

# Applied potential of econometric instrumentation of substantiation of economic decisions within fisheries sector

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**Abstract.** The article discusses the econometrics potential to substantiate economic decisions aimed at improving the competitiveness of fishery enterprises. The authors specified the definition of the economic category “competitiveness of fishery enterprises” and emphasized the importance of this concept as an indicator of the effectiveness of economic decisions. The paper contains the analysis of indicator methods for assessing the competitiveness of enterprises. The modified graphical indicator method named “competitiveness polygon” is recommended for assessing the competitiveness of fishery enterprises. The method for calculating the area of a competitiveness polygon was improved by replacing the expert method of determining the values of significance coefficients for relevant competitiveness factors with the econometric method by composing a multiple regression equation.

## 1 Introduction

Econometrics is a unique science at the confluence of statistics and economics, the potential of which is not fully fulfilled by this moment. It can help to solve many economic problems, taking into account the trends prevailing in the past, the current state of the processes and phenomena of economic life, and look ahead drawing on the appropriate scientific rationale.

Besides all the variety of independent tasks (from global to specific) solved by econometric methods, the tools of econometric modeling can also be used as an alternative instrument in the process of substantiating certain aspects of economic decisions. This fact predetermined the subject of the present research: the application potential of econometric tools in the process of making economic decisions aimed at improving the competitiveness of fishery enterprises of Crimea.

The fishing business of Crimea considered as a subject-objective basis for economic decision-making is characterized by socio-economic significance for the region, which has deep historical roots. This significance results from the state policy of ensuring food security and implementing import substitution policies. The competitiveness of fishery enterprises is the characteristic of the business, which accumulates the results of economic decisions, their

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quality and validity that are determined by the adequacy and objective feasibility of the applied model (method) of assessing the competitiveness of an enterprise.

The study is aimed at bringing the "competitiveness polygon" method of assessing the competitiveness of enterprises to the level of applied implementation on the basis of econometric approach to determining the ranks (weighting coefficients) of the relevant factors of competitiveness of fishery enterprises and at testing this method in order to justify the priority directions of development of fishing business. In other words, the goal is to demonstrate the potential of econometric tools for justifying fishery solutions.

## **2 Theoretical and methodological aspects of the substantiation of economic decisions on the example of assessing the competitiveness of fishery enterprises**

The competitiveness of enterprises is at the same time the aim of their development, and a factor that determines the ability of a particular business to function successfully and develop sustainably, and an indicator, which enables assessing the company's ability to withstand market competition and realize its own strategic goals and objectives.

The reason of such an ambiguous approach to interpreting the essence of the term "enterprise competitiveness" lies in the fact that this universal as a scientific economic category belongs to the conceptual apparatus of various areas of economy science and practice based on the development of foreign and domestic authors. (In particular, strategic management [1-5, etc.], the theory of competition and the competitiveness of enterprises as a factor of market economy [6–11, etc.], economic analysis, the assessment methodology of which is given in many relevant publications, etc.).

According to scientific developments in the field of competition and competitiveness of enterprises and taking into account the strategic and tactical approaches to understanding the subject matter and significance of this scientific category, the competitiveness of a fishery enterprise should be understood as its integrated characteristic, which takes into account and reflects the work performance and interaction of all its production and functional units within the framework of the relevant areas of fishery activities (fishery itself, marketing and logistics, innovation and investment activities, finance and management). The competitiveness of a fishery enterprise is manifested in its ability to offer fish and other fishery products in the desired quantity, at the right time, meeting the specific requirements of a consumer and taking into account the seasonality factor, besides under the same or most favorable conditions than its competitors offer.

It is worth mentioning that the oligopolistic type of market with a standardized product mainly of mass consumption and with similar organizational and technological conditions of its production obstruct providing more favorable realization conditions for consumers in the short term next to competitors. At the same time, making effective economic decisions of current and prospective nature requires constant monitoring of enterprise's own competitiveness, analysis of the factors that determine the competitiveness, timely implementation of measures for preserving and increasing the level of competitiveness of its products and all elements of a fishery enterprise. Only observing these conditions will ensure current and future market success for an enterprise and provide it with the entrepreneurial profit and capitalization of a business.

Emphasizing the competitiveness of an enterprise as a detector of economic decision effectiveness, the authors note the need to include the method of its assessment into the analytical practice of fishery enterprises. This method takes into account the industry specifics, the available information and analytical base, the average qualification level of company's specialists and clearly reflects the results of the assessment.

Indicator methods for assessing enterprise competitiveness, which are presented in methodological and analytical sources, include STEP-analysis, SPACE-analysis, GAP-analysis, LOTS-analysis, PIMS-analysis, Ansoff's method for CSF, graphic method named "competitiveness polygon", method of integral criterion, method of gathering competitive elements, etc. [12].

The methods listed above are based on the use of the system of indicators, which imply a set of characteristics that enable describing in a formalized form the state of the parameters of a particular object under study (in this case, enterprise competitiveness), and, on this basis, formulating recommendations for their improvement. Indicators in their turn are divided into a number of particular (specific) factor indexes reflecting the state of elements of an object under study. Although the methods for assessing the competitiveness of an enterprise differ by their "own" sets of assessment indicators and specific (factor) indexes, most of them involve ranking, or in other words determining weight and significance of the  $i$ th factor index in their total.

Mentioning the difficulties in developing a comprehensive information base, which is necessary for carrying out the STEP, GAP and LOTS analysis and noting the relative simplicity of the methodology, for analyzing the competitive micro and macro environment of fishery enterprises a graphical indicator method named "polygon competitiveness" is suggested to assess the competitiveness of enterprises [14, p. 169]. This method implies distinguishing relevant evaluation criteria: integrated factor indicators. The method should be preliminarily improved by, first, specifying the technology of converting the actual values of integrated factor indicators of enterprise competitiveness into relative units (which allows preserving their economic sense). Another step of improving is replacing the expert method of determining the significance rate of relevant competitiveness factors with econometric method by composing the equation of multiple regression and calculating the values of specific elasticity rates and specific  $\beta$ -rates.

The competitiveness polygon is drawn on the wind rose diagram. The value levels of each integrated factor indicator, characterizing certain aspects of the competitiveness of enterprises, converted into conventional units [14-15] are marked on the axes of the relevant chart starting at the zero point (origin). It should be emphasized that the set of factor indicators of the enterprise competitiveness can be of any description both in terms of the amount of factors and in their semantic content. The set of factor indicators is determined by the purpose of the study, the capabilities of the information base and the subject of analysis. An enterprise with the highest level of competitiveness will correspond to a polygon with the maximum area, which is calculated by the formula:

$$S_i = \frac{1}{2} \sum_{j=1}^m g_j \cdot g_{j+1} \cdot \sin \alpha_j, \quad (1)$$

where  $S_i$  – area of competitiveness polygon of the  $i^{\text{th}}$  enterprise;

$g_j$  – value of  $j^{\text{th}}$  integrated factor index for each factor of a competitor enterprise under assessment, expressed in unit fractions (relative units);

$m$  – number of factor indexes being accounted for each competitor enterprise

$\alpha_j$  – angle between the axes, on which the values of adjacent factor indexes are marked. This angle depends on the rank (importance, weight) of the corresponding factor and is calculated by the formula

$$\alpha_j = 360 \cdot R_j, \quad (2)$$

$R_j$  – rank of the  $j^{\text{th}}$  factor expressed in unit fractions and determined based on specific elasticity rates or specific  $\beta$ -rates

The actual values of integrated factor index of competitiveness of fishery enterprises are proposed to be converted into relative units:

– when optimal (aimed)  $x_j \rightarrow \max$  by the following formula:

$$g_j = \frac{x_j}{x_j^{\max}}; \quad (3)$$

– when optimal (aimed)  $x_j \rightarrow \min$  by the following formula:

$$g_j = \frac{x_j^{\min}}{x_j}, \quad (4)$$

where  $x_j$  – particular value of  $j^{\text{th}}$  integrated factor index expressed in units of measure corresponding to its economic content.

Adaptation of the “competitiveness polygon” method for assessing the competitiveness of enterprises to the specifics of the fishing business and its testing was carried out for “K” Ltd (Kerch). The actual enterprises under the code names PK “Fishing collective farm“ A ”, PK “Fishing collective farm “B”, “C” Ltd took on the role of direct competitors of enterprise “K” Ltd in the regional market of the city of Kerch.

### **3 Econometric approach to ranking indicator factor indexes of competitiveness of fishing enterprises**

Putting forward the idea that the competitiveness of an enterprise is determined by the productivity (efficiency) of using the resources involved in the production process and its level depends on the level of competitiveness of all elements of the enterprise and primarily products, capital productivity index was taken as the criterion performance indicator (response of the corresponding multifactor econometric model). This index reflects the volume of sales per 1 ruble of the total capital of the economic entity. The authors believe that using indexes of financial results in absolute terms or profitability indexes derived from them as a criterion of fishery enterprises’ competitiveness is not correct under conditions of their mainly unprofitable activity.

As indicators, i.e. integrated factor indexes (regressors of the corresponding five-factor econometric model) of competitiveness of selected fishery enterprises the following indexes were taken:

- market share characterizing the market position of an enterprise and the efficiency (competitiveness) of its production and sales activities;
- the expenses per ruble of products sold comprehensively characterizing the degree of use of all enterprise resources, the level of technical equipment and the perfection of the technological process, the level of organization of production and labor, rational methods of production management, efficiency (competitiveness) of organization and management activities;
- capital productivity characterizing the efficiency (competitiveness) of the production activity of an enterprise;
- duration of one turnover of working capital, which characterizes the efficiency (competitiveness) of enterprise’s commercial activities;

– current liquidity, which characterizes the ability of an enterprise to cover its short-term liabilities from the most easily sold part of the assets - working capital, i.e. efficiency (competitiveness) of the financial activity of the enterprise.

The choice of indexes is determined not only by economic content of the relevant indicators, but also by their relative nature, since for ensuring object and time comparability the criterion and factor indexes of econometric model must be represented by relative values: in this case, by relative structure value (market share) and relative intensity values (all other indexes).

The conventional values of integrated factor indexes obtained by using formulas 3 and 4 are calculated on the basis of averaged annual data on the performance of “K” Ltd, PK “Fishing collective farm A”, PK “Fishing collective farm B”, “C” Ltd for the last eight years (Table 1). It should be emphasized that along with the average values of indexes characterizing the central trend in the analyzed period, the values of factor indexes attributed to a particular period of assessment can be used to evaluate the competitiveness of enterprises (for example: year, quarter, month).

**Table 1.** Values of integrated factor indexes of competitiveness of Kerch fishery enterprises (relative units).

Indexes ( $g_j$ )	«K» Ltd	PK «Fishing collective farm «A»	PK «Fishing collective farm «B»	«C» Ltd
Market share ( $g_1$ )	1.00	0.89	0.64	0.15
Expenses per 1 ruble of sold products ( $g_2$ )	0.82	0.85	0.68	1.0
Capital productivity ( $g_3$ )	0.22	0.22	0.19	1.0
Duration of single turnover ( $g_4$ )	1.00	0.44	1.00	0.84
Current liquidity ratio ( $g_5$ )	0.22	0.67	1.00	0.67

To establish the ranks of the relevant integrated factor indexes on the basis of partial elasticity rates and  $\beta$ -rates, a five-factor regression model was constructed based on the activity data of the competing enterprises under evaluation. Indicators of the parameter reliability of the model and the paired linear correlation coefficients of the factors included in it are given in Tables 2 and 3.

**Table 2.** Indicators of reliability of the five-factor regression equation.

Indicator	Value	Characteristics
Coefficient of multiple determination ( $R^2$ )	0.852504	The variation of the effective indicator (capital productivity) of “K” Ltd, PK “Fishing collective farm “A”, PK “Fishing collective farm “B” and “C” Ltd within the studied period is 85.3% due to the variation of factors introduced into the econometric model, which indicates the sufficient rationality and optimality of their set
Multiple correlation coefficient (R)	0.923312	There is a strong connection between the capital productivity of “K” Ltd, PK “Fishing collective farm “A”, PK “Fishing collective farm “B” and “C” Ltd
Actual Fisher Criterion ( $F_a$ )	25.43	$F_t < F_a$ , that confirms with 0.95 probability the reliability of the parameters of the regression equation, i.e. reliability of correlation between the studied characteristics
Theoretical Fisher's criterion ( $F_t$ )	2.71	
The significance of the Fisher criterion	1,86E-08	The model is adequate, as $0.0000000186 < 0.05$ – the critical value of the Fisher criterion

**Table 3.** Paired linear correlation coefficients of factors included in the five-factor regression equation.

Index	Values of pair correlation coefficients					
	$r_{YX_i}$	$r_{X_1X_i}$	$r_{X_2X_i}$	$r_{X_3X_i}$	$r_{X_4X_i}$	$r_{X_5X_i}$
Y	1	-	-	-	-	-
X <sub>1</sub>	-0.5857	1	-	-	-	-
X <sub>2</sub>	-0.4355	0.0170	1	-	-	-
X <sub>3</sub>	0.8536	-0.6589	-0.4816	1	-	-
X <sub>4</sub>	-0.5410	-0.0394	0.6133	-0.3079	1	-
X <sub>5</sub>	0.0917	-0.1306	0.0359	0.0318	0.0440	1

According to the economic meaning of the resultant attribute, the values of the regression coefficients are approximated to pro mille, or in other words tenths of a kopeck. In a form adapted for perception, the five-factor regression equation is represented by the formula:

$$\overline{Cp_x} = 0,688 - 0,004 \cdot S_m + 0,288 \cdot E/SP + 0,332 \cdot Cp - 0,002 \cdot D + 0,011 CL_r, \quad (5)$$

where Cp (Y) – capital productivity, rub./rub.;

Sm (X<sub>1</sub>) – market share, %;

E/SP (X<sub>2</sub>) – expenses per ruble of sold products, rub./rub.;

Cp (X<sub>3</sub>) – capital productivity, rub./rub.;

D (X<sub>4</sub>) – duration of one turnover, days;

CL<sub>r</sub> (X<sub>5</sub>) – current liquidity ratio.

The interpretation of values of regression equation parameters reflects the quantitative characterization of qualitatively defined dependencies. In particular:

– with an increase in the share of the regional market of fish products of a competitor by 1%, its capital productivity decreases by an average of 0.4 kopecks, which is conditioned by the appearance of a negative scale effect that results from the specifics of the fishery industry. Within the industry, on the one hand, both large and small enterprises can function successfully, on the other hand, consumer demand for fish products has certain limits, which requires additional costs associated with its promotion to the market;

– growth of expenses per ruble of sales per one kopeck contributes to an increase in the capital productivity of competing companies for 0.3 kopecks by an average. It is associated with the outpacing growth rates of capital of competing fishery enterprises if comparing with the growth rate of their product sales as well as with the economic law of diminishing returns;

– increase in the capital productivity of competing enterprises by one kopeck allows for an average capital productivity of 0.3 kopecks;

– slowdown in the turnover of working capital of competing enterprises (increase in the duration of one turnover for a day) leads to a decrease in capital productivity of 0.2 kopecks by an average;

– increase in the current liquidity ratio by 1 (reduction of entrepreneurial financial risks) determines the average capital productivity of competing companies by 1.1 kopecks.

The values specific elasticity rates and specific β-rates calculated for assessing the degree of influence of the relevant factors on the capital productivity of the estimated competing enterprises (level of significance of integrated factor indicators) and the values of their ranks (R<sub>j</sub>) are given in Table 4.

The rank values of the first, fourth and fifth factors calculated on the basis of specific elasticity rates and specific β-rates are almost the same. Only the ranks of the expenditure indices for 1 ruble of products sold and capital productivity differ significantly, which affected the ordinal rank significance of expenditures for 1 ruble of products sold as a potential reserve for increasing the capital productivity of competing enterprises

**Table 4.** Data characterizing the importance of integrated factor indicators for assessing the competitiveness of fishery enterprises in the city of Kerch using the “competitiveness polygon” method.

Integrated factor index	j	$\varepsilon_j$	$\beta_j$	Value of rank of jth factor	
				R <sub>j</sub> over $\varepsilon_j$	R <sub>j</sub> over $\beta_j$
Market share	1	0.102	0.132	0.09	0.08
Expenses per 1 ruble of sold products	2	0.333	0.202	0.29	0.12
Capital productivity	3	0.367	0.807	0.31	0.47
Duration of one turnover	4	0.332	0.485	0.29	0.29
Current liquidity ratio	5	0.026	0.073	0.02	0.04
Totally	-	1.160	1.699	1.00	1.00

## 4 Practical results of the study

Data for a comparative assessment of the competitiveness of Kerch fishery enterprises by using the “competitiveness polygon” method, that are obtained using formula 1 and taking into account the values of the indexes from Table 1 and ranks of factor indexes calculated on the basis of specific elasticity rates and specific  $\beta$ -rates from Table 4, are presented in Table 5 and Figure 1.

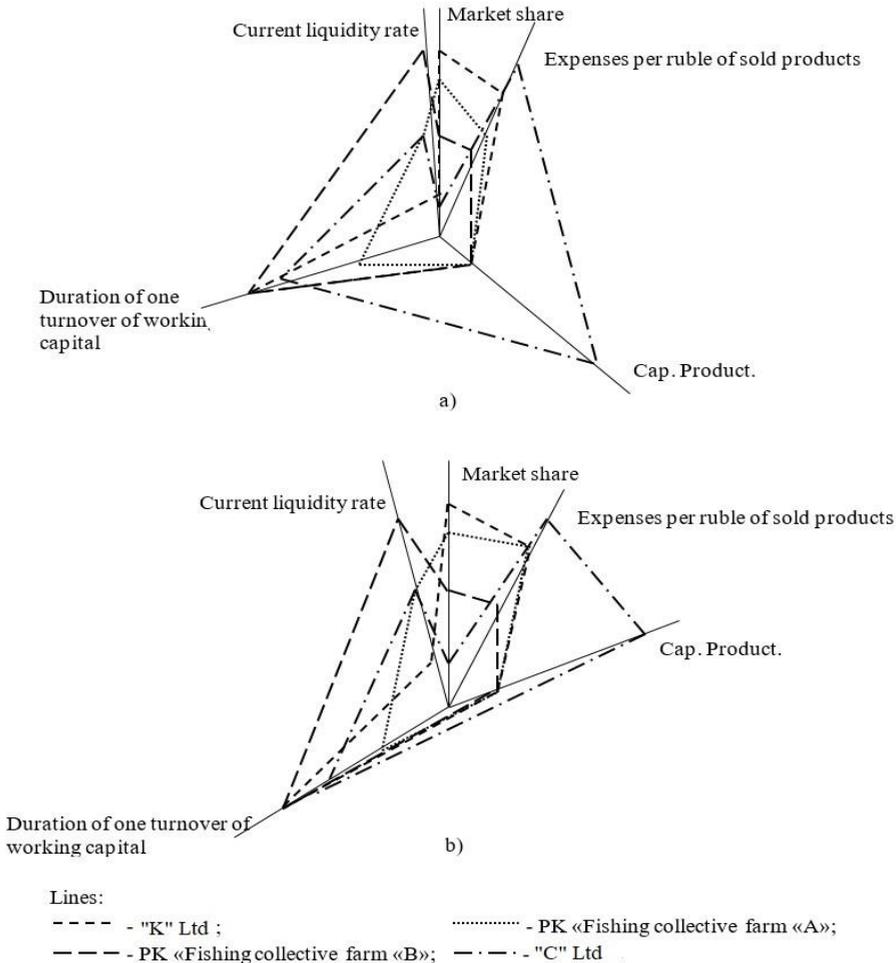
**Table 5.** Estimated indexes of competitiveness of Kerch fishery enterprises obtained by the “competitiveness polygon” method using specific elasticity rates and specific  $\beta$ -rates.

Integrated factorial index	$S_i = \frac{1}{2} \sum_{j=1}^m g_j \cdot g_{j+1} \cdot \sin \alpha_j$		Competitiveness assessment*	
	R <sub>j</sub> over $\varepsilon_j$	R <sub>j</sub> over $\beta_j$	over $\varepsilon_j$	over $\beta_j$
<b>«K» Ltd</b>				
Market share ( $g_1$ )	$S_1 = \frac{1}{2} \cdot (1,0 \cdot 0,82 \cdot \sin 32,4 + 0,82 \cdot 0,22 \cdot \sin 104,4 + 0,22 \cdot 1,0 \cdot \sin 111,6 + 1,0 \cdot 0,22 \cdot \sin 104,4 + 0,22 \cdot 1,0 \cdot \sin 7,2) = 0,530$	$S_1 = \frac{1}{2} \cdot (1,0 \cdot 0,82 \cdot \sin 28,8 + 0,82 \cdot 0,22 \cdot \sin 43,2 + 0,22 \cdot 1,0 \cdot \sin 169,2 + 1,0 \cdot 0,22 \cdot \sin 104,4 + 0,22 \cdot 1,0 \cdot \sin 14,4) = 0,414$	3	4
Expenses per 1 ruble of sold products ( $g_2$ )				
Capital productivity ( $g_3$ )				
Duration of one turnover ( $g_4$ )				
Current liquidity ratio ( $g_5$ )				
<b>PK «Fishing collective farm «A»</b>				
Market share ( $g_1$ )	$S_2 = \frac{1}{2} \cdot (0,89 \cdot 0,85 \cdot \sin 32,4 + 0,85 \cdot 0,22 \cdot \sin 104,4 + 0,22 \cdot 0,44 \cdot \sin 111,6 + 0,44 \cdot 0,67 \cdot \sin 104,4 + 0,67 \cdot 0,89 \cdot \sin 7,2) = 0,518$	$S_2 = \frac{1}{2} \cdot (0,89 \cdot 0,85 \cdot \sin 28,8 + 0,85 \cdot 0,22 \cdot \sin 43,2 + 0,22 \cdot 0,44 \cdot \sin 169,2 + 0,44 \cdot 0,67 \cdot \sin 104,4 + 0,67 \cdot 0,89 \cdot \sin 14,4) = 0,472$	4	3
Expenses per 1 ruble of sold products ( $g_2$ )				
Capital productivity ( $g_3$ )				
Duration of one turnover ( $g_4$ )				
Current liquidity ratio ( $g_5$ )				
<b>PK «Fishing collective farm «B»</b>				
Market share ( $g_1$ )	$S_3 = \frac{1}{2} \cdot (0,64 \cdot 0,68 \cdot \sin 32,4 + 0,68 \cdot 0,19 \cdot \sin 104,4 + 0,19 \cdot 1,0 \cdot \sin 111,6 + 1,0 \cdot 1,0 \cdot \sin 104,4 + 1,0 \cdot 0,64 \cdot \sin 7,2) = 0,792$	$S_3 = \frac{1}{2} \cdot (0,64 \cdot 0,68 \cdot \sin 28,8 + 0,68 \cdot 0,19 \cdot \sin 43,2 + 0,19 \cdot 1,0 \cdot \sin 169,2 + 1,0 \cdot 1,0 \cdot \sin 104,4 + 1,0 \cdot 0,64 \cdot \sin 14,4) = 0,731$	2	2
Expenses per 1 ruble of sold products ( $g_2$ )				
Capital productivity ( $g_3$ )				
Duration of one turnover ( $g_4$ )				
Current liquidity ratio ( $g_5$ )				
<b>«C» Ltd</b>				

Market share ( $g_1$ )	$S_4 = \frac{1}{2} \cdot S_4$	$S_4 = \frac{1}{2} \cdot S_4$		
Expenses per 1 ruble of sold products ( $g_2$ )	$(0,15 \cdot 1,0 \cdot \sin 32,4 +$	$(0,15 \cdot 1,0 \cdot \sin 28,8 +$	1	1
Capital productivity ( $g_3$ )	$+1,0 \cdot 1,0 \cdot \sin 104,4 +$	$+1,0 \cdot 1,0 \cdot \sin 43,2 +$		
Duration of one turnover ( $g_4$ )	$+1,0 \cdot 0,84 \cdot \sin 111,6 +$	$+1,0 \cdot 0,84 \cdot \sin 169,2 +$		
Current liquidity ratio ( $g_5$ )	$+0,84 \cdot 0,67 \cdot \sin 104,4 +$	$+0,84 \cdot 0,67 \cdot \sin 104,4 +$		
	$=1,194$	$=0,742$		

Note: \*- assessment of the competitiveness of enterprises is given on a regression basis, i.e. the most competitive enterprise was assigned with a score of 1.

The analysis of the competitiveness of Kerch fishing enterprises confirmed the conclusions concerning the fact that the small fishing business presented in this study by “C” Ltd is more competitive under the current economic conditions, which is evidenced by the current trends in the organizational forms of fishery activities. According to the Department of Fisheries and Aquaculture of the Ministry of Agriculture of the Republic of Crimea, more than 80 percent of the 224 fishery subjects registered in the region belong to small (in particular, micro) entrepreneurship and are mainly represented by self-employed entrepreneurs.



**Fig. 1.** Competitiveness polygons of Kerch fishery enterprises constructed with regard to the values of ranks of factor indexes calculated on the basis of specific elasticity rates (a) and specific  $\beta$ -rates (b).

The small fishing business focused on renting fishing vessels turned out to be more competitive (more viable and efficient in terms of management) than the medium-sized enterprises of the fisheries sector, which have their own fishing fleet. Moreover, small fishing business being relatively young was created on the debris of large and medium-sized fishery enterprises by leasing or redeeming medium Black Sea seiners (often very cheaply) and attracting highly qualified personnel. Another significant difference of small fishing enterprises from medium and large ones is usual lack of their own capacities for further processing of fish (freezing, salting, drying, smoking, canning). On the one hand, it simplifies the structure of an enterprise and reduces the cost of the business process, and on the other hand, it does not reduce their competitiveness, as there are unloaded capacities of specialized fish processing enterprises in the region that have high demand for raw fish.

Thus, “competitiveness polygon” method of evaluation can be used as a rapid test of the competitiveness of enterprises in the fisheries sector that allows identifying industry leaders and outsiders with a further deeper analysis of competitive advantages of first ones and problems of second ones. The calculation of the area of the competitiveness polygon with account for the importance of integrated factor indexes calculated by specific elasticity rates and specific  $\beta$ -rates has identified the undoubted competitive leader among Kerch fishery enterprises: “C” Ltd. “K” Ltd and PK “Fishing collective farm A” are undoubted outsiders. Despite the fact that different methods for determining the ranks of factor indicators reverse the competitive positions of these enterprises, the gap in the area values of their competitiveness polygons is very small.

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