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Digital accessibility in the context of preference for financial services

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The paper addresses the question of how digital access is related to the preference for financial services. The purpose of the research was to reveal the main types of interrelationships between digital and financial access by dividing and comparing countries with different corresponding characteristics. The research hypothesis suggested a negative correlation would exist between digital access and penetration of traditional financial services. To test this hypothesis, data from countries with advanced and developing markets were analyzed. The share of the population with Internet access was used as an indicator of digital access. To evaluate the availability of financial services, the IMF financial access index was considered. The countries were ranked by the level of digital and financial access, which allowed them to be divided into four groups according four sub-hypotheses: low financial and high digital penetration, high digital and financial penetration, low digital and high financial penetration, and low digital and financial penetration. The correlation analysis of the obtained data revealed a weak negative relationship between digital and financial access for each of the groups, and confirmed the tested hypotheses. It was concluded that digital access by itself is not a driver for expanding the availability of financial services, but it can contribute to innovative financial development through the formation of alternative financial services. This research contributes to the understanding of the ambiguous relationship between digital and financial access and, ultimately, to the criticism of the optimistic perception of digital finance, which has practical significance for financial regulation.

Keywords: digital access, digital penetration, financial access, financial penetration, sustainable development, sustainable financial development, advanced markets, emerging markets, frontier markets, low-income countries.

Introduction

Access to financial services is an essential quality of life factor (Sahay et al., 2015a), as evidenced by the opinion of consumers[1]. Increasing financial access has a positive effect on the social characteristics of economic territories, reducing poverty and inequality,

[1] The Bank of Russia. (2018) *Report on financial inclusion in the Russian Federation 2017*. URL: https://cbr.ru/content/document/file/47548/rev_fin_20180907_e.pdf (accessed: 28.10.2022).

boosting economic growth, and contributing to sustainable development (Popov, 2017; Pazarbasioglu et al., 2020). It is noteworthy that the link between financial systems and sustainable development, along with issues of financial regulation (targets 10.4–10.6) and financial support for developing and least developed countries (targets 17.1, 17.3, 17.5), has been specifically declared among the aspects of financial access (targets 8.3, 8.10, 9.3)[2]. At the same time, the typical positive impact of financial access for some countries may be absent in other countries (Demirguc-Kunt, Klapper and Singer, 2017), and more detailed research, taking into account the financial characteristics of the economic territory, is required.

In the context of the new technological order, digital penetration is becoming an important condition for the availability of financial services (Ozili, 2018)[3]. Thus, expansion of the population's access to the Internet will activate new channels for the provision of financial services, transforming financial systems and financial intermediation mechanisms. Along with the processes of disintermediation and customization, the processes of intersectoral convergence of financial services affect not only the financial but also the technology industries[4]. Accordingly, the relevance of digitalization in the financial accessibility regulation is recognized by the Bank of Russia. In particular, the potential for increasing financial access through the development of online service channels is emphasized in such program documents as the Russian financial market development program[5] and the financial inclusion priorities for Russia[6] for 2022–2024.

Therefore, we considered how digital penetration correlates with the availability of financial services by comparing countries with advanced and developing markets. As a starting point for our study, we formulated the assumption that the expansion of digital penetration should change the demand for financial services, reducing the level of demand for traditional banking services. The latter refers to the key characteristics of financial services access for the general public; as a result, we will use the terms "financial access" and "financial penetration" interchangeably throughout the rest of the paper, which is consistent with widely accepted approaches in this field (see, for example, the IMF methodology (Svirydzenka, 2016; Sahay et al., 2015b)).

Correspondingly, the purpose of this research was to reveal the main types of interrelationships between digital and financial access by dividing countries into four groups for comparison: 1) low digital and high financial access; 2) simultaneously high digital and financial access; 3) high digital and low financial access; 4) digital and financial access. The

[2] The United Nations. (2015) *17 goals to transform our world*. URL: https://www.un.org/sustainabledevelopment/ (accessed: 28.10.2022).

[3] Z/Yen Group. (2021) *See also: International financial centers: facilitating financial inclusion via digitalization*. URL: https://www.zyen.com/media/documents/IFC_Research_Paper_25062021_FINAL_for_launch.pdf (accessed: 28.10.2022).

[4] The future of financial services. How disruptive innovations are reshaping the way financial services are structured, provisioned and consumed, in J. R. McWaters (ed.) *The World Economic Forum*, the Deloitte 2015. URL: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf (accessed: 28.10.2022).

[5] Central Bank of the Russian Federation. (2021) *The Russian Financial Market Development Program for 2022–2024*. URL: https://cbr.ru/Content/Document/File/132531/fm_development_program_2022-2024.pdf (accessed: 28.10.2022).

[6] Central Bank of the Russian Federation. (2021) *The financial inclusion priorities for Russia in 2022–2024*. URL: https://cbr.ru/Content/Document/File/133266/Prioritet_naprav_FinUslug_2022-2024.pdf (accessed: 28.10.2022).

main research hypothesis was formulated as follows: there will be a negative correlation between digital access and penetration of traditional financial services.

1. Literature review

The problem of our research corresponded to the issues of financial access, which is an important condition for sustainable development. Financial access is one of the key factors of financial inclusion, and this can be judged by how the demand matches the supply of financial services. An example in this regard is the study of (Cámara and Tuesta, 2016), which proposed a multidimensional financial inclusion index, combining three areas of assessment: usage, access, and barriers. Moreover, financial access is most closely related to quality of life in the context of the sustainable development goals. A low or uneven level of financial services access indicates that there are groups of people in the country who cannot properly use financial services. This usually applies to the most vulnerable groups, as well as residents of remote and hard-to-reach areas (see, for example: Náñez, Jorge-Vazquez and Reier Forradellas, 2020). Obviously, in countries with a high quality of life, oriented towards the sustainable development goals, this situation is unacceptable. Therefore, the level of financial access can be one of the indicators of the quality of life of the population of a particular economic territory.

Ensuring equal opportunities in access to financial services actualizes the increase in digital accessibility, which helps to overcome the problems of physical access to these services. In addition, some new digital financial solutions can provide a reduced tax burden (Victorova, Pokrovskaia and Yevstigneev, 2020), while at the same time creating tax prerequisites for the sustainable development of territories (Viktorova et al., 2020). However, any innovation entails new risks and challenges, requiring adequate approaches for regulation, in the absence of which the positive effects can lost. Thus, among the main reasons for the most recent global recession, along with unjustified government support for the development of the US housing market an gaps in financial regulation, conflicts of interest involving rating agencies, which allowed them to increase the level of information asymmetry in financial markets, was the custom of attributing financial innovations in a way that allowed credit institutions to accumulate significant uncovered risk (Batrancea et al., 2013).

Within this discourse, the question of the practical implementation of digital financial technologies and related services is relevant (Bechtel et al., 2020) highlighted the features of smart contracts, such as the possibility of programming payments, defining properties (for example, white/blacklists), and generating tokens, and outlined the taxonomy of a programmed payment system based on programmable money (smart contracts). A new level of accessibility of financial services has been demonstrated by digital currencies, including cryptocurrencies, which have by now acquired a certain popularity due to their convenience for making payments, the high speed of the transactions, and the application of modern technology to ensure transaction security. The use of cryptocurrencies brings investment opportunities for both legal entities and individuals to a new level (Saksonova and Kuzmina-Merlino, 2018). Another topical issue in this area is the introduction of digital currencies of central banks (CBDC), which is one of the practical approaches to overcoming natural financial decentralization. (Cunha, Melo and Sebastião, 2021) provided a detailed overview of the research and practical development regarding the value,

advantages, disadvantages, and future of digital currencies, with a focus on central bank digital currencies.

The issue of introducing digital currencies is being investigated with consideration of the achieved level of financial access (Náñez Alonso et al., 2020) summarized the arguments of most national banks, both defending and refusing to take decisive steps towards introducing CBDCs into circulation. Arguments such as geographic dispersion of access to financial services, as well as increased bank penetration and access to financial services, are being used by developing countries in favor of introducing CBDCs (Náñez Alonso et al., 2020). For developed economies with a high level of financial inclusion, there may not be any advantage to CBDCs at all in comparison with existing payment systems (cards, etc.). However, for countries with low consumer protection of financial services and an insufficient level of financial inclusion, the latter could be increased with the introduction of CBDCs.

The use of digital currencies is an important step towards the digital transformation of financial systems. However, it remains to be seen how much digital finance will beaccepted by society. As these changes occur, consumer tastes can be expected to increasingly shift towards digital channels of access. Likewise, as shown in (Cohen et al., 2020), when cash is excluded from circulation, banknotes can be replaced with alternative money. At the same time, expanding digital access to financial services may not be feasible if the demand for them is insufficient.

Athique (Athique, 2019), using the example of India, showed that government imposition of digital finance hinders progress in this area, with unreliable communications and a lack of POS machines and the means to support personal devices. Most importantly, consumers are not convinced of the benefits of digital payments and the need to carry associated costs. On the other hand, according to research by (Moon, 2017), a program of transition to a cashless society is being successfully implemented in Korea. This is based on the widespread use of the Internet and mobile phones, along with the development of financial technology. This is leading to the emergence of new digital payment instruments and services that are rapidly replacing the use of cash in payments. However, widespread use of these services and a complete transition to a cashless society would not have been possible without the active coordination and support of both the government and the central bank.

Extending the results of the study by (Humbani and Wiese, 2018) in the field of mobile payment services to digital financial services and technologies in general, the following can be noted. There are four drivers and four inhibitors of new digital financial service acceptance. The drivers are optimism (a positive view of technology and the belief that it offers increased control, flexibility, and efficiency), personal innovation (a person's tendency to try out any new information systems), convenience (belief in the benefits of technology in terms of making life easier and performing common tasks), and compatibility (compliance of innovation with human values, patterns of behavior, and experience). The inhibitors are insecurity (transaction security), discomfort (seeming lack of control over technology and feeling overwhelmed by it), perceived cost (worry about the costs of using services), and perceived risks (other people's use of the phone if the device is lost, difficulty in tracking payments, possible errors in payment transactions).

"Inferred cost", "perceived risks", "risk", and "insecurity" are significant barriers, while "convenience" and "interoperability" are significant driving forces in digital financial ser-

vices adoption. “Optimism” and “personal innovativeness” are not important in encouraging consumers to use digital financial services, while “discomfort” is not a significant inhibitor. Gender only mitigates the impact of “convenience” on the adoption of digital services. An influence of gender on the other seven factors has not been identified. Men pay attention to convenience more than their female colleagues.

A literature review showed that increasing digital accessibility as a driver of financial innovation carries a certain risk, but can be considered as a factor that has a positive effect on the level of financial inclusion, in connection with the neutralization of the problems of physical access to financial services. Findings of the research in the field of digital financial services and technologies do not allow it to be unequivocally stated that the supply of digital services itself determines the corresponding demand, which depends on many factors. Thus, the assumption that the expansion of digital penetration will reduce the level of demand for traditional banking services requires specification and verification. Interestingly, countries with initially different levels of financial inclusion appear to have mixed results from expanding digital financial services offerings. However, the relationship between digital and financial access is being explored in the context of individual innovations (for example, smart contracts and digital currencies), while general patterns have not received as much attention, limiting the potential of financial regulation. These identified gaps and controversies determined the methodology of our research.

2. Methods and results

The research information base was formed by data from the repositories of the World Bank[7] and the International Monetary Fund[8]. To evaluate digital access, the share of Internet users in the total population (INU)[9] was used; to assess the demand for traditional financial services, the index of financial penetration in relation to financial institutions (FIA)[10] was used as an aggregate indicator of the availability of bank branches and ATMs (Svirydzenka, 2016; Sahay et al., 2015b).

The most complete data for the first indicator were present in the World Bank database for 2017, so we considered this period, having previously removed the aggregated data and countries with incomplete data. The second indicator was published on the IMF website in the section for financial development monitoring[11]. The relevant data from 2017 to 2019, cleared of aggregated and incomplete information, allowed us to assess the stability of the relationship with a basic level of digital access. As a result, the base sample represented 708 observations. The basic method of testing the research hypothesis was to assess the correlation between the INU and FIA, which allowed us to establish the nature of the relationship (positive or negative) between digital and financial stability.

The summary assessment of the correlation between the analyzed indicators showed that the regression analysis was non-indicative. The correlation was positive but relatively

[7] The World Bank. (2021) *World Bank open data*. URL: https://data.worldbank.org/ (accessed: 28.10.2022).

[8] The International Monetary Fund. (2021) *IMF financial development index data base*. URL: https://data.imf.org/?sk=F8032E80-B36C-43B1-AC26-493C5B1CD33B (accessed: 28.10.2022).

[9] The World Bank. (2021) *World Bank open data*.

[10] Ibid.

[11] The International Monetary Fund. (2021) *IMF financial development index data base.*

low (10 % according to 2017 data and 9 % compared to financial access data for 2018 and 2019).

To form more homogeneous groups of countries, we estimated the median values and removed those values in the interval [10; –10] of basis points from the medians. Thus, the final sample was reduced to 368 observations, which were distributed into four groups (Fig. 1):

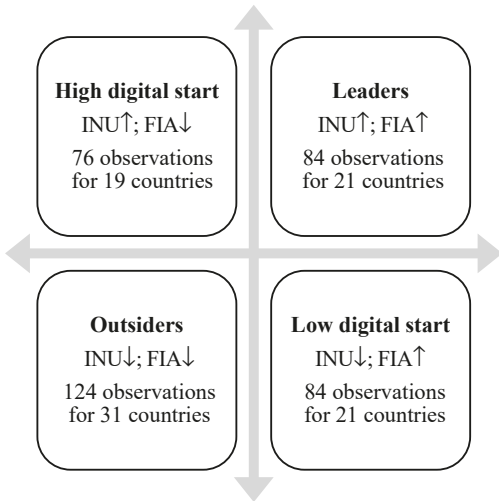


Fig. 1. The characteristics of the sample in terms of digital and financial access
Notes: INU — Internet users (share of population, u. f.);
FIA — financial institutions access (0–1 indicator)
Compiled by the authors based on: The World Bank. (2021) World Bank open data.
URL: https://data.worldbank.org/ (accessed: 28.10.2022);
The International Monetary Fund. (2021) IMF financial development index data base.
URL: https://data.imf.org/?sk=F8032E80-B36C-43B1-AC26-493C5B1CD33B (accessed: 28.10.2022).

To reveal the interrelationships between digital and financial access, the correlation between INU and FIA was assessed separately for each of the groups. This allowed us to decompose the main research hypothesis into four parts, which will be given at the beginning of each corresponding subsection.

The results obtained were supplemented by descriptive statistical analysis, as well as the characteristics of the economic and financial development of the respective countries:

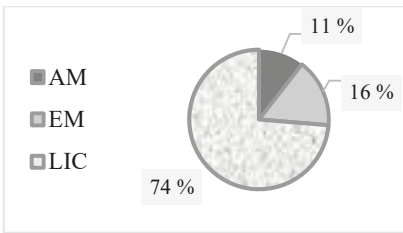
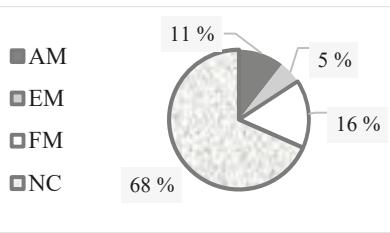
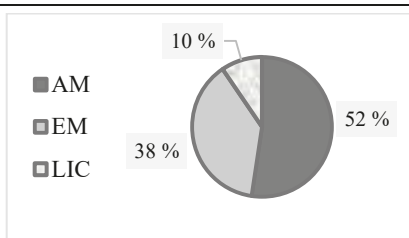
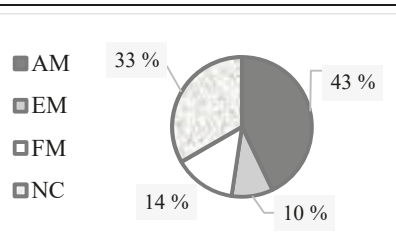
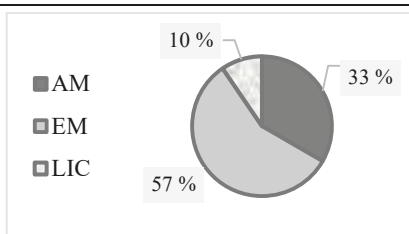
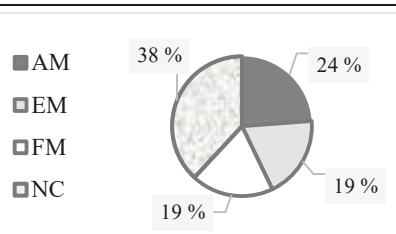
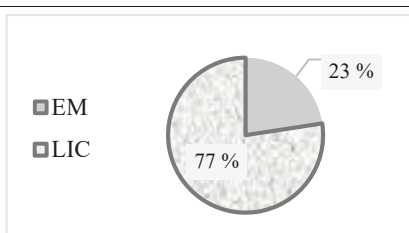
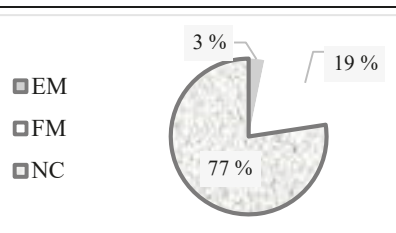
— to assess economic development, the IMF classification was used, according to which three groups of economic territories have been distinguished: advanced markets (AM), emerging markets (EM), and low-income countries (LIC)[12];
— the classifiers used in the compilation of global stock indexes were used to assess financial progress, according to which the existence of less developed markets is offered in addition to three categories of economic territories: advanced (AM), emerging (EM), and frontier markets (FM)[13].

[12] The International Monetary Fund. (2021) *IMF financial development index data base.*

[13] FTSE Equity Country Classification Process. FTSE Russel Sept. 2019; MSCI Market Classification. MSCI 2019; S&P Dow Jones Indices: S&P Global BMI. S&P/IFCI Methodology. S&P Dow Jones Aug. 2019.

The major economic and financial characteristics of the sample countries are presented in Table 1.

Table 1. **The characteristics of the sample countries in terms of economic and financial development**

Group of countries	Economic profile	Financial profile
1st group "High digital start"		
2nd group "Leaders"		
3rd group "Low digital start"		
4th group "Outsiders"		

Notes: AM — advanced market; EM — emerging market; FM — frontier market; NC — not classified (least developed market); LIC — low-income country.

Compiled by the authors based on: The World Bank. (2021) World Bank open data. URL: https://data.worldbank.org/ (accessed: 28.10.2022); The International Monetary Fund. (2021) IMF financial development index data base. URL: https://data.imf.org/?sk=F8032E80-B36C-43B1-AC26-493C5B1CD33B (accessed: 28.10.2022); FTSE Equity Country Classification Process. FTSE Russel Sept. 2019; MSCI Market Classification. MSCI 2019; S&P Dow Jones Indices: S&P Global BMI. S&P/IFCI Methodology. S&P Dow Jones Aug. 2019.

Let us turn to the obtained results in relation to the tested hypotheses.

Tested hypothesis 1: in countries with high digital access and limited penetration of traditional financial services, there is a negative correlation between INU and FIA.

The countries of this group were characterized by high digital penetration in terms of coverage of the population with Internet access. The median value for this indicator was 84 % of the population. At the same time, the penetration of traditional financial services was very low at, on average, 8 % of the maximum possible (Table 2).

Table 2. **The first group of countries ("high digital start")**

No	Country	Economic Development	Financial Development	INU	FIA2017	FIA2018	FIA2019
1	Benin	LIC	FM	0.98	0.06	0.06	0.07
2	Cameroon	LIC	NC	0.93	0.04	0.05	0.05
3	Chad	LIC	NC	0.82	0.02	0.02	0.01
4	Congo, Rep.	LIC	NC	0.72	0.09	0.09	0.09
5	Eritrea	LIC	NC	0.88	0.00	0.00	0.00
6	Ethiopia	LIC	NC	0.98	0.03	0.03	0.03
7	Finland	AM	AM	0.81	0.22	0.21	0.22
8	Haiti	LIC	NC	0.86	0.04	0.04	0.04
9	Kiribati	LIC	NC	0.95	0.13	0.13	0.13
10	Lao PDR	LIC	NC	0.80	0.15	0.15	0.15
11	Libya	EM	NC	1.00	0.14	0.14	0.14
12	Malawi	LIC	NC	0.80	0.05	0.05	0.05
13	Mali	LIC	FM	0.81	0.08	0.08	0.08
14	Micronesia, Fed. Sts	LIC	NC	0.76	0.21	0.20	0.20
15	Nigeria	EM	FM	0.88	0.12	0.12	0.12
16	Norway	AM	AM	0.80	0.22	0.22	0.20
17	Philippines	EM	EM	0.76	0.23	0.23	0.23
18	Sierra Leone	LIC	NC	0.84	0.03	0.03	0.03
19	South Sudan	LIC	NC	0.85	0.02	0.02	0.02
Median				0.84	0.08	0.08	0.08
St. Dev.				0.08	0.08	0.08	0.08
Coefficient of Variation				0.09	0.78	0.77	0.77
Correlation Coefficient (INU/FIA)				x	–0.34	–0.34	–0.33

Notes: AM — advanced market; EM — emerging market; FM — frontier market; NC — not classified (least developed market); LIC — low-income country; INU — Internet users (share of population, u. f.); FIA — financial institutions access (0–1 indicator).

Compiled by the authors based on: The World Bank. (2021) World Bank open data. URL: https://data.worldbank.org/ (accessed: 28.10.2022); The International Monetary Fund. (2021) IMF financial development index data base. URL: https://data.imf.org/?sk=F8032E80-B36C-43B1-AC26-493C5B1CD33B (accessed: 28.10.2022); FTSE Equity Country Classification Process. FTSE Russel Sept. 2019; MSCI Market Classification. MSCI 2019; S&P Dow Jones Indices: S&P Global BMI. S&P/IFCI Methodology. S&P Dow Jones Aug. 2019; Astapov, A. (2022) International lists of offshore zones and non-cooperating jurisdictions. The World of New Economy, 16 (4), pp. 99–112; The International Wealth 2021. URL: https://internationalwealth.info/deofshorization/mezhdunarodnye-spiski-offshornyh-zon-i-nesotrudnichajushhih-jurisdikcij/ (accessed: 28.10.2022).

This group was dominated by low-income countries, for which the limited availability of bank branches and ATMs is explained by the low level of financial systems development. Nevertheless, the group also included advanced markets, such as Finland and Norway, characterized by a completely different level of financial development (advanced financial markets are included in the list of territories that have sufficiently implemented international financial standards, hereinafter referred to as the "OECD white list")[14]. In this case, the relatively low values of the financial access indices were probably associated with the prevalence of alternative channels for the provision of financial services. The Philippines (an emerging financial market; included in the OECD white list) and the Federated States of Micronesia (a low-income country with an emerging financial market) also demonstrated an atypically high level of financial access for the group[15]. The uneven distribution of the financial access index values among the analyzed countries was reflected in the high level of the variation coefficient, which fluctuated in the range of 0.77–0.78.

It is interesting that digital penetration is generally higher in low-income countries. According to this indicator, the leaders in the group were Libya, Benin, Ethiopia, Kiribati, and Cameroon[16]. Only Libya is classified as an emerging market in terms of economic development, and financially it is an undeveloped country, and not included in the category of frontier markets[17]. In a number of low-income countries (Eritrea, Haiti, South Sudan, Sierra Leone), the proportion of the population with Internet access exceeds the median value[18]. Thus, increasing digital access by itself is not a driver for expanding the availability of financial services and, ultimately, financial development.

With regards to the relationship between the level of digital and financial access, it had a weak negative character, as evidenced by the values of the correlation coefficient of 0.33–0.34. Therefore, the first tested hypothesis was confirmed. Accordingly, the role of banks in providing financial services to the population in the countries of this group was not decisive. In the case of low-income countries, this indirectly indicated the increased importance of the shadow (criminal and illegal) financial economy. In countries with an advanced market, it is advisable to assume an increased demand for alternative financial services that may be included in the perimeter of shadow banking (banking services provided by non-banking organizations), but that do not go beyond the framework of legal financial relationships.

Tested hypothesis 2: in countries with high digital access and deep penetration of traditional financial services, there is a negative correlation between INU and FIA.

The countries of the second group, on average, dominated both in terms of access to the Internet and the availability of banking services, making them "leaders" in the context of our study. The median share of the population with Internet access in these countries reached 0.82, which is only two basis points less than in the first group. At the same time, the median financial access in the analyzed period fluctuated around 0.66, exceeding the same indicator of the previous group by more than 8 times (Table 3).

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[14] Astapov, A. (2022) International lists of offshore zones and non-cooperating jurisdictions. *The World of New Economy*, 16 (4), pp. 99–112.

[15] FTSE Equity Country Classification Process; MSCI Market Classification; S&P Dow Jones Indices.

[16] World Bank open data; IMF financial development index database.

[17] IMF financial development index database; FTSE Equity Country Classification Process; MSCI Market Classification; S&P Dow Jones Indices.

[18] World Bank open data; IMF financial development index database.

Table 3. **The first group of countries ("leaders")**

No	Country	Economic Development	Financial Development	INU	FIA2017	FIA2018	FIA2019
1	Armenia	EM	NC	0.97	0.54	0.55	0.56
2	Aruba	EM	NC	0.87	0.71	0.69	0.66
3	Australia	AM	AM	0.88	0.83	0.81	0.81
4	Austria	AM	AM	0.79	0.63	0.63	0.63
5	Bahamas	EM	NC	0.96	0.81	0.81	0.77
6	Brazil	EM	EM	0.78	0.70	0.68	0.66
7	Cyprus	AM	FM	0.79	0.72	0.66	0.58
8	Czech Republic	AM	EM	0.97	0.48	0.49	0.49
9	France	AM	AM	0.73	0.86	0.83	0.82
10	Georgia	EM	NC	0.84	0.71	0.70	0.75
11	Hong Kong SAR, China	AM	AM	0.77	0.46	0.47	0.47
12	Ireland	AM	AM	0.82	0.63	0.58	0.56
13	Korea, Rep.	AM	AM	0.84	0.67	0.67	0.67
14	Luxembourg	AM	AM	0.83	1.00	1.00	1.00
15	Moldova	LIC	NC	0.97	0.60	0.62	0.59
16	Mongolia	EM	NC	0.71	0.92	0.98	1.00
17	Poland	EM	AM	0.74	0.65	0.65	0.64
18	Romania	EM	FM	0.76	0.59	0.57	0.55
19	Slovak Republic	AM	FM	0.79	0.57	0.56	0.55
20	Tonga	LIC	NC	0.77	0.56	0.55	0.55
21	United Kingdom	AM	AM	0.87	0.78	0.78	0.77
Median				0.82	0.67	0.66	0.64
St. Dev.				0.08	0.14	0.14	0.15
Coefficient of Variation				0.01	0.02	0.21	0.22
Correlation Coefficient (INU/FIA)				x	–0.18	–0.15	–0.15

Notes: AM — advanced market; EM — emerging market; FM — frontier market; NC — not classified (least developed market); LIC— low-income country; INU — Internet users (share of population, u.f.); FIA — financial institutions access (0–1 indicator).

Compiled by the authors based on: The World Bank. (2021) World Bank open data. URL: https://data.worldbank.org/ (accessed: 28.10.2022); The International Monetary Fund. (2021) IMF financial development index data base. URL: https://data.imf.org/?sk=F8032E80-B36C-43B1-AC26-493C5B1CD33B (accessed: 28.10.2022); FTSE Equity Country Classification Process. FTSE Russel Sept. 2019; MSCI Market Classification. MSCI 2019; S&P Dow Jones Indices: S&P Global BMI. S&P/IFCI Methodology. S&P Dow Jones Aug. 2019; Astapov, A. (2022) International lists of offshore zones and non-cooperating jurisdictions. The World of New Economy, 16 (4), pp. 99–112.

From the standpoint of assessing economic and financial development, low-income countries (Moldova and Tonga), as well as countries with an emerging but financially undeveloped market (Armenia, Aruba, Bahamas, Georgia, Mongolia), did not correspond to

the general profile of the group[19]. These cases require more detailed attention. In particular, Aruba and the Bahamas are offshore jurisdictions[20], which explains their high positions in terms of digital and financial penetration indicators. Moldova, Armenia, Georgia, and often Mongolia belong to the same region of the post-Soviet space, and this may determine their financial specifics.

Three quarters of the analyzed countries were included in the OECD white list. In addition to Aruba and the Bahamas, these were Austria, Australia, Brazil, Great Britain, Hong Kong, Ireland, Korea, Cyprus, Luxembourg, Poland, Slovakia, Tonga, France, and the Czech Republic[21].

It is characteristic that the maximum values of digital penetration, as in the previous group, were demonstrated by the less developed countries with different financial profiles: the Czech Republic (an emerging financial market that has sufficiently implemented international tax standards), Armenia and Moldova (undeveloped financial markets), and the Bahamas (offshore)[22]. This further highlighted the controversial reasons for the negative relationship between digital and financial access.

For the penetration of ATMs and bank branches as reflected in the Financial Access Index, the distribution of countries was more consistent. However, along with Luxembourg, France, Australia, and the Bahamas (representatives of the OECD white list), we also found Mongolia as a leader[23]. Its financial market does not even belong to the frontier group[24].

Despite the uneven composition of the group for economic and financial development, the distribution of digital and financial access values was rather homogeneous, as can be judged by the coefficient of variation, the maximum value of which in the analyzed period was 0.22 (FIA in 2019). The second hypothesis was also confirmed, since the relationship between digital and financial characteristics of access was still negative. However, it was even less pronounced than in the High Digital Start group.

Tested hypothesis 3: in countries with low digital access and deep penetration of traditional financial services, there is a negative correlation between INU and FIA.

This group of countries is characterized, on average, by a low share of the population with access to the Internet, while the availability of banking services is relatively high. The median values of indicators in these assessment areas were 0.33 and 0.60–0.61, respectively (Table 4).

This group, whose countries can be characterized by the phrase "low digital start", was of mixed nature, including advanced (Belgium, Germany, New Zealand, Spain, Switzerland), emerging (Kuwait, Russia, Thailand, Turkey), frontier (Bulgaria, Iceland, Malta, Panama), and other financial markets[25]. With the exception of Cape Verde and Uzbekistan, there were almost no low-income countries in this group. According to the IMF classification, 33 % of the sample were advanced economies, and 57 % were emerging[26].

[19] IMF financial development index database; FTSE Equity Country Classification Process; MSCI Market Classification; S&P Dow Jones Indices.

[20] Astapov. Op. cit.

[21] Ibid.

[22] FTSE Equity Country Classification Process; MSCI Market Classification; S&P Dow Jones Indices; Astapov. Op. cit.

[23] IMF financial development index database; Astapov. Op. cit.

[24] FTSE Equity Country Classification Process; MSCI Market Classification; S&P Dow Jones Indices.

[25] FTSE Equity Country Classification Process; MSCI Market Classification; S&P Dow Jones Indices.

[26] IMF financial development index database.

Table 4. **The first group of countries ("low digital start")**

No	Country	Economic Development	Financial Development	INU	FIA2017	FIA2018	FIA2019
1	Belgium	AM	AM	0.47	0.77	0.72	0.72
2	Bosnia and Herzegovina	EM	NC	0.41	0.58	0.59	0.59
3	Bulgaria	EM	FM	0.16	0.92	0.92	0.92
4	Cabo Verde	LIC	NC	0.33	0.56	0.58	0.59
5	Costa Rica	EM	NC	0.44	0.51	0.55	0.53
6	Germany	AM	AM	0.38	0.64	0.62	0.62
7	Guatemala	EM	NC	0.11	0.55	0.47	0.45
8	Iceland	AM	FM	0.32	0.78	0.73	0.68
9	Iran, Islamic Rep.	EM	NC	0.49	0.66	0.74	0.74
10	Kuwait	EM	EM	0.38	0.46	0.49	0.51
11	Malta	AM	FM	0.39	0.60	0.56	0.53
12	New Zealand	AM	AM	0.28	0.60	0.59	0.57
13	Panama	EM	FM	0.11	0.56	0.55	0.55
14	Russian Federation	EM	EM	0.22	0.82	0.79	0.78
15	Seychelles	EM	NC	0.13	0.86	0.88	0.90
16	Spain	AM	AM	0.34	1.00	0.99	0.98
17	Switzerland	AM	AM	0.34	0.89	0.88	0.86
18	Thailand	EM	EM	0.27	0.63	0.63	0.62
19	Turkey	EM	EM	0.21	0.56	0.56	0.55
20	Uruguay	EM	NC	0.49	0.50	0.61	0.61
21	Uzbekistan	LIC	NC	0.26	0.54	0.53	0.55
Median				0.33	0.60	0.61	0.61
St. Dev.				0.12	0.16	0.15	0.15
Coefficient of Variation				0.39	0.24	0.22	0.23
Correlation Coefficient (INU/FIA)				x	–0.18	–0.06	–0.08

Notes: AM — advanced market; EM — emerging market; FM — frontier market; NC — not classified (least developed market); LIC — low-income country; INU — Internet users (share of population, u. f.); FIA — financial institutions access (0–1 indicator).

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Almost half of the countries in the group belong to the OECD white list: Belgium, Spain, and Switzerland (relatively high indicators of digital and financial access), Malta and Costa Rica (relatively high level of digital penetration with moderate indices of financial access), Iceland and Seychelles (the opposite), and New Zealand, Turkey, and Panama

(relatively low values of the analyzed indicators)[27]. Panama is included in the grey list of the Financial Action Task Force on Money Laundering (hereafter the FATF), which indicates increased country risks for investors[28].

The share of the population with access to the Internet was unevenly distributed in the countries of the group. Iran, Uruguay, and Belgium[29] were leading countries, with very different financial and economic profiles. Iran is one of two countries in the world (along with Sudan) in which the financial system is fully subject to the requirements of Sharia (Lvova, Pokrovskaia and Ivanov, 2016), and it is included in the FATF blacklist, since it does not cooperate with this organization[30]. Its financial market is one of the least developed. Uruguay is an emerging market in terms of economic development[31], but is not included in the frontier financial markets[32]. Belgium belongs to the group of economically and financially developed countries[33]. With a significant proportion of bank assets, non-bank financial institutions prevail in its financial system[34].

In terms of the availability of financial services for the population in this group, countries with different financial and economic profiles led: Spain, Switzerland, Seychelles, and Bulgaria[35]. However, the values of the financial access index for the countries of the group as a whole were quite homogeneous (the coefficient of variation in the study period did not exceed 0.24). The relationship between the indicators of digital and financial penetration, as in the previous cases, was weakly negative, and in terms of the correlation coefficient, was closer to the characteristics of the second group of countries. The third hypothesis was confirmed.

Tested hypothesis 4: in countries with low digital access and limited penetration of traditional financial services, there is a negative correlation between INU and FIA.

The group of countries with low characteristics of digital and financial access was the largest, which generally corresponds to the distribution of countries in the world by the level of economic and financial development, since the world economy is dominated by low-income and undeveloped territories. The median digital penetration in this group was 0.2. This is about 4 times less than the same value in the first two groups, and 1.7 times less than in the third group. The average financial access index (0.09) did not significantly exceed the corresponding value for the countries of the first group (0.08), but was about 7 times lower than in countries with high financial penetration (Table 5).

Although some of the countries in the group were classified as emerging markets (Algeria, Angola, Equatorial Guinea, Gabon, Syria, and Turkmenistan) or frontier financial markets (Burkina Faso, Guinea Bissau, Kenya, Niger, Togo, and Zambia), only Egypt

[27] Astapov. Op. cit.

[28] Ibid.

[29] World Bank open data.

[30] Astapov. Op. cit.

[31] IMF financial development index database.

[32] FTSE Equity Country Classification Process; MSCI Market Classification; S&P Dow Jones Indices.

[33] IMF financial development index database; FTSE Equity Country Classification Process; MSCI Market Classification; S&P Dow Jones Indices.

[34] The Financial Stability Board. (2019) *Global monitoring report on non-bank financial intermediation*. 2020. URL: https://www.fsb.org/2020/01/global-monitoring-report-on-non-bank-financial-intermediation-2019/ (accessed: 25.03.2022).

[35] IMF financial development index database; FTSE Equity Country Classification Process; MSCI Market Classification; S&P Dow Jones Indices.

Table 5. **The first group of countries ("outsiders")**

No	Country	Economic Development	Financial Development	INU	FIA2017	FIA2018	FIA2019
1	Algeria	EM	NC	0.48	0.10	0.10	0.10
2	Angola	EM	NC	0.14	0.20	0.19	0.19
3	Burkina Faso	LIC	FM	0.03	0.05	0.05	0.05
4	Cambodia	LIC	NC	0.23	0.16	0.17	0.20
5	Central African Rep.	LIC	NC	0.06	0.01	0.01	0.01
6	Comoros	LIC	NC	0.09	0.06	0.06	0.06
7	Congo, Dem. Rep.	LIC	NC	0.09	0.02	0.02	0.02
8	Egypt, Arab Rep.	EM	EM	0.34	0.13	0.14	0.16
9	Equatorial Guinea	EM	NC	0.01	0.11	0.12	0.12
10	Gabon	EM	NC	0.20	0.16	0.16	0.16
11	Guinea	LIC	NC	0.04	0.04	0.04	0.04
12	Guinea-Bissau	LIC	FM	0.37	0.06	0.05	0.07
13	Guyana	LIC	NC	0.12	0.18	0.18	0.18
14	Kenya	LIC	FM	0.15	0.10	0.10	0.09
15	Lesotho	LIC	NC	0.08	0.11	0.11	0.10
16	Liberia	LIC	NC	0.22	0.05	0.05	0.05
17	Madagascar	LIC	NC	0.14	0.04	0.04	0.04
18	Marshall Islands	LIC	NC	0.21	0.19	0.18	0.17
19	Mozambique	LIC	NC	0.24	0.10	0.10	0.09
20	Myanmar	LIC	NC	0.37	0.07	0.08	0.09
21	Nicaragua	LIC	NC	0.10	0.20	0.20	0.20
22	Niger	LIC	FM	0.07	0.03	0.03	0.03
23	Rwanda	LIC	NC	0.34	0.09	0.09	0.08
24	Solomon Islands	LIC	NC	0.02	0.10	0.10	0.10
25	Sudan	LIC	NC	0.49	0.06	0.07	0.07
26	Syrian Arab Rep.	EM	NC	0.22	0.09	0.09	0.09
27	Timor-Leste	LIC	NC	0.12	0.11	0.12	0.11
28	Togo	LIC	FM	0.41	0.08	0.08	0.09
29	Turkmenistan	EM	NC	0.49	0.00	0.00	0.00
30	Yemen, Rep.	LIC	NC	0.28	0.05	0.05	0.05
31	Zambia	LIC	FM	0.27	0.10	0.10	0.08
Median				0.20	0.09	0.09	0.09
St. Dev.				0.14	0.06	0.06	0.06
Coefficient of Variation				0.07	0.61	0.60	0.60
Correlation Coefficient (INU/FIA)				x	–0.09	–0.09	–0.05

Notes: AM — advanced market; EM — emerging market; FM — frontier market; NC — not classified (least developed market); LIC — low-income country; INU — Internet users (share of population, u. f.); FIA — financial institutions access (0–1 indicator).

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noticeably differed from the general profile, having a sufficiently developed financial system[36]. In general, the study group was dominated by low-income countries[37], which accounted for about 80 % of the total. At the same time, only three economic territories in the group had the official status of offshore zones (Comoros, Liberia, and the Marshall Islands), and only two had sufficiently implemented international tax standards[38], which sharply distinguished this group from more prosperous ones. Notably, the largest number of countries, in comparison with other groups, was included in the FATF grey list: Cambodia, Myanmar, Nicaragua, Syria, and Yemen[39].

The distribution of the analyzed indicators in the group was uneven, both in terms of digital access (the coefficient of variation was 0.70) and in terms of financial services access to the population (this indicator fluctuated at the level of 0.60–0.61). Low-income countries led in digital penetration: Sudan, Turkmenistan, Algeria, and Togo[40]. Financial access, in terms of the prevalence of ATMs and bank branches, was significantly higher than the average values in Nicaragua, Angola, the Marshall Islands, and Gain (about 0.20)[41]. However, these relatively high values were about 3 times lower than the average values of the financial access index in the countries of the second and third groups. The relationship between digital and financial access in this analyzed group of countries was the least pronounced, but, as in all previous cases, it was negative and confirmed the fourth tested hypothesis.

Conclusion

This research confirmed the hypothesis that increased digital access reduces the demand for traditional financial services. Countries with a higher percentage of people using the Internet have comparatively lower ATM and branch penetration rates, indirectly indicating a higher preference for alternative financial services. However, there are differences in this regard which require more detailed information on country groups. The proposed methodology, within which only relatively high and low values of digital and financial access were considered in various combinations, showed its efficiency. It was found that the selected groups of countries quite obviously ranged from clear leaders to outsiders, including intermediate groups with a low and high digital start.

Despite the weak negative relationship between the analyzed indicators in all groups of countries, it was found that in countries with relatively low digital access but rather high penetration of traditional financial services to the population, this effect was most pronounced. If low digital access is accompanied by low financial access, the expected effect

[36] FTSE Equity Country Classification Process; MSCI Market Classification; S&P Dow Jones Indices.

[37] IMF financial development index database.

[38] Astapov. Op. cit.

[39] Ibid.

[40] World Bank open data; IMF financial development index database.

[41] IMF financial development index database.

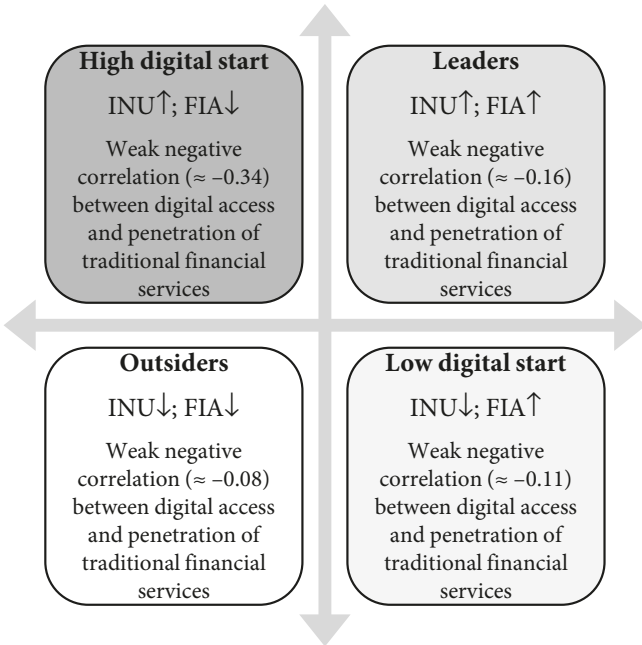

Fig. 2. The characteristics of the sample in terms of digital and financial access

Notes: INU — Internet users (share of population, u. f.); FIA — financial institutions access (0–1 indicator).

Compiled by the authors based on: The World Bank. (2021) World Bank open data. URL: https://data.worldbank.org/ (accessed: 28.10.2022); The International Monetary Fund. (2021) IMF financial development index data base. URL: https://data.imf.org/?sk=F8032E80-B36C-43B1-AC26-493C5B1CD33B (accessed: 28.10.2022)

was virtually nonexistent. In low-income countries with underdeveloped financial markets, increased digital access, combined with low penetration of traditional financial services, may reflect the defining importance of the shadow sector of the financial economy, while in rich countries, a similar situation may be associated with an increase in the importance of formal non-banking institutions. The results obtained are summarized in Fig. 2.

Thus, the research results contribute to refining scientific views on the impact of digital finance (Ozili, 2018; Frost et al., 2019). In contrast to studies that have confirmed the positive impact of digitization on financial access (Ozili, 2018), we found that the analyzed relationship was ambiguous. It depended on the type of financial services consumed, and confirmed the variety of factors of preference for digital innovations (Humbani and Wiese, 2018).

In was shown that the initial levels of digital and financial access should be taken into account, which correlates with some previous empirical results on introducing CBDCs (Náñez Alonso et al., 2020). Many low-income countries have a high proportion of the population with access to the Internet. Thus, increasing digital access by itself is not a driver for expanding the availability of financial services, but it can contribute to innovative financial development through the formation of alternative financial services. However, positive changes in this area are possible only under conditions of sufficiently high financial access.

These conclusions are of practical importance for financial supervision and regulation; in particular, when developing strategies to increase financial access and digital financial access. Providing conditions for increasing the level of financial access correlates with an expanded range of tasks that the state and society have to solve for sustainable development (Batrancea et al., 2020a; Batrancea and Nichita, 2015; Batrancea et al., 2020b). This implies the continuation of empirical research in the context of advanced and emerging markets, as well as taking into account the level and model of financial development.

The choice of indicators of digital and financial access in relation to such significant factors as the level of disposable incomes of the population requires special attention (Miroshnichenko et al., 2022). Besides, the problems of regulating financial access in the aspect of digitalization are not limited to the household sector, as it generates new opportunities and risks for the corporate sector (Lyukevich et al., 2020). Thus, in the program documents of the Bank of Russia, the enhancement of financial access for business is given no less high importance than for households[42]. Therefore, further research should be based on a longer analyzed period, more detailed database, and more sophisticated methods to develop sufficient econometric models.

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Цифровая доступность в контексте предпочтения финансовых услуг

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Статья посвящена исследованию вопросов цифровой доступности в финансовой сфере. Цель исследования состояла в том, чтобы выявить основные типы взаимосвязей между цифровой и финансовой доступностью путем группировки и сравнения стран с различными соответствующими характеристиками. Гипотеза исследования предполагала наличие отрицательной корреляции между цифровой доступностью и проникновением традиционных финансовых услуг. Для проверки гипотезы были проанализированы данные из стран с развитыми и развивающимися рынками. В качестве индикатора цифровой доступности использовалась доля населения, имеющего доступ в Интернет. Для оценки доступности финансовых услуг рассматривался композитный индекс доступа к финансовым услугам, публикуемый Международным валютным фондом. Страны были ранжированы по уровню цифровой и финансовой доступности, что позволило разделить их на четыре группы: с низким финансовым и высоким цифровым проникновением, высоким цифровым и финансовым проникновением, низким цифровым и высоким финансовым проникновением, низким цифровым и финансовым проникновением. Корреляционный анализ полученных данных выявил слабую отрицательную связь между цифровой и финансовой доступностью для каждой из групп, подтвердив проверяемую гипотезу. В статье был сделан вывод о том, что цифровая доступность сама по себе не является определяющей движущей силой расширения доступности финансовых услуг, но может способствовать инновационному финансовому развитию за счет формирования широкого спектра альтернативных финансовых услуг на рынке. Исследование вносит вклад в понимание неоднозначной связи между цифровой и финансовой доступностью, что имеет практическое значение для финансового регулирования.

Ключевые слова: цифровая доступность, цифровое проникновение, финансовая доступность, финансовое проникновение, развитые рынки, развивающиеся рынки, пограничные рынки, страны с низким уровнем дохода.

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