Social safety and behavioral aspects of populations financial inclusion: A multicountry analysis

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Abstract. This article aims to investigate the connection between behavioral aspects of populations financial inclusion and the level of social safety. The study was conducted in several stages: collecting the necessary input, determining The Index of socio-safety, selecting the most relevant factors that characterize the behavioral aspects of financial inclusion, determining the functional relationships between The Index of socio-safety and indicators describing critical behavioral issues of

financial inclusion. The study involved 26 countries with different levels of economic development, and 18 indicators (10 characterized the behavioral aspects of financial involvement of the population, 8 - the world vectors of social safety). The Index of socio-safety was obtained with the help of PCA. Russian Federation and South Africa have the highest level of The Index among the studied countries. The lowest level of the calculated indicator is in Mozambique and Burkina Faso. Correlation and regression analysis revealed a statistically significant relationship between The Index of socio-safety and an increasing number of ATMs per 100,000 adults, usage of the internet to pay bills or to buy something online and increase the percentage of respondents who report having a credit card.

1. INTRODUCTION

The financial sector is a robust set of financial information that requires daily detailed analysis and processing. Financial inclusion, as a part of the formation of the general level of consumers' interests protection in the financial services market, is a driver for social inclusion. The European Microfinance Platform identifies 20 trends that can be used to analyze the population's financial inclusion, which updates the value of data science in its research. It is known that psychological impulses (existing bias, aversion to loss, and cognitive overload) can lead to reckless financial decisions. For members of society in poverty or on the brink of poverty, the consequences of such financial decisions (low economic level, chronic debt, short-term investment) can be devastating.

Many international organizations (World Bank, International Labor Organization, Food, and Agriculture Organization of the United Nations) consider social safety as a set of measures aimed at reducing social and economic risk and vulnerability and reducing overall poverty. Today, social safety includes three vectors: social assistance (publicly provided conditional or unconditional remittances or in-kind transfers, or community service programs); social insurance programs that contribute to specific emergencies that affect the well-being or income of households); labor market protection (provides unemployment benefits, develops skills and trains employees). Social safety refers not only to social development but also to economic transformation (increasing the purchasing power of households and stimulating and growing demand for food and other goods and services). The comprehensive action of social protection measures is aimed at combining programs of subsidies and savings and affects social protection measures. It allows poor people to overcome poverty steadily.

Nowadays, a lot of digital financial services are not incomprehensible, so many financial transactions are conducted through local agency networks. The reason of the low level of financial involvement of the population is not the level of financial literacy, but behavioral aspects (mismatch of certain functions with expectations, misconceptions about the principles of financial product or service, the influence of majority opinion on financial decision-making). Today, more and more people are talking about the true nature of the population's low financial activity. According to the latest data from the World Bank, 69 percent of adults around the world have an account. In the context of global digitalization of financial transactions, this figure should be expected to be higher.

Many adults in developing countries do not benefit from sophisticated financial instruments, such as automatic payroll deposits, mandatory pension contributions, or default insurance programs that help mitigate the effects of intuitive thinking. All these tools only complicate the financial decision-making process. Therefore, studying the impact of behavioral aspects of financial inclusion on the level of social safety is relevant and needs to be addressed. The aim of the article is to assess the level of connection between behavioral aspects of populations financial inclusion and the level of social safety.

2. LITERATURE REVIEW

Financial inclusion of the population determines the degree to which consumers have access to financial products and services. Usually, this concept is considered from three main points: financial literacy, financial security and financial activity. It is an opportunity to have access to branches of banks and other financial institutions, ATMs, self-service terminals, freely to control personal accounts, savings, and the distance to the service unit, trust in financial institutions, operating expenses, document flow. Besides, the works of (Bagmet & Obeid, 2017), (Bakari et al., 2018), (Buriak et al., 2019), (Caplinska & Ohotina, 2019), (Greco, 2017), (Kliestik et al., 2020), (Stefko et al., 2019), (Morscher et al., 2017), (Makarenko & Sirkovska, 2017), (Dave, 2017a; 2017b), (Singh, 2018), (García, 2016) consider financial inclusion as an integral part in the development of "healthy" financial society.

A group of researchers headed by Demirguc-Kunt in their study (Demirguc-Kunt et al., 2017) analyzes the impact of population financial inclusion on economic growth at the household level. Heng (2015) focuses on exploring the impact of new financial services on the financial stability of Bolivia and the financial inclusion of its population. Garcia (2016) investigates the relationship between financial security and affordability by the correlation model based on data from 2008 - 2016 in more than 150 countries. Such scientists as (Grybaitė & Stankevičienė, 2018), (Khan et al., 2017), (Levchenko et al., 2019), (Mishchuk et al., 2019), (Nocoń & Pyka, 2019), (Sisodia, 2019), (Vasileva & Lasukova, 2013), (Vasilyeva et al., 2020), (Grenčíková et al., 2019) used regression-correlation analysis and other methods as the way to process large amounts of financial data in the works.

Many works, in particular, (Bausch, 2019), (Bilan et al., 2019a, 2018), (Brychko & Olejarz, 2019), (Munk et al., 2017), (Rudiawarni et al., 2020), (Vasilyeva et al., 2016, 2019), (Shvindina, 2019) deal with the study of financial and business cycles based on time series analysis (seasonal, trend, cyclical component separation). Also there are a lot investigations about behavioral aspects in financial inclusion ((Brychko, 2013), (Churilova et al., 2019), (Cortés-Sánchez & Rivera, 2019), (Djajanto et al., 2019), (Djalilov et al., 2015), (Hadbaa & Boutti, 2019), (Kaasa, 2019), (Katan et al., 2019), (Kolomiiets & Petrushenko, 2017), (Matošková, 2019), (Němcová & Staňková, 2019)) and protection of consumers ((Piatek, 2018), (Poliakh, 2018), (Rehman, 2020), (Shapovalova et al., 2019), (Mihalčová et al., 2018)). Many scientific papers have found that the social safety of the population is also determined by the macroeconomic situation of the country (Aqil et al., 2019), (Bilan et al., 2019b, 2019f), (Logan & Esmano, 2017), (Próchniak & Szyszko, 2019), (Packard et al., 2019); alternative factors related to the development of other sectors of the economy (industry, banking, investment, education) (Bilan et al., 2019c); (Buriak, 2015), (Ch & Semenog, 2017), (Klimontowicz, 2019), (Leonov et al., 2014, 2019), (Pryima et al., 2018), (Trębska, 2018); socio-economic challenges (Gupta, 2017), (Korcsmáros & Šimova, 2018), (Kostyuchenko et al., 2018), (Louis, 2017), (Lyeonov & Liuta, 2016).

3. METHODOLOGY

The methodology of research involves the following steps:
- collection of necessary input information;
- determination of the Index of socio-safety;
- selection of the most relevant factors that characterize the behavioral aspects of financial inclusion;
- identification of functional relationships between The Index of socio-safety and indicators that characterize the key behavioral issues of financial inclusion.

Information from the World Bank databases was used as input variables in the article: Coverage of Social Protection and Labor programs by harmonized program category and Global Financial Inclusion for 26 countries with different economic development levels. The input indicators and their symbols are presented in the Table 1 of Annexes. From the given data, ten indicators (x1-x10), which characterize the behavioral aspects of financial inclusion. The choice of such a set of indicators to assess the behavioral aspects of financial inclusion is due to the openness of information from the international database The Global Findex, which allows for multicountry analysis of the financial inclusion. Eight indicators of social safety (Y1-Y8) were selected according to the world vectors of social safety (social insurance, social assistance, labor market). The method developed in this article is implemented on the example of data for 2014, as it is for this period that we have available data.

It is proposed to express the Index of socio-safety through the integral index determined by the principal component method by adjusting the inputs (Y1-Y8) by the weighting coefficients wi obtained from the following formula (1):

$$w_i = \frac{f_i d_k}{\sum_k f_i d_k} \tag{1}$$

where:
w_i – weight i variables;
f_i – factor load i variables;
d_k – share of total variance.

The integral index is determined by the formula (2):

$$I = \sum \bar{y}_{ij} w_i \tag{2}$$

where:
$\bar{y}_{ij}$ – normalized indicator value.

Normalization for the stimulants is carried out according to the formula (3):

$$\bar{y}_{ij} = \frac{y_{ij} - y_{min}}{y_{max} - y_{min}} \tag{3}$$

For the destimulants (4):

$$\bar{y}_{ij} = 1 - \frac{y_{ij} - y_{min}}{y_{max} - y_{min}} \tag{4}$$

In our case, all indicators are stimulants.

The selection of the most relevant factors that characterize the behavioral aspects of the financial inclusion of the population will be made using Principal Component Analysis. Principal Component Analysis, PCA is at the part of factor analysis. Factor analysis is used to solve two main problems: reducing the number of variables (data reduction); defining the structure of relationships between variables, their classification.

PCA allows to identify a number of components (factors) that explains all the variance and correlations of the initial values. The selected components (their number can be both set individually and programmatically obtained) are ranked in descending order of the proportion of total variance explained by each component. It is generally accepted that those components that account for more than 70% of the total variance can be called the most influential among the entire sample. The principle of selecting is next – the first component is to choose exactly the direction in the space of initial variables, in which the set of objects (points) under study has the greatest variation (variance). Each subsequent component is calculated to have its direction parallel to the first component and to account for as much of the residual dispersion as possible. This process continues until all the components that determine 100% of the variance of the studied variables are found. In addition, it is possible to determine the required number of factors by using a scree plot, where, on the basis of the eigenvalues of factors, Cattell (1966) suggested to find a place on the graph when the velocity of decreasing eigenvalues, when looking at the graph from left to right, decreases significantly. Anything left on the right side of the checkpoint is called "debris" that does not have a significant effect on the result. After determining the optimal number of factors, it is necessary to analyze the eigenvalues of the factors - these are the variances that are allocated to each of the factors.

Correlation analysis is required before identifying functional relationships between variables. It allows to determine the closeness and direction of the relationship between variables. Formalization of functional dependencies between The Index of socio-safety and indicators characterizing the behavioral aspects of financial inclusion will be carried out using regression analysis. The selection of the most relevant factors that characterize the behavioral issues of the financial inclusion of the population will be made using PCA.

It is necessary to take into account the values of the main parametric criteria, which can be used to assess the accuracy and significance of the model results. The obtained model will be evaluated according to the following criteria: coefficient of determination, Fisher's, and Student's tests. The ratio of determination $R2$ shows what part of the performance indicator's variation is related to the variety of the factor indicators. Fisher's (F-test) and Student's (t-test) criteria can answer the significance of the obtained results. The F-criterion's actual value is compared with its tabular value at given degrees of freedom and level of significance. If the condition is met, under which $F_{crit} > F_{tabl}$. And the probability p is less (equal) than 0,05 (at a given confidence level of 0,95), the hypothesis of the significance of the relationship between the dependent and factor variables is confirmed, if on the contrary - is rejected. In the case of the Student's t-test, the calculated value of the t-test is compared with the tabular value, which is selected from the corresponding statistical tables at a certain level of significance and degrees of freedom. If $t_{tabl} < t_{crit}$, then we can talk about the significance of the coefficient of determination. In the case of the obtained coefficients of the equation, this equality, as well as the probability value p, for each value of the criterion, which must also be less (equal) than 0,05 (for a given confidence level of 0,95). It tells that they are significant in models and different from 0. All identified stages of the study were implemented using STATISTICA software.

4. EMPIRICAL RESULTS AND DISCUSSION

As a result of using PCA The Index of socio-safety is presented in the Table 2 of Annexes and in the cartogram (Fig 1).
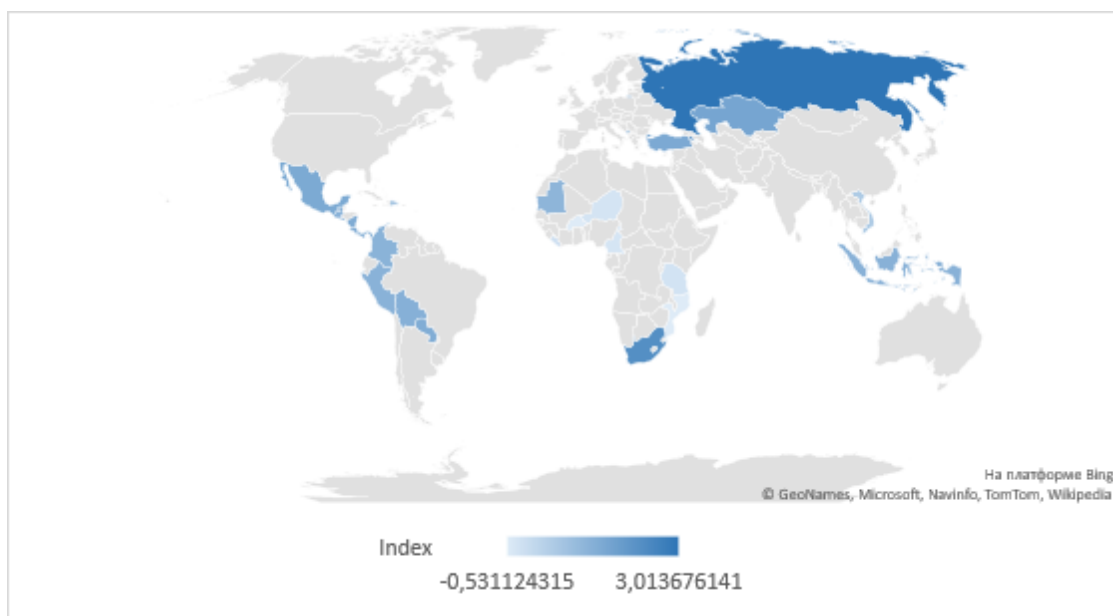

Figure 1. The Index of socio-safety in the world
Source: Authors' results

In this case we can see that Russian Federation and South Africa have the first position in the rating of The Index of socio-safety. Other countries have much smaller the level of of socio-safety.

As a result of the next step, 6 from 10 inputs (x1-x10) were selected. The number of selected factors and factor loadings for each indicator are presented in the Table 3.

Table 3

Factor loadings

Legend	Factors		
	Factor 1	Factor 2	Factor 3
x1	-0,451	0,644	0,025
x2	-0,833	0,406	-0,040
x3	-0,743	-0,140	0,328
x4	-0,542	-0,405	0,353
x5	-0,815	-0,174	0,011
x6	-0,569	-0,468	-0,198
x7	0,288	0,186	0,615
x8	-0,882	-0,061	0,174
x9	-0,893	-0,180	-0,095
x10	-0,868	0,375	-0,165

Source: Authors' results.

As we can see, from the results, the variables x2, x3, x5, x8-x10 are the most relevant in the study. Before including them in the process of determining the functional relationships with The Index of socio-

safety, we will conduct a correlation analysis to select those indicators of financial inclusion that have the closest relationship with The Index.

The result of the correlation analysis is the correlation matrix and the scattering matrix (Fig. 2).

|	Y	x2	x3	x5	x8	x9	x10
Y	1,000000	0,195984	0,692467	0,249860	0,427406	0,421611	0,279503
x2	0,195984	1,000000	0,478639	0,596055	0,653023	0,639135	0,921919
x3	0,692467	0,478639	1,000000	0,472046	0,705310	0,585116	0,543892
x5	0,249860	0,596055	0,472046	1,000000	0,720524	0,800735	0,642433
x8	0,427406	0,653023	0,705310	0,720524	1,000000	0,840130	0,708854
x9	0,421611	0,639135	0,585116	0,800735	0,840130	1,000000	0,680723
x10	0,279503	0,921919	0,543892	0,642433	0,708854	0,680723	1,000000
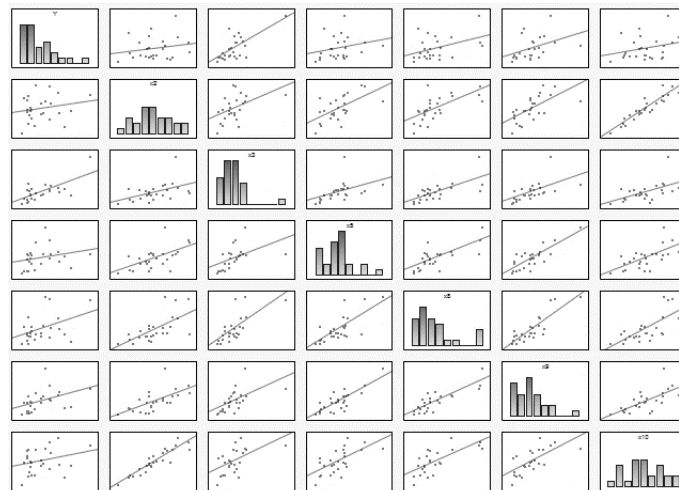
Figure 2. Results of the correlation analysis
Source: Authors' results.

To formalize the relationship between The Index of socio-safety and indicators of financial inclusion, multifactor regression model is constructed, where the integral index The Index (Y) will be as the dependent variable. The indices obtained in the results of PCA and correlation analysis (x3, x8, x9), which will act as independent variables. The obtained simulation parameters are presented in the table 4.

Table 4

Results of modeling

Variables	Parameters	t-crit	p-level
free term	0,075	4,849	0,000**
X3	0,670	3,228	0,001**
X8	-0,119	-5,006	0,005**
X9	0,217	7,838	0,001**
$R^2 = 0,62$			
F = 8,07; p-level = 0,0008			

Source: Authors' results ** indicates significance level at 0.05 level

The results of regression are next:
- increasing of the ATMs per 100,000 adults per unit causes increasing of The Index of socio-safety by 0,670;
- usage of the internet to pay bills or to buy something online decreases The Index of socio-safety by 0,119;

- increasing of the percentage of respondents, who report having a credit card causes increasing of The Index of socio-safety index by 0,217.

The quality of the calculations is confirmed by the high value of the coefficient of determination and the level of p which is less than 0,05.

As we can see, the result of the study shows the presence of a close functional relationship between The Index of socio-safety and indicators of financial inclusion, which are characterized by behavioral aspects. 62% of the change in The Index is due to changes in these indicators of financial inclusion. The negative impact on The Index of internet usage to pay bills or to buy something online is explained by insufficient regulatory support for the regulation of financial Internet services.

5. CONCLUSION

Formalization of the functional dependence between The Index of socio-safety and behavioral aspects of financial inclusion was carried out in several steps: a collection of necessary input information, determination of The Index of socio-safety, selection of the most relevant factors characterizing behavioral aspects of financial inclusion, determination of functional connections between The Index of socio-safety and indicators that describe the critical behavioral issues of financial inclusion of the population. Using PCA, The Index of socio-safety was obtained: Russian Federation and South Africa have the highest level of The Index of socio-safety among 26 countries with different levels of income. The lowest level of the calculated indicator is in Mozambique and Burkina Faso. Correlation and regression analysis revealed the presence of a statistically significant relationship between The Index of socio-safety and increasing the ATMs per 100,000 adults, usage of the internet to pay bills, or to buy something online and increasing the percentage of respondents who report having a credit card. Taking into account the obtained results will create a basis for reforming the social safety sector of consumers in the financial services market.

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ANNEXES

Table 1

Input variables

No	Name of variable	Sense of variable	Legend
1	Financially literacy	Adults who are financially literate (%)	x1
2	Account (% age 15+)	Denotes the percentage of respondents, ages 15+, who report having an account	x 2
3	ATMs per 100,000 adults	Denotes the total number of ATMs for every 100,000 adults in the reporting country	x 3
4	Branches per 100,000 adults	Denotes the number of branches of commercial banks for every 100,000 adults in the reporting country	x 4
5	Deposit accounts per 1,000 adults	Denotes the total number of deposit accounts that are held by resident nonfinancial corporations	x 5
6	POS terminals per 100,000 adults	Denotes the number of point of sale (POS) terminals per 100,000 adults.	x 6
7	Outstanding loans per 1,000 adults	Denotes the total number of loan accounts that are obtained by resident nonfinancial corporations	x 7
8	Used the internet (adults)	Used the internet to pay bills or to buy something online in the past year, older adults (% age 25+)	x 8
9	Credit card ownership, older adults (% age 25+)	The percentage of respondents who report having a credit card, older adults (% age 25+)	x 9
10	Made or received digital payments in the past year, older adults (% age 25+)	The percentage of respondents who report using mobile money, a debit or credit card, or a mobile phone to make a payment from an account, or report using the internet to pay bills or to buy something online, in the past 12 months, older adults (% age 25+)	x 10
11	Contributory pensions (Total Population)	Coverage of social insurance programs (% of population)	Y1
12	Social contributions (% of revenue)	Social contributions include social security contributions by employees, employers, and self-employed individuals, and other contributions whose source cannot be determined. They also include actual or imputed contributions to social insurance schemes operated by governments.	Y2
13	Coverage of social protection and labor programs (% of population)	Coverage of social protection and labor programs (SPL) shows the percentage of population participating in social insurance, social safety net, and unemployment benefits and active labor market programs. Estimates include both direct and indirect beneficiaries.	Y3
14	Unemployment, total (% of total labor force)	Unemployment refers to the share of the labor force that is without work but available for and seeking employment.	Y4
15	Wage and salaried workers, total (% of total employment)	Wage and salaried workers (employees) are those workers who hold the type of jobs defined as "paid employment jobs," where the incumbents hold explicit (written or oral) or implicit employment contracts that give them a basic remuneration that is not directly dependent upon the revenue of the unit for which they work.	Y5
16	Coverage of social safety net programs (% of population)	Coverage of social safety net programs shows the percentage of population participating in cash transfers and last resort programs, noncontributory social pensions, other cash transfers programs, conditional cash transfers, in-kind food transfers and public works programs.	Y6
17	Cash transfers (% of population)	Coverage of social safety net programs shows the percentage of population participating in cash transfers.	Y7
18	Conditional cash transfer (% of population)	Coverage of social safety net programs shows the percentage of population participating in conditional cash transfers.	Y8

Table *2*

Index of socio-safety in the world

Country	Income classification	Index
Armenia	Upper middle income	1,897
Bolivia	Lower middle income	1,239
Burkina Faso	Low income	-0,530
Cameroon	Lower middle income	-0,352
Colombia	Upper middle income	1,161
Costa Rica	Upper middle income	1,606
Dominican Republic	Upper middle income	0,651
El Salvador	Lower middle income	1,100
Guatemala	Upper middle income	1,179
Indonesia	Lower middle income	1,198
Kazakhstan	Upper middle income	1,562
Liberia	Low income	-0,180
Mauritania	Lower middle income	1,085
Mexico	Upper middle income	1,436
Montenegro	Upper middle income	1,800
Mozambique	Low income	-0,531
Nicaragua	Lower middle income	1,363
Niger	Low income	-0,322
Panama	High income	1,462
Paraguay	Upper middle income	1,339
Peru	Upper middle income	1,173
Russian Federation	Upper middle income	3,014
South Africa	Upper middle income	2,240
Tanzania	Low income	-0,297
Turkey	Upper middle income	1,443
Vietnam	Lower middle income	0,427