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DATA SET NORMALISATION FOR BANKS PERFORMANCE ASSESSMENT

1. Introduction

Multivariate statistical methods often require that the scales of measurement of all variables are either the same or at least similar (as similar interval and ratio scale are considered as well as nominal and ordinal). In the theory of measurement four basic scales are distinguished: nominal, ordinal, interval and ratio. They were introduced by Stevens (1959). Among the four scales of measurement, the nominal is considered the lowest. It is followed by the ordinal scale, the interval scale, and the ratio scale, which is highest. The basic rules for scales of measurement are summarised in Table 1.

Many multivariate statistical methods, like linear ordering methods, require variables' normalisation. The purpose of normalisation is to adjust the size (magnitude) and the relative weighting of the input variables (see e.g. Milligan and Cooper (1988), p. 182). The normalisation is used when the variables are measured on interval or ratio scale. In the case of nominal and ordinal scales, normalisation is not necessary, because on nominal and ordinal values such relations as equality of differences and equality of ratios are not permitted. The use of different normalisation formulas depends on the particular scale of measurement (see Fig. 1).

Reference boundary system construction requires normalisation of variable values. This system is comprehended as a set of restrictions and/or recommendations, which enables the identification of the performance level of business units (economic objects, e.g. banks). Restrictions and recommendations are suggested by the theory of economy, expert's opinions and/or researchers knowledge and are formulated in boundary model which declares so-called veto thresholds for variables values, or recommended values that imply a minimum satisfaction level in the object's performance assessment. Normalisation procedures distinguish three types of variables: stimuli, destimuli and nominants.

Table 1. The rules for scales of measurement

Scale	Basic empirical operations	Allowed mathematical transformations	Allowed arithmetic operations
Nominal	equal to $(x_A = x_B)$, not equal to $(x_A \neq x_B)$	$z = f(x)$, $f(x)$ – any one-to-one correspondence function	counting of events (numbers of relations equal to, not equal to)
Ordinal	above and greater than $(x_A > x_B)$, smaller than $(x_A < x_B)$	$z = f(x)$, $f(x)$ – any strictly increasing function	counting of events (numbers of relations equal to, not equal to, greater than, smaller than)
Interval	above and equality of differences $(x_A - x_B = x_C - x_D)$	$z = bx + a$ $(b > 0)$, $z \in R$ for all possible values x in R. The zero value on this scale is usually assumed, either arbitrarily or by the convention	above and addition, subtraction
Ratio	above and equality of ratios $(\frac{x_A}{x_B} = \frac{x_C}{x_D})$	$z = bx$ $(b > 0), z \in R_+$ for all possible values x in R_+. The natural origin of the ratio scale is zero (this scale is bounded from the left)	above and multiplication, division

Source: see Jajuga and Walesiak (1999).

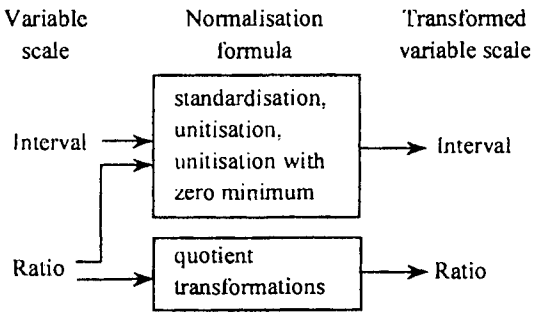

Figure 1. Classification of normalisation formulas from the measurement scales point of view
Source: adapted from Jajuga and Walesiak (1999).

Modification of the normalisation formulae for reference boundary system can be found in: Strahl and Walesiak (1996; 1997), Strahl and Dziechciarz (1999).

In the paper the Polish banks are evaluated. For this purpose the aggregate measure is being build.

2. Normalisation of the variable values in reference boundary system for banks assessment

The performance variables are classified into three types (see Hellwig (1968)):
– stimuli – where higher value means better performance;

– destimuli – where low values indicate better performance;

– nominants – where the best value (or best value interval) is implied. Bank performance is positively assessed either if the measure has implied value or its value lies within implied interval.

Such a general classification needs further analysis (see Rogowski (1998), p. 174), where the deep inquiry into bank performance measures typology is presented. Division listed doesn't explore all possible evaluations so it requires further division in more detailed classification.

Stimuli are classified into:

– *stimuli* S_1 without veto threshold value, with values $x_{kj} \in R_+$,

– *stimuli* S_2 with veto threshold value $x_{0j}^{S_2}$, with values $x_{kj} \in R$.

The example of stimuli without veto threshold value could be the balance of the bank and income volume of the bank. As an example of second type stimuli one can mention the indicator of bank solvency with minimum threshold established by BTS Bank of International Settlements at the level of 8%.

Destimuli, with values $x_{kj} \in R_+$ are classified into:

– *destimuli* D_1 without veto threshold value,

– *destimuli* D_2 with veto threshold value $x_{0j}^{D_2}$.

Generally one can expect that variables which have destimuli character do have veto threshold value. Indicator of the so-called „bad credits" or „difficult credits" in the bank credits portfolio may serve as an example of the destimuli with veto threshold. In an established market economies it is assumed at the level of 5% (comp. [3]). As next example could stand ratio of „bad credits" and operating assets which in accordance with D. Blickenstaff (see Patterson (1995), p. 35) should be higher than 1%, i.e. $x_{0j}^{D_2} = 1\%$. He defines also veto threshold for the rate of overheads in operating assets, at the level not higher than 2%, i.e. $x_{0j}^{D_2} = 2\%$.

Nominants, with values $x_{kj} \in R_+$ are classified into:

– *nominants* N_1 with recommended nominal value $x_{0j}^{N_1}$,

– *nominants* N_2 with recommended interval of values which limits are defined by the veto threshold values $x_{0j}^{N_2^1}$ and $x_{0j}^{N_2^2}$,

– *nominants* N_3 with recommended nominal value and acceptable value interval which limits are defined by the veto threshold values $x_{0j}^{N_3^1}$ and $x_{0j}^{N_3^2}$.

Current liquidity measure defined as ratio current assets to current liabilities can be shown as example of nominant N_2. The value of the ratio should lie within the certain interval e.g. [1.0; 1.25]. Dropping of the ratio below 1.0 signals that finan-

cial safety is endangered. Too high value of this measure indicates over liquidity of a bank. In our notion we have $x_{0j}^{N_2^1} = 1.0$, and $x_{0j}^{N_2^2} = 1.25$. As an example of nominant N_3 can stand ratio of deposits to credits, with optimal value equalling one and allowable (acceptable) values could come up to $x_{0j}^{N_3^1} = 0.8$ and $x_{0j}^{N_3^2} = 1.6$. Allowable value interval is certainly discussible and should be individually settled for each bank, depending on credit portfolio and financial market volume, etc.

It could be regarded that the displayed classification does not show all the possibilities and will be supplemented in future.

In order to identify banks, which don't meet the declared or recommended threshold values appropriate methods for the normalisation of variables' values should be proposed. Due to that need the transborder reference system has been introduced. Transborder reference system is defined as a set of limits or recommendations allowing identification of considerably worse banks, which break established limits or recommended variables' values. The evaluation process may be done after completion of the normalisation procedure for variables' values in particular banks.

Normalisation of the variable values for reference boundary system should be done due to following formulas (see Strahl and Walesiak (1997)):

Stimuli

The variable values, which have stimuli character of type S_1 (in the notion $j \in S_1$) are normalised as follows:

$$z_{kj} = \frac{x_{kj} - \min\limits_k \{x_{kj}\}}{\max\limits_k \{x_{kj}\} - \min\limits_k \{x_{kj}\}}, \quad z_{kj} \in [0; 1], \tag{1}$$

where: x_{kj} (z_{kj}) – value (normalised value) of variable j-th in k-th bank.

The variable values, which have stimuli character of type S_2 (in the notion $j \in S_2$) are normalised as follows:

$$z_{kj} = \begin{cases} \dfrac{x_{kj} - \min\limits_k \{x_{kj}\}}{\max\limits_k \{x_{kj}\} - \min\limits_k \{x_{kj}\}} & \text{for } x_{kj} \geq x_{0j}^{S_2}, \\ \dfrac{x_{kj} - \max\limits_k \{x_{kj}\}}{\max\limits_k \{x_{kj}\} - \min\limits_k \{x_{kj}\}} & \text{for } x_{kj} < x_{0j}^{S_2}, \end{cases} \quad z_{kj} \in [-1; 1]. \tag{2}$$

Destimuli

The variable values, which have destimuli character of type D_1 (in the notion $j \in D_1$) are normalised as follows:

$$z_{kj} = \frac{\max\limits_{k}\{x_{kj}\} - x_{kj}}{\max\limits_{k}\{x_{kj}\} - \min\limits_{k}\{x_{kj}\}},\ z_{kj} \in [0;1]. \tag{3}$$

The variable values, which have destimuli character of type (in the notion $j \in D_2$) are normalised as follows:

$$z_{kj} = \begin{cases} \dfrac{\max\limits_{k}\{x_{kj}\} - x_{kj}}{\max\limits_{k}\{x_{kj}\} - \min\limits_{k}\{x_{kj}\}} & \text{for } x_{kj} \le x_{0j}^{D_2}, \\ \dfrac{\min\limits_{k}\{x_{kj}\} - x_{kj}}{\max\limits_{k}\{x_{kj}\} - \min\limits_{k}\{x_{kj}\}} & \text{for } x_{kj} > x_{0j}^{D_2}, \end{cases},\ z_{kj} \in [-1;1]. \tag{4}$$

Nominants

The variable values, which have nominant character of type N_1 (in the notion $j \in N_1$) are normalised as follows:

$$z_{kj} = \begin{cases} \dfrac{x_{kj} - \max\limits_{k}\{x_{kj}\}}{\max\limits_{k}\{x_{kj}\} - \min\limits_{k}\{x_{kj}\}} & \text{for } x_{kj} < x_{0j}^{N_1}, \\ 1 & \text{for } x_{kj} = x_{0j}^{N_1}, \\ \dfrac{\min\limits_{k}\{x_{kj}\} - x_{kj}}{\max\limits_{k}\{x_{kj}\} - \min\limits_{k}\{x_{kj}\}} & \text{for } x_{kj} > x_{0j}^{N_1}, \end{cases}\ z_{kj} \in [-1;1]. \tag{5}$$

The variable values, which have nominant character of type N_2 (in the notion $j \in N_2$) are normalised as follows:

$$z_{kj} = \begin{cases} \dfrac{x_{kj} - \max\limits_{k}\{x_{kj}\}}{\max\limits_{k}\{x_{kj}\} - \min\limits_{k}\{x_{kj}\}} & \text{for } x_{kj} < x_{0j}^{N_2^1}, \\ 1 & \text{for } x_{0j}^{N_2^1} \le x_{kj} \le x_{0j}^{N_2^2}, \\ \dfrac{\min\limits_{k}\{x_{kj}\} - x_{kj}}{\max\limits_{k}\{x_{kj}\} - \min\limits_{k}\{x_{kj}\}} & \text{for } x_{kj} > x_{0j}^{N_2^2}, \end{cases}\ z_{kj} \in [-1;1]. \tag{6}$$

The variable values, which have nominant character of type (in the notion $j \in N_3$) are normalised as follows:

$$z_{kj} = \begin{cases} \dfrac{x_{kj} - \max\limits_k \{x_{kj}\}}{\max\limits_k \{x_{kj}\} - \min\limits_k \{x_{kj}\}} & \text{for } x_{kj} < x_{0j}^{N_3^1}, \\ \dfrac{x_{kj} - \max\limits_k \{x_{kj}\}}{\max\limits_k \{x_{kj}\} - \min\limits_k \{x_{kj}\}} & \text{for } x_{0j}^{N_3^1} \le x_{kj} \le x_{0j}^{N_3}, \\ 1 & \text{for } x_{kj} = x_{0j}^{N_3}, \\ \dfrac{\max\limits_k \{x_{kj}\} - x_{kj}}{\max\limits_k \{x_{kj}\} - \min\limits_k \{x_{kj}\}} & \text{for } x_{0j}^{N_3} < x_{kj} \le x_{0j}^{N_3^2}, \\ \dfrac{\min\limits_k \{x_{kj}\} - x_{kj}}{\max\limits_k \{x_{kj}\} - \min\limits_k \{x_{kj}\}} & \text{for } x_{kj} > x_{0j}^{N_3^1}, \end{cases} \quad , z_{kj} \in [-1;1]. \qquad (7)$$

Interpretation of normalised variables' values is intuitive and straightforward. Values close to one can be read as high bank ranking due to the given variable. Value close to lower limit of interval denotes considerably worse bank ranking.

Proposal of normalisation of variables is based on the idea of transborder reference system, what in consequence responds to the indications of Dale Blickenstaff, Warsaw Banking Institute adviser – in which he says that good bank should fulfil key bank variables. The list of key variables based on the proposals given in Patterson's work (see Patterson (1995), p. 35) is presented in Table 2.

Table 2. Veto thresholds for example variables

No	Variable	Assumed value of veto threshold
1	$\frac{\text{operating assets}}{\text{assets}}$	$\geq$ 90%
2	margin of income	$\geq$ 5.0%
3	$\frac{\text{overheads}}{\text{total operating assets}}$	$\leq$ 2.0%
4	$\frac{\text{bad credits}}{\text{operating assets}}$	$\leq$ 1.0%

Source: based on the paper of Patterson (1995).

3. Aggregate measure construction

Construction of aggregate measure means the construction of synthetic model for certain set of banks or one bank with multibranch structure. Aggregate measure allowing bank evaluation is being built upon the formula of „average" normalised

values assumed for evaluation variables. The measure is given in the following formula:

$$s_k = \frac{1}{m}\sum_{j=1}^{m} z_{kj} \text{ for } j \in \{S_1, S_2, D_1, D_2, N_1, N_2, N_3\}, \tag{8}$$

where: z_{kj} – value of j-th feature for k-th bank normalised according to appropriate the formula (1)-(7).

Normalisation performed using the formula (1)-(7) has a common property that values of aggregate measure s_k are from interval $[-1; 1]$.

We have to define minimal value of bank evaluation measure, which can be still considered as positive i.e. veto point for measure (8) or threshold for minimal satisfaction. To achieve that we introduce the following aggregate measure:

$$s_0 = \frac{1}{m}\sum_{j=1}^{m} z_{0j} \text{ for } j \in \{S_1, S_2, D_1, D_2, N_1, N_2, N_3\}, \tag{9}$$

where:

$$z_{kj} = \begin{cases} \min\limits_k \{x_{kj}\} & \text{for } j \in S_1, \\ \dfrac{x_{0j}^{S_2} - \min\limits_k \{x_{kj}\}}{\max\limits_k \{x_{kj}\} - \min\limits_k \{x_{kj}\}} & \text{for } j \in S_2, \\ 0 & \text{for } j \in D_1, \\ \dfrac{\max\limits_k \{x_{kj}\} - x_{0j}^{D_2}}{\max\limits_k \{x_{kj}\} - \min\limits_k \{x_{kj}\}} & \text{for } j \in D_2, \\ 1 & \text{for } j \in N_1, \\ 1 & \text{for } j \in N_2, \\ \min\left\{ \dfrac{x_{0j}^{N_3^1} - \min\limits_k \{x_{kj}\}}{\max\limits_k \{x_{kj}\} - \min\limits_k \{x_{kj}\}}; \dfrac{\max\limits_k \{x_{kj}\} - x_{0j}^{N_3^2}}{\max\limits_k \{x_{kj}\} - \min\limits_k \{x_{kj}\}} \right\} & \text{for } j \in N_3. \end{cases} \tag{10}$$

These statements allow us to say that k-th bank will receive:

1. Positive assessment, if

$$s_k > s_0, \tag{11}$$

2. Minimum satisfaction assessment, if:

$$s_k = s_0, \tag{12}$$

where: s_0 is given by (9) and (10).

4. An example

The following measures of bank evaluation have been chosen to illustrate the presented procedures:

x_{k1} – share of irregular receivables in credits (in %),
x_{k2} – share of earning assets in total bank assets (in %),
x_{k3} – gross yield (in %),
x_{k4} – net yield (in %),
x_{k5} – return on capital (in %),
x_{k6} – return on assets (in %),
x_{k7} – net profit per employee (in thousands PLN),
x_{k8} – own capital of the bank (in millions PLN),
x_{k9} – ratio of solvency (in %).

Thirty-one banks quoted in Gazeta Bankowa (No 22, June 1999) have undergone this procedure. Veto threshold values were formulated as result of the authors' analysis based on proposals given by Patterson (1995) and Rogowski (1998). The following veto threshold have been used:

$$x_{01}^{D_2} = 5\%, \qquad x_{06}^{S_2} = 1.2\%,$$
$$x_{02}^{S_2} = 85\%, \qquad x_{07}^{S_2} = 0,$$
$$x_{03}^{S_2} = 0, \qquad x_8 \in S_1,$$
$$x_{04}^{S_2} = 0, \qquad x_{09}^{N_2^1} = 8\%;\ x_{09}^{N_2^2} = 18\%.$$
$$x_{05}^{S_2} = 11\%,$$

Normalisation of variables' values was done according to the formulae (1)-(7). Variables' values and normalised variables' values are shown in Tables 3 and 4.

Values of aggregate measure have been calculated on the formula (8) and presented in Table 5. Veto threshold for aggregate measure was calculated:

$$s_0 = \frac{0.811 + 0.233 + 0.09 + 0.279 + 0.440 + 0.231 + 0.039 + 0 + 1}{9} = 0.348.$$

It establishes the level of minimal satisfaction value. Positive evaluation got the banks where $s_k \geq 0.348$ (see Table 5).

Table 3. Variables' values of banks evaluation

Bank	x_{k1}	x_{k2}	x_{k3}	x_{k4}	x_{k5}	x_{k6}	x_{k7}	x_{k8}	x_{k9}
BRE	6.7	89.0	40.4	24.0	21.46	2.39	106.6	1 135	12.1
Kredyt Bank PBI	1.9	86.9	31.7	19.4	27.02	1.35	23.7	665	8.1
Przemysłowo-Handlowy	3.2	87.1	44.8	26.2	23.99	2.40	43.3	1 380	14.2
Ochrony Środowiska	3.6	90.7	55.2	37.8	30.60	3.56	77.1	403	22.6
Powszechny Bank Kredytowy	9.1	85.2	44.3	29.4	35.61	2.29	44.1	802	9.4
Wielkopolski Bank Kredytowy	2.5	88.9	42.8	28.6	34.13	2.47	42.0	580	10.1
Gospodarstwa Krajowego	0.9	96.1	86.4	82.6	64.62	10.29	472.8	284	28.7
PPA Bank	1.6	84.3	29.3	20.0	18.09	2.09	39.3	119	10.3
Komunalny	0.7	90.5	45.8	29.5	22.08	2.57	40.7	35	16.8
Handlowy	5.1	86.4	39.0	25.3	13.11	1.73	74.1	2 558	13.7
Westdeutsche Landesbank	0.1	98.2	50.6	34.6	12.45	2.03	334.0	173	14.0
BIG Bank Gdański	6.9	84.8	39.0	25.8	11.89	1.54	29.1	1 258	16.8
Amerbank	3.6	92.8	33.8	21.7	16.50	1.82	95.6	154	12.3
Śląski	12.2	89.5	29.5	19.2	17.80	1.81	29.3	1 182	11.9
LG Petro Bank	2.0	92.1	33.7	20.9	8.20	2.13	24.5	232	26.2
Rabobank	0.3	96.2	31.7	20.1	8.70	1.30	101.3	131	20.8
Pol-Can Bank	0.3	97.2	60.4	35.7	11.99	3.33	147.3	30	49.7
Częstochowa	2.1	85.7	32.9	19.7	19.25	1.99	17.7	21	14.8
Deutsche Bank Polski	8.9	88.7	38.9	25.4	6.77	1.94	139.3	446	57.9
Credit Lyonnais	4.6	90.0	43.8	24.6	16.14	2.30	143.6	147	21.3
PeKaO	3.9	81.0	32.8	17.7	15.17	1.00	20.8	3 712	13.5
Raiffeisen Centrobank	7.4	88.2	29.6	17.7	14.24	1.27	59.6	191	14.0
Lukas Bank Świętokrzyski	3.0	83.1	16.2	7.0	16.35	2.64	30.7	51	11.0
Cukrobank	0.9	86.0	28.4	16.6	15.10	1.25	10.9	27	8.2
Opel Bank	2.9	96.0	32.5	17.7	10.82	1.59	82.8	49	11.9
ABN Amro	26.0	90.2	29.1	16.1	7.08	1.04	111.7	233	24.5
Austria Creditanstalt	2.3	87.3	21.8	14.6	9.53	0.91	44.7	163	10.8
Invest Bank	2.1	84.6	13.4	11.9	11.91	0.88	10.2	140	11.4
PKO BP	3.8	89.0	-9.5	-31.9	-31.17	-1.53	-19.4	2 623.1	10.4
Współpracy Europejskiej	16.2	88.6	29.7	18.4	10.14	1.01	36.1	123.4	17.5
BIG Bank	6.8	90.5	20.2	9.5	10.8	0.25	10.4	1 258	0.0
Veto threshold value	5	85	0	0	11	1.2	0	21	8-18

Source: „Gazeta Bankowa" 1999, No. 22.

Table 4. Normalised variables' values of banks evaluation

Bank	z_{k1}	z_{k2}	z_{k3}	z_{k4}	z_{k5}	z_{k6}	z_{k7}	z_{k8}	z_{k9}
BRE	-0.255	0.465	0.520	0.488	0.549	0.332	0.256	0.302	1.000
Kredyt Bank PBI	0.931	0.343	0.430	0.448	0.607	0.244	0.088	0.174	1.000
Przemysłowo-Handlowy	0.880	0.355	0.566	0.507	0.576	0.332	0.127	0.368	1.000
Ochrony Środowiska	0.865	0.564	0.675	0.609	0.645	0.431	0.196	0.103	1.000
Powszechny Bank Kredytowy	-0.347	0.244	0.561	0.535	0.697	0.323	0.129	0.212	1.000
Wielkopolski Bank Kredytowy	0.907	0.459	0.545	0.528	0.682	0.338	0.125	0.151	1.000
Gospodarstwa Krajowego	0.969	0.878	1.000	1.000	1.000	1.000	1.000	0.071	-0.496
PPA Bank	0.942	-0.808	0.405	0.453	0.514	0.306	0.119	0.027	1.000
Komunalny	0.977	0.552	0.577	0.536	0.556	0.347	0.122	0.004	1.000
Handlowy	-0.193	0.314	0.506	0.500	0.462	0.276	0.190	0.687	1.000
Westdeutsche Landesbank	1.000	1.000	0.627	0.581	0.455	0.301	0.718	0.041	1.000

Table 4 cont.

BIG Bank Gdański	–0.263	–0.779	0.506	0.504	0.450	0.260	0.099	0.335	1.000
Amerbank	0.865	0.686	0.452	0.468	0.498	0.283	0.234	0.036	1.000
Śląski	–0.467	0.494	0.407	0.446	0.511	0.283	0.099	0.315	1.000
LG Petro Bank	0.927	0.645	0.450	0.461	–0.589	0.310	0.089	0.057	–0.453
Rabobank	0.992	0.884	0.430	0.454	–0.584	0.239	0.245	0.030	–0.359
Pol-Can Bank	0.992	0.942	0.729	0.590	0.451	0.411	0.339	0.002	–0.858
Częstochowa	0.923	0.273	0.442	0.451	0.526	0.298	0.075	0.000	1.000
Deutsche Bank Polski	–0.340	0.448	0.505	0.500	–0.604	0.294	0.322	0.115	–1.000
Credit Lyonnais	0.826	0.523	0.556	0.493	0.494	0.324	0.331	0.034	–0.368
PeKaO	0.853	–1.000	0.441	0.433	0.484	–0.786	0.082	1.000	1.000
Raiffeisen Centrobank	–0.282	0.419	0.408	0.433	0.474	0.237	0.161	0.046	1.000
Lukas Bank Świętokrzyski	0.888	–0.878	0.268	0.340	0.496	0.353	0.102	0.008	1.000
Cukrobank	0.969	0.291	0.395	0.424	0.483	0.235	0.062	0.002	1.000
Opel Bank	0.892	0.872	0.438	0.433	–0.562	0.264	0.208	0.008	1.000
ABN Amro	–1.000	0.535	0.403	0.419	–0.601	–0.783	0.266	0.057	–0.423
Austria Creditanstalt	0.915	0.366	0.326	0.406	–0.575	–0.794	0.130	0.038	1.000
Invest Bank	0.923	–0.791	0.239	0.382	0.450	–0.796	0.060	0.032	1.000
PKO BP	0.857	0.465	–1.000	–1.000	–1.000	–1.000	–1.000	0.705	1.000
Współpracy Europejskiej	–0.622	0.442	0.409	0.439	–0.569	–0.785	0.113	0.028	1.000
BIG Bank	–0.259	0.552	0.310	0.362	–0.562	–0.849	0.061	0.335	–1.000
Normalised veto threshold value	0.811	0.233	0.099	0.279	0.440	0.231	0.039	0.000	1.000

Source: own research.

Table 5. Ordered values of aggregate measure for banks evaluation

No	Bank	s_k
1	Gospodarstwa Krajowego	0.714
2	Westdeutsche Landesbank	0.636
3	Ochrony Środowiska	0.565
4	Wielkopolski Bank Kredytowy	0.526
5	Przemysłowo-Handlowy	0.523
6	Komunalny	0.519
7	Amerbank	0.502
8	Kredyt Bank PBI	0.474
9	Częstochowa	0.443
10	Cukrobank	0.429
11	Handlowy	0.416
12	BRE	0.406
13	Pol-Can Bank	0.400
14	Opel Bank	0.395
15	Powszechny Bank Kredytowy	0.373
16	Credit Lyonnais	0.357

No	Bank	s_k
17	Śląski	0.343
18	PPA Bank	0.329
19	Raiffeisen Centrobank	0.322
20	Lukas Bank Świętokrzyski	0.286
21	PeKaO	0.279
22	Rabobank	0.259
23	BIG Bank Gdański	0.235
24	LG Petro Bank	0.211
25	Austria Creditanstalt	0.201
26	Invest Bank	0.167
27	Współpracy Europejskiej	0.051
28	Deutsche Bank Polski	0.027
29	BIG Bank	–0.117
30	ABN Amro	–0.125
31	PKO BP	–0.219

Source: own research.

5. Conclusion

The presented procedure may be adopted to different purposes, such as:
- evaluation from the point of shareholder's view,
- evaluation from the investors' point of view,
- evaluation from clients' point of view,
- comparative analysis on national and international level.

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Procedury normalizacji zmiennych w ocenie działalności banków

Streszczenie

Artykuł przedstawia modyfikację procedur normalizacji wartości zmiennych wprowadzającą do formuł normalizacyjnych referencyjny system graniczny. System ten rozumiany jest jako zbiór ograniczeń nałożonych na wartości zmiennych przyjętych do porządkowania liniowego zbioru obiektów ekonomicznych (np. banków). Źródłem zbioru ograniczeń nałożonych na wartości zmiennych są: teoria ekonomii, wiedza badacza oraz opinie ekspertów. Ograniczenia te, zwane progami veta, pozwalają określić minimalny poziom satysfakcji w ocenie banków. Procedury normalizacyjne w referencyjnym

systemie granicznym uwzględniają podział zmiennych na stymulanty, destymulanty i nominanty oraz definiują dla każdego typu zmiennej odpowiednią formułę normalizacji. Zaproponowana procedura badawcza została empirycznie sprawdzona na podstawie danych dotyczących polskiego sektora bankowego.