

Digital Technologies and Saving Behavior

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Abstract. Digitalization penetrates all aspects of economy and finance, changes the behavior of major economic agents. The primary research question is to determine whether digital technology is really a tool for increasing savings in the economy. The empirical study has included the construction of a logit model, in which the probability of short-term savings of an agent acts as a dependent variable. The results of the modelling show that saving behavior is sensitive to the introduction of digital technologies such as the Internet and the proliferation of mobile phones. Having an account at a financial institution also increases the likelihood of savings. However, when developing and implementing public policies, it is necessary to take into account the fact that digital technologies can stimulate the use of informal savings institutions. The findings of the study substantiate the need to build skills in the use of mobile and Internet technologies to increase the financial inclusion of all segments of the population and increase the level of savings.

1. Introduction

According to 2017 Gallup World Poll data, about half of the adult population (48 percent) around the world made savings in the past 12 months. However, there are differences in the savings behavior of individuals depending on the level of development of the country's economy: in advanced economies, the percentage of the population that made short-term savings is significantly higher - 71 percent compared to 43 percent in developing and emerging countries [1]. Consequently, the problem of activating savings behavior among individuals is especially relevant for countries with developing economies. However, developed countries are also looking for new tools that can involve all segments of the population in saving behavior.

One of the key tools that can activate the savings process and ensure financial inclusion for all segments of the population are digital technologies. The ongoing process of digitalization of public affects all areas of human activity. The spread of digital technology is rapid and creates added value in the global economy. According to estimates by the GSMA Association, in 2018, mobile technologies generated \$ 3.9 trillion of economic value (4.6 percent of GDP) globally [2].

The impact of digital technology on the saving behavior of individuals does not have a clear direction of impact. On the one hand, digital technologies are an innovation that facilitates individuals' access to financial services, and the removal of barriers should stimulate saving behavior. On the other hand, the accessibility of financial technologies becomes the basis for changing traditional business models in the financial market, the gradual loss by banks of their financial intermediary functions. In addition, digital technologies open up wide access not only to savings products, but also to borrowed ones, which in the conditions of a "consumer society" by Baudrillard [3] acts as an anti-stimulus to the

accumulation of funds. Stimulating consumer behavior with the help of new financial instruments can lead to imbalances in the financial market and even to global economic crises, as in 2008-2009. Nizamutdinov and Malaev [4] in their work indicate that the instability of the financial market is a prerequisite for lowering the level of savings and increasing the propensity for consumer behavior.

2. Literature review

Deaton A.S. [5] made a significant contribution to the development of a microeconomic approach to the analysis of agent savings behavior, he proposed a concept of precautionary saving and liquidity constraint. In a situation where a representative agent may be limited by liquidity, he or she will seek for creation precautionary saving in good times in order to consume his or her labor income in bad times. Consequently, it can be suggested that in the absence or reduction of liquidity constraint, dictated by the expansion of access to financial services through the introduction of digital technology, a representative agent will aim to save.

Empirical studies show that the proliferation of digital technology activates household saving behavior. Jack and Suri [6], using evidence of the mobile technology M-PESA introduced in Kenya, illustrated how shocks in changing earnings can be shared between subscribers of the digital technology, minimizing loss in consumption. In this case, digital technology is an informal institution that can replace the financial risk insurance service. Honohan and King, according to the data from eleven surveys in sub Saharan Africa, examined the impact of individual, geographic, and national characteristics on the use of formal financial institutions. The researchers concluded that “financial access is likely to have a slow-burning effect on the household’s welfare” [7]. At the same time, they proved that income and education are key determinants of access to formal banking.

Ouma et al. [8] conducted the investigation how mobile technology influences savings in 4 selected countries in sub Saharan Africa. The findings of their research showed that usage of mobile phones to provide financial services promotes the likelihood of saving at the household level. Based on the construction of a logit model, the researchers evaluated the impact of mobile technologies on the volume and likelihood of savings and concluded that mobile technologies act as a tool to increase savings in Africa. They use the probability of savings as a dependent variable, when building a logit model, and the amount of savings, when they specified OLS regression. The control variables were age, income, formal education, family size, gender, and marital status of respondents. The simulation results showed the significance of the influence of mobile financial service.

A significant part of theoretical and empirical literature advocates the intensification of financial literacy and the implementation of relevant government programs in developing and developed countries (Hogarth and Anguelov, Servon and Kaestner, Honohan and King [9]). The main factor that influencing the saving behavior of individuals and households is the level of income. J.M. Keynes [10] proved that an agent is inclined to save more by increasing income. Differentiation of individuals by income level leads to the fact that financial information technologies can expand access for low-income groups and make financial products more accessible for them. This function of digital technology - financial inclusion - has become widespread in empirical literature. Aizcorbe et al. [11] showed that financial behavior of households depends on the level of household income. Loans occupy a much larger share in the family budget of low-income households. Servon and Kaestner [12] empirically tested the impact of online banking on the financial behavior of customers with low income living in an urban area. The researchers concluded that access to information technology, combined with increased financial literacy, makes household financial behavior more effective.

3. Data and hypotheses

The primary research question is the empirical evidence of the direction of changes in saving behavior under the influence of the spread of digital technology.

The source of microdata was the results of adult surveys from The Global Findex database by the World Bank. To construct the model, we used the data of the last available wave of the survey, which

was conducted in 2017, and includes a number of questions on the saving behavior of individuals, the use of digital technologies. More than 150 thousand observations were used in the research.

The main hypothesis of the study is that digital technologies activate short-term saving behavior of the adult population. Putting such a hypothesis, we proceed from the economic mechanism, when a rational agent in the conditions of facilitating access to financial services will activate savings behavior. The services of financial institutions for storing funds in the context of the development of mobile technologies, Internet technologies reduces the individual's costs: transactional, transport, time - and contributes to access to formal financial institutions.

The fundamental peculiarity of the study is the analysis of the savings behavior of those individuals who made savings in formal financial institutions, and those individuals who saved using informal institutions. The development of digital technology contributes to the appearance of various savings clubs, the use of crowdfunding technology, which was discussed in the literature review. The appearance of new informal savings institutions contributes to the growth of savings in the economy.

4. Empirical model

To assess the impact of digital technologies on the probability of saving, we used the binary variable *saving* (see Appendix), which acts as a dependent variable. We constructed the logit model, which has a number of advantages compared to the linear probability model.

The logit of the model assumes the existence of a hidden variable - the propensity to save (*saving**), which linearly depends on a number of factors:

$$saving_i^* = \ln \frac{P_i}{1-P_i} = \beta_0 + \sum_{j=1}^k \beta_j x_{ij} + u_i \quad (1)$$

Using a hidden variable, we evaluated the probability of a dependent variable:

$$\frac{P_i}{1-P_i} = \exp_i(saving^*) = \exp(\beta_0 + \sum_{j=1}^k \beta_j x_{ij} + u_i) \quad (2)$$

Using equation (2), we estimated the predicted probability of the dependent variable:

$$\hat{P}_i = \frac{1}{1 + \exp(-saving_i^*)} = \frac{1}{1 + \exp(-(\beta_0 + \sum_{j=1}^k \beta_j x_{ij}))} \quad (3)$$

As explanatory variables, we have chosen variables that are proxies for digital technologies - payment via the Internet (*Internet*) and ownership of a mobile phone (*mobile*). In our opinion, the essential is not just the dissemination of digital technology, but the individual's access and use in financial transactions. Therefore, a variable was selected that reflects the skill of making financial transactions via the Internet. The presence of a mobile phone allows us to evaluate the development of mobile technologies and their impact on the likelihood of savings.

The impact of the institutional environment of financial institutions on the propensity for saving behavior is assessed using a variable that describes the existence of an account in a formal financial institution (account).

To obtain reliable results, in addition to the variables associated with mobile technologies, sociodemographic characteristics of the adult population were included that affect the propensity to save: gender of the respondent, age, level of education, membership in the income group, participation in the workforce, which showed their importance in empirical research (Ouma et al., Honohan and King, King [13]).

Expression (2) is an odds ratio, which can be interpreted as the ratio of the probability that an individual saves to the probability that he does not save [14].

5. Results and discussion

The main research question is to examine in which direction digital technologies influence the saving behavior of individuals. We suggested that in the context of the spread of the Internet, mobile phones, access to financial technologies is expanding, which will increase the tendency of individuals to save. The probability of saving more than 150 thousand respondents over the past 12 months served as the basis for constructing a logit model, in which proxy variables for digital technologies and sociodemographic characteristics acted as factors to control the robustness of simulation results.

The impact of access to digital technology is traced on the example of Internet technologies. Paying bills online is an incentive for saving behavior. The results of the study in table 1 show that the likelihood of saving behavior is increasing. At the same time, the results of the model demonstrate that owning a mobile phone also increases the likelihood of individual savings decisions. In this case, the hypothesis about an increase in the probability of saving behavior is confirmed. The increase in the likelihood of saving behavior due to the spread of digital technologies can be explained by the presence of financial inequality and the problem of financial exclusion, when significant barriers to access to financial services prevent low-income group of adults in developing and emerging countries. Digital technologies facilitate access to financial services, thereby reducing an individual's costs (transportation costs, transaction costs, time and money costs), which can be considered as a growth in disposable income. Therefore, the spread of digital technologies at the global level leads to an increase in the likelihood of savings due to a growth in disposable income and in the access of low-income segments of the population to financial services. A similar explanation of the discovered pattern is consistent with the results of a study conducted Ouma et al. using countries in sub Saharan Africa as an example. Researchers argued that availability and usage of mobile phones contribute to the growth of the likelihood of saving at the household level, with both savings stored directly on the mobile phone and savings in the account at a financial institution [8].

The pattern of the increase of probability of savings in the context of the digitalization in high income countries requires further study. This is especially relevant in the light of the results of a study by Demombynes and Thegeya, which revealed that the introduction of mobile money contributed to the growth of savings in the so-called "basic mobile savings", even among those respondents who did not potentially seek make no savings. At the same time, the M-KESHO mobile savings system had limitations for storing the savings of wealthy segments of the population [15]. Consequently, digital technologies are currently being developed along the path of developing products for different segments of the population that present a different set of requirements for the characteristics of financial services.

Having an account at a financial institution is also an incentive for saving behavior. At the same time, the presence of an account at a financial institution and the ability to pay bills via the Internet contribute to an increase in the probability of saving behavior, as evidenced by a positive coefficient before the intersection of the *account* and *Internet* variables. Thus, the possession of digital skills increases the likelihood of formal savings.

The results of a study by Demombynes and Thegeya, conducted in Kenya, added an interesting remark to the identified trend. Digital technologies expand the access of low-income groups of the population to formal and, to a greater extent, informal institutions, creating opportunities to save those who do not seek to do this [15]. King M. wrote about the threat to the status of formal institutions when he proved that digital technologies have a significant advantage over the physical offices of banks, which is manifested in distance and time saved [16].

The results of the study showed that the age of the respondent acts as an incentive to saving behavior, which can be explained as the life-cycle model Modigliani [17], when the individual seeks to maintain the level of consumption throughout life. Each additional year of age reduces the

likelihood of savings, due to the fact that with an increase in age, an individual spends almost all of his or her income without saving.

Table 1. Results of logit model estimation^a.

Variable	Coeff.	Odds Ratio
Internet	0.63854604***	1.893725***
account	0.79624439***	2.217198***
account#internet	0.20444536***	1.226844***
mobile	0.1696251***	1.184861***
female	0.00584569	1.005863
age	-0.00369823***	0.9963086***
secondary education	0.17670206***	1.193276***
completed tertiary education	0.32637727***	1.385938***
second income_group	0.23844636***	1.269276***
middle income_group	0.40328243***	1.49673***
fourth income_group	0.58228465***	1.790124***
fifth income_group	0.83378383***	2.302013***
employment	0.52753059***	1.694742***
_cons	-1.526911***	0.2172056***
<i>Pseudo R2</i>	<i>0.117</i>	
<i>Correctly classified</i>	<i>66.59%</i>	

^aNote: 0.01 - ***; 0.05 - **; 0.1 - *.

Among the sociodemographic characteristics, the respondent's gender was insignificant for saving behavior. On the contrary, research on financial inclusion emphasizes differences in access to financial services between men and women. The difference in gender financial inclusion is emphasized by researchers of the FDPI project, who analyse the progress of 21 countries on the path to financial inclusion and conclude that it is necessary to promote more comprehensive data collection and analysis regarding financial access and usage, particularly among traditionally underserved groups such as women [18].

For the first time, an analysis of employment on savings behavior was carried out. Economically active individuals have greater guarantees compared to economically inactive, therefore, they can take loans from financial institutions. In this case, the relationship between economic activity and financial activity is traced. The findings of the study indicated that the probability of saving behavior increases among economically active respondents.

A higher level of education enlarges the tendency to saving behavior. The reason for the impact of education on financial behavior is a greater level of knowledge, including in the financial sector. Honohan and King highlighted education as a key factor in saving [7].

We have found that the probability of savings behavior increases with rising income. Saving behavior is sensitive to income groups. If we combine this conclusion with the effect of education on saving behavior, we will get a justification for the widespread direction of financial literacy among low-income population, carried out in the policies of developing and emerging countries.

The odds ratio based on logistic regression shows the ratio of the probability of savers to the probability of not saving. In table 1, all variables except the respondent's gender are significant at 1%. The value of this statistical indicator is higher than 1. The odds ratio indicates an increase in the probability of saving behavior under the influence of digital technologies.

6. Conclusion and policy implications

The results of the study confirm that the formation of skills to use banking products via the Internet can increase the volume of financial transactions performed at the individual level, increase the amount of savings at the national level. This effect can be used in the formation of financial literacy programs and financial education of the population in developing and emerging countries.

Recommendations for implementation in the policy are to determine the importance of introducing technological innovations that expand the access of low-income groups of the population to mobile and Internet technologies. At the same time, policymakers should take into account the fact that digital technologies expand access not only to the financial services of formal institutions, but also informal ones, which requires regulatory supervision of the central bank in this direction. The introduction and expansion of the availability of digital technologies can be one of the ways to alleviate poverty and solve the problems of inequality in access to educational, financial, cultural, social benefits.

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Appendix

Table A. List of variables.

Variable	Description
<i>saving</i>	Dummy variable taking the value 1 if a respondent has made savings in the last 12 months
<i>Internet</i>	Dummy variable that takes the value 1 if a respondent has paid bills via the Internet in the last 12 months
<i>mobile</i>	Dummy variable that takes the value 1 if a respondent owns a mobile phone
<i>account</i>	Dummy variable that takes the value 1 if a respondent has an account with a financial institution
<i>female</i>	Dummy variable taking the value 1 if a respondent is a woman
<i>age</i>	Age of the respondent, years
<i>education</i>	Level of education, takes the value 0 for primary education, 1 - secondary education, 2 - completed tertiary or more education
<i>income_group</i>	Income group, 0 - first income quantile, 1 - second income quantile, 2 - middle income quantile, 3 - fourth income quantile, 4 - richest, fifth income quantile
<i>employment</i>	Dummy variable for employment, 1 - if a respondent in workforce.

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