useful data for firms and governments, influences purchase habits by increasing attention to the usage costs of the products (Raya & Vargas, 2022), contributes to decreasing tax evasion, illegal immigration and crime, facilitates handling economic crises (Rogoff, 2017). These results convincingly point to the critical point related to the need for cashless payments. As stated by Garcia-Swartz et al. (2007), various payment instruments are socially efficient based on the transaction size; cash is effective for small payments, and debit cards outperform cash as a socially optimal instrument as transactions grow in size. Given that, Khan and Craig-Lees (2009) have predicted the prevalence of mobile payments and argued that the volume, value and type of products purchased increase while using credit card payment. However, promoting a cashless payment policy does not affect economic growth in the short term (Tee & Ong, 2016).

Financial access is often restricted by a lack of demand due to voluntary self-exclusion, a low supply of financial services due to lack of competition, and imprudent lending practices (Beck & De La Torre, 2007). Meanwhile, public credit registries supplement financial access fostering (Asongu & Odhiambo, 2018), as government incentives encourage the private sector and non-profit organizations to focus on technology development (Anderloni & Carluccio, 2007). Banks lower bank interest rate spreads by increasing financial access via branches and ATMs (De Moraes et al., 2021).

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Financial access can also be enhanced through cost-effective branch strategies and services that meet the needs of the unbanked population (Allen et al., 2021), the existence of which reflects a financial market failure (Anderloni & Carluccio, 2007).

In turn, Hasan et al. (2013), exploring 27 European markets during 1995–2009, concluded that the development of electronic payments is an efficient measure of economic growth by stimulating trade and consumption. Such link is the most powerful for card payments, followed by credit transfers, and weak for cheque payments. Gabor and Brooks (2017) specify pushing the spread of electronic payments through the most significant financial development institutions, state or international, as the instrument for financial inclusion. Igamo and Falianty (2018), examining non-cash payment instrument development during 2007–2017 in Indonesia, suggest that electronic money increases private consumption spending and lowers narrow money (M1). Wong et al. (2020) drew evidence that cashless payment resulted in growth (primarily by payment cards, but not by e-money or cheques) in OECD-developed countries during 2007–2016. As stated by Shapoval (2021), the economic growth of developed OECD countries during 2007–2018 was driven by financial depth and financial innovation and, to a lesser extent, by institutional development.

Among the determinants of cashless payments, Goswami and Sinha (2019) note literacy, mobile internet penetration, net of POS and ATM, etc. Analyzing the effect of mobile money on entrepreneurship and economic development in Kenya, Beck et al. (2018) define that high-level productive entrepreneurs are more likely than suppliers to use credits by mobile money as a payment instrument. In contrast, Cohen et al. (2020) have found that eliminating cash helps decrease the economy's shadow sector. Likewise, Klapper et al. (2019) state that digital financial services can make it easier for informal firms to register and operate as formal businesses while creating synergies between separate reforms.

In an effort to find out the role of digital money in increasing the financial inclusion level, Siddik and Kabiraj (2020) point out that factors of e-finance (net of ATMs per 100,000, the share of the population with access to the internet, e-money transaction share to GDP) effects positively on economic growth in 189 countries during 2004–2016. Also, Khera et al. (2021), dealing with electronic payments in 52 countries during 2011–2018, have found that increasing digital financial inclusion usage indices boosts annual economic growth (GDP per capita) by up to 2.2 p.p. In addition, they conclude that significant unsatisfied demand for standard financial services should exist for financial inclusion. Van et al. (2021), analyzing financial inclusion indicators of 152 countries during 2004–2015, state that economies with different institutional frameworks can target different levels of financial inclusion and, therefore, can influence the extent to which financial inclusion is linked to economic growth.

Recently, Kotkowski and Polasek (2021) note that consumers (from 22 European countries) without cashless instruments may need help adjusting to the pandemic. In this regard, Jonker et al. (2022) substantiate that COVID-19 has pushed the rapid increase in payment card usage and changes in the payment practice of older adults towards more contactless payments in the Netherlands. Since the first lockdown, the containment measures led to a 12 p.p. increase in the probability of debit card use at the POS. Approximately 60% of this shift persisted for several months after the initial lockdown, and some persisted for several months after the second lockdown. On the other hand, the preference for anonymity, the lack of literacy in the use of mobile applications, and the failure of the payment infrastructure to respond to the increase in demand inhibit the cashless economy (Wisniewski et al., 2021).

In parallel, Kajol et al. (2022) demonstrate that clients prefer cash and physical access to many transactions that they think digital payment methods lack. Turning to green financial inclusion, Cui et al. (2022), bringing together indices of financial inclusion in 40 countries during 2010–2020, have revealed the spatial autocorrelation in inclusive growth with zero-emission practice. Yang et al. (2022), considering seven emerging economies during 2004–2019, suggest that a one-unit increase in financial inclusion brings about the value of energy productivity.

Concerning Ukraine, Pyrih et al. (2019) have revealed the direct effect of increasing the share of non-cash payments on GDP during 2010–2017 by increasing the speed and number of transactions due to the cost reduction of each transaction. Lutsyk (2020) shows that the preference for cash or non-cash payments depends on the rate of economic growth, its traditions and areas of economic activity in society. Notably, state authorities need to use measures to promote cashless payments to equalize the structure of the money supply and reduce cash in circulation, along with regulatory measures (Bublyk, 2016). Similarly, Chkan (2014) argues that cashless payments are growing despite a small share of money turnover and growth in payment card issuance. Since only salary card projects are being developed intensively, the primary function of payment card systems is not carried out. Following this, Lebedyk et al. (2016) note that non-cash transaction dominance indicates a progressive decline in shadow circulation and contributes to tax transparency and economic growth. Additionally, Skreb and Khvedchuk (2016) emphasize the significant role of FX cash in Ukraine, which amounts to about half of the broad money. The rise of FX share to GDP is due to the decline in GDP after 2014 and the hryvnia depreciation. Oleshko et al. (2018) point to the role of state influence in the development of cashless payments. Analyzing payments infrastructure as a dimension of financial inclusion associated with banking digitalization, Naumenkova et al. (2019) highlight unbalanced and low digital financial services levels in Ukraine during 2009–2018 compared to European middle-income countries.

Therefore, formalizing the factors of the progress of the cashless economy development requires a deeper assessment of its interrelationships. This paper exploits the effect of financial access factors on the cashless economy.

2. METHODS

The hypothesis of the paper suggests that the expansion of infrastructural and technological capabilities contributes to the formation of a cashless economy. Hence, firstly, the effect of financial access on the change of money supply structure in 2021, based on world data, is assessed. Secondly, the impact of the development of the payment infrastructure of Ukraine, according to the NBU's data in 2001–2022, is analyzed.

The indicators used in the model characterize the share of the population with access to technologies and financial instruments and the share of the population that consume them. Given that cashless reflects the level of multi-vector development of the economic environment, an iterative approach is used to investigate the impact of groups of indicators on the outcome.

2.1. The resulting variables

To test the sensitivity of individual indicators, including monetization, two options of the resulting indicators (dependent) are chosen: a) the ratio of cash to the money supply (M0/M3) as an indicator of cash to the overall potential of financial operations; the ratio of cash to the volume of annual output (M0/GDP) as an indicator of cash to ensuring economic reproduction; the ratio of broad money (M3/GDP), which reflects the monetization of the economy's GDP. Having analyzed the influence of factors on the resulting indicators, it is stated that the correlation coefficients of the ratio of cash to the money supply (M0/M3) are higher than M0/GDP and M3/GDP. For modelling, it is acceptable to use the ratio of cash to the M0/M3 as the resulting indicator (Table 1).

2.2. Factor variables

Independent variables include indicators of financial services usage, which are provided in cash and non-cash form and can be used to assess the propensity to use cash, as well as the technological capabilities of using non-cash transactions. There are three main groups:

a) indicators of financial access;

b) indicators of usage of essential technologies for financial transactions (Internet and mobile communication);

c) indicators of usage of financial services (including the share of the population having cryptocurrencies).

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NumPy (Python) is used to perform correlation/regression analysis.

For the correlation analysis, data from the IMF concerning the monetary indicators, data from the World Bank regarding the level of financial inclusion for 2021, and data on cryptocurrencies from the TripleA are collected. A sample of 59 countries is formed based on 16 analytical data sources. The selection criterion is the availability of indicator data for the countries observed.

The study also applies a structural and comparative analysis of cash and non-cash payments in Ukraine, using NBU's data from 2000 to November 2022 via Excel.

3. RESULTS

Ukraine's case is a typical example of a relatively successful development of electronic payment systems through the distribution of bank payment cards, ensured by the central bank's appropriate regulatory policy and commercial banks' marketing. Since 2002, the share of cash in GDP (M0/GDP) peaked at a high of 17.0% in 2010 and 17.8% in 2014 amid the increased demand for cash and a shrinking GDP during the consequences of the GFC and Ukrainian banking crisis, characterized by deposit withdrawal and the NBU's bank refinancing expansion (Figure 1). In comparison to the pandemic, there was no substantial surge (2020 – 12.2%). In general, the share of cash in the total money supply (M0/M3) decreased from 40.6% in 2002 to 26.99% in November 2022. The increase in M0/M3 ratio in 2009 (32.2%) and 2014 (29.6%) was attributable to the periods of crisis.

Shares of cash withdrawals by the volume of transactions and by the number of transactions decreased from 94.2% in 2002 to 32.4% in November 2022 and from 91.9% to 7.4%, similarly indicating cashless payments development (Figure 1). The upswing of the ratio of the volume of non-cash payments to the volume of cash withdrawals from

Source: Compiled by the authors based on NBU (2022).

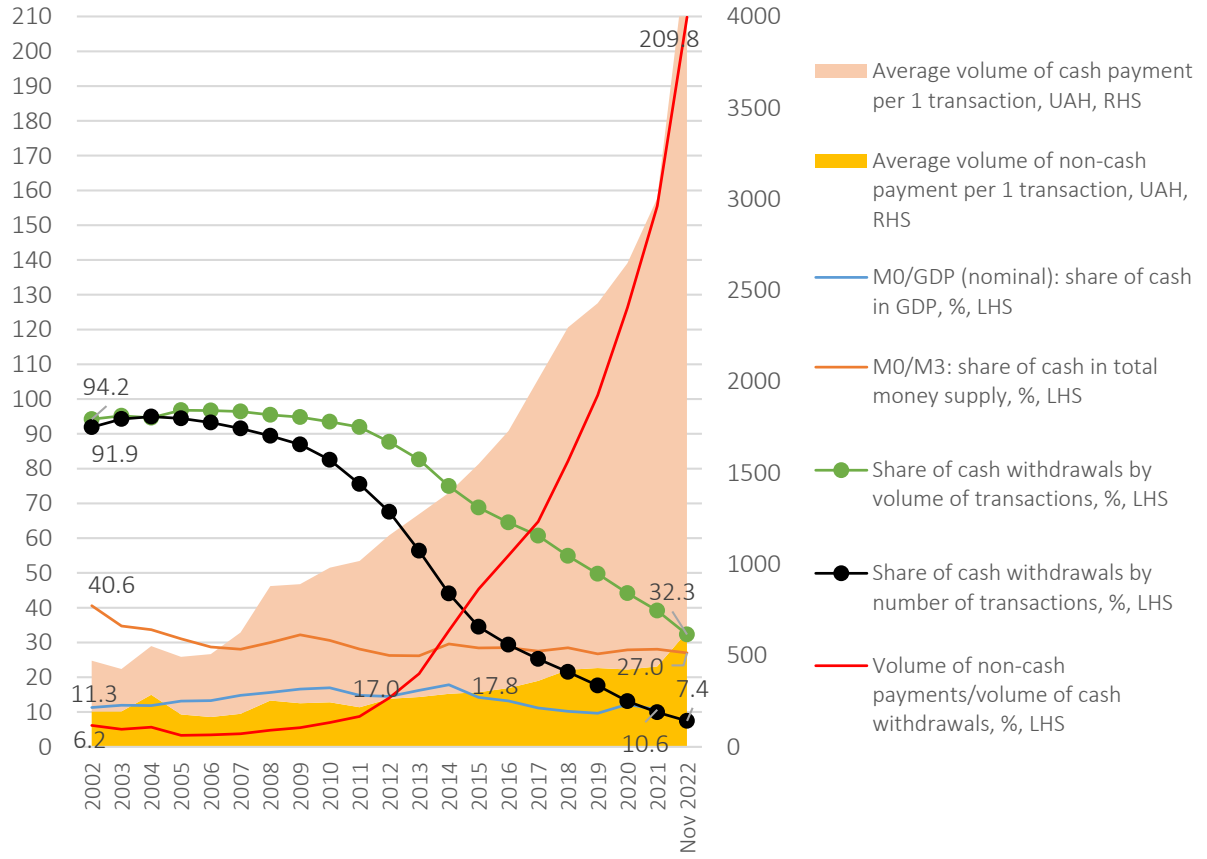

Figure 1. Types of payments in Ukraine, 2000 – November 2022

6.2% in 2002 to 209.8 % in November 2022 confirms the prevailing usage of cards as a cashless instrument in spite of crisis periods. At the same time, there is a simultaneous growth in non-cash and cash payment volumes per transaction. On average, as of November 2022, Ukrainians spend around 629 UAH cashless and 3,728 UAH cash for 1 payment.

The growth of non-cash transactions is driven by the expansion of payment infrastructure (Figure 2). Specifically, since 2002 number of banking self-service machines (ATMs, cash-in ATMs, self-service kiosks) per 100,000 adults increased from 3.8 units in 2002 to 81.7 units in 2021; the number of POS terminals per 100,000 adults increased from 30.1 units in 2002 to 1066.8 units in 2021; the number of debit active cards per 1000 adults increased from 74.9 units to 1124.4; the number of bank branches per 100,000 adults decreased from 45.5 units in 2007 to 16.2 units in 2021. In the meantime, the slight reduction in these indicators during 2014–2015 was caused by physical losses of banking infrastructure due to the annexation of Crimea and Donbas, and putting banks into the category of "insolvent". Looking at similar indicators across the EU, the electronic payment infrastructure in Ukraine is lagging. As of the end of 2021, there were 84.2 units of ATMs per 100,000 adults; 3606.4 units of POS terminals per 100,000 adults; 1,238 units of cards with a debit function per 1000 adults; 30.9 units of bank branches per 100,000 adults in the EU (ECB, 2022).

The share of active debit cards has decreased since 2008 (85.1%), reaching 41.4% in November 2022, demonstrating that Ukrainians have begun using to pay online with payment cards (Figure 2). While the share of retail POS-terminals has increased (from 63.7% in 2003 to 97.5% in November 2022), the share of manual cash (bank) POS-terminals is declining (from 36.3% in 2003 to 2.5% in November 2022), showing the dominated role of retail infrastructure for the Ukrainian financial access.

Thus, even during the crises, Ukrainians have preferred to conduct cashless transactions with payment cards, which has generally improved the lev-

Source: Compiled by the authors based on NBU (2022).

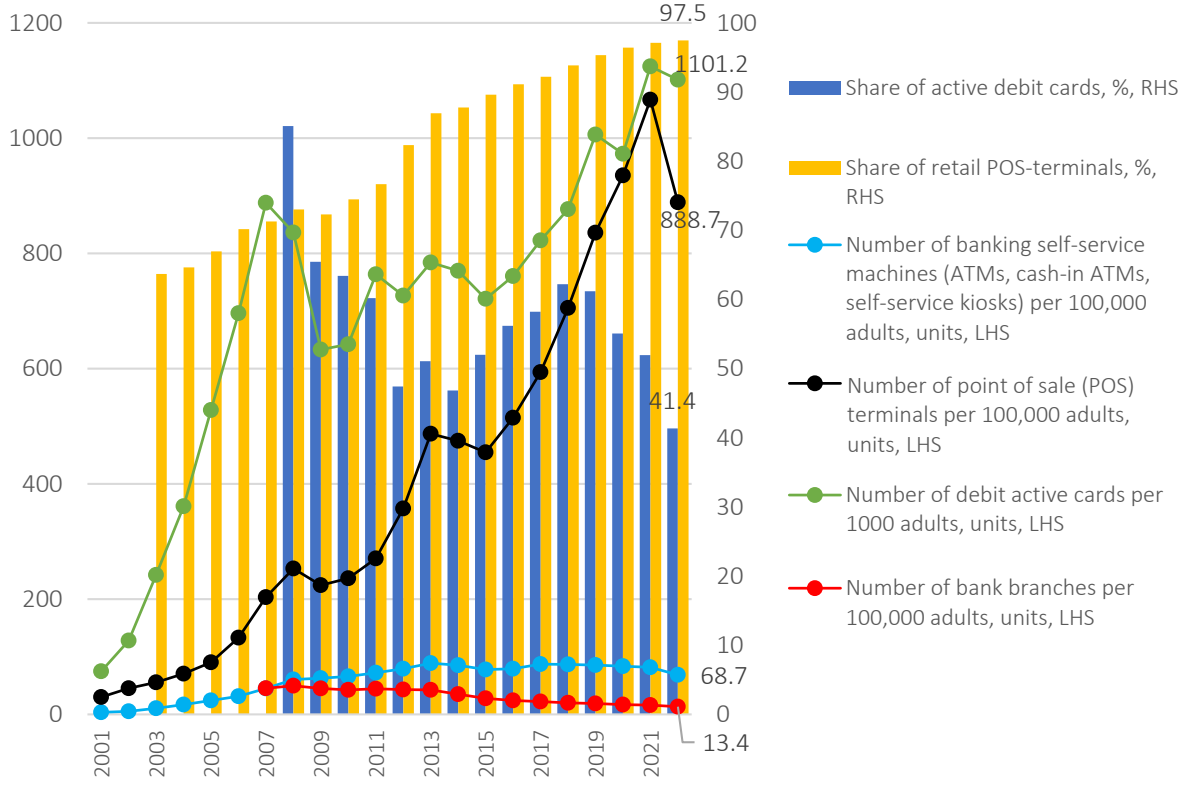

Figure 2. Ukraine's payment infrastructure, 2001 – November 2022

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el of cash in the national economy, demonstrating a positive trend towards greater financial access.

Despite massive missile attacks on Ukraine, the NBU's electronic payment system (SEP) operates smoothly. Bank branches continue their activities across the country and make regular customer payments. This is because cloud service regulations have been enacted in Ukraine before the Russian invasion, and banks are permitted to use loud technologies located in other countries. Hence, the prior booming Ukrainian tech ecosystem has helped banks to save time and money under missile and cyber-attacks and blackouts instead of moving their servers to a new place. At the same time, during the first couple of weeks of the war, banks experienced cash liquidity panic amongst the population as long queues at ATMs were observed. Moreover, there was a cash shortage in active military action areas due to the impossibility of its timely delivery by cash couriers. The number of active payment terminals in retail networks decreased by a third compared to the beginning of 2022, and the number of ATMs decreased by 20%. That is because many of these payment devices are located where active hostilities are going on. Furthermore, not all business enterprises have returned to work in the liberated territories. Despite the reduced payment infrastructure compared to pre-war times, Ukraine's financial payment system remains resilient.

Among the financial access factors, the most significant relationship with M0/M3 is observed with the share of the population with open financial accounts (–0.659) (Table 1). This relationship is inverse, as more open accounts result in a decrease in cash in circulation. There is also a significant relationship between the M0/M3 ratio and the share of the population who has credit/debit cards (–0.533 and –0.558). At the same time, the correlation between the population with open financial accounts and those with credit/debit cards is also high, indicating the multicollinearity within the model. Therefore, all three factors have a significant effect on the resulting indicator.

As for *technological access*, the relationship of the ratio of cash to the M3 from the group of usage indicators (–0.52 – use of technology for consumer transactions and –0.552 – use of technology for paying bills) is twice as high compared to the group of availability indicators access (–0.330 – access to the Internet and –0.305 – access to a mobile phone).

Among the indicators of *cash usage*, the most significant dependence is observed between the indicators of shares of the population receiving transfers to financial accounts (–0.502) and paying utility bills by cards (–0.33). At the same time, the modelling shows a noticeable direct relationship between the share of the population receiving salaries in cash (0.411) and paying utility bills in cash (0.341). In other words, a significant share of the population receiving salaries and paying utility bills in cash helps to preserve a large part of the cash in the M3.

Internal connections between individual factors. The link between the technological level of economic development and the level of usage of financial services in the economy is also robust. However, there is a stable relationship between the share of the population using a cell phone for payments and transfers from a personal financial account and the share of the population having savings at a financial institution (correlation levels 0.9 and 0.86). There are relatively high levels of correlation between basic Internet access, mobile phone ownership and digital payments (0.628 and 0.599) and a much lower correlation of these factors with e-commerce purchases (0.433 and 0.385).

After constructing the regression coefficients and excluding the statistically non-significant values, the coefficients of Table 2 are obtained. Values are determined for variables which are significant at a confidence interval of 90% of the share of the population receiving pensions and the share of the population making savings, 95% of the share of the population making digital payments, and only 80% of the share of the population making transactions with cryptocurrencies. At the same time, the impact of the share of the population using cryptocurrencies has significance in the cashless economy: a 1% increase in the share of the population with accounts in cryptocurrencies leads to a decrease in the share of cash by 0.5%. There is a direct relationship between the share of the population receiving public pensions and the share of cash in the economy.

Table 1. Correlation matrix between factors

Source: Calculated by the authors based on data from the World Bank (2022), IMF (2022), Triple-A (2022).

Type	Indicators	Result			Access indicators (financial inclusion: access)					Technology access				Usage indicators							Cash using direct and indirect indicators						
		M0/M3	M0/GDP	M3/GDP	Account (% age 15+)	Mobile money account (% age 15+)	Owns a credit card (% age 15+)	Owns a debit card (% age 15+)	Coming up with emergency funds in 30 days: not possible (% age 15+)	Has access to the internet (% age 15+)	Own a mobile phone (% age 15+)	Use a mobile phone or the internet to make payments, buy things, or to send or receive money using a financial institution account (% age 15+)	Used a mobile phone or the internet to pay bills (% age 15+)	Made a digital payment (% age 15+)	Received a public sector pension (% age 15+)	Made a digital merchant payment (% age 15+)	Saved at a financial institution (% age 15+)	Saved for old age (% age 15+)	Uses a debit or credit card: in-store (% age 15+)	Cryptoassets	Can use account at a bank or financial institution without help if opened (% without an account, age 15+)	Received government transfer or pension: cash only (% age 15+)	Received government transfer or pension: into an account (% age 15+)	Received government transfer or pension: through a mobile phone (% age 15+)	Received government transfer or pension: to a card (% age 15+)	Received wages: in cash only (% age 15+)	Made a utility payment (% age 15+)	Made a utility payment: using cash only (% age 15+)
Result	M0/M3	1.000	0.599	–0.254	–0.659	0.064	–0.533	–0.558	0.129	–0.330	–0.305	–0.552	–0.520	–0.596	–0.270	–0.142	–0.570	–0.490	–0.156	–0.116	0.204	0.120	–0.502	–0.095	–0.198	0.411	–0.333	0.341
	M0/GDP	0.599	1.000	0.393	–0.377	–0.208	–0.227	–0.214	0.158	0.030	–0.044	–0.315	–0.330	–0.423	–0.062	–0.045	–0.325	–0.301	–0.025	0.034	0.162	0.154	–0.195	–0.058	–0.018	0.386	0.104	0.528
	M3/GDP	–0.254	0.393	1.000	0.218	–0.192	0.363	0.288	–0.090	0.246	0.141	0.189	0.167	0.149	0.090	0.056	0.194	0.142	0.093	0.140	–0.059	0.019	0.256	0.131	0.163	–0.069	0.273	0.053
Access indicators (financial inclusion: access)	Account (% age 15+)	–0.659	–0.377	0.218	1.000	–0.202	0.772	0.874	–0.386	0.716	0.683	0.875	0.837	0.954	0.674	0.441	0.791	0.761	0.463	–0.063	–0.371	–0.060	0.798	0.025	0.305	–0.620	0.630	–0.468
	Mobile money account (% age 15+)	0.064	–0.208	–0.192	–0.202	1.000	–0.472	–0.507	0.133	–0.553	–0.430	–0.399	–0.322	–0.134	–0.479	–0.119	–0.350	–0.397	–0.262	0.375	0.197	–0.083	–0.440	0.441	–0.269	0.184	–0.622	–0.169
	Owns a credit card (% age 15+)	–0.533	–0.227	0.363	0.772	–0.472	1.000	0.772	–0.434	0.644	0.569	0.841	0.800	0.797	0.672	0.133	0.842	0.791	0.207	–0.197	–0.521	–0.148	0.777	–0.159	0.274	–0.590	0.590	–0.479
	Owns a debit card (% age 15+)	–0.558	–0.214	0.288	0.874	–0.507	0.772	1.000	–0.414	0.813	0.729	0.916	0.853	0.834	0.726	0.336	0.811	0.816	0.402	–0.117	–0.461	0.019	0.834	–0.084	0.344	–0.552	0.755	–0.314
	Coming up with emergency funds in 30 days: not possible (% age 15+)	0.129	0.158	–0.090	–0.386	0.133	–0.434	–0.414	1.000	–0.330	–0.344	–0.509	–0.527	–0.437	–0.280	0.041	–0.543	–0.545	0.042	0.121	0.417	–0.150	–0.403	0.089	–0.081	0.201	–0.301	0.338
Technology access	Has access to the internet (% age 15+)	–0.330	0.030	0.246	0.716	–0.553	0.644	0.813	–0.330	1.000	0.902	0.731	0.684	0.628	0.700	0.433	0.585	0.635	0.482	–0.243	–0.145	0.237	0.744	–0.001	0.432	–0.292	0.817	0.003
	Own a mobile phone (% age 15+)	–0.305	–0.044	0.141	0.683	–0.430	0.569	0.729	–0.344	0.902	1.000	0.661	0.612	0.599	0.621	0.385	0.498	0.528	0.422	–0.191	–0.096	0.242	0.668	0.073	0.326	–0.200	0.666	–0.044
	Use a mobile phone or the internet to make payments, buy things, or to send or receive money using a financial institution account (% age 15+)	–0.552	–0.315	0.189	0.875	–0.399	0.841	0.916	–0.509	0.731	0.661	1.000	0.970	0.914	0.708	0.298	0.902	0.863	0.350	–0.097	–0.587	–0.064	0.828	–0.078	0.258	–0.632	0.673	–0.519
	Used a mobile phone or the internet to pay bills (% age 15+)	–0.520	–0.330	0.167	0.837	–0.322	0.800	0.853	–0.527	0.684	0.612	0.970	1.000	0.902	0.674	0.306	0.860	0.825	0.340	–0.059	–0.592	–0.071	0.791	–0.051	0.232	–0.639	0.650	–0.562
Usage indicators	Made a digital payment (% age 15+)	–0.596	–0.423	0.149	0.954	–0.134	0.797	0.834	–0.437	0.628	0.599	0.914	0.902	1.000	0.660	0.372	0.829	0.793	0.389	–0.043	–0.499	–0.120	0.760	–0.017	0.204	–0.651	0.562	–0.607
	Received a public sector pension (% age 15+)	–0.270	–0.062	0.090	0.674	–0.479	0.672	0.726	–0.280	0.700	0.621	0.708	0.674	0.660	1.000	0.329	0.643	0.632	0.396	–0.178	–0.305	0.082	0.795	–0.047	0.263	–0.483	0.704	–0.191
	Made a digital merchant payment (% age 15+)	–0.142	–0.045	0.056	0.441	–0.119	0.133	0.336	0.041	0.433	0.385	0.298	0.306	0.372	0.329	1.000	0.095	0.134	0.981	0.133	0.218	0.288	0.368	0.205	0.314	–0.207	0.427	0.042
	Saved at a financial institution (% age 15+)	–0.570	–0.325	0.194	0.791	–0.350	0.842	0.811	–0.543	0.585	0.498	0.902	0.860	0.829	0.643	0.095	1.000	0.949	0.142	–0.126	–0.704	–0.135	0.797	–0.172	0.122	–0.653	0.564	–0.540
	Saved for old age (% age 15+)	–0.490	–0.301	0.142	0.761	–0.397	0.791	0.816	–0.545	0.635	0.528	0.863	0.825	0.793	0.632	0.134	0.949	1.000	0.182	–0.244	–0.687	–0.039	0.734	–0.242	0.064	–0.569	0.606	–0.461
	Uses a debit or credit card: in–store (% age 15+)	–0.156	–0.025	0.093	0.463	–0.262	0.207	0.402	0.042	0.482	0.422	0.350	0.340	0.389	0.396	0.981	0.142	0.182	1.000	0.051	0.175	0.268	0.419	0.128	0.332	–0.241	0.492	0.044
	Cryptoassets	–0.116	0.034	0.140	–0.063	0.375	–0.197	–0.117	0.121	–0.243	–0.191	–0.097	–0.059	–0.043	–0.178	0.133	–0.126	–0.244	0.051	1.000	0.094	0.086	–0.071	0.501	0.001	0.021	–0.099	0.041
	Can use account at a bank or financial institution without help if opened (% without an account, age 15+)	0.204	0.162	–0.059	–0.371	0.197	–0.521	–0.461	0.417	–0.145	–0.096	–0.587	–0.592	–0.499	–0.305	0.218	–0.704	–0.687	0.175	0.094	1.000	0.161	–0.419	0.312	0.161	0.385	–0.237	0.529
Cash using direct and indirect indicators	Received government transfer or pension: cash only (% age 15+)	0.120	0.154	0.019	–0.060	–0.083	–0.148	0.019	–0.150	0.237	0.242	–0.064	–0.071	–0.120	0.082	0.288	–0.135	–0.039	0.268	0.086	0.161	1.000	0.028	0.129	0.143	0.429	0.244	0.483
	Received government transfer or pension: into an account (% age 15+)	–0.502	–0.195	0.256	0.798	–0.440	0.777	0.834	–0.403	0.744	0.668	0.828	0.791	0.760	0.795	0.368	0.797	0.734	0.419	–0.071	–0.419	0.028	1.000	0.106	0.359	–0.567	0.717	–0.307
	Received government transfer or pension: through a mobile phone (% age 15+)	–0.095	–0.058	0.131	0.025	0.441	–0.159	–0.084	0.089	–0.001	0.073	–0.078	–0.051	–0.017	–0.047	0.205	–0.172	–0.242	0.128	0.501	0.312	0.129	0.106	1.000	0.127	0.059	–0.086	0.023
	Received government transfer or pension: to a card (% age 15+)	–0.198	–0.018	0.163	0.305	–0.269	0.274	0.344	–0.081	0.432	0.326	0.258	0.232	0.204	0.263	0.314	0.122	0.064	0.332	0.001	0.161	0.143	0.359	0.127	1.000	–0.085	0.384	0.158
	Received wages: in cash only (% age 15+)	0.411	0.386	–0.069	–0.620	0.184	–0.590	–0.552	0.201	–0.292	–0.200	–0.632	–0.639	–0.651	–0.483	–0.207	–0.653	–0.569	–0.241	0.021	0.385	0.429	–0.567	0.059	–0.085	1.000	–0.302	0.619
	Made a utility payment (% age 15+)	–0.333	0.104	0.273	0.630	–0.622	0.590	0.755	–0.301	0.817	0.666	0.673	0.650	0.562	0.704	0.427	0.564	0.606	0.492	–0.099	–0.237	0.244	0.717	–0.086	0.384	–0.302	1.000	0.184
	Made a utility payment: using cash only (% age 15+)	0.341	0.528	0.053	–0.468	–0.169	–0.479	–0.314	0.338	0.003	–0.044	–0.519	–0.562	–0.607	–0.191	0.042	–0.540	–0.461	0.044	0.041	0.529	0.483	–0.307	0.023	0.158	0.619	0.184	1.000

Note: All indicators refer to a formal financial institution such as a bank, credit union, microfinance institution, or post office that falls under prudential regulation.

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Table 2. Regression parameters

Source: Calculated by the authors.

Parameters	Coefficients	Standard error	t stat	p-value
Intercept	0.288	0.031	9.166	0.000
Made a digital payment (% age 15+)	–0.192	0.081	–2.376	0.021
Received a public sector pension (% age 15+)	0.290	0.172	1.690	0.097
Saved at a financial institution (% age 15+)	–0.177	0.095	–1.865	0.068
Cryptocurrencies	–0.547	0.421	–1.299	0.200

The presence of a technological infrastructure forms the basis for developing a financial and technological infrastructure, which reduces the circulation of cash liquidity. Correlation-regression analysis demonstrates that digital payments are a significant factor in a cashless economy (Table 2).

4. DISCUSSION

The case of Ukraine shows that the active implementation of fintech in electronic payment systems ensures the stability of banking operations even in large-scale hostilities and attacks on the electricity system. A sufficiently sizeable cashless payment infrastructure in the POS terminals, set up mainly by the banks, has ensured the stability of public and private regulations. POS terminals are far more widely distributed in Ukraine than ATMs (close to 13 times). This trend and the fact that the electronic payment system has remained stable during the war demonstrate that the diversification of POS terminals is a critical factor in the payment infrastructure.

The correlation regression analysis also determined the number of relationships between the spread of fintech worldwide and the establishment of the cashless economy. In particular, the most noticeable relationship between the M0/M3 is observed and the share of the population with financial accounts – 0.659. Thus, a high share of the population receiving a salary and paying utility bills in cash contributes to the preservation of a high level of M0/M3 and thus slows the promotion of cashless. This proves that the state directly influences the formation of a cashless ecosystem in the country and, accordingly, has a direct tool for affecting the level of cash in the economy.

Continuing the debate on the indirect influence of the state instruments on the cash level, it should be noted that the relationship between the share of the population receiving payments from the state cashless and the share of the population saving at financial accounts is 0.797 and 0.734. That is, the state automatically boosts both a decline of the level of cash and a level-up rate of savings in the economy by stimulating the expansion of cashless payments. The spread of bank payment cards in Ukraine by aggressively issuing them supports this statement.

The stable relationship between the share of the population using a smartphone for banking payments and transfers and the share of the population having savings at a financial institution confirms that keeping funds in financial accounts stimulates cashless. In addition, there are reasonably high correlation levels between basic Internet access, mobile phone ownership and digital payments (0.628 and 0.599). This finding complements the conclusions of Goswami and Sinha (2019) on the need to spread mobile communication and the Internet for the cashless. There needs to be more than the availability of essential technologies for creating a cashless economy. Only the scaling up of appropriate technologies in the financial sphere has a commensurate impact.

The analysis of the factors of electronic payments development confirms the presence of an almost linear relationship between the share of the population making electronic payments and the share of the population having open accounts (0.954), and the share of the population using a mobile phone or the Internet for payments (0.902). Hence, the use of the Internet and mobile phone for payments and the presence of accounts stimulate the development of electronic payments, leading to cashless economy development.

CONCLUSION

Moving towards a cashless economy through the development of electronic payment systems meets the need to ensure the banking system's stability in the face of global challenges, such as a pandemic or war. The results show that at the initial stages, the extensive increase of cashless payments by coverage of the population with open financial accounts and the requirement to make mandatory payments cashless plays a more prominent role. Notably, the number of electronic payments and the number of open financial accounts has an almost linear relationship of 0.954.

Promoting electronic payments and the use of cryptocurrencies stimulates the formation of a cashless economy. Globally, a 1% increase in the share of the population making electronic payments leads to a decrease in the share of cash in the economy by 0.2%, and an increase in the share of the population operating with cryptocurrencies by 1% reduces the share of cash by 0.5%. Therefore, developing modern payment infrastructure and expanding access to cryptocurrencies encourages a lower level of cash flows in the economy. As a general caveat, however, it must also be stressed that the bigger share of the population receiving pensions in cash is the risk of declining cashless payments.

The findings substantiate the need for an increase in the share of the population receiving government payoffs cashless on banking accounts and to push POS terminals spreading within the framework of the state policy of cashless economy development.

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