ACTA UNIVERSITATIS LODZIENSIS FOLIA OECONOMICA 164, 2003

Dorota Kwiatkowska-Ciotucha*, Urszula Załuska**, Pawel Hanczar***

OBJECTIVE AND SUBJECTIVE EVALUATION OF THE CONDITION OF MANUFACTURING BRANCHES IN POLAND – A COMPARATIVE ANALYSIS

Abstract. The paper presents the results of the examination of the condition of manufacturing branches in Poland obtained by applying two approaches. In the first (objective) approach the values of a composite indicator have been taken as the criterion for evaluating the effectiveness of management. The composite indicator has been constructed on the basis on a vector of component variables whose source were statistical reports. In the second (subjective) approach the results of business surveys have been applied as the evaluation criterion. The resulting orderings of individual branches obtained based on both criterions have been compared. For comparing the Spearman's coefficient of rank correlation and values of average differences of the locations have been used.

Key words: comparative analysis, ordering methods, composite indicators, business surveys.

1. INTRODUCTION

We have researched the application of multivariate statistical analysis for evaluating the present and future situation of different branches in Polish economy. We wanted to find an assessment criterion which was good enough for precise measurements, but at the same time, simple and easy to use. The individual branches may be ranked using these measurements at any given period. This criterion could be based on the results of business surveys – to be more specific: opinion surveys of chief executives. In

^{*} Ph. Doctor, Department of Forecasting and Economic Analysis, Wroclaw University of Economics.

^{**} Master of Science, Department of Forecasting and Economic Analysis, Wroclaw University of Economics.

^{***} Master of Science, Department of Logistic, Wroclaw University of Economics.

Western Europe business surveys have been widely used for years, and they have been conducted in Poland since 1992. The advantages of these surveys are speed and the simplicity of gathering the necessary information. Above all the information gathered expresses the opinion of managerial staff about the situation of their own companies. The reliability of the evaluation depends on the managers' qualifications, including their abilities to avoid excessive optimism or pessimism. We will call this approach subjective.

On the assumption that the managers can evaluate the situation of their own enterprises, the results of business surveys should be similar to those obtained from statistical reports.

We checked this assumption. A composite indicator was proposed and became a criterion for the evaluation. The component variables for the composite indicator were taken from official statistics (statistical reports). The data coming from the reports can be considered as objective and reliable. They reflect the real situation, or at least they measure it for all enterprises in the same way. Although it is not an ideal measure, it evaluates each branch in the same way. We will call this approach objective.

2. THE SCOPE OF RESEARCH

We compared the ordering results of individual branches using both approaches. The results obtained were not very encouraging, as they indicated the existence of significant differences. Then we attempted to narrow the diversity of the orderings. We have suggested several ways for improving the results. In these proposals, we have tried to correct the evaluations resulting from business surveys. For this purpose, the data from the surveys were adjusted by introducing correction parameters.

The research was carried out on data gathered according to the NACE (definition: NACE – General Nomenclature of Economic Activities/Manufacture in European Community Member Countries). It covered the divisions (branches) of its section D (manufacturing). In Table 1, branches of section D are presented. We analysed monthly data during the period from January 1995 to March 1998. The source data have been taken from "Badania" (1995–1998) and "Biuletyn" (1995–1998).

144

Table 1

Division	Description					
15*	Manufacture of food products and beverages					
16*	Manufacture of tobacco products					
17	Manufacture of textiles					
18	Manufacture of wearing apparel and furriery					
19	Processing of leather and manufacture of leather products					
20	Manufacture of wood and wood, straw and wicker products					
21	Manufacture of pulp and paper					
22	Publishing and printing					
23	Manufacture of coke, refined petroleum products and derivatives					
24	Manufacture of chemicals and chemical products					
25	Manufacture of rubber and plastic products					
26	Manufacture of other non-metallic mineral products					
27	Manufacture of basic metals					
28	Manufacture of metal products (except machinery and equipment)					
29	Manufacture of machinery and equipment					
30*	Manufacture of office machinery and computers					
31	Manufacture of electrical machinery and apparatus					
32	Manufacture of radio, television and communication equipment and apparatus					
33	Manufacture of medical, precision and optical instruments, watches and clocks					
34	Manufacture of motor vehicles, trailers and semi-trailers					
35	Manufacture of other transport equipment					
36	Manufacture of furniture; other manufacturing					
37*	Waste management					

Specification of divisions of section D: manufacturing

* These divisions have been skipped over in the research: divisions 30 and 37 because of the lack of data, divisions 15 and 16 due to different ways of presenting data in data sources. Source: On the basis of NACE.

3. THE METHODS

3.1. The objective approach

The procedure of the composite indicator's construction consisted of the following steps:

- component variables selection;

- component variables normalization - the use of the appropriate formula depends on their nature - stimulant, destimulant or nominant;

- component variables weighting;

- combining of component variables with the composite indicator.

The stimulant is a variable whose higher value is preferable or positively assessed.

The destimulant is a variable whose lower value is preferable or positively assessed.

The nominant is a variable which should possess a recommended value or a value from the recommended range.

In Polish literature, one can find proposals for normalization formulas (cf. Strahl (1996), Walesiak (1996)). Also the weighting and combining of component variables into the composite indicator are discussed. The diversity of possibilities makes it necessary for the researcher to make his individual choices at every step.

We raised the following question: Has a way of construction of the composite indicator a significant impact on ordering results?

We checked several composite indicators. We had eight component variables for each branch:

1. The dynamics of incomes from sale in fixed prices from March 1998 – index on a constant basis – January 1995 = 100% – a stimulant,

2. The cost of obtaining income from total activity - a destimulant,

3. The profitability rate of gross turnover in % – the relation of gross financial results to income from total activity – a stimulant,

4. The profitability rate of net turnover in % – the relation of net financial results to income from total activity – a stimulant,

5. The liquidity ratio of the second degree - the relation of current assets decline of stocks to short-term liabilities - a nominant,

6. The liquidity ratio of the third degree - the relation of current assets to short-term liabilities - a nominant,

7. The share of the companies showing net profit among the companies in a given division - a stimulant,

8. Share of incomes of the companies showing net profit among the incomes of the whole activity of a division - a stimulant.

In each case, the value of the composite indicator Z for each branch and period was calculated according to the following formula:

$$z_{jt} = \sum_{i=1}^{m} z_{ijt} \cdot w_i \tag{1}$$

where:

 z_{it} - value of the composite indicator in period t for division j,

 z_{ijt} - value of the normalized *i*-th component variable in period t for division *j*,

 w_i - weight ascribed to *i*-th component variable, $w_i \in (0, 1)$, $\sum w_i = 1$,

i - number of the component variable, i = 1, ..., m,

The nature of	The variant of normalization $(Z_i - variable after normalization)$						
component variable X_i	I Comparison to the average value of section D	II Comparison to max/min value in a given period	III Comparison to the range				
Stimulant	$z_{ijt} = \frac{x_{ijt}}{av(x_{it})}$	$z_{ijk} = \frac{x_{ijk}}{\max_{j} (x_{ijk})}$	$z_{ijt} = \frac{x_{ijt} - \min_{j} (x_{ijt})}{R_{it}}$				
Nominant with recommended value range of $[x_{i,\min}, x_{i,\max}]$		$z_{ijt} = \begin{cases} 1 & \text{for } x_{i,\min} \leqslant x_{ijt} \leqslant x_{i,\max} \\ \frac{x_{ijt}}{x_{i,\min}} & \text{for } x_{ijt} < x_{i,\min} \\ \frac{x_{i,\max}}{x_{ijt}} & \text{for } x_{ijt} > x_{i,\max} \end{cases}$					
Destimulant	$z_{ijt} = \frac{av(x_{it})}{x_{ijt}}$	$z_{ijk} = \frac{\min(\mathbf{x}_{ijk})}{\mathbf{x}_{ijk}}$	$z_{ijt} = \frac{\max_{j} (x_{ijt}) - x_{ijt}}{R_{it}}$				
Where:	x_{ijt} - the value of the variable X_i in j av x_{it} - the average value of the varial max x_{ijt} - maximum value of the varia j^i - the range <i>i</i> -th variable in period $x_{i,min}$ - the value of upper limit for the $x_{i,min}$ - the value of lower limit of the <i>i</i> - number of variable; $i = 1,, m; m$ j - number of division takes its values t - number of period; $t = 1,, 39$ (fr	-th division in period t ble X_i for section D in period t able X_i in period t; min x_{ijt} - minimum t recommended value range for nominant recommended value range for nominant - number of component variables taken from 17 to 36 (without 30) om 01 1995 to 03 1998)	value of the variable X_i in period nt t a for composite indicator constructio				

Variants of normalization formulas of component variables values

Source: Based on papers: Strahl (1996), Walesiak (1996).

147

Table 2

j - number of the division, j = 17, ..., 36 (except 30),

t – number of the period, t = 1, ..., 39.

The composite indicator has the nature of a stimulant. It means that a higher value is preferable.

We applied three variants of normalization and three ways of weighting component variables. In Table 2, the variants of normalization are presented. The average value of component variable for the whole of section D in a given period was the normalization base in the first variant (for the stimulant and the destimulant). In the second calculated technique, a comparison to maximum (for the stimulant) or minimum (for the destimulant) value in a given period was made. In the third variant, a comparison to the span (the range between maximum and minimum value of the variable X_i in a given period) was used. In each case, the values of the nominant were normalized in the same way. Values below the lower limit of the recommended values range were normalized in the same way as the stimulant. Values higher than the upper limit of the recommended values range were normalized in the same way as the destimulant. All values within the recommended range were replaced value equal one.

The following criteria were used for determined weightings:

A. All variables should have the same importance – the weights for all variables are the same,

B. The more diverse variables should have a higher impact – the weights of component variables are in proportion to the coefficients of variation:

$$w_i = \frac{V_i}{\sum\limits_{i=1}^m V_i},\tag{2}$$

where:

 V_i - coefficient of variation of *i*-th component variable

C. The correlation between variables should be taken into account – the weights of component variables are in proportion to coefficients of correlation. These weights were obtained by correlation matrix structure analysis:

$$w_{i} = \frac{\left|\sum_{i=1}^{m} r_{il}\right|}{\sum_{i=1}^{m} \left|\sum_{l=1}^{m} r_{il}\right|}, \quad i, \ l = 1, \ ..., \ m,$$
(3)

where:

 r_{il} - correlation coefficient between *i*-th and *l*-th component variables.

Objective	and	subjective	evaluation
objective	terrer.	Judjecure	erandanon

In Table 3, the weights of particular component variables are shown. They were calculated depending on the way of weighting. We observed large differences among the obtained weights, particularly for variable number 1 - the dynamics of incomes from sales – and variable number 2 - the cost of obtaining income from total activity.

Table 3

Way of weighting	The component variable							
	1	2	3	4	5	6	7	8
Α	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,5
B	17,0	3,0	14,0	13,0	15,0	18,0	10,0	10,0
C	8,0	13,0	16,0	15,0	11,0	11,0	12,0	14,0

Weights (in %) of component variables obtained for particular way of weighting

Source: Own research.

During the first step of the analysis we took into account indicators which differed in variants of normalization, or the ways of weighting component variables. Then we also analysed the indicators which differed in the number of component variables.

For all the pairs of indicators, we examined the similarity of obtained orderings. We did it in two ways:

- by comparing the ordering of all the branches in a given month - for this purpose, Spearman's coefficient of rank correlation (ρ) was applied;

- by comparing the locations which have been occupied by a given branch in a given month – for this purpose, the differences between the locations occupied by a specific branch in individual months were calculated and then the arithmetic average for absolute values of those differences for the whole scope of branches was calculated (\overline{d}) .

It may be pointed out that these compared orderings were very similar. The lowest average value of Spearman's coefficient was 0.906, and the highest average value of differences between the locations was 1.60. All Spearman's coefficients for all comparing pairs and for all particular periods were statistically significant (at the level a = 0.01).

After analysis of the results, we came to the conclusion that the way of construction of composite indicators has little impact on ordering results of manufacturing branches.

3.2. The subjective approach

In this approach, we used the results of business surveys which are conducted and published by the Polish Central Statistical Office each month. They contain the opinions of chief executives of manufacturing enterprises aggregated into divisions. They are published in the form of answers' balances in percents. All these balances have the nature of stimulants, which are normalized, in an interval [-100%, 100%]. For our analysis we used balances of answers to the questions of diagnostic character. The nature of these questions was twofold. The first type of questions concerns firms situation in a given month; the second type describes the expectations concerning the situation's change, compared to the situation during the previous month.

For the evaluation of individual branches we have constructed two different indices. The index S_1 was based on the question concerned the situation on a given period. We used the balances of answers to the question about the assessment of the general economic condition of their own enterprise. The answer to this question requires an overall evaluation of the situation in all enterprise's performance areas. Because of that, one may expect it to give a true reflection of the enterprise's condition. However, managers find it very difficult to conduct such an evaluation.

Additionally, we constructed the index S_2 based on answers referring to simple phenomena. The managers were asked to describe changes in:

- sold production;
- demand for company's products;
- stock level of final goods;
- capability to pay current financial liabilities;
- level of total receivables.

The index S_2 was constructed as an arithmetic average of the cumulated balances of answers to these questions. We analysed these balances in a cumulated form because the answers required comparison of the current situation with the situation in the previous month.

4. THE APPROACHES' COMPARISON

As an objective criterion we chose the composite indicator Z that consists of eight component variables. In this indicator the first normalization variant and equal weights were applied.

We compared the ordering results of individual branches for both objective and subjective approaches. It means that we compared ranking results obtained based on Z with those based on S_1 . The ordering comparison

was also conducted for the indicator Z and the index S_2 . Using the same comparison techniques we examined the ordering's similarity. We did this in two ways:

- by comparing the ordering of all branches in a given month - for this purpose, Spearman's coefficient of rank correlation was applied (ρ) ;

- by comparing the locations which have been occupied by a given branch in a given month – for this purpose, the differences between the locations occupied by a specific branch in individual months were calculated and then the arithmetic average for absolute values of those differences for the whole scope of branches was calculated (\bar{d}) .

The outcomes indicated the existence of significant differences. In Figure 1, Spearman's coefficients of rank correlation for the ordered pairs in the particular months are presented. In both cases, a large number of Spearman's coefficients was not significant at the level a = 0.01. Regarding the pairs Z and S_1 , 38% of coefficients were not significant and the average coefficient's value was 0.631. Regarding the pairs Z and S_2 , only 37% of coefficients were significant, and the average coefficient's value was 0.500. Also the average differences of the location \overline{d} were high. The mean value for the first analysed pair was 3.40 and for the second pair, the mean value was 4.36. These figures proved low similarity of both approaches.



R e m a r k: critical value for the coefficient on the level of significance a = 0.01 equals 0.564. Fig. 1. Spearman's coefficients of rank correlation for the orderings based on composite indicator Z and index S_1 (on the left) and S_2 (on the right) – January 1995 to March 1998

5. THE CORRECTION OF RESULTS BASED ON BUSINESS SURVEYS

In this discussion, the results based on the composite indicator Z were treated as objective. We assume that the cause of large differences in the results is the inaccuracy in managers' evaluations.

Because of that, we attempted to narrow the diversity of orderings. For this purpose, we tried to correct the evaluations resulting from business surveys.

In our opinion the managers made systematic errors in their evaluations. The cause of these errors was an inability of objective view of the impact of the changes in the environment on their enterprises' situation. We may call this inability excessive optimism or excessive pessimism.

For the purpose of elimination this excessive optimism or pessimism impact the correction parameters a_j were introduced for each branch. Additionally, for the index S_2 a variety of starting values were applied. The diversity of the starting values was considered favourable because the index S_2 was calculated on the cumulated balances of answers. Its starting value had an impact on the positions occupied by a given branch in all-next periods.

The parameters values a_j and b_j were determined by means of optimisation methods. We used local search method. We started with the following matrix S:

 $\mathbf{S} = [s_{tj}]_{n \times m},$

where:

 s_{tj} - the value of the index S_1 or S_2 in period t for division j; t - the number of period, t = 1, ..., 39; j - the number of division, j = 17, ..., 36 (except 30); n - the number of the analysed months, n = 39, m - the number of the analysed divisions, m = 19. Then the matrix X was calculated:

$$\mathbf{X} = [x_{tj}]$$
 (t, j, n, m - the symbols as earlier)

where:

for index S_1 : (4)

(5)

and

 $x_{tj} = \begin{cases} b_j & \text{for } t = 1\\ a_j \cdot s_{tj} + b_j & \text{for } t > 1 \end{cases} \quad \text{for index } S_2:$

where:

 a_j – excessive optimism or pessimism correction parameter for the division j;

 b_j - starting value for the division j.

 $x_{tj} = a_j \cdot s_{tj}$

152

The starting value b_j for the given branch j depends on the position of this branch obtained from the composite indicator Z in the first period (t = 1). They were calculated as:

$$b_i = -p_{lj}^z \cdot c, \tag{6}$$

where:

 p_{ij}^{z} - the position of the division j in period t = 1 according to the value of the composite indicator Z,

c – the constant value.

The starting values of the parameters a_j and c were set to 1. In the next steps, these parameters were changed on the value 0.1. If the arithmetic average for absolute values of differences \overline{d} was decreased, we had accepted this change of parameter value $(a_j \text{ or } c)$, otherwise we had it refused. It means that we tried to minimize the value of \overline{d} .

In Table 4, the average values of Spearman's coefficient of rank correlation $\bar{\rho}$, the percent of ρ coefficients which were significant at the level $\alpha = 0.01$ and the average differences of the location \bar{d} before and after correction are presented. The outcomes for the pair Z and S_2 are much better then earlier. The average value of Spearman's coefficient increased from 0.500 to 0.803. The percent of significant coefficient was raised from 37% to 97%. The average differences of the location \bar{d} was decreased from 4.36 to 2.33. The results for the pair Z and S_1 are also better than earlier but they still do not suit our needs well enough.

Table 4

Comparison pairs	ρ		% of ρ significant		đ	
Comparison pairs	before	after	before	after	before	after
Composite indicator Z_1 IA and the index S_1	0.631	0.689	62	77	3.40	2.93
Composite indicator Z_1 IA and the index S_2	0.500	0.803	37	97	4.36	2.33

The average values of Spearman's coefficient of rank correlation $\bar{\rho}$, the percent of significant coefficient ρ and the average differences of the location \bar{d} before and after correction



R e m a r k: critical value for the coefficient on the level of significance a = 0.01 equals 0.564. Fig. 2. Spearman's coefficients of rank correlation for the orderings based on composite indicator Z and index S_1 (on the left) and S_2 (on the right) – January 1995 to March 1998 – after correction

Spearman's coefficients of rank correlation after correction for the ordered pairs in the particular months are presented in Figure 2.

6. THE CONCLUSIONS

To conclude, it seems that when thinking about the economic condition of Polish manufacturing, it is worth taking into consideration both objective and subjective evaluations. Nevertheless, one has to remember that subjective evaluations only deserve recommendation if the managers are sufficiently well qualified. This means that it is assumed that they are able to correctly evaluate the situation of their own enterprises. As the results of the conducted research have shown, we cannot consider the analytical abilities of Polish managers as satisfactory. Therefore, evaluations from the business surveys should rather be treated as the expression of the current mood, which may be influenced by media reports, political events or current developments in their own enterprises.

Only 10% of manufacturing enterprises take part in business surveys. In contrast, the statistical reports encompass the all manufacturing enterprises. This may also be a source of the differences in ranking results obtained.

This paper has been prepared within the framework of the research project KBN 1 HO2B 005 17 "Multivariate Statistical Analysis in the Comparative Studies of Manufacturing Divisions in Poland".

REFERENCES

"Badania Koniunktury Głównego Urzędu Statystycznego" 1995–1998, Warszawa. "Biuletyn Statystyczny Głównego Urzędu Statystycznego" 1995–1998, Warszawa. Europejska klasyfikacja działalności, Ośrodek Badawczo-Rozwojowy Statystyki GUS, Warszawa.

Strahl D. (1996), Modele zarządzania bankiem (model Triada), Wydawnictwo AE we Wrocławiu.

Walesiak M. (1996), Metody analizy danych marketingowych, Wydawnictwo Naukowe PWN, Warszawa.

Dorota Kwiatkowska-Ciotucha, Urszula Załuska, Pawel Hanczar

OBIEKTYWNE I SUBIEKTYWNE OCENY KONDYCJI BRANŻ PRODUKCYJNYCH W POLSCE – ANALIZA PORÓWNAWCZA

(Streszczenie)

W artykule porównano wyniki badań kondycji branż produkcyjnych w Polsce uzyskane przy zastosowaniu dwóch podejść. W podejściu pierwszym (obiektywnym) jako kryterium oceny efektywności gospodarowania przyjęto wartości zmiennej syntetycznej. Zmienną syntetyczną zbudowano oparając się na wektorze zmiennych cząstkowych, których źródłem były sprawozdania statystyczne. W podejściu drugim (subiektywnym) jako kryterium oceny zastosowano wyniki testów koniunktury. Następnie porównano uporządkowania branż uzyskane na podstawie obu kryteriów oceny. Do porównań tych wykorzystano współczynnik korelacji rang Spearmana oraz wartości średnich różnic lokat.