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## SELECTED DETERMINANTS OF COOPETITION OF INDUSTRIAL ENTERPRISES IN SOUTH-WESTERN POLAND IN 2009–2011

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### Abstract

When studying literature on the issue coopetition it may be found that this issue has become more and more popular in recent years. However, this finding was not confirmed in economic practice. Reluctance or concerns about coopetition result from caution and distrust of Polish entrepreneurs in relation to other players on the market. In the previous socio-political conditions this approach was successful. However, the current situation forces small and medium-sized enterprises to draw attention to the strategy of “sleeping with the enemy.” In this context, the objective of the study was to answer the question of what factors influence establishing coopetition in south-western Poland in a simulative or detrimental way.

**Keywords:** coopetition, coompetition, cooperation.

**JEL classification:** O31, O32, O33.

## **Introduction**

The concept of “coopetition” was formulated for the first time in 1990 by a multi-year CEO of Novell -R. Noorda<sup>1</sup>. The term then became the subject of investigations of Brandenburg and Nalebuff<sup>2</sup>. Most researchers treat coopetition as a situation in which companies compete and cooperate with each other at the same time. This is a combination of cooperation and competition<sup>3</sup>.

The more far-reaching interpretation of coopetition is that enterprises cooperate with their competitors<sup>4</sup>. In this perspective, coopetition signifies working with competitors of the companies that compete in the same market and cooperate in other areas. Going even further coopetition could be called an aggressive strategy of “sleeping with the enemy”<sup>5</sup>.

The current situation forces, especially small and medium-sized enterprises, to establish coopetition. This is due to the increasing complexity of technologies of manufactured products and the progressive globalization<sup>6</sup>. In this case, entities classified as SMEs face a number of barriers, which may include, among others: the high cost of R&D, high risk of this kind of activity and the lack of resources to conduct innovative activities on a large scale<sup>7</sup>. You may also hear the opinions that cooperation between competitors in the SME sector is vital to the survival of the sector<sup>8</sup>. It is also worth mentioning that companies classified as SMEs, as opposed to larger businesses, can create coopetition easier than larger businesses, because SMEs are more flexible and less constrained by existing structures, formal procedures and policies<sup>9</sup>.

Studies show that in developed countries, more than 50% of the connections between enterprises appear in one sector, or at least between competitors<sup>10</sup>. Benefits of the cooperation between these entities are especially true for companies: a) from the knowledge-based sectors, b) using multi-disciplinary technologies, c) manufacturing products with relatively short life cycle<sup>11</sup>. In these sectors such coopetition contributes to the increase of technological diversity and the common use of complementary resources, which were previously only available to a single entity. The condition of sharing resources with another entity is of course the opportunity to achieve additional benefits, compared to the variant in which an independent company would use this resource alone<sup>12</sup>. Competitors often face similar challenges and threats as they often operate in similar conditions. Thanks to these similarities, in the case of initiating cooperation, entities that used to compete with each other can also effectively compete with big businesses that are trying to push the smaller players out of the market. In this case, the cooperation of former competitors can contribute to: a) the creation of the benefits of economies of scale, b) distribution of risks assumed by larger number of entities, c) more effective use of

complementary resources, d) facilitating entry into new markets e) facilitated access to external resources<sup>13</sup>.

In this context, the research hypothesis is the claim that the establishment of cooperation with a competitor is one of the least popular forms of innovative collaboration in South-Western Poland. The main objective of the study was an attempt to respond to the question, what factors have a simulating or detrimental effect on establishing cooperation in South-Western Poland.

## 1. Methodological aspects of the study

Part of the methodological analysis was based on econometric modeling for which the research tool is an econometric model. According to the definition, the model presents interdependencies between variables using an equation. Each model consists of the following components: endogenous and exogenous variables, parameters and random factor.

Seven basic stages should be included while conducting econometric research: a) selection of endogenous variable and selection of “candidates” for exogenous variables ( $x_1, x_2, \dots, x_k$ ), b) collection of statistical data, c) the choice of exogenous “candidates” having a significant impact on the endogenous variable, d) selection of a mathematical model that will illustrate the relationship between the variables, e) estimation of the model parameters, namely the replacement of unspecified parameters by specific numerical values, determined on the basis of empirical data, f) verification of the model, using the hypotheses and statistical tests, g) the application of the model for analytical or prognostic goals.

According to the research procedure presented above, the first step should be the choice of the endogenous variable and the candidates for exogenous variable. It should be noted that the content of this article applies only to a narrow section of the broader study, including the effect of different conditions on the cooperation of industrial enterprises. Thus, the endogenous variable is the fact that industrial entities cooperate with competitors. The list of “candidates” for the endogenous variable was long and included, among others, parameters characterizing the company, or parameters characterizing the innovative activity of enterprises, broken down into the investment, and implementation aspects.

The second stage of the research procedure was collecting statistical data. One of the lists of companies available on the internet was used as a starting point. This list of companies in the study area included address data of 54,227 companies, of which industrial enterprises accounted for 7,602 units. A questionnaire was sent to all industrial enterprises.

The level of return of the questionnaires ranged from 8.45% in Lower Silesia to 30.6% in Lubuskie. The high degree of return of questionnaires in Lubuskie resulted from the easy access to the business venues for the interviewers, who were from the area, and a small number of industrial enterprises in the voivodeship.

The third stage is the choice 'candidates' for exogenous variable having a significant impact on the endogenous variable. A total of 45 variables were adopted from a long list for exogenous variables. They were divided into five groups: a) variables indicating the sector of origin of the recipient (14 variables), b) variable indicating the distance from: a competitor, a supplier and a recipient (12 variables), c) variable indicating maintained relationships with competitors, suppliers and customers (12 variables), d) variables indicating the trend illustrating the industrial company's income (3 variables), e) variables indicating the technological classes used by the company (4 variables).

The endogenous and exogenous variables adopted in the study were of dichotomous nature, which means that they adopted an even value, either 0 or 1. In the case of endogenous variable it means that either, a cooperation with the client occurred (thus the variable accepted the value of 1) or not (thus the variable have taken the value of 0).

The exogenous variables for each company were examined, as mentioned earlier, in terms of 45 variables, divided into five groups.

The adoption of dichotomous values by the endogenous and exogenous variables means that the most popular methods of modeling could not be used, which include, among others, multiple regression. In order to obtain a model in which the endogenous variables are binary (0,1), logit or probit regression should be used. In logit regression, the predicted values of the endogenous variable must be between 0 and 1, which can be achieved by using logit transformation. However, in probit regression, the endogenous variable can be regarded as the result of a hidden variable with normal distribution, which actually has a value in the range from plus to minus infinity<sup>14</sup>.

The logit or probit models in which the endogenous variable takes the binary value, the expected value of the endogenous variable can be interpreted as the probability of the event in certain conditions, determined by exogenous variables. Probit modeling used in the research procedure is based on the classical theory of probability, which was presented at the beginning of the nineteenth century by P. Laplace.

Estimation of the model parameters to build a probit model followed the method of maximum likelihood. The basic assumption of this method is based on the likelihood function.

It is used in the additive random component models, assuming a normal distribution of this component.

For the purposes of this study, calculations were performed using Statistica software. For one endogenous variable, 45 probit models were made, of which only 13 were statistically significant and were later part of the study presented and discussed.

Due to the use of models that take into account only one factor for interpretation of researched interdependencies, the models are presented in structural form. The symbol by the parameter is essential. The positive symbol indicates that the probability of establishing cooperation with the entity by the industrial company of certain size is higher than in the other groups combined. The negative sign, on the other hand, means that the probability of an innovative collaboration with the entity is lower than in the other groups combined. The studies are static in nature and relate to a period of three years, which is consistent with the standards described in the methodological manual from Oslo<sup>15</sup>.

## 2. Characteristics of the research group

The questionnaires were sent to all industrial enterprises in South-Western Poland. 1,037 companies returned the completed surveys. Territorial structures of the companies that returned a completed questionnaire are presented in the table below.

Table 1. Number and territorial structure of companies which returned the completed questionnaire

No.	Region	Number of enterprises	Structure of enterprises (%)
1	Lower Silesia	492	47.44
2	Lubuskie	545	52.56
4	South-Western Poland	1,037	100.00

Source: own calculations on the basis of the research.

Table 2 illustrates the number and structure of companies cooperating innovatively.

Table 2. Number and structure of companies cooperating innovatively

No.	Region	Number of enterprises	Ratio of companies cooperating innovatively to the number of companies that return a completed questionnaire (%)
1	Lower Silesia	231	46.95
2	Lubuskie	268	49.17
3	South-Western Poland	499	48.12

Source: own calculations on the basis of the research.

Table 2 shows that the ratio of companies cooperating innovatively to all the companies that responded to the questions in the questionnaire amounts to almost 47% in the province of Lower Silesia, and just over 49% in the Lubuskie. In South-Western Poland average ratio of enterprises cooperating innovatively to everyone who sent the completed questionnaire is 48.12%.

### 3. Characteristics of cooperation relations in South-Western Poland

Table 3 shows the structure of industrial companies which have initiated innovative cooperation with regards to the entity with the cooperation was established.

Table 3. The structure of companies cooperating innovatively with regards to entity cooperation in the provinces of Lower Silesia and Lubuskie in 2009–2011 (%)

No.	Cooperating entity	Lower Silesia	Lubuskie
1	Supplier	60.6	63.1
2	Competitor	5.6	16.4
3	The Polish Academy of Sciences	1.3	1.9
4	University College	13.9	6.7
5	National units of development	14.7	12.7
6	Foreign units of development	3.0	3.4
7	Recipients	53.7	50.0

Source: own calculations on the basis of the research.

Industrial enterprises of South-Western Poland frequently exhibited establishing an innovative collaboration with more than one partner. Frequently, cooperation was undertaken with suppliers and recipients. However, a competitor was not seen as an interesting partner for cooperation. This trend was particularly evident in the region of Lower Silesia. In the case of Lower Silesia more often than with a competitor, the industrial companies collaborated with: national units of development and university colleges.

Table 4 illustrates how did the cooperation with a competitor fare, depending on the technological group represented by the industrial companies of South-Western Poland.

Table 4. The structure of the companies cooperating innovatively with a competitor considering the technological group represented by the industrial companies in the area of Lower Silesia and Lubuskie provinces in 2009–2011 in relation to the number of enterprises establishing innovative cooperation (%)

No.	Region	Technology used by the company			
		low	medium-low	medium-high	high
1	Lower Silesia	5.7	2.8	8.8	6.7
2	Lubuskie	16.9	12.2	23.1	25
3	South-Western Poland	12.9	9.6	9.7	13.0

Source: own calculations on the basis of the research.

The above table shows that in South-Western Poland, enterprises that represent the high and medium-high technology establish innovative cooperation with their competitors most frequently. This trend is consistent with the results of the work conducted by E.G. Carayannisa and J. Alexander<sup>16</sup>.

Table 5 illustrates what size companies cooperate with their competitors most often.

Table 5. The structure of the companies cooperating innovatively with a competitor considering the size of the companies in the area of Lower Silesia and Lubuskie provinces in 2009–2011 in relation to the number of enterprises establishing innovative cooperation (%)

No.	Region	Size of the enterprise			
		micro	small	medium	large
1	Lower Silesia	2.9	6.7	13.6	3.8
2	Lubuskie	13.8	20.2	16.7	6.7
3	South-Western Poland	13	7.5	13.3	13

Source: own calculations on the basis of the research.

Table 5 shows that enterprises belonging to the SME sector establish cooperation with their competitors most often. This trend is also consistent with the work carried out by Gnyawali and Park<sup>17</sup>.

#### 4. The impact of the sector of the recipients' origin on establishing cooperation in South-Western Poland

While analyzing the impact of the sector of the industrial enterprises recipients' origin is worth noting that only some of the sectors have a stimulating or detrimental effect on establishing cooperation, as shown in Table 6.

Table 6. The impact of the sector on the industrial enterprises recipients' origin in South-Western Poland in 2009–2011

Sector in which the recipient of the industrial enterprise's product is located	Parameter	$s$	$T$	$P >  z $	$p_1$	$p_2$	$\chi^2$	$p$
Sectors of transport	+0.39	0.15	2.629	0.0090	0.16	0.08	6.935	0.0090
Sectors of trade	+0.62	0.17	3.628	0.0003	0.23	0.09	12.714	0.0003

$s$  – standard error;  $T$  – T-student statistics for the parameter;  $P > |z|$  – probability of no significance parameter;  $p_1$  – the probability of a given phenomenon in the researched group of companies;  $p_2$  – the probability of a given phenomenon in other groups companies;  $\chi^2$  – Chi square test compliance;  $p$  – the probability of insignificance model.

Source: own calculations on the basis of the research.

Having customers located in the sectors of transport and trade has a stimulating effect on the establishment of cooperation. In both cases, the probability of establishing cooperation with a competitor is twice as high as opposed to establishing cooperation with a competitor by an industrial company with recipients located in other sectors.

#### 5. The impact of relationships with participants of the delivery network on the occurrence of cooperation in South-Western Poland

Table 7 illustrates the impact of relationships with participants of the delivery network on the occurrence of cooperation among industrial enterprises in South-Western Poland.

The above table shows that maintaining only close contacts with a competitor stimulates the establishment of cooperation among industrial enterprises in South-Western Poland. In such a case, the likelihood of cooperation is 0.21 and is more than 2-fold higher than the probability of establishing cooperation with entities that maintain relation other than close with their competitors. Maintaining good neighborly relations means that the probability of establishing cooperation is almost 2-fold lower than the probability of establishing cooperation by enterprises that maintain contacts other than neighborly.

Table 7. The impact of maintaining relationships with participants of the delivery network on the occurrence of cooptation among industrial enterprises in the South-Western Poland in 2009–2011

Participant of the delivery network	Parameter	<i>s</i>	<i>T</i>	$P >  z $	$p_1$	$p_2$	$\chi^2$	<i>p</i>
Lack, or maintaining only necessary contacts								
Supplier	-0.71	0.27	-2.660	0.008	0.03	0.13	8.829	0.003
Recipients*	+0.78	0.34	2.292	0.022	0.40	0.15	5.088	0.024
Maintaining close contacts								
Competitor	+0.52	0.17	3.065	0.002	0.21	0.09	9.094	0.0026
Maintaining good neighborly contacts								
Competitor	-0.38	0.19	-1.978	0.049	0.07	0.13	4.200	0.0404
Supplier	+0.51	0.21	2.386	0.017	0.22	0.10	5.422	0.0199

*s* – standard error; *T* – T-student statistics for the parameter;  $P > |z|$  – probability of no significance parameter;  $p_1$  – the probability of a given phenomenon in the researched group of companies;  $p_2$  – the probability of a given phenomenon in other groups companies;  $\chi^2$  – Chi square test compliance; *p* – the probability of insignificance model.

\* Statistically relevant model could only be obtained for enterprises from Lubuskie province.

Source: own calculations on the basis of the research.

What is worth noting while analyzing the relationship maintained with the supply network participants is the model illustrating the stimulatory effect, necessary to maintain relationships with recipients, on cooptation. In this case, the likelihood of establishing cooptation amounts to 0.40 and is more than 2.5 times greater than the probability of establishing cooptation by companies that maintain relationships other than necessary.

The logit models that illustrate the impact of relationships held by the suppliers to establish cooptation are also interesting. If good neighborly relations with the supplier are maintained, the probability of establishing cooptation is 0.22, and is more than 2-fold greater than the probability of establishing cooptation by companies that maintain relationships with suppliers other than neighborly. The confirmation of the situation is that fact that the probability of establishing cooptation by companies that maintain only necessary contacts with suppliers is 0.03 and it is more than 4-fold lower than the probability of establishing cooptation by companies that maintain relationships with suppliers other than necessary.

## 6. The effect of distance from the supply network participants on the occurrence of cooperation in South-Western Poland

Table 8 illustrates the effect of distance from the supply network participants on the occurrence of cooperation in South-Western Poland.

Table 8. The effect of distance from the supply network participants on the occurrence of cooperation in South-Western Poland in 2009–2011

Supply network participant	Parameter	$s$	$T$	$P >  z $	$p_1$	$p_2$	$\chi^2$	$p$
Local venue								
Supplier	+0.39	0.17	2.277	0.023	0.18	0.10	5.032	0.0250
Foreign location								
Supplier	-0.62	0.27	-2.266	0.024	0.04	0.13	6.184	0.0130
Recipients	-0.64	0.24	-2.648	0.008	0.04	0.13	8.362	0.0038

$s$  – standard error;  $T$  – T-student statistics for the parameter;  $P > |z|$  – probability of no significance parameter;  $p_1$  – the probability of a given phenomenon in the researched group of companies;  $p_2$  – the probability of a given phenomenon in other groups companies;  $\chi^2$  – Chi square test compliance;  $p$  – the probability of insignificance model.

Source: own calculations on the basis of the research.

Table 8 shows that only having a local supplier affects the occurrence of cooperation stimulatingly. The likelihood of establishing cooperation in such a situation is 0.18 and is 80% higher than the probability of cooperation by companies whose suppliers are located outside the town borders of the venue of the industrial company. Having an industrial supplier located outside the country affects the occurrence of cooperation particularly adversely. In this case, the probability of establishing cooperation with a competitor is 0.04, and is more than 3 times smaller than the probability of cooperation among industrial companies whose suppliers are located throughout the country.

Having customers located outside the country also affects the occurrence of cooperation negatively. In this case, the probability of establishing cooperation is 0.04 and is more than 3-fold lower the probability of establishing cooperation by industrial enterprises that have customers located on Polish territory.

## 7. The impact of the industry's income on cooperation with a competitor

In the case of the variable illustrating the income of the enterprise in the time it was possible to obtain only one, statistically relevant, probit model. It took the following form:

Table 9. The effect of industry's income on the occurrence of cooperation in South-Western Poland in 2009–2011

Income of companies	Parameter	<i>s</i>	<i>T</i>	$P >  z $	$p_1$	$p_2$	$\chi^2$	<i>p</i>
Constant income of companies	+0.38	0.17	2.23	0,03	0.18	0.10	4.84	0.03

*s* – standard error; *T* – T-student statistics for the parameter;  $P > |z|$  – probability of no significance parameter;  $p_1$  – the probability of a given phenomenon in the researched group of companies;  $p_2$  – the probability of a given phenomenon in other groups companies;  $\chi^2$  – Chi square test compliance; *p* – the probability of insignificance model.

Source: own calculations on the basis of the research.

According to the model presented above, the probability of establishing cooperation in a group of companies that keep constant income is 0.18 and is about 80% higher than in the group companies, whose income has increased or decreased.

## 8. The impact of technological group of the industrial enterprise on cooperation with a competitor

In the case of the variable illustrating the technological group used by the enterprise it also was possible to obtain only one, statistically relevant, probit model. It took the following form:

Table 10. The effect of technological group on the occurrence of cooperation in South-Western Poland in 2009–2011

Technological group	Parameter	<i>s</i>	<i>T</i>	$P >  z $	$p_1$	$p_2$	$\chi^2$	<i>p</i>
Medium-low technology	–0.52	0.25	–14.53	0.03	0.05	0.13	5.15	0.02

*s* – standard error; *T* – T-student statistics for the parameter;  $P > |z|$  – probability of no significance parameter;  $p_1$  – the probability of a given phenomenon in the researched group of companies;  $p_2$  – the probability of a given phenomenon in other groups companies;  $\chi^2$  – Chi square test compliance; *p* – the probability of insignificance model.

Source: own calculations on the basis of the research.

According to the presented model, the probability of establishing cooperation in the group of companies that use medium-low technology is 0.05, and is more than 2.5 times lower than the probability of establishing cooperation by companies using technologies other than medium-low.

## **Conclusions**

Reviewing both domestic and foreign literature it can be seen that the issue of cooperation has become increasingly popular in recent times. The same cannot be said about cooperation in terms of economic practice. Reluctance or concerns about cooperation result from caution and distrust of Polish entrepreneurs in relation to other players on the market, whose strategy has proved successful in the previous socio-political conditions. However, the current situation forces small and medium-sized enterprises to draw attention to the strategy of “sleeping with the enemy”.

The high cost of R&D, high risk of this kind of activity and the lack of resources to conduct innovative activities on a large scale more and more often create an impassable barrier for small and medium enterprises. In a situation, where the technological gap between Poland and highly developed countries is growing every year, cooperation may be the chance of survival and development for the Polish SMEs. Cooperation of former competitors may cause: the creation of the benefits of economies of scale, distribution of risks assumed by larger number of entities, more effective use of complementary resources, facilitating entry into new markets, facilitated access to external resources.

While analyzing the impact of the sector of the industrial enterprises recipients' origin is worth noting that only some of the sectors have a stimulating or detrimental effect on establishing cooperation. The results indicate that to cooperating with competitors has a positive influence on consumers located in transport and trade.

While analyzing the relationships maintained with the participant of the supply network, it may be seen that keeping only close contacts may increase the chance of establishing cooperation. Other types of relationships clearly have a detrimental effect on the occurrence of cooperation.

Interestingly, not maintaining contacts with the recipients by the industrial enterprises in South-Western Poland affects cooperation positively. Having no contact with customers forces the industrial enterprises to look for other parties with whom these entities may tie their future development. Maintaining good neighborly relations with suppliers stimulates establishing cooperation as well.

From the point of view of the distance from the participants of the supply network, having local suppliers, i.e. operating in the area of activity of the given industrial enterprise, affects cooperation favorably. On the other hand, having suppliers and recipients located outside the country's borders clearly affects establishing cooperation.

## Notes

- <sup>1</sup> Peng et. al (2011), p. 532.
- <sup>2</sup> Brandenburg, Nalebuff (1996).
- <sup>3</sup> Chen (2008), pp. 288–304; Gimeno (2004), pp. 820–842; Kim, Parkhe (2009), pp. 363–376; Lado, Boyd, Hanlon (1997), pp. 110–141; Luo (2007), pp. 129–144; Madhavan, Gnyawali, He (2004), pp. 918–927; Peng, Bourne (2009), pp. 377–400.
- <sup>4</sup> Bengtsson, Kock (2000), pp. 411–426; Luo, Rindfleisch, Tse (2007), pp. 73–83; Ritala, Hurmelinna-Laukkanen (2009), pp. 819–828.
- <sup>5</sup> Quint (1997), pp. 7–8.
- <sup>6</sup> Coy (2006), pp. 96–97.
- <sup>7</sup> BarNir, Smith (2002), pp. 219–232; Gomes-Casseres (1997), pp. 33–44.
- <sup>8</sup> Merrifield (2007), pp. 10–14.
- <sup>9</sup> Gnyawali, Park (2009), pp. 308–330.
- <sup>10</sup> Harbison, Pekar (1998).
- <sup>11</sup> Carayannis, Alexander (1999), pp. 197–210.
- <sup>12</sup> Quintana-Garcia, Benavides-Velasco (2004), pp. 927–928.
- <sup>13</sup> Chen (1996), pp. 100–134.
- <sup>14</sup> www.statsoft.pl.
- <sup>15</sup> Oslo Manualy (2005).
- <sup>16</sup> Carayannis, Alexander (1999).
- <sup>17</sup> Gnyawali, Park (2009).

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