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DRIVERS OF COOPERATION ACTIVITY IN HUNGARIAN AGRICULTURE[1]

CZYNNIKI MAJĄCE WPŁYW NA NAWIĄZYWANIE WSPÓŁPRACY W WĘGIERSKIM ROLNICTWIE

Key words: collaboration of farms, binomial logistic regression, Hungary
Slowa kluczowe: współpraca gospodarstw, dwumianowa regresja logistyczna, Węgry
JEL codes: Q12, Q13

Abstract. The present study attempts to identify factors that influence the readiness of Hungarian agricultural producers' to effectively and efficiently cooperate with each other. Analyses based on the binomial logistic regression method have revealed a clear correlation between activities conducive to cooperation, the demographics of producers, farming conditions and the level of trust. Findings highlight that producers who live in smaller rural settlements as well as those who are younger and have a higher level of educational attainment show a higher level of activity associated with cooperation that can be statistically justified whereas farms managed by women are less inclined to cooperate. Calculations indicate that as the size of holdings increases, their readiness for cooperation increases too, while in terms of the type of farming, crop farmers are more open to cooperate effectively than livestock farmers. Finally, this model has revealed a significant positive correlation between producers' readiness to cooperate and their level of trust.

Introduction

The profitability of agricultural production is strongly influenced by how efficiently producers cooperate with each other. Cooperation among producers falls into two broad categories: formal and informal[2]. Obviously, informal activities, by their very nature, are less likely to be easily documented and they are more difficult to study since in many cases they belong to the zone of the black and grey economy. In contrast, the theoretical and practical advantages of formal collaborations such as cooperatives and producer organizations have been extensively explored through diverse approaches as evidenced by the vast amount of previous research.

Relevant literature on the topic highlights a number of advantages cooperation may bring about. These may be classified under three main categories: most sources underline the economic benefits arising from cooperatives [Franks, McGloin 2007, Valentinov 2007, Di Falco et al. 2008], while the past decade has seen a rise in the number of studies that shed light on the social [Wynne-Jones 2017, Gonzales 2017, Forney, Haberli 2017, Vladimirova 2017] and environmental advantages [Asai, Langer 2014, Martin et al. 2016] that result from collaboration.

Despite all its undisputable benefits, empirical evidence shows that the opportunities inherent in cooperation have not yet been exploited in most European Union member states and this is especially true of younger members such as Hungary [Bijman et al. 2012, COGECA 2015].

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[2] Formal cooperation primarily includes collaborations regulated by written contract in accordance with existing legal provisions (e.g. cooperatives, machinery rings and other producer organisations, etc.) while informal cooperation is usually based on verbal agreements made by relatives, friends and acquaintances without its content made compliant with relevant pieces of legislation and with operating conditions shaped by the participants (e.g. paid machine services, reciprocal labour practices, lending of machinery and tools, joint input purchase and sales, joint use of services, etc.) [Baranyai, Szabó 2017].

This is quite an unfortunate situation, all the more so as since accession, cooperation among producers and coordination established by producer organizations have become an issue of efficiency and competitiveness for the whole agri-food economy in Hungary, due to the dual structure of agriculture which is coupled with fragmented land ownership and farm structure in a lot of sectors within the industry. Hence, research into cooperation and collaboration is imperative, since subsequent results may benefit the economy and society as a whole.

To reflect on the problems outlined above, the objective of the present study is to identify factors that influence the cooperation readiness of Hungarian agricultural producers by exposing reasons that either promote or hinder collaboration.

Research material and methods

To explore the factors that influence the cooperation readiness of Hungarian agricultural producers an online survey was conducted from May to October 2017 in the Southern Great Plain region of Hungary. Information was provided by a total of 1398 farmers (N = 1398) which is cca. 1% of total number of farms in the region. Despite its large size, the sample cannot be considered statistically representative due to the sampling method applied.

The logical structure of the examinations is illustrated in figure 1. To explain cooperation activity a binomial logistic regression model was developed where cooperation activity was included as the binary dependent variable (does not cooperate – 0; cooperates – 1). By creating three groups of assumed explanatory variables, seven variables were included in the model using the enter method: I Type of Settlement: the type of the settlement where the farm has its registered seat (and thus probably the permanent residence of the producer as well) [(1) settlement with a population lower than 2000; (2) settlement with a population between 2000-5000; (3) settlement

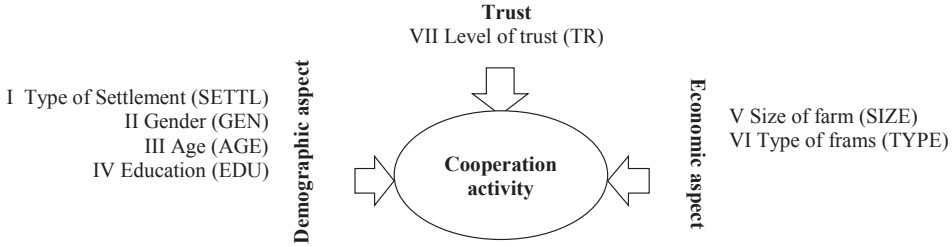

Figure 1. The logical model of the examinations
Source: own study

with a population over 5000]; II Gender: the sex of the responsible leader of the farm [(1) male; (2) female]; III Age: the age of the main decision-maker of the farm [year]; IV Education: the highest level of completed education of the leader of the farm [(1) less than eight completed years of primary education; (2) primary education (eight completed years); (3) vocational school; (4) GCSE; (5) trained technician; (6) college-level or BA, BSc degree; (7) university-level or MA, MSc, or PhD degree]; V Size of Farm: based on annual net sales revenue [(1) less than HUF 1 million; (2) between HUF 1-5 million; (3) between HUF 5-20 million; (4) between HUF 20-50 million; (5) between HUF 50-100 million; (6) more than HUF 100 million]; VI Type of Farm: the type of agricultural activity accounting for the larger part of annual sales revenue: 1 – crop production; 2 – animal husbandry. VII Level of Trust: the responses of farmers given on a 5-point Likert scale to the following statement: "I think most of my fellow farmers are trustworthy" (1 – strongly disagree; 5 – strongly agree.). Out of the seven variables, I, IV and V were included as categorical variables with the last category marked as reference value in each case.

Results

An important aim of the research was to offer a situation assessment regarding the level of cooperation activity among farmers in the Southern Great Plain region. According to the data thus collected, 40% of the farms (568) in the sample belong to some type of producer collaboration. In the course of the examination, distinction was made between formal and informal types of cooperation and statistics indicate a higher rate of participation in the case of formal cooperation: 33% of the total sample participate in such forms of collaboration with the most popular type being the so-called producer-owned organisational forms (e.g. POs, cooperatives, etc.). A somewhat lower activity level amounting to 20% is characteristic of the area of informal cooperation that mainly focuses on lending machinery and tools, joint sales and reciprocal labour practices. The rate of farms active in both types of cooperation (formal and informal) is 11%.

According to survey findings, 60% of farmers are unwilling to join or participate in any type of cooperation. The attempts at finding out the reasons of inactivity among non-cooperating producers highlighted that the main underlying causes include the wish to retain autonomy/independence („I don't want to commit myself and become dependent on anybody"), the lack of economic pressure („I don't need it, I can get by on my own") and the low level of knowledge regarding the operation of various cooperation forms („I do not have information about cooperation forms and I am not aware of my options").

Seven factors that appeared to have an impact on cooperation activity were identified for our logical model (fig. 1). The following section briefly introduces the sample according to these factors. As far as demographics are concerned, half of the participants have their registered seat in settlements with a population size of between 2000 and 5000 residents as opposed to one in every three respondents from settlements with fewer than 2000 inhabitants. 13% of producers run their businesses in settlements with a large population, typically in towns and cities of more than 5000 residents. Gender distribution shows that in more than three quarters of cases (77%) the leading role on farms is assumed by males. The mean age of the persons in the sample is 51.4 years (standard deviation: 13.3 years; mode: 55 years) which – taken together with Pearson's index of skewness (P) at a value of -0.26[3] – indicates that the cohort of Hungarian farmers constitute a rapidly ageing population. With regard to the highest level of educational attainment, data reflects a favourable situation: more than one-third of respondents completed a higher-level education (6 and 7) while the number of farmers with secondary schooling (3, 4 and 5) is close to 60%. Only 6.5% of respondents marked primary education (2) or the lack of it (1) as their highest completed level of schooling. Viewed from another angle, more than 60% of participants have some kind of education in agriculture.

Regarding economic factors, the size of farms was expressed in the value of annual net sales revenue. The uneven distribution of farms within individual sales revenue categories clearly reflects both the existing structure and prevailing problems of Hungarian agriculture with 64% of the farms having a revenue of less than HUF 5M (circa EUR 16,000) (1 and 2). Based on the estimated net income earned from that amount, it can be assumed that agricultural production is not the main business activity for these producers. According to the model calculations and considering the feedback from farmers, only a revenue of above HUF 20M (circa EUR 65,000) implies that agricultural production might become the main activity of a business, farms with a turnover below that level can only pursue subsistence farming or fulfil an income support function. The category for the revenue exceeding HUF 20M (4, 5 and 6) includes 15% of the farms. Depending on the activity that accounts for the larger part of revenue, farms were divided into two categories: crop producers (84.3%) and livestock farmers (15.7%).

[3] The value of P is less than 0 which indicates that the shape of the distribution is skewed to the right, i.e. there are more producers whose age is higher than the average. On the other hand, the value is lower than 1, thus it marks only a slight asymmetry.

The level of trust among farmers was also measured. The mean average of answers given on a 5-point Likert scale was 2.95 (standard deviation: 1.06; mode: 3; P = -0.04), which is significantly lower than 3, the value expressing a medium level of trust.

Before summarizing the experience gained from using a logistic regression model and discussing the results, certain technical aspects pertaining to the validation of the statistical model need to be highlighted. Out of the measures used to check the suitability of the model, the value of the Cox & Snell R-squared is 0.215 with Nagelkerke R^2 at 0.290. The value of R^2_{LA} that expresses the ratio of variance explained to the total heterogeneity is satisfactory, being as high as 0.178[4]. In contrast to the accuracy of the mode estimation method (where the ratio of non-cooperating farms is 59.4%), the present model, – according to its classification table – may

Table 1. Factors influencing cooperation activity – the output of the binomial logistic regression model

Factors	B	Wald	Exp(B)	CI 95% for Exp(B)		Sig.	R
				lower	upper		
SETTL	-	11.296	-	-	-	0.004	0.062
– SETTL(1)	0.388	3.666	1.474	0.991	2.193	0.046	0.030
– SETTL(2)	-0.053	0.073	0.949	0.647	1.390	0.786	-
GEN	-0.352	5.370	0.703	0.522	0.947	0.020	0.042
AGE	-0.023	20.872	0.978	0.968	0.987	0.000	0.100
EDU	-	21.831	-	-	-	0.001	0.072
– EDU(1)	-0.921	1.232	0.398	0.078	2.025	0.267	-
– EDU(2)	-0.857	5.935	0.424	0.213	0.846	0.015	0.046
– EDU(3)	-0.889	17.429	0.411	0.271	0.624	0.000	0.090
– EDU(4)	-0.513	6.204	0.599	0.400	0.896	0.013	0.047
– EDU(5)	-1.068	4.217	0.344	0.124	0.953	0.040	0.034
– EDU(6)	-0.361	2.881	0.697	0.459	1.058	0.090	0.022
SIZE	-	138.750	-	-	-	0.000	0.261
– SIZE (1)	-3.109	60.222	0.045	0.020	0.098	0.000	0.176
– SIZE (2)	-2.091	29.230	0.124	0.058	0.264	0.000	0.120
– SIZE (3)	-1.438	13.379	0.237	0.110	0.513	0.000	0.078
– SIZE (4)	-1.081	6.249	0.339	0.145	0.792	0.012	0.047
– SIZE (5)	-0.813	2.456	0.443	0.160	1.226	0.117	0.016
TYPE	-0.551	9.394	0.576	0.405	0.820	0.002	0.063
TR	0.275	21.197	1.316	1.171	1.480	0.000	0.101
Constant	3.419	31.238	30.537	-	-	0.000	-

Source: own calculation

[4] With regard to the application of logistic regression models Ildikó Barna and Mária Székelyi [2008] draw attention to the fact that in cases when too many independent variables are included in a model, the overall R-squared value of the model will be inflated. To avoid that, they recommend the use of the following formula to measure explanatory power: $R^2_{LA} = \frac{G_M - 2k}{D_0}$, where: G_M is deviation chi-square, k denotes the number of independent variables in the model; and $D_0 = -2\{(n_{Y=1})\ln[P(Y=1)] + (n_{Y=0})\ln[P(Y=0)]\}$, in which $n_{Y=1}$ denoting the frequency of the occurrence of cooperation as an event; $P(Y=1)$ means the probability of the occurrence of the same event; $n_{Y=0}$ and $P(Y=0)$ marks the frequency and probability of the non-occurrence of cooperation. The value thus calculated also falls in the band between 0 and 1 where 0 means that the independent variables added to the model do not contribute to the prediction of the value of the dependent variable whereas 1 implies a clear determination.

reach an estimation/prediction accuracy of 71.1%, which is a significant improvement even when checked against related statistical examinations (cross-tabulations analysis). In line with the above, the statistical model is valid, thus its results may be generalized. The key output of the model is summarized in table 1.

The examination results support the hypothesis: it can be statistically justified ($p < 0.05$) that all the seven variables included in the model have an impact on cooperation activity. Based on the value of R[5], it can be stated that cooperation activity is mostly (0.261) shaped by the size of the farm (SIZE) followed by the level of trust (TR; 0.101) and the partial impact (0.100) of age (AGE).

The statistical model evaluated the partial influence of the type of settlement as the one of the lowest, however, its impact can still be considered significant (sig. 0.004). As mentioned above, this was entered into the model as a categorical variable in the cases of which the reference value is represented by the last category, i.e. the group of farmers running their businesses in settlements with a population exceeding 5000 residents.

To sum up, the likelihood of cooperation activity is higher in smaller settlements probably due to stronger ties, bonds and networks of acquaintances. This is also expressed by the Exp(B) value of SETTL (1) implying that for farmers operating in settlements of less than 2000 residents the probability of cooperation is 1.474 times higher than for producers from settlements of more than 5000 inhabitants. However, it needs to be highlighted that the cooperation activity of farmers in settlements with a population size of 2000-5000 and above 5000 residents respectively do not show significant differences.

According to results, gender also has an important role with regard to cooperation activity. On farms managed by female leaders, cooperation is less common whereas farms led by men are 1.422 times more likely to cooperate (1/0.703).

Demographic characteristics include two further factors with significant impact, namely age and the highest level of educational attainment that reveal the following correlations: with the increase of age, the probability of cooperation decreases slightly while there is an explicitly positive correlation between the level of education and cooperation activity of producers. The higher the level of education is, the higher the value of Exp(B), i.e. each group of farmers having higher qualification are more willing to cooperate with the most intensive level of cooperation being characteristic of the group with the highest degrees (7).

Findings reveal that out of all the factors examined, economic conditions have the greatest influence on farmers' readiness to cooperate, among them the size of the farm being the dominant one. The direction of the latter correlation is positive; the larger the farm, the more intense the cooperation activity. Differences in the level of cooperation activity between farms within individual revenue categories are clearly visible. For example, compared to farms in the smallest revenue category of less than HUF 1M (SIZE (1)), farms with the highest annual turnover (SIZE (7)) are 22 times more likely to cooperate (1/0.045).

According to the estimation of the model, farm type is also one of the factors whose influence on farmers' willingness to cooperate can be statistically supported. As far as the direction of the correlation is concerned, for crop producers the probability of cooperation is 1.74 times higher than for livestock farmers.

During research, it was also found that there is a connection between the level of trust and cooperation activity. As was expected, higher levels of trust entail a stronger likelihood of cooperation.

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[5] Papers on methodology recommend the use of the so-called R value to express the role and power of specific independent variables in a model. The size of the value denotes the order of „importance" of independent variables. This index is not a part of the output of the model, it needs to be calculated using the following equation: $R = \sqrt{\frac{Wald - 2df}{D_0}}$.

Conclusions

The present study attempted to identify the factors that influence the cooperation activity of producers in Hungarian agriculture. Research findings clearly justify the important role that demographic and economic factors as well as the level of trust play in the shaping of cooperation activity.

With regard to demographics, findings have revealed that producers who live in smaller rural settlements as well as those who are younger and have a higher level of educational attainment show a higher level of activity that can be statistically verified whereas farms managed by women are less inclined to cooperate. This confirms the notion that tight social relations among producers as well as an appropriate level of education and knowledge are important conditions for cooperation to develop. Therefore, in order to foster cooperation, there is a strong need for initiatives that improve the above areas (e.g. community development programmes, education, etc.). In addition, an important issue that emerged from the research is the fact that younger generations of producers tend to be more open to cooperation.

Calculations underline that the size of the farm is commensurate with the willingness to cooperate, evidently resulting from the fact that larger farms have more pressing economic needs and interests. It can thus be clearly seen that on the long run farmers engaged in full-time production activities will be the most attracted to developing and maintaining cooperation. The model employed in the research also points to the fact that crop farmers are more open to cooperation than livestock farmers which seems to be related to the types of cooperation accessible for them and the number of farmers that can potentially be involved in cooperation.

Finally, a strong positive correlation has been detected between the level of trust and cooperation activity, a finding that indicates the need for further research into potential ways of developing trust.

It should be highlighted that the research has certain limitations. The present study focused on a single statistical region of Hungary. To arrive at more general conclusions, investigations covering all the seven regions of the country are needed. Moreover, further unexplored factors that influence cooperation shall be identified with a view to the development of effective action plans that aim to improve the cooperation activity of producers.

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Streszczenie

Celem badań była identyfikacja czynników mających wpływ na gotowość węgierskich producentów rolnych do współpracy. Z analiz opartych na metodzie dwumianowej regresji logistycznej wyłania się wyraźna korelacja pomiędzy współpracą, demografią producentów, warunkami uprawy oraz poziomem zaufania. Wyniki badań wskazują, że producenci rolni żyjący w mniejszych osadach wiejskich oraz osoby młodsze i legitymujące się wyższym poziomem wykształcenia wykazywały wyższy stopień aktywności, dający się uzasadnić statystycznie, natomiast gospodarstwa zarządzane przez kobiety charakteryzowały słabsze tendencje do współpracy. Z obliczeń wynika, że wraz ze wzrostem wielkości gospodarstw wzrastała również ich gotowość do współpracy. Stwierdzono, że rolnicy zajmujący się uprawą roślin byli bardziej otwarci na współpracę niż rolnicy zajmujący się hodowlą zwierząt. Model ujawnił występowanie znaczącej pozytywnej korelacji pomiędzy gotowością wytwórców do współpracy a ich poziomem zaufania. Na podstawie wyników badań sformułowano również zalecenia, które mają zwiększyć gotowość rolników do współpracy.

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