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MODELING INTEGRAL FINANCIAL STABILITY INDEX: A CROSS-COUNTRY STUDY[3]

The recent global financial crisis significantly affected world economies and revealed a problem of the clear financial stability measures absence. The construction of an integral index is highly desirable to track the financial stability level over time and diminish the probability of financial instability through the recognition of its sources. The novelty of the current research is that such an index is being built for various countries at the same time and the quantitative measures are being introduced to select the best model by comparing the behavior of different models with the benchmark. It was shown that data non-stationarity plays a significant role in the best predictors' selection. Therefore, the best model is that built on the first differences of initial indicators. The best model contains "Return on Assets" and "Regulatory Capital to Risk-Weighted Assets" as financial stability predictors.

Keywords: financial stability, integral index, economic resilience, IMD, early warning system

JEL Codes: G01, G21

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1. Introduction

The 2008 global financial crisis had a significant impact on economies all over the world and revealed a problem of integral index construction. Such an index would reflect the financial stability level evolution in time in a specific country. The purpose of this research is to construct an index based on individual microeconomic indicators. These would not only track financial stability evolution, but would also enable one to compare different countries in terms of attractiveness for investors.

Such an index composed of relatively easy to monitor and interpret individual indicators might also be helpful providing regulators and other interested parties with a tool which could allow financial stability level monitoring and better recognition of financial stress to the system sources to prevent uncontrollable instability growth.

To the best of our knowledge, this is the first effort to combine the Financial Soundness Indicators (IMF data) and the Resilience of the Economy index (IMD data) in one approach to construct an aggregate financial stability index. The IMF data allows using the same indicators for all countries under consideration being assured that they were collected in a similar way. Also as the IMF continues amassing these indicators on an even broader scale (more countries participate in this project as time moves on), it is possible that all the data for the integral financial stability index (IFSI) calculation would be available. The IMD data provides the "learning" variable which can also be treated as a benchmark in cases when IFSI is used to obtain a financial stability forecast.

The structure of this paper is following: In the second section presents a brief literature overview of existing integral financial stability index construction attempts. The third section is devoted to the investigated data, and the fourth to the methodology description. In the fifth section the current results of the research are presented. Finally, section six makes some concluding remarks.

2. Literature overview

The idea of developing an Early Warning System (EWS) first occurred in 1975. In 1977 the numerical index on bank vulnerability, based on factor analysis technique, was developed by the Federal Reserve Bank of New York (Goodhart, 2011).

In 2003 the International Monetary Fund (IMF) proposed a set of 39 individual financial soundness indicators. They were divided into a "Core set" and "Encouraged set" (FSI) for the purpose of financial stability level tracking (San Jose, et al., 2008; Gadanecz, Jayaram, 2009).

Nevertheless, the multi-directional movements of these indicators make the defining an actual financial stability level and discovering the nature of the changes overcomplicated. This set of indicators has not allowed one to predict the instability of 2008–2009 or has been uninformative about making a decision based on it.

There already have been various attempts at integral index construction for specific countries (for example, Turkey (Central Bank of the Republic of Turkey, 2009), Columbia (Morales, Estrada, 2010), Czech Republic (Geršl, Hermánek, 2008)) and for the global economy (Dattels, et al., 2010).

Generally, the most common current approaches to aggregate index development can be divided into three groups:

Weighted-average approach (WAA)

This is the most basic and commonly used method where the resulting aggregate index is the simple weighted average of initial indicators. In the paper of Geršl and Hermánek (2008), this approach was used to build the financial stability index for the Czech Republic based on IMF FSI (the core set).

The Central Bank of the Republic of Turkey (2009) built the integral Financial Strength Index for Turkey as a weighted average of the indicators from the following categories: asset quality, liquidity, exchange rate risk, interest rate risk, profitability, and capital adequacy.

In order to construct an aggregate financial stability index for Macao, Cheang and Choy (2011) applied this technique to 19 individual indicators split into three categories: “financial soundness”, which are partly similar to IMF FSI; “financial vulnerability”, a region’s macroeconomic factors; and “regional economic climate”, the macroeconomic indicators of neighboring regions. All the indicators were normalized before inclusion in the index (two ways of normalization were considered: statistical and empirical).

Morales and Estrada (2010) constructed an integral index for the whole financial system of Columbia as well as for separate groups of financial institutions. The weighted-average approach, among others, was used for this purpose.

Principal components analysis (PCA)

Also commonly used, this method implies the principal components calculation for initial indicators. After being determined, the first principal component (accounting for the biggest part of overall variability in indicators) is used as an aggregate index.

This method was used to construct the “financial conditions index” for the U.S., based on 100 financial variables of different frequency (Brave, Butters, 2011). All indicators were split into three groups: money markets, debt and equity markets, and the banking system.

Morales and Estrada (2010) employed the PCA as an alternative to the WAA to develop a Columbian integral index.

The PCA and its modifications were also used in financial stability index construction for Israel (Arzamasov, Penikas, 2014).

Regressions estimation

In the presence of a “learning” variable, associated with financial stability level, one can use it as a dependent variable in regression analysis. For example, Morales and Estrada (2010) found that the number of entities with high stress level (higher than pre-defined threshold) was used as a dependent variable in Poisson regression.

Other suggested financial stability measures

Dattels, et al. (2010) analyzes the dynamics of the Global Financial Stability Map. The map was initially proposed by IMF in April 2007 and published twice a year. The graphical representation of the map is an octahedron with the center connected to apexes by rays. The length of each ray is propotional to the current point value (evaluated with the use of precious dynamics) of corresponding indicator. Each indicator is the aggregate of the related individual factors. For these map dynamics to be interpreted, the analysis of changes in each indicator is necessary. The authors argue that the map cannot be reduced to a single index.

The financial stability of the Czech Republic was also defined in relation to a set of other European countries (Geršl, Hermánek, 2008). For this purpose the IMF FSI (the core set) were used. The value of each indicator defines the rank of each country for each indicator. The overall rank of the country in terms of financial stability is the function of its ranks obtained using each indicator.

A study by Lunde (2009) focuses on building stability indicators for the banking system of Denmark. The author argues that the use of individual data (for owner occupiers) better suits the stability monitoring purpose than an aggregated one. The following four ratios were considered: housing wealth/gross income, net liabilities/gross income, net liabilities/wealth, and net interest expenditure/income. The medians and high percentiles of these indicators for the younger group of borrowers (aged 30–39) are proposed as banking stability mirrors.

All the approaches are summarized in Table 1.

Table 1. Approaches to aggregate financial stability index construction.

Authors	Year	Country	Time period for the data	Approach
Geršl, Hermánek	2008	Czech Republic	1997–2006	WAA, Other
Central Bank of the Republic of Turkey	2009	Turkey	2009	WAA
Lunde	2009	Denmark	1999–2009	Other
Dattels et al.	2010	World	2007–2009	Other
Morales, Estrada	2010	Columbia	1995–2008	WAA, PCA, Regression
Brave, Butters	2011	U.S.	1973–2010	PCA
Cheang, Choy	2011	Macao	1996–2010	WAA
Arzamasov, Penikas	2014	Israel	2003–2013	PCA

Only few of these studies contain a dependent variable in index development (Morales, Estrada, 2010) or introduce some benchmark to analyze the resulting index behavior (Geršl, Hermánek, 2008; Brave, Butters, 2011). And none of them use quantitative measures to give a numerical estimate for the quality of developed indices. Moreover most indices are built for a specific country so different countries cannot be compared as their indices were built with different sets of indicators. Even assuming that the same data is available, the ability of any model to predict the financial stability in other countries is questionable.

The data used in the current research presents benchmark stability values and will help us to calculate the quantitative model goodness measured to range different models and select the best. It also will enable us to use the developed models and the same data to calculate the financial stability level in a rather broad set of countries; and probably (with some extra assumptions) to extend the model's scope to the countries for which the dependent variable is not presented.

3. Data

3.1. Independent variables

Financial Soundness Indicators (both core and encouraged sets) were used as independent variables. All these data are available on the IMF website. Altogether 48 countries were included in the initial (non-filtered) dataset. The records with periodicity different from annual (for example, semi-annual or quarterly) were led to annual periodicity: for the variable "Number of Bankruptcy Proceedings Initiated", the annual value is the sum of quarterly values; for all the others indicators the last period values of each year were used. The final sample period ranges from 2002 to 2013. This set can be treated as an unbalanced panel since there is no data for some countries for early years.

3.2. Dependent variable

The indicator, "Resilience of the Economy" (ER), was used as a dependent variable. IMD publishes reports with this factor's actual values for different countries on a regular basis. The values of the ER indicator range from 0 (the worst situation) to 10 (the best situation).

As a result of primary data collection 439 rows (each marked by ID="year-country") were obtained where at minimum one independent variable's value is available. In 296 of these rows the dependent variable values are presented. The other records were removed since the methods used in the research assume the presence of a dependent variable. The list of all variables as well as summary statistics for both sets are presented in Appendix 1A (**initial set** – "Before empty ER removing", and the set containing the dependent variable's values **short set** – "After empty ER removing").

Figure 1, which presents a histogram for the indicator "Capital to Assets", was used to describe the core of graphical analysis. Orange marks affiliation with the short set, and light yellow to initial set. The top plot is a box and whisker plot. The bold line marks the location of the sample median and the left and right borders of the rectangle are the boundaries for the first and the third quartiles, correspondingly. The whisker boundaries are defined by the function $\max(\min(x), lb - 1.5 * ir)$ for the left one and $\min(\max(x), rb + 1.5 * ir)$ for the right. Here x is the variable under consideration, lb, rb – left and right borders of the rectangle, $ir = rb - lb$. The points are the outliers, i.e. the values lying beyond the whisker boundaries. When plotting the box and whisker plot for the sample obtained from a Gaussian distribution, one notices that less than 5% of points are outliers. The bottom plot is the histogram. Yellow denotes the places where two dataset histograms overlap. The larger the amount of yellow in the histogram, the more similar the datasets are.

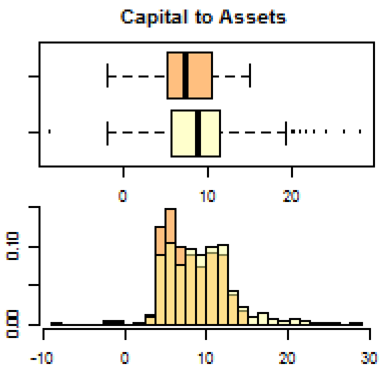


Figure 1. Graphical analysis for one of the independent variables.

The analysis in the histogram shows that described sample reduction generally has not affected the representativeness in the context of individual indicators. Statistical comparison of these two datasets also presented in Appendix 1B.

As there is not enough data for some variables, and because of possible interdependence between other variables further reduction of the sample is necessary.

Firstly, the variables with the numbers 34–36 – “Net Foreign Exchange Exposure to Equity”, “Average Bid-Ask Spread in the Securities Market”, and “Average Daily Turnover Ratio in the Securities Market” (see Appendix 1) – were excluded from the short set because of the relatively small amount of data and extremely large variance (the values for different countries are several orders of magnitude different).

Then remaining data was analyzed in terms of individual indicators value completeness (Appendix 2). As a result, 10 indicators, providing a maximum 233 “full rows”, were selected for further research (this set will be referred to as the **filtered set**). These variables – marked by a “1” in the column “First 10” in the table presented in Appendix 1. Summary statistics of these indicators are presented in Table 1 of Appendix 4A in two variants: for all the values of the variable in the short set (Before NA removal) and only for the rows in the filtered set (After NA removal). It is worth noting that all these indicators are in the IMF “core set.

In Table 2 of Appendix 4A correlation matrix is presented for variables from filtered set. Correlation matrix analysis suggests that in pooled regression (without taking into account potential country and time effects) one would expect a significant relationship between the indicators, “Non-performing Loans to Total Gross Loans” (–0.49), “Return on Assets” (+0.18), “Return on Equity” (+0.29), and the dependent variable: “Resilience of the Economy”.

However, one can assume that there exists a country-specific or time-specific part of variance in the “Resilience of the Economy” indicator. This can be taken into account by introducing dummy-variables (for time codes or countries) into a simple regression of the indicator under consideration on the ER index. The visual representation of this analysis is shown in Appendix 3. The results, including regression coefficients and corresponding p-values, are presented in Table 3 of Appendix 4A.

Based on p-values, the conclusion can be made that the indicator, “Non-performing Loans to Total Gross Loans”, is suitable for country comparison at a particular time point whereas the indicator, “Regulatory Capital to Risk-Weighted Assets”, can better distinguish between different time periods for one country. Both of these indicators entering the single-factor regression with a negative sign implying their the negative relation to financial stability. The indicators, “Return on Assets” and “Return on Equity”, can be used for both. For these two indicators, the regression coefficients are positive. The other variables seem to be unrelated to dependent variable (p-value greater than 5%) at least being used separately.

One can also see that there are two large correlation coefficients between two pairs of independent variables: FSERE and FSERA, FSKRTC and FSKRC, i.e. “Return on Assets” and “Return on Equity”, “Regulatory Capital to Risk-Weighted Assets” and “Regulatory Tier 1 Capital to Risk-Weighted Assets”. This can cause a problem with multicollinearity. So the variables with large variance inflation factor (VIF) values – greater than three – were excluded from the final set. The exclusion was made step-by-step starting from the indicators with the highest VIF values and continuing until there were no indicators with VIF values greater than three. The result (later referred to as **final set 1**) is shown in Table 4 of Appendix 4A. So final set 1 consists of the variables with non-empty cells in the lower row of this table.

As all of variables are time series (given the specific country), implying the potential presence of nonstationarity, their first differences were also analyzed. The first differences were calculated using the filtered set data as input separately for each country in successive time periods. The results in the form similar to the tables above are presented in Tables 1–4 of Appendix 4B.

The statistics comparison allows us to conclude that the indicators interdependence changes when turned to the first differences. In particular, the indicators “Non-performing Loans to Total Gross Loans”, “Return on Assets” and “Return on Equity”, no longer reveal a connection to the explained variable. Instead of this, both “Regulatory Capital to Risk-Weighted Assets” (–0.32) and “Regulatory Tier 1 Capital to Risk-Weighted Assets” (–0.27) show a significant influence on ER according to the correlation matrix (Table 2 of Appendix 4B). These variables allow predicting ER in a concrete country rather than comparing different countries with each other (Table 3 of Appendix 4B).

As in case of initial variables, there are some pairs of indicators with large correlation coefficients. To exclude them from further analysis, VIF values were obtained and variables with the largest VIF-values were eliminated step by step until the remaining VIF values were all less than the threshold, equal to three. The result (later referred to as **final set 2**) is shown in Table 4 of Appendix 4B. So final set 2 consists of the variables with non-empty cells in the lower row of this table

4. Methodology

Linear regression was used in this study as the basic method with some extensions, like introducing dummy-variables for countries or time codes (fixed effect model), and for groups of dummy-variables (in some moments similar to the CART[4] model). As the methodology is identical to the sample of initial values (final set 1) and transformed to first differences (final set 2), any of these datasets will be referred to as a sample.

Modeling is performed in L steps, where L is the number of variables in the sample. At the first step only one indicator was explored: "Interest Margin to Gross Income", with final set 1, and "Non-interest Expenses to Gross Income" with final set 2 (because of the absence of the prior). Then at each step, one more variable is added according to the sequence, giving maximum "full rows" (defined by row sequence in Appendix 2).

The sample was split into two parts: modeling sample and test sample. Several regressions were estimated on the modeling set:

- Linear regression including only variables significant at the 5% level (so-called, "backward elimination" was used at this step) – model1.
- Linear regression including only that variables significant at the 5% level and dummy-variables for countries/time codes divided into several groups by analytical procedure – model2.
- Linear regression including dummy-variables for countries/time codes divided into several groups by analytical procedure – model3.

For each model the hypothesis of residual normality was verified by the Jarque-Bera test.

In order to split countries/time codes into groups, an auxiliary regression was estimated. This included all available variables at this step significant at a 5% level and dummy-variables for countries/time codes. The k-means procedure was then used to divide observations onto a pre-defined number of groups.

To assess the quality of model in terms of its forecasting power, the values of the dependent variable (Resilience of the Economy) on the test sample were predicted using only the independent variables. They were then compared with the fact. To quantify the result of the comparison, the three following statistics were selected (hereafter, in all cases the initial values of ER – not the first differences – will be referred to as forecast values):

- Mean squared error – MSE
- R-squared statistics for forecast – RSQ. The formula is the same as for model R-squared:

[4] Classification And Regression Tree analysis

$$R^2 = 1 - \frac{\text{Residual sum of squares}}{\text{Total sum of squares}},$$

but the values are taken for the test sample.

- Spearman correlation coefficient between fact and forecast values – Corr

The variants set division into modeling and test samples are the following:

- If dummy variables for country groups were used, the modeling sample is all observations with time codes 2012 and 2013 (first variant).
- If dummy variables for time codes were used, the 2013 dataset was excluded – there was a lack of data. And one more set division variant was used: the set was divided into samples by countries randomly so that the test sample contained 25% (11 out of 44) countries (second variant). The data from final set 1 only was used in this case.

5. Results

5.1. Initial variables (final set 1)

5.1.1. Model with Country Effect

The groups' number (for dummy variables in model2 and model3) was taken equal to three that corresponds to assumption that three different groups could be distinguished: countries with high, medium and low financial stability.

The results of model implementation for final set 1 with dummy-variables for countries are presented in Tables 1–2 of Appendix 5A. For comparison purposes the same statistics were also calculated for the "naive" model – the model which forecasts the values of ER being equal to the observed in the previous year for corresponding country (Benchmark).

Fact and forecast values for "Resilience of the Economy" obtained from the test sample for step 8 are visualized in Fig. 3.

It can be easily seen from the Table 1 of Appendix 5A (the last step of the algorithm hereafter used) that model2 and model3 perform (MSE=1.13 and MSE=1.13, RSQ=0.56 and RSQ=0.56, Corr=0.84, and Corr=0.83, correspondingly) much better than the model1 (MSE=2, RSQ=0.26 and Corr=0.66). This means that the "country effect" is much more significant in explaining the financial stability level than the indicator dynamics. One can also see that the naïve model's performance is in turn much better than the other models', implying that the large stability variation was not accounted for by the indicators under consideration.

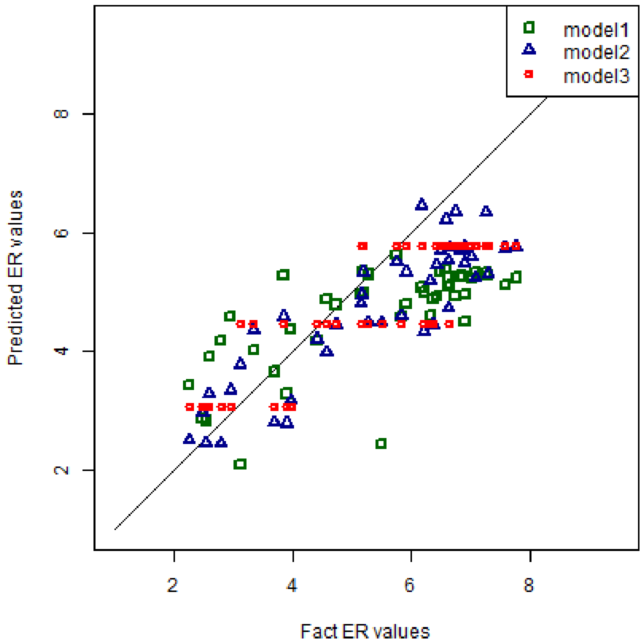


Figure 3. Actual and forecasted values of the ER. Initial variables (final set 1), dummies for countries (model2, model3). Note: vertical axis – ER values; horizontal axis – number of observation in the test sample.

5.1.2. Model with Time Effect

The number of groups was taken equal to two in this case. That is, it was assumed that there was some period in the time series – somewhere behind the crisis years where the dependence structure of indicators changed significantly and then returned back to pre-crisis levels. Or there could be two different dependence structures one – before and another – after the crisis year which is also a current dependence structure.

A) First variant of set division

To make the forecast, the test sample (i.e. the data of 2012) was attributed to the same group as 2011. This is consistent with the assumption made for the number of groups defining: in both cases, a temporary change and structural shift in dependence structure can make 2011 and 2012 similar.

In Table 1–2 of Appendix 5B, forecast quality measures and coefficients obtained using this model are presented. Fact and forecast values (obtained for the test sample) for "Resilience of the Economy" corresponding to these models are visualized in Fig. 4.

As in case of country effect the model2 outperforms model1 (MSE=1.43, RSQ=0.44 and Corr=0.65 vs MSE=1.98, RSQ=0.24 and Corr=0.66) but the results of model2 are worse compared with the corresponding model with country effect.

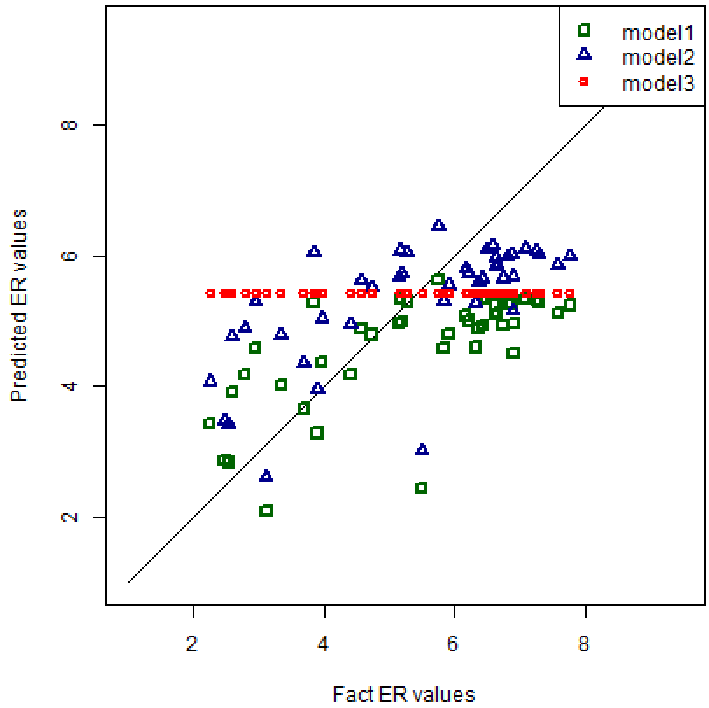


Figure 4. Fact vs. forecasted values of the ER for step 8 (time effect). Note: vertical axis – ER values; horizontal axis – number of observation in the test sample.

B) Second variant of set division.

In this exercise, as the data was split into samples randomly, the conclusions would be misleading if only one iteration was carried out. To obtain a realistic picture, 100 iterations of randomly splitting data into groups were carried out. On each iteration, all modeling steps were conducted. Table 3 of Appendix 5B presents summary statistics for the forecast quality measures obtained on the 8th (the last) step of each iteration.

The mean RSQ values for all the model predictions (model1, model2 and model3) in this case are close to zero with high negative values obtained in some iterations. This means that even if the time effect exists it is comparatively less significant than the influence of the country specificity.

5.2. First differences (final set 2)

The results for the models in first differences (final set 2) are presented in Tables 1–2 of Appendix 5C.

Figure 5 presents forecasted values of ER obtained on the test sample using the models estimated on step 7 and fact ER values.

As the prediction values were transformed back to the absolute values (from the first differences) before the goodness-of-the-model statistics were calculated, these statistics can be compared with the other models' statistics. One could see that in case of the model in first differences the results of model1 are more accurate than the model2 and comparable (of the same order) with the benchmark – "naïve" model's results.

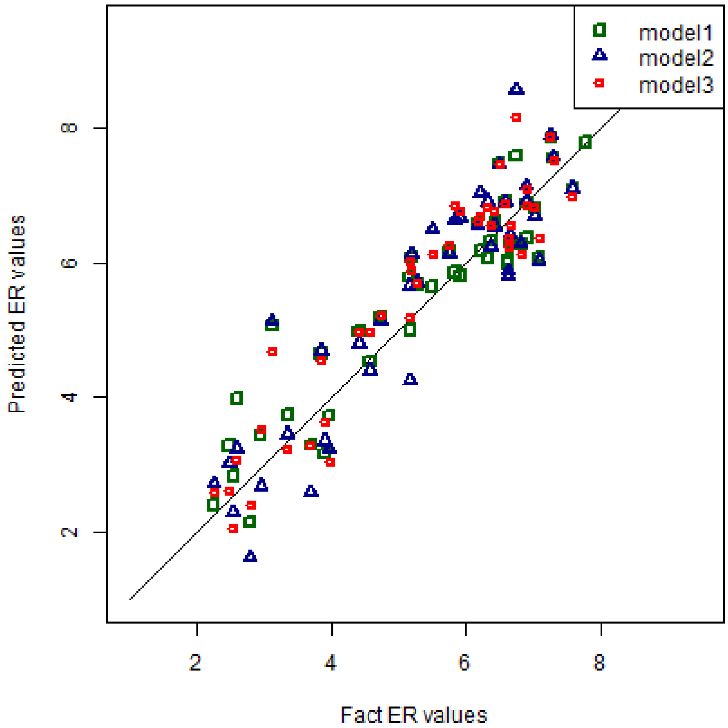


Figure 5. Fact vs forecasted values of the ER. Variables in first differences (final set 2), dummies for countries (model2, model3). Note: vertical axis – ER values; horizontal axis – number of observation in the test sample.

5.3. Summary results and discussion

In Table 2 shows all coefficients for all the models developed (see Appendix 5).

The variables, "Interest Margin to Gross Income" and "Return on Assets", always had positive coefficients whenever they occurred in models. And for indicators, "Regulatory Capital to Risk-Weighted Assets" and "Liquid Assets to Short Term Liabilities", coefficients were always negative. Concerning the indicators, "Non-performing Loans Net of Provisions to Capital" and "Non-performing Loans to Total Gross Loans", the coefficients changed the sign when the dataset was changed (i.e. regression in first differences were built instead of regression in initial values).

Table 2. Indicator coefficients obtained from different models.

Indicator		FSEIM	FSERA	FSKRC	FSKNL	FSANL	FSLS	MSE	RSQ	Corr
country-effect, final set 1	model1				0,019	–0,194		2,005	0,225	0,657
	model2	0,013	0,224	–0,109			–0,004	1,126	0,564	0,841
time-effect,	model1				0,019	–0,194		1,976	0,235	0,656

final set 1	model2				0,022	−0,208		1,425	0,448	0,652
country-effect, final set 2	model1		0,1083	−0,2488				0,372	0,856	0,916
	model2			−0,338	−0,021	0,132		0,558	0,785	0,874

* The result for first variant of data set splitting

From the last three columns and rows corresponding to final set 1 only, it becomes obvious that the models with time country effect considered are more accurate than the ones with time effect; and the models with dummies (model2) are better than models with only intercept (model1)

Regression coefficients change significantly if final set 2 (data in first differences) is considered. The models of this group are much better than the others according to the forecast quality measures. Moreover, model1 is better than model2 meaning that there is no country effect: the model with first differences is the same with no respect to specific country.

The most surprising thing is that in all the cases the variable “Regulatory Capital to Risk-Weighted Assets” entered the model with negative sign meaning that the higher value this indicator had, the lower was the financial stability. Or in case of first differences – the growth of this indicator leads to the reduction in financial stability level. This is an unexpected result because with the maximum capital level, the financial system could not exist – so there is not any stability in such case. Conversely, if the capital is equal to zero, it is quite obvious that the stability level is very low.

6. Conclusion

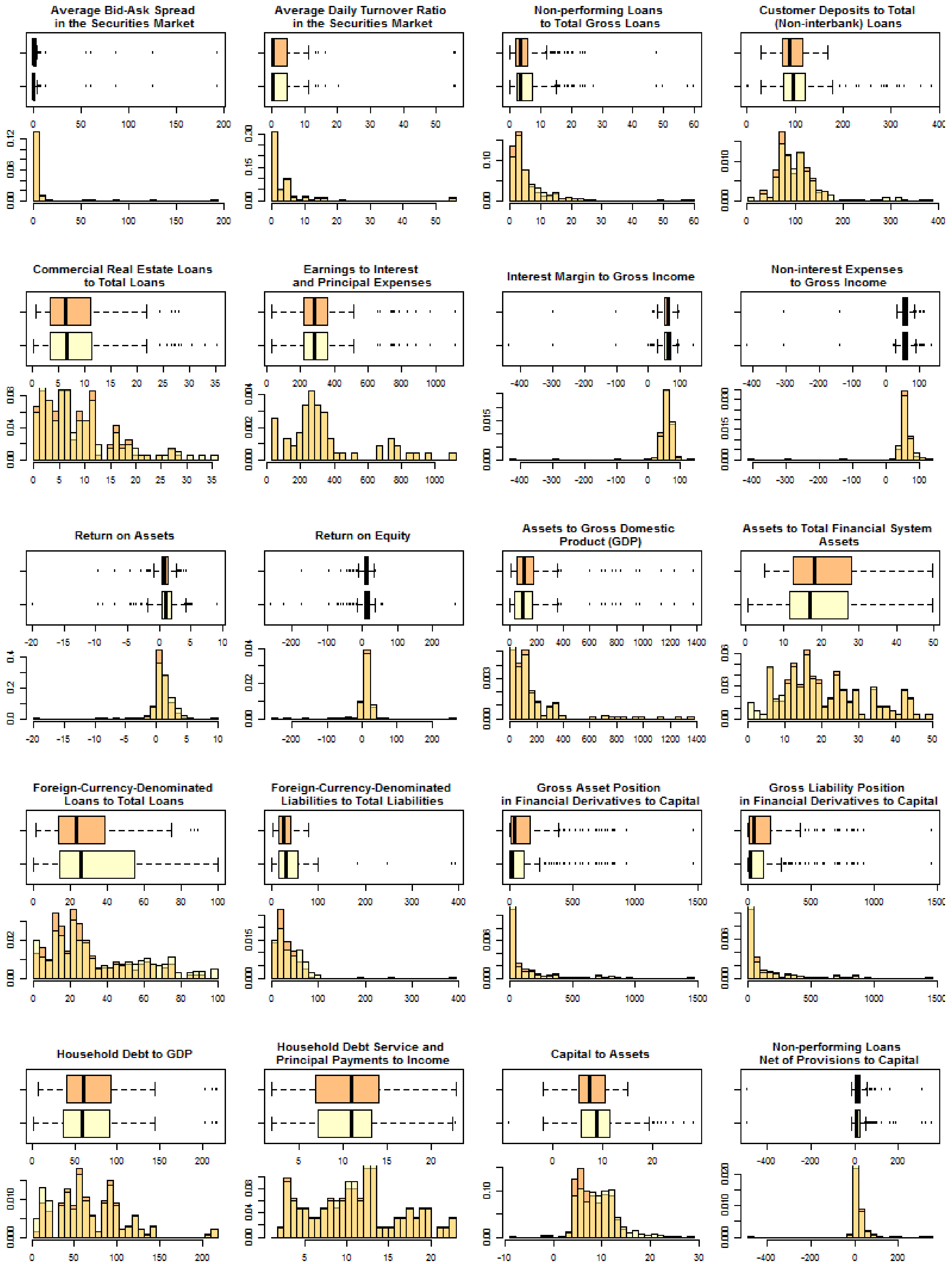
In this paper, the methods based on linear regression and panel analysis were proposed to develop an integral financial stability index. The data on Financial Soundness Indicators collected by the IMF and on the Resilience of the Economy index published by IMD were used as independent variables and a dependent variable, correspondingly.

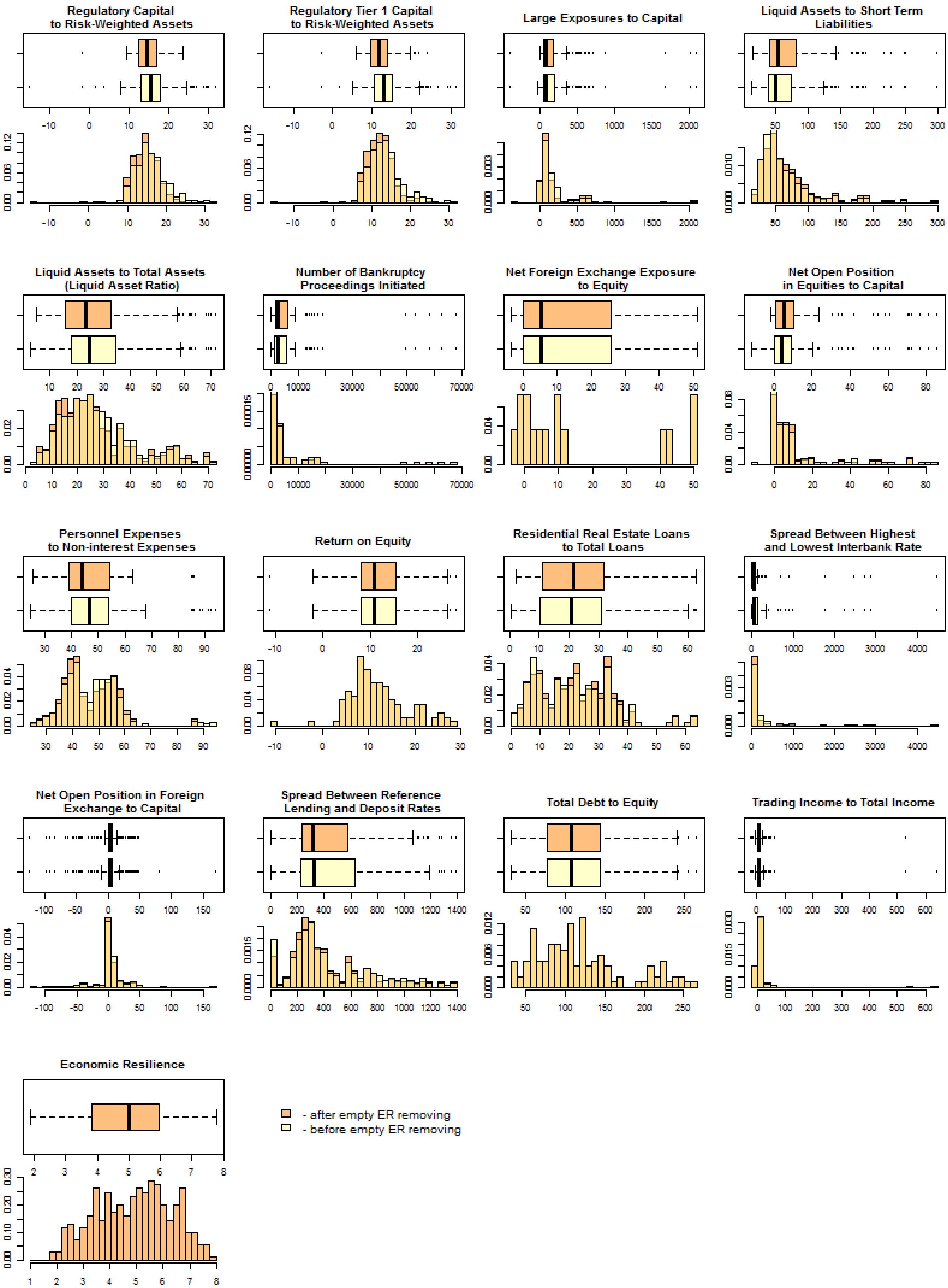
Also three numerical statistics were explored as the resulting index’s quality measures. Based on these measures it was shown that the best model is the model exploring the first differences of initial indicators’ values, i.e. the stationary time series for each country. In these cases the specific country differences disappear and the methodology can be extended even to the countries which were not in the development sample, providing they have necessary data.

The best model contains “Return on Assets” and “Regulatory Capital to Risk-Weighted Assets” as financial stability predictors.

It also occurred from the calculations that the variable “Regulatory Capital to Risk-Weighted Assets” seems to have a strong negative impact on financial stability. Although it is obvious that this variable’s very low values would lead to instability. So the finding of optimal value of “Regulatory Capital to Risk-Weighted Assets” indicator is a possible further research direction.

Appendix 1A. Graphical comparison of datasets.




Regulatory Capital to Risk-Weighted Assets
Regulatory Tier 1 Capital to Risk-Weighted Assets
Large Exposures to Capital
Liquid Assets to Short Term Liabilities
Liquid Assets to Total Assets (Liquid Asset Ratio)
Number of Bankruptcy Proceedings Initiated
Net Foreign Exchange Exposure to Equity
Net Open Position in Equities to Capital
Personnel Expenses to Non-interest Expenses
Return on Equity
Residential Real Estate Loans to Total Loans
Spread Between Highest and Lowest Interbank Rate
Net Open Position in Foreign Exchange to Capital
Spread Between Reference Lending and Deposit Rates
Total Debt to Equity
Trading Income to Total Income
Economic Resilience
- after empty ER removing
- before empty ER removing

Appendix 1B. Statistical comparison of datasets.

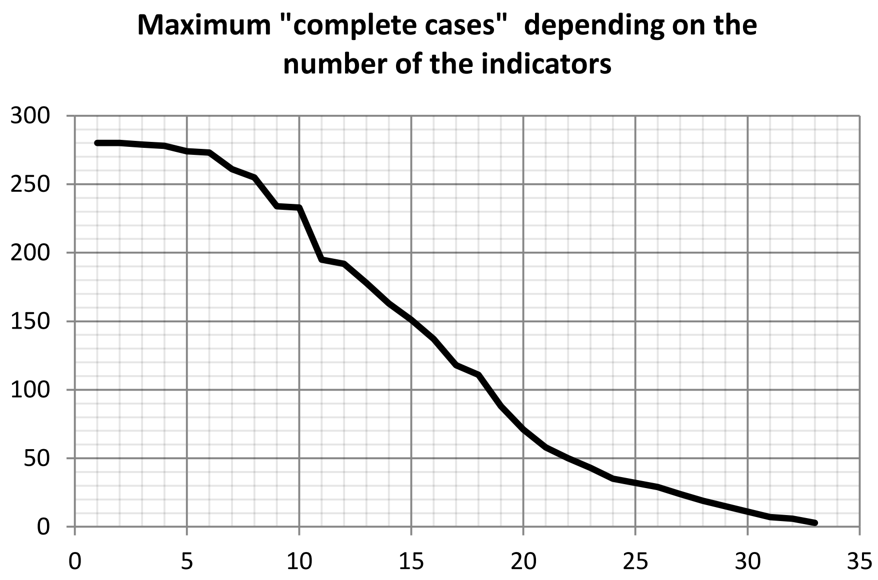
			After empty ER removing					Before empty ER removing							
N	Concept code	Concept	Min	Max	Mean	Sd	Filled	Min	Max	Mean	Sd	Filled	First 10	Core	Category
0	Y	Economic resilience	1,89	7,77	4,92	1,41	296	1,89	7,77	4,92	1,41	296			
1	FSANL	Non-performing Loans to Total Gross Loans	0,08	48,12	5,07	5,62	260	0,08	59,76	5,98	6,96	401	**1**	**1**	AQ
2	FSCD	Customer Deposits to Total (Non-interbank) Loans	29,08	168,33	94,89	29,77	224	2,50	385,26	106,06	51,41	337			DT
3	FSCR	Commercial Real Estate Loans to Total Loans	0,56	28,25	8,15	6,17	136	0,16	35,46	8,75	7,21	170			REM
4	FSEI	Earnings to Interest and Principal Expenses	29,67	1120,25	345,84	241,48	65	29,67	1120,25	345,84	241,48	65			NFC
5	FSEIM	Interest Margin to Gross Income	-294,34	100,45	57,52	26,96	280	-433,38	142,77	57,30	33,68	422	**1**	**1**	EP
6	FSENE	Non-interest Expenses to Gross Income	-303,47	115,77	57,49	27,66	280	-413,69	137,38	56,79	33,89	422	**1**	**1**	EP
7	FSERA	Return on Assets	-9,52	4,35	0,85	1,37	280	-19,80	9,14	1,09	1,93	421	**1**	**1**	EP
8	FSERE	Return on Equity	-169,20	38,81	10,12	17,21	279	-258,00	266,04	10,93	27,34	420	**1**	**1**	EP
9	FSFAG	Assets to Gross Domestic Product (GDP)	4,05	1378,52	172,36	227,62	167	0,32	1378,52	161,19	223,76	179			OFC
10	FSFAT	Assets to Total Financial System Assets	5,10	49,45	21,35	11,24	153	0,58	49,45	20,27	11,73	165			OFC
11	FSFC	Foreign-Currency-Denominated Loans to Total Loans	1,48	90,11	28,46	20,18	206	0,00	100,00	34,52	25,27	318			DT
12	FSFCD	Foreign-Currency-Denominated Liabilities to Total Liabilities	2,81	79,02	29,62	18,72	203	0,00	392,82	38,73	40,23	308			DT
13	FSGA	Gross Asset Position in Financial Derivatives to Capital	0,24	1470,16	142,54	232,87	192	0,00	1470,16	113,75	214,91	242			DT
14	FSGL	Gross Liability Position in Financial Derivatives to Capital	0,70	1458,52	145,76	233,93	192	0,00	1458,52	116,40	216,11	242			DT
15	FSHG	Household Debt to GDP	7,08	217,51	69,35	39,35	183	2,06	217,51	64,44	40,99	200			HH
16	FSHS	Household Debt Service and Principal Payments to Income	1,96	22,84	11,01	5,42	85	1,96	22,84	11,01	5,28	90			HH
17	FSKA	Capital to Assets	-1,88	15,03	7,91	3,09	247	-8,42	28,28	9,22	4,21	375			DT
18	FSKNL	Non-performing Loans Net of Provisions to Capital	-484,06	313,82	17,55	42,25	267	-484,06	352,44	18,60	44,03	408	**1**	**1**	CA
19	FSKRC	Regulatory Capital to Risk-Weighted Assets	-1,67	23,73	14,68	3,06	275	-14,93	32,10	15,70	4,32	418	**1**	**1**	CA
20	FSKRTC	Regulatory Tier 1 Capital to Risk-Weighted Assets	-2,62	24,34	12,02	3,19	274	-15,60	31,48	13,26	4,47	417	**1**	**1**	CA
21	FSLE	Large Exposures to Capital	-380,37	2100,51	189,50	324,82	139	-380,37	2100,51	169,09	269,01	210			DT
22	FSLS	Liquid Assets to Short Term Liabilities	13,95	299,95	68,45	44,95	245	13,30	299,95	62,26	39,83	381	**1**	**1**	LI
23	FSLT	Liquid Assets to Total Assets (Liquid Asset Ratio)	4,79	72,06	26,73	14,86	255	2,78	72,06	27,60	13,84	397	**1**	**1**	LI
24	FSNA	Number of Bankruptcy Proceedings Initiated	191,00	68226,00	8629,65	15406,03	65	146,00	68226,00	7991,74	14725,19	73			
25	FSNO	Net Open Position in Equities to Capital	-1,53	85,93	13,06	20,82	108	-11,83	85,93	10,99	19,13	146			DT
26	FSPE	Personnel Expenses to Non-interest Expenses	25,40	86,26	46,27	9,81	239	24,58	94,29	47,09	10,56	350			DT
27	FSRE	Return on Equity	-10,99	28,30	12,06	6,40	115	-10,99	28,30	12,06	6,40	115			NFS
28	FSRR	Residential Real Estate Loans to Total Loans	2,20	63,14	22,55	12,78	200	0,61	63,14	21,45	12,97	235			REM
29	FSSH	Spread Between Highest and Lowest Interbank Rate	0,00	4494,00	239,72	714,54	85	0,00	4494,00	262,63	675,97	107			DT
30	FSSNO	Net Open Position in Foreign Exchange to Capital	-122,15	50,56	-0,54	23,24	209	-122,15	170,37	2,97	22,95	313		**1**	FX
31	FSSR	Spread Between Reference Lending and Deposit Rates	0,02	1393,58	414,20	293,03	190	0,02	1393,58	434,21	320,22	228			DT
32	FSTD	Total Debt to Equity	32,83	266,37	118,40	56,40	127	32,83	266,37	118,40	56,40	127			NFC
33	FSTI	Trading Income to Total Income	-18,05	531,96	10,48	36,41	225	-18,05	641,91	12,05	47,47	312			DT
34	FSNF	Net Foreign Exchange Exposure to Equity	-3,50	50,99	14,84	19,92	15	-3,50	50,99	14,84	19,92	15			NFC
35	FSAB	Average Bid-Ask Spread in the Securities Market	0,00	193,00	7,87	28,48	79	0,00	193,00	7,51	27,82	83			ML
36	FSAD	Average Daily Turnover Ratio in the Securities Market	0,00	55,95	3,86	8,83	89	0,00	55,95	3,87	8,53	101			ML

*Sd – (sample) standard deviation; Filled – the number of non-empty values; First 10 – the variable equal to 1 if the indicator is presented in the first 10 (Section 3); Core – the variable equal to 1 if the indicator is from «Core set» of financial soundness indicators IMF (if Core =1 it automatically means that the indicator corresponds to Deposit Takers); Category – indicator's category; AQ – Asset Quality; CA – Capital Adequacy; EP – Earnings and Profitability; LI – Liquidity; FX – Exposure to FX Risk; DT – Deposit Takers; OFC – Other Financial Corporations; NFC – Nonfinancial Corporations; HH – Households; ML – Market Liquidity; REM – Real Estate Markets; UoM – Unit of Measure.

Appendix 2. Factor analysis from the standpoint of data fullness

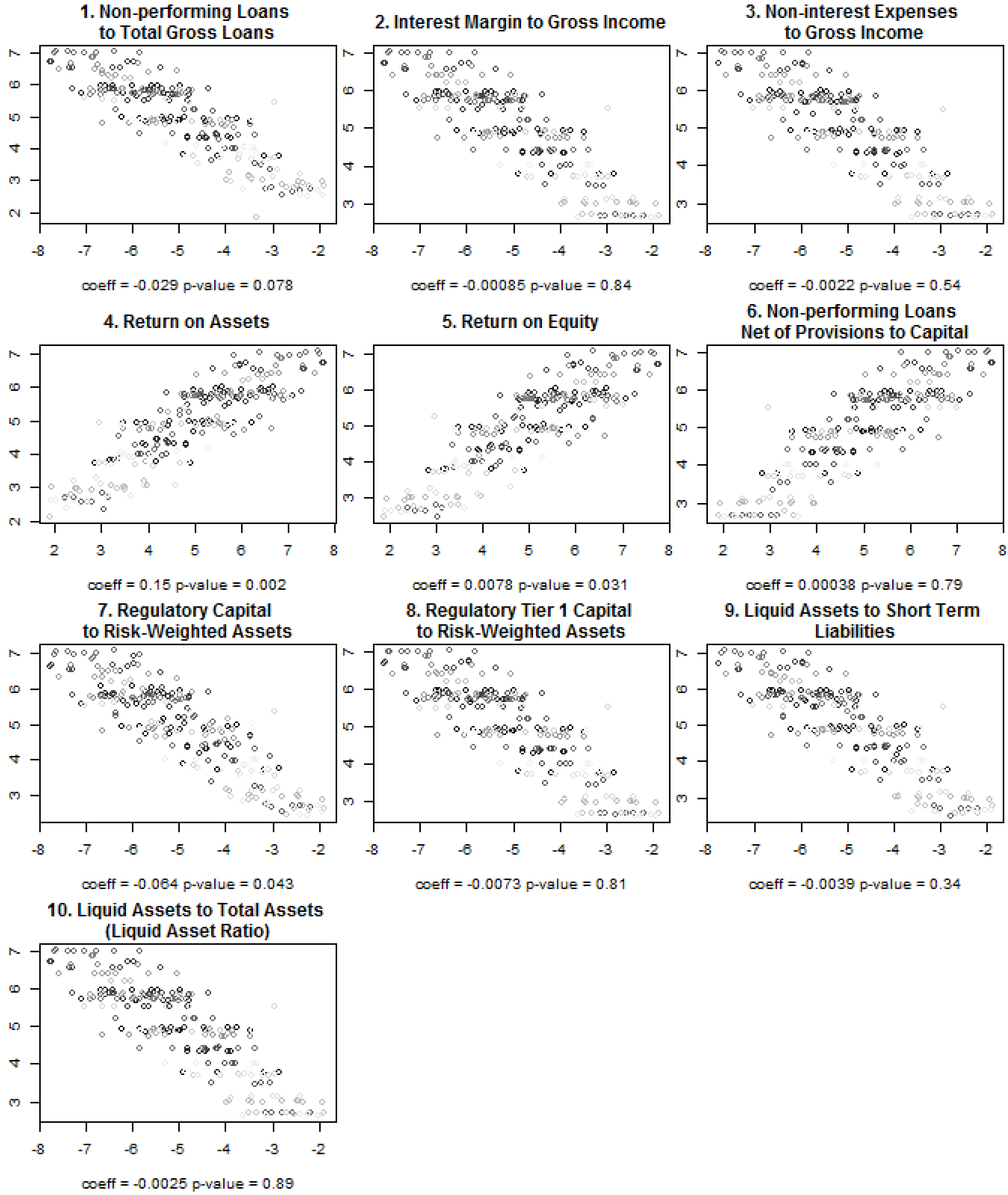
The following procedure was applied to the indicators 1–33 (Appendix 1). For each a-priory defined number k from 1 to 33 the list of k independent variables and ER was found such that for all other lists consisted of k independent variables and ER the number of "full rows" (or "complete cases" – the records with no missing values) was less or equal. The results of this analysis are presented in the table below and their graphical representation is on the figure.

Number of factors	"Full rows" quantity	Factors' numbers (according to Appendix 1) which provide the maximum of "full rows"
1	280	5
2	280	5; 6
3	279	5; 6; 7
4	278	5; 6; 7; 8
5	274	5; 6; 7; 19; 20
6	273	5; 6; 7; 8; 19; 20
7	261	5; 6; 7; 8; 18; 19; 20
8	255	1; 5; 6; 7; 8; 18; 19; 20
9	234	1; 5; 6; 7; 18; 19; 20; 22; 23
10	233	1; 5; 6; 7; 8; 18; 19; 20; 22; 23
11	195	1; 5; 6; 7; 8; 17; 18; 19; 20; 22; 23
12	192	1; 5; 6; 7; 8; 17; 18; 19; 20; 22; 23; 26
13	178	1; 5; 6; 7; 8; 17; 18; 19; 20; 22; 23; 26; 33
14	163	1; 2; 5; 6; 7; 8; 17; 18; 19; 20; 22; 23; 26; 33
15	151	1; 2; 5; 6; 7; 8; 11; 12; 17; 18; 19; 20; 22; 23; 26
16	137	1; 2; 5; 6; 7; 8; 11; 12; 17; 18; 19; 20; 22; 23; 26; 33
17	118	1; 5; 6; 7; 8; 11; 12; 13; 14; 17; 18; 19; 20; 22; 23; 26; 33
18	111	1; 2; 5; 6; 7; 8; 11; 12; 13; 14; 17; 18; 19; 20; 22; 23; 26; 33
19	88	1; 2; 5; 6; 7; 8; 11; 12; 13; 14; 17; 18; 19; 20; 22; 23; 26; 30; 33
20	71	1; 2; 5; 6; 7; 8; 11; 12; 13; 14; 17; 18; 19; 20; 22; 23; 26; 30; 31; 33
21	58	1; 2; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 17; 18; 19; 20; 22; 23; 26; 28; 33
22	50	1; 2; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 17; 18; 19; 20; 22; 23; 26; 28; 33
23	43	1; 2; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 17; 18; 19; 20; 22; 23; 26; 28; 30; 31; 33
24	35	1; 2; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 17; 18; 19; 20; 22; 23; 26; 28; 30; 31; 33
25	32	1; 2; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 17; 18; 19; 20; 22; 23; 26; 27; 28; 31; 32; 33
26	29	1; 2; 3; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 17; 18; 19; 20; 22; 23; 26; 27; 28; 31; 32; 33
27	24	1; 2; 3; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 17; 18; 19; 20; 21; 22; 23; 26; 27; 28; 31; 32; 33
28	19	1; 2; 3; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 17; 18; 19; 20; 22; 23; 25; 26; 27; 28; 30; 31; 32; 33
29	15	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 17; 18; 19; 20; 22; 23; 26; 27; 28; 29; 30; 31; 32; 33
30	11	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 17; 18; 19; 20; 22; 23; 25; 26; 27; 28; 29; 30; 31; 32; 33
31	7	1; 2; 3; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 17; 18; 19; 20; 21; 22; 23; 24; 25; 26; 27; 28; 29; 30; 31; 32; 33
32	6	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 17; 18; 19; 20; 21; 22; 23; 24; 25; 26; 27; 28; 29; 30; 31; 32; 33
33	3	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 16; 17; 18; 19; 20; 21; 22; 23; 24; 25; 26; 27; 28; 29; 30; 31; 32; 33



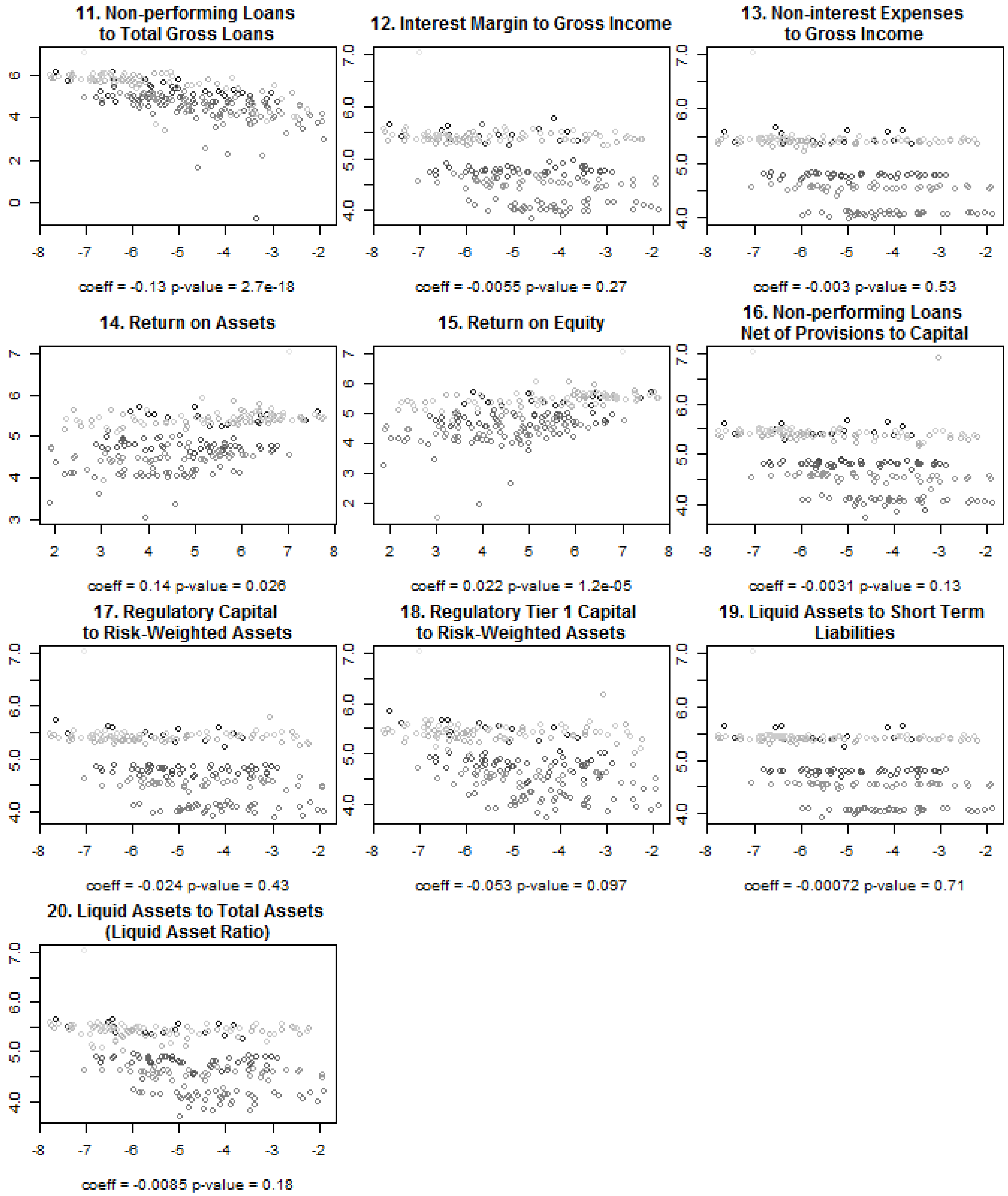
The number of “full rows” depending on the number of indicators. Vertical axis: the maximum number of “full rows”, horizontal axis: the number of independent variables (FSIs)

Appendix 3. Graphical analysis of dependent variable and independent variables interconnectedness in time and spatial (determined by country) dimensions.



The horizontal axis indicates fact values of "The Resilience of the Economy" index multiplied by the sign of estimated coefficient of indicator under consideration, vertical axis – estimated values of this index using regression with indicator under consideration and dummy-variables for countries as dependent variables (can be treated as fixed effect model with one dependent variable). Under each graph coefficient estimates and corresponding p-values are shown.

The points of the same shade correspond to the same country. Clearly pronounced horizontal lines imply probable absence of dependence between ER and indicator under consideration (as confirmed by high p-values. Ex. Graphs N 2, 3, 6, 8, 9, 10).



The horizontal axis indicates fact values of “The Resilience of the Economy” index multiplied by the sign of estimated coefficient of indicator under consideration, vertical axis – estimated values of this index using regression with indicator under consideration and dummy-variables for time labels as dependent variables (can be treated as fixed-time effect model with one dependent variable). Under each graph coefficient estimates and corresponding p-values are shown.

The points of the same shade correspond to the same time-period. Clearly pronounced horizontal lines imply probable absence of dependence between ER and indicator under consideration (as confirmed by high p-values. Ex. Graphs N 12, 13, 16, 19, 20).

Appendix 4A. Data analysis, filtering and reduction

Table 1. Indicators providing maximum "full rows" for k=10

			Before NA removal					After NA removal (N=233)			
N	Concept code	Concept	Min	Max	Mean	Sd	Filled	Min	Max	Mean	Sd
1	FSANL	Non-performing Loans to Total Gross Loans	0,08	48,12	5,07	5,62	260	0,08	48,12	4,94	5,53
5	FSEIM	Interest Margin to Gross Income	–294,34	100,45	57,52	26,96	280	–99,61	100,45	58,91	17,94
6	FSENE	Non-interest Expenses to Gross Income	–303,47	115,77	57,49	27,66	280	–135,47	115,77	58,99	18,36
7	FSERA	Return on Assets	–9,52	4,35	0,85	1,37	280	–9,52	4,35	0,91	1,42
8	FSERE	Return on Equity	–169,20	38,81	10,12	17,21	279	–169,20	38,81	10,24	17,84
18	FSKNL	Non-performing Loans Net of Provisions to Capital	–484,06	313,82	17,55	42,25	267	–484,06	313,82	16,64	43,27
19	FSKRC	Regulatory Capital to Risk-Weighted Assets	–1,67	23,73	14,68	3,06	275	–1,67	22,32	14,97	2,96
20	FSKRTC	Regulatory Tier 1 Capital to Risk-Weighted Assets	–2,62	24,34	12,02	3,19	274	–2,62	22,07	12,31	2,94
22	FSLS	Liquid Assets to Short Term Liabilities	13,95	299,95	68,45	44,95	245	13,95	299,95	68,13	45,73
23	FSLT	Liquid Assets to Total Assets (Liquid Asset Ratio)	4,79	72,06	26,73	14,86	255	4,99	72,06	26,87	14,12
	Y	**Resilience of the Economy**	**1,89**	**7,77**	**4,92**	**1,41**	**296**	**1,89**	**7,77**	**4,90**	**1,41**

Table 2. Correlation matrix for filtered set

	FSANL	FSEIM	FSENE	FSERA	FSERE	FSKNL	FSKRC	FSKRTC	FSLS	FSLT	Y
FSANL	1										
FSEIM	0,17**	1									
FSENE	–0,03	0,36**	1								
FSERA	–0,3**	–0,14*	–0,17**	1							
FSERE	–0,39**	–0,16*	–0,12	0,9**	1						
FSKNL	0,44**	–0,01	0,02	0,15*	0,29**	1					
FSKRC	0,04	–0,05	0,03	0,4**	0,33**	0,2**	1				
FSKRTC	0,01	–0,06	0,04	0,43**	0,33**	0,17*	0,89**	1			
FSLS	–0,03	0,1	0,01	–0,01	–0,04	–0,04	0,07	0,02	1		
FSLT	–0,07	0,07	–0,02	0,1	0,01	–0,12	0,19**	0,23**	0,26**	1	
Y	–0,49**	–0,08	–0,03	0,18**	0,29**	–0,12	–0,03	–0,06	–0,02	–0,1	1

** – significance at 1%-level, * – significance at 5%-level.

Table 3. Regression coefficients for each variable and corresponding p-values (data: filtered set).

		FSANL	FSEIM	FSENE	FSERA	FSERE	FSKNL	FSKRC	FSKRTC	FSLS	FSLT
country dimension	**coeff**	-0,03	0,00	0,00	0,15	0,01	0,00	-0,06	-0,01	0,00	0,00
	p-value	0,08	0,84	0,54	0,00	0,03	0,79	0,04	0,81	0,34	0,89
time dimension	**coeff**	-0,13	-0,01	0,00	0,14	0,02	0,00	-0,02	-0,05	0,00	-0,01
	p-value	0,00	0,27	0,53	0,03	0,00	0,13	0,43	0,10	0,71	0,18

Note: country dimension – dummy variables for countries are included, time dimension – dummy variables for time codes are included

Table 4. VIF values depending on the set of indicators.

	FSANL	FSEIM	FSENE	FSERA	FSERE	FSKNL	FSKRC	FSKRTC	FSLS	FSLT
VIF	2,49	1,25	1,25	8,20	10,38	2,40	5,14	5,42	1,11	1,19
	1,63	1,25	1,25	1,59		1,47	5,12	5,33	1,10	1,18
	1,63	1,24	1,24	1,55		1,46	1,31		1,09	1,15

Appendix 4B. Data analysis, filtering and reduction for the first differences

Table 1. first differences of indicators providing maximum "full rows" for k=10

			Before NA removal					After NA removal (N=189)			
N	Concept code	Concept	Min	Max	Mean	Sd	Filled	Min	Max	Mean	Sd
1	FSANL	Non-performing Loans to Total Gross Loans	–44,23	17,91	0,47	3,78	214	–44,23	17,91	0,32	3,87
5	FSEIM	Interest Margin to Gross Income	–354,38	334,96	0,78	34,82	233	–52,79	168,45	0,81	14,74
6	FSENE	Non-interest Expenses to Gross Income	–349,59	348,97	1,32	36,02	233	–23,89	209,88	1,26	16,78
7	FSERA	Return on Assets	–9,52	9,61	–0,03	1,36	233	–9,52	9,61	–0,04	1,37
8	FSERE	Return on Equity	–169,18	119,06	–1,26	17,48	232	–169,18	119,06	–1,00	18,70
18	FSKNL	Non-performing Loans Net of Provisions to Capital	–526,05	646,95	0,84	60,79	220	–526,05	84,67	–3,12	45,22
19	FSKRC	Regulatory Capital to Risk-Weighted Assets	–13,93	11,24	0,46	1,88	228	–13,93	7,79	0,44	1,80
20	FSKRTC	Regulatory Tier 1 Capital to Risk-Weighted Assets	–13,89	11,80	0,59	1,83	227	–13,89	7,14	0,59	1,71
22	FSLS	Liquid Assets to Short Term Liabilities	–98,47	83,77	0,26	15,33	201	–98,47	83,77	0,38	15,71
23	FSLT	Liquid Assets to Total Assets (Liquid Asset Ratio)	–10,97	10,46	0,04	3,01	210	–10,97	10,46	0,09	3,00
	Y	**Resilience of the Economy**	**–2,72**	**2,37**	**0,06**	**0,81**	**248**	**–2,31**	**2,37**	**0,12**	**0,80**

Table 2. Correlation matrix for the first differences of filtered set

	FSANL	FSEIM	FSENE	FSERA	FSERE	FSKNL	FSKRC	FSKRTC	FSLS	FSLT	Y
FSANL	1										
FSEIM	0,09	1									
FSENE	0,07	0,84**	1								
FSERA	–0,24**	–0,22*	–0,11	1							
FSERE	–0,21**	–0,2**	–0,1	0,95**	1						
FSKNL	0,42**	0,07	0,05	0,32**	0,46**	1					
FSKRC	0,1	0	0,06	0,35**	0,45**	0,5**	1				
FSKRTC	0,02	–0,06	0	0,43**	0,54**	0,51**	0,86**	1			
FSLS	0,05	–0,07	–0,03	0,05	0,01	0,01	0,14*	0,11	1		
FSLT	0,14	0,06	0,1	0,06	0,05	0,1	0,25**	0,23**	0,27**	1	
Y	–0,12	0,01	–0,07	0,12	0,06	0	–0,32**	–0,27**	–0,03	–0,06	1

** – significance at 1%-level, * – significance at 5%-level.

Table 2. Regression coefficients for each variable and corresponding p-values (data: filtered set, first differences, 189 rows)

		FSANL	FSEIM	FSENE	FSERA	FSERE	FSKNL	FSKRC	FSKRTC	FSLS	FSLT
country dimension	coeff	-0,02	0,00	0,00	0,04	0,00	0,00	-0,18	-0,18	0,00	-0,02
	p-value	0,27	0,57	0,41	0,43	0,96	0,58	0,00	0,00	0,65	0,34
time dimension	coeff	-0,01	0,00	0,00	0,03	0,00	0,00	-0,02	-0,02	0,00	0,02
	p-value	0,47	0,36	0,59	0,37	0,57	0,18	0,40	0,60	0,72	0,27

Note: country dimension – dummy variables for countries are included, time dimension – dummy variables for time codes are included

Table 4. VIF values for first differences depending on the set of indicators.

	FSANL	FSEIM	FSENE	FSERA	FSERE	FSKNL	FSKRC	FSKRTC	FSLS	FSLT
VIF	1,72	3,65	3,47	15,53	20,19	2,74	4,17	4,72	1,12	1,18
	1,58	3,65	3,47	1,59		2,04	4,16	4,43	1,10	1,18
	1,54	3,65	3,47	1,56		1,97	1,53		1,10	1,17
	1,53		1,04	1,45		1,90	1,52		1,10	1,17

Appendix 5A. Models for initial variables (final set 1). Country effect taken into account

Table 1. Models' forecast quality statistics. Initial variables (final set 1), dummies for countries (model2, model3).

			Step number							
		Opt.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Model1	MSE	0	2,881	2,940	2,664	2,816	2,468	2,097	2,005	2,005
	RSQ	1	–0,094	–0,116	–0,012	–0,069	0,063	0,221	0,225	0,225
	Corr	1	0,219	–0,186	0,498	0,427	0,553	0,673	0,657	0,657
Model2	MSE	0	1,381	1,381	1,299	1,142	1,103	1,267	1,126	1,126
	RSQ	1	0,476	0,476	0,507	0,566	0,581	0,529	0,564	0,564
	Corr	1	0,631	0,631	0,735	0,795	0,823	0,803	0,841	0,841
Model3	MSE	0	1,367	1,367	1,518	1,034	1,023	1,237	1,144	1,144
	RSQ	1	0,481	0,481	0,424	0,608	0,612	0,540	0,558	0,558
	Corr	1	0,746	0,746	0,703	0,822	0,832	0,798	0,827	0,827
Benchmark	MSE	0	0,275	0,275	0,275	0,275	0,275	0,279	0,262	0,262
	RSQ	1	0,896	0,896	0,896	0,896	0,896	0,896	0,899	0,899
	Corr	1	0,934	0,934	0,934	0,934	0,934	0,931	0,928	0,928

Note: Opt. – optimum value

Table 2. Estimated coefficients for step 8 (country effect). All the coefficients presented are significant at 5%-level.

Step8	**FSEIM**	**FSERA**	**FSKRC**	**FSKNL**	**FSANL**	**FSLS**
Model1				0,019	–0,194	
Model2	0,013	0,224	–0,109			–0,004

Appendix 5B. Models for initial variables (final set 1). Time effect taken into account

Table 1. Models' forecast quality statistics. Initial variables (final set 1), dummies for time labels (model2).

			Step number							
		Opt.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Model1	MSE	0	2,836	2,885	2,633	2,764	2,422	2,069	1,976	1,976
	RSQ	1	–0,080	–0,099	–0,002	–0,053	0,078	0,229	0,235	0,235
	Corr	1	0,186	–0,164	0,481	0,403	0,557	0,671	0,656	0,656
Model2	MSE	0	2,642	2,696	2,458	2,458	2,111	1,504	1,425	1,425
	RSQ	1	–0,006	–0,027	0,064	0,064	0,196	0,440	0,448	0,448
	Corr	1	0,186	–0,164	0,481	0,331	0,476	0,677	0,652	0,652
Benchmark	MSE	0	0,278	0,278	0,278	0,278	0,278	0,282	0,265	0,265
	RSQ	1	0,894	0,894	0,894	0,894	0,894	0,895	0,897	0,897
	Corr	1	0,935	0,935	0,935	0,935	0,935	0,932	0,929	0,929

Table 2. Estimated coefficients for step 8 (time effect). All the coefficients presented are significant at 5%-level.

Step 8	**FSKNL**	**FSANL**
model1	0,019	–0,194
model2	0,022	–0,208

Table 3. Quality of forecast measures' summary statistics for models with time effect taken into account.

Step 8		Opt.	min	max	mean	sd
Model1	MSE	0	0,899	4,508	1,948	0,660
	RSQ	1	−2,120	0,349	−0,113	0,449
	Corr	1	−0,032	0,857	0,442	0,168
Model2	MSE	0	0,702	4,963	1,752	0,735
	RSQ	1	−2,010	0,506	0,004	0,460
	Corr	1	0,173	0,842	0,591	0,136
Model3	MSE	0	0,847	2,998	1,843	0,469
	RSQ	1	−1,324	0,155	−0,027	0,218
	Corr	1	0,137	0,645	0,346	0,099

Note: Opt. – optimum value

Appendix 5C. Models for first differences (final set 2). Country effect taken into account

Table 1. Models' forecast quality statistics. Variables in first differences (final set 2), dummies for countries (model2, model3).

			Step number						
		Opt.	1	2	3	4	5	6	7
Model1	MSE	0	0,299	0,302	0,328	0,335	0,342	0,372	0,372
	RSQ	1	0,887	0,885	0,876	0,873	0,873	0,856	0,856
	Corr	1	0,934	0,929	0,928	0,929	0,926	0,916	0,916
Model2	MSE	0	0,437	0,412	0,473	0,491	0,562	0,558	0,558
	RSQ	1	0,834	0,843	0,820	0,814	0,791	0,785	0,785
	Corr	1	0,901	0,914	0,892	0,891	0,882	0,874	0,874
Model3	MSE	0	0,449	0,430	0,412	0,414	0,397	0,378	0,378
	RSQ	1	0,830	0,837	0,843	0,843	0,852	0,854	0,854
	Corr	1	0,904	0,915	0,916	0,916	0,913	0,904	0,904
Benchmark	MSE	0	0,275	0,275	0,275	0,281	0,285	0,268	0,268
	RSQ	1	0,896	0,896	0,896	0,893	0,894	0,897	0,897
	Corr	1	0,934	0,934	0,934	0,936	0,933	0,930	0,930

Note: Opt. – optimum value

Table 2. Estimated coefficients for step 7 (country effect). All the coefficients presented are significant at 5%-level.

Step 7	FSERA	FSKRC	FSANL	FSKNL
Model1	0,108	-0,249		
Model2		-0,338	0,132	-0,021

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