STOWARZYSZENIE EKONOMISTÓW ROLNICTWA I AGROBIZNESU
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GAMES OF FARMERS – TO COOPERATE OR NOT?

GRY ROLNIKÓW – WSPÓŁPRACOWAĆ CZY NIE?

Key words: agriculture, payoff, utility, decision, game theory, simulation model
Słowa kluczowe: rolnictwo, wypłata, użyteczność, decyzja, teoria gier, model symulacyjny

Abstract. Signs of the crisis of the Hungarian agriculture are in relation with the economic and social model that has become rigid throughout the past two decades. The evolved structure of agricultural holdings the networks among the farmers have been restructured as well as have become losen. The degree of trust has decreased. Based on the principles of the modern economic schools, e.g. the game theory, the study examines how the existing trust level among farmers affects the farmers' preferences of choice among the different forms of dependencies, as well as which factors affect the individual utility functions, focused on the role of subsidies from the social transaction costs. Due to the information asymmetry between farmers and the lack of confidence, the individual and the social expenditures are higher than economically justifable. Based on a simulation model the paper examines the payoffs of the farms as well as the community from the point of view of machinery use and investment strategies.

Introduction

The transition from the socialist regime has basically reconstructed the ownership conditions and property structure of the arable land in most of the Central-Eastern European countries. [Takács-György et al. 2008]. In addition to the changes in ownership, the farm scales have also been modified and the landed property structure has diversified. [Takács-György, Sadowski 2005]. The new property structure has resulted in significant alterations in land use and high number of small-scale, divided farms have emerged. Limitation of the land market preserves [Magda 2001], permanently maintains the diversified estate structure in a sense. The technical requirements under the new conditions impose great challenges to the farmers as well as to the government.

The social-economic processes, the economic and social tensions make it clear that new problems require the development of new structures which consider the economic, social and environmental interests of the local communities, as well as their sustainability.

Analysing this problem the paper focuses on the game theory, using the models for supporting the economic decisions and explaining the reasons for the real processes, in order to find scientific explanations for the attitudes of local communities in connection with cooperation [Takács 2003; Baranyai 2009].

Supposing that the general aspects and features are widely known, the paper focuses on the aspects of the question that can help to find the reasons (and necessity) of machinery sharing arrangements or the lack of cooperation (and economic rationality behind this decision) among farmers, who are the main targets of our research.

The prisoner's dilemma, or the implementation of game theory in exploring the problems

From the aspect of game theory, the economic processes can be regarded as the game of two or more players, who make decisions in the game [Kreps 2005]. The explanatory models usually start from the point that the decision is rational (the player is homo economicus) and identical decisions can be expected because the condition system remains unchanged. Decision of farmers about cooperation is determined by the information asymmetries among them on the one hand and by the different experiences of the participants on the other hand. Regarding this as the principle of the tit for tat affects [Axelrod 1984], i.e. acquiring as well as keeping the trust, which was discussed earlier, is more difficult as its loss.

Starting from the non-cooperative game theory, the implementation of the normal form is prioritized in the research. According to the non-cooperative game theory, the players make decisions independently, thus there is no self-restraint during decision-making, everybody aims to maximize his/her own profit. It is not indifferent whether the decision-maker knows the decision of the other player or not. The normal form is appropriate for describing the decisions made simultaneously (in the lack of knowing the other's

		B	
		S^B_1	S^B_2
A	S^A_1	$a_{1,1};\ b_{1,1}$	$a_{1,2};\ b_{1,2}$
	S^A_2	$a_{2,1};\ b_{2,1}$	$a_{2,2};\ b_{2,2}$

or in matrix form

$$P = \begin{bmatrix} a_{1,1};\ b_{1,1} & a_{1,2};\ b_{1,2} \\ a_{2,1};\ b_{2,1} & a_{2,2};\ b_{2,2} \end{bmatrix} \quad (3)$$

Figure 1. Payoffs of players described in table, according to the normal form
Rysunek 1. Wypłaty dla graczy w postaci normalnej
Source: own study
Źródło: opracowanie własne

decision), while the extensive form – that is not used in this paper – as a decision tree, the graphic description of decisions, in which the subsequence of decisions appear, too, due to the features of description.

The normal form is the description of players' payoffs in a matrix (P), which gives the due pairs of payoffs of strategy pairs. (Fig. 1, Equation 1).

The rows show the strategies of player one (A in this case), while the columns show the strategies of the other player (B in this case). The result of the rational selection is that the player chooses the option that offers higher payoff (profit). Therefore there are balanced decision pairs called Nash equilibriums. The point in Nash equilibrium is that the player follows the strategy that is the best for him/her (results the highest payoff) until the other player does not change his/her own best strategy and vice versa.

The researchers of the game theory have studied a lot of cases and developed the „games" as the basis of economic modelling. In our research – considering the decisions of machinery use or machinery investments – we tried to find games, which meet the following conditions: two players are involved, each player has two possible strategies, the players do not have the perfect information and it is not zero sum game. There are several games that meet these criteria: Battle of the sexes, Chicken (aka hawk-dove), Deadlock, Prisoner's Dilemma, Stag hunt and War of attrition. The Prisoner's Dilemma was chosen in the explanatory model.

The Prisoners' Dilemma is a well-known model about the trust in the partner. If the two players trusted each other it would be the most rewarding (as well as Pareto efficient) for them. But, because of the information asymmetry, most probably both parties confess against the other, then both of them are sentenced, but still for less than the longest sentence, due to the cooperation with the authorities. The Nash equilibriums of the game, if one of the parties betrays, the other remains silent, while because both players – supposedly – considers the possibilities similarly, and none of them trusts that the other chooses to remain silent, therefore he/she betrays. Since it can be supposed that both of them acts the same, the actual sum of their 'payoff" is the least beneficial. And though they know that the most beneficial would be for them to trust each other, since they are afraid that the trust is not mutual, they choose the solution – as a damage minimization – which is not favourable for them but still it is not the least favourable solution.

Because of the risks and information asymmetries in the machinery sharing arrangements the farmers (as the players of the game of prisoners' dilemma) choose the non-optimum solution. At the cooperation in machinery using, on the one hand, machine-related moral hazard [Holmstrom, Milgrom 1994, Allen, Lueck 2002] as well as labour risk hazard [Holmstrom 1982, Eswarten, Kotwal 1985] could be identified, and on the other hand the time has importance in agricultural production. The actions carried out earlier or later than the due time involve extra costs or losses (profit losses) [Edwards, Boehle 1980], i.e. timeliness cost [Short, Gitu 1991; Larsen 2008].

The experiences prove that the joint machinery sharing arrangements may result in the loss or forced surrender of independence, image losses, sometimes professional jealousy or envy, which can often be led back to the generation gap and the farmer's pride. [Haag 2004] According to the Hungarian experiences, the negative aspects of machinery sharing arrangements include the increasing dependence of the individual and the pressure to consult before decisions or actions [Takács 2003].

Materials and methods

During the research a model was developed by adapting the game theory models and examined the investment decisions of field crops farms from game theory aspects. On the basis of the data of survey documented by Baranyai [2009] and data of basis farm system by Gockler [2012] the parameters of the model were outlined in which each of the two players participates with two possible cooperation strategies (Tab. 1). The number of actual players, of course, is significantly higher, but in most cases the players can be divided into two sets (those owning machinery and performing machine investments, and those not having and not wanting machinery). These two groups can be substituted with two players. The payoffs of the players come from the balance of the possible income (production, services, land-based subsidy given to the producers in some models), costs (variable costs of production: fertilizer, pesticide, etc., variable costs of machine use; variable costs of machinery services, divided permanent cost of asset use (amortization); and the opportunity cost of land use). Four variants of the models were examined in order to analyse how the subsidies affect the farmer's decisions and the observed fact, according to which the farmers usually calculate with the return of the actually risked, own financial means disregarding the subsidies received for the investment. The model variants are as follows:

1) without land-based subsidy and amortization-reducing factors (basic case),
2) with land-based subsidy, without amortization-reducing factors,
3) with land-based subsidy, factor that reduces amortization: subsidy,
4) with land-based subsidy, factor that reduces amortization: subsidy + residual value.

Table 1. Strategies of the players
Tabela 1. Strategie graczy

Player/ *Gracz*	**Strategy/ *Strategia***	**Description of strategy/ *Opis strategii***
A	A1	Invests and offers services/ *inwestuje i świadczy usługi*
	A2	Has no equipment, does not invest, looks for services/*nie ma maszyn, nie inwestuje, nie świadczy usług*
B	B1	Invests and offers services/ *inwestuje i świadczy usługi*
	B2	Has no equipment, does not invest, looks for services/*nie ma maszyn, nie inwestuje, nie świadczy usług*

Source: own construction
Źródło: badania własne

The calculation of the payoff is made with equation (2), according to which the payoff vector is the product of the coefficient matrix of factors involved in the model variant (3) and (4), and the payoff factor vector (5). The payoff vector (6) gives the net output of players by strategy pairs.

Based on these equations the impacts of changing rate of players having the same strategy to the payoffs were analysed by a simulation model. Scenarios were counted at different capacity surpluses comparing to the equipped farm demand. The values of capacity surpluses based on *Takács and Bojar* [*2003*] experiences.

Table 2. Variables of the model
Tabela 2. Zmienne w modelu

Title of variable/*Zmienna*	**Sign of variable/ *Oznaczenie***
Production value from production/*wartość wytworzenia z produkcji*	B_p
Production value from machinery service/fee of machinery service/*wartość wytworzenia z usług wynajmu*	B_s
Variable cost of production/*zmienny koszt wytworzenia*	C_v^P
Variable cost of machine use in production/*zmienny koszt maszyn w produkcji*	C_v^{MP}
Variable cost of machine services/*zmienny koszt usług maszynami*	C_v^{MS}
Depreciation of machine tools/*amortyzacja*	C_f^A
Income from land-based subsidy/*dopłaty bezpośrednie*	B_G
Depreciation of asset value reduced by subsidy/*amortyzacja pomniejszona o dopłaty bezpośrednie*	$C_f^{A\text{-}G}$
Depreciation of asset value reduced by subsidy and residual value/*amortyzacja pomniejszona o dopłaty bezpośrednie i wartość rezydualną*	$C_f^{A\text{-}G\text{-}R}$
Opportunity cost of land/*koszty alternatywne ziemi*	C_O^L

Source: own study
Źródło: opracowanie własne

$$\overline{p} = E \cdot \overline{f}^T \qquad (2)$$

where:

$$E = \left\langle \begin{matrix} e_{1,1}\ e_{1,2} \dots e_{1,j} \dots e_{1,m} \\ e_{2,1}\ e_{2,2} \dots e_{2,j} \dots e_{2,m} \\ \dots\ \dots\ \dots\ \dots\ \dots \\ e_{i,1}\ e_{i,2} \dots e_{i,j} \dots e_{i,m} \\ \dots\ \dots\ \dots\ \dots\ \dots \\ e_{n,1}\ e_{n,2} \dots e_{n,j} \dots e_{n,m} \end{matrix} \right\rangle \quad (3) \quad \text{and } e_{i,j} = sgn\ \{f_i | p_i\} \quad (4)$$

in case of involving f_i into the equation and sign in case of strategy pair belonging to p_i payoff.

The model variables determining the payoff vector (Tab. 3) enabled the all-round examination of payoffs that provide the basis for decision. Only some of the results are introduced below due to the lack of space:

$$\bar{f} = \begin{pmatrix} f_1 \, (\equiv B_p) \\ f_2 \, (\equiv B_s) \\ f_3 \, (\equiv C_v^{P}) \\ f_4 \, (\equiv C_v^{MP}) \\ f_5 \, (\equiv C_v^{MS}) \\ f_6 \, (\equiv C_f^{A}) \\ f_7 \, (\equiv B_G) \\ f_8 \, (\equiv C_f^{A-G}) \\ f_9 \, (\equiv C_f^{A-G-R}) \\ f_{10} \, (\equiv C_0^{L}) \end{pmatrix} \quad (5) \quad \text{and} \quad \bar{p} = \begin{pmatrix} p_1 \, (A{:}A1-B1) \\ p_2 \, (A{:}A1-B2) \\ p_3 \, (A{:}A2-B1) \\ p_4 \, (A{:}A2-B2) \\ p_5 \, (B{:}A1-B1) \\ p_6 \, (B{:}A1-B2) \\ p_7 \, (B{:}A2-B2) \\ p_8 \, (B{:}A2-B2) \end{pmatrix} \quad (6)$$

The coefficient matrixes of model variants are described by equation (7):

$$E_1 = \begin{bmatrix} 1 & 0 & -1 & -1 & 0 & -1 & 0 & 0 & 0 & -1 \\ 1 & 1 & -1 & -1 & -1 & -1 & 0 & 0 & 0 & -1 \\ 1 & -1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \\ 1 & 0 & -1 & -1 & 0 & -1 & 0 & 0 & 0 & -1 \\ 1 & -1 & -1 & -1 & 0 & 0 & 0 & 0 & 0 & -1 \\ 1 & 1 & -1 & 0 & -1 & -1 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \end{bmatrix} \quad E_2 = \begin{bmatrix} 1 & 0 & -1 & -1 & 0 & -1 & 1 & 0 & 0 & -1 \\ 1 & 1 & -1 & -1 & -1 & -1 & 1 & 0 & 0 & -1 \\ 1 & -1 & -1 & 0 & 0 & 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & -1 \\ 1 & 0 & -1 & -1 & 0 & -1 & 1 & 0 & 0 & -1 \\ 1 & -1 & -1 & -1 & 0 & 0 & 1 & 0 & 0 & -1 \\ 1 & 1 & -1 & 0 & -1 & -1 & 1 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & -1 \end{bmatrix}$$

$$E_3 = \begin{bmatrix} 1 & 0 & -1 & -1 & 0 & -1 & 1 & -1 & 0 & -1 \\ 1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & 0 & -1 \\ 1 & -1 & -1 & 0 & 0 & 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & -1 \\ 1 & 0 & -1 & -1 & 0 & -1 & 1 & -1 & 0 & -1 \\ 1 & -1 & -1 & -1 & 0 & 0 & 1 & 0 & 0 & -1 \\ 1 & 1 & -1 & 0 & -1 & -1 & 1 & -1 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & -1 \end{bmatrix} \quad E_4 = \begin{bmatrix} 1 & 0 & -1 & -1 & 0 & -1 & 1 & 0 & -1 & -1 \\ 1 & 1 & -1 & -1 & -1 & -1 & 1 & 0 & -1 & -1 \\ 1 & -1 & -1 & 0 & 0 & 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & -1 \\ 1 & 0 & -1 & -1 & 0 & -1 & 1 & 0 & -1 & -1 \\ 1 & -1 & -1 & -1 & 0 & 0 & 1 & 0 & 0 & -1 \\ 1 & 1 & -1 & 0 & -1 & -1 & 1 & 0 & -1 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & -1 \end{bmatrix} \quad (7)$$

The total area of the arable lands of the modelled settlement was 3000 hectares, and the interval of the range of the players with same strategy was 0 to 1 (i.e. 100%), and the parameters of the other group were complements.

Fee of machinery services was calculated by the function (8) as follow:

$$B^S = \frac{A}{r^b} + C_v^{MS} \quad (8)$$

where:

B^s – fee of machinery service, as an equilibrium price of the machine service supply and demand (HUF),
A – constant of steepness of curve (value at simulation was 10,000 HUF, estimation based on earlier experiences),
r – rate of Players A with strategy 1 (value was between 0 and 1 w/o dimension),
b – exponent of variable r (value was 1 w/o dimension).
C_v^{MS} – variable cost of machine services as the asymptote of the machinery service fee (HUF).

Decision function of players (9) about changing strategy or continuing production on the earlier way as follow:

$$\Delta^{S^i}_{(A1;B2)} = \left| p_i^A - p_i^B \right| > T_j \quad (9)$$

where:

$\Delta^{si}_{(A1;B2)}$ – difference between the payoffs of Players A with strategy 1 and Players B with strategy 2 (HUF),
p_i^A – payoffs of Players A with strategy 1 (HUF),
p_i^B – payoffs of Players B with strategy 2 (HUF),
T_j – variable the cut value of player j (depending on the transaction costs of changing strategy, including the costs of risks) (HUF).

Table 3. Starting data set of the model calculations
Tabela 3. Dane wyjściowe do modelu

Denomination of variable/*Nazwa zmiennej*	**Unit/*Jedn.***	**A**	**B**
Land size/*Powierzchnia użytków*	ha	50	50
Crop/*Uprawa*		cereals/*zboża*	cereals/*zboża*
Yield average/*Średni plon*	t/ha	6	6
Unit price/*Cena jednostkowa*	1000 HUF/t	40	40
Gross asset value/*Wartość brutto aktywów*	mln HUF	30	30
Depreciation/*Amortyzacja*	year/*rok*	6	6
Opportunity cost of land/*Koszty alternatywne ziemi*	1000 HUF/ha	40	40
Variable production costs without machinery/ *Zmienne koszty wytworzenia bez maszyn*		50	50
Variable costs of machinery/*Zmienne koszty maszyn*		30	30
Land-b ased subsidy/*Dopłaty bezpośrednie*		48	48
Subsidy ratio of machine investment/ *Wskaźnik subsydiowania inwestycji w maszyny*	% of purchase price/*% ceny zakupu*	40	40
Calculated residual value of machines in case of new purchase/ *Wartość rezydualna maszyn w przypadku zakupu nowych*		30	30
Fee of machinery services/*Opłaty za usługi maszynami*	1000 HUF/ha	variable/*zmienna*	variable/*zmienna*

Source: own study
Źródło: opracowanie własne

Results

It gives reasonable result if the payments of A1-B2 or A2-B1 strategy pairs are analysed. The functions of A2-B1 strategy pairs are the mirror of the A1-B2 strategy pairs. In other cases, if all players choose the strategy 1 (i.e. everybody invests to machinery) there is not any occasion to cooperate, and in case all players choose the strategy 2 (i.e. nobody invests to machinery), despite the willingness to cooperation there is not any ability to cooperate.

The payments of the scenarios of A1-B2 strategy pair are summarized in figure 2. It shows the average individual farm payoffs (i.e. incomes) of the two groups of players. Left part of the curves shows the cases when all capacity of the Players A (i.e. machinery supply) does not cover all capacity demand of Players B, so lots of Players B would not be able to cultivate their arable lands and they would suffer losses. As a result the difference between the average income of Players A and B is significant, it could exceed the transaction costs of the strategy changing, and it could stimulate a part of the Players B investing into farm equipment.

The optimum points of curves (see the embedded chart on figure 2) would be the maximum of the incomes at the community level. Theoretically before this optimum Players B have advantages though, because the services fee is lower than the operational costs of machinery. At the same time, analysing scenarios S1, S2 and S3 it could be stated that the supports decrease the impacts of the market forces, because the difference between the average individual (farm) incomes at the alternative strategies decreased under the value of transaction costs of strategy change (see 10).

$$\Delta^{S0}_{(A1;B2)} > \Delta^{S1}_{(A1;B2)} > T_j > \Delta^{S2}_{(A1;B2)} > \Delta^{S3}_{(A1;B2)} \quad \text{or} \quad \Delta^{S0}_{(A1;B2)} > \Delta^{S1}_{(A1;B2)} > \Delta^{S2}_{(A1;B2)} > T_j > \Delta^{S3}_{(A1;B2)} \qquad (10)$$

The result of it is the aggregated community level of incomes if more and more farmers make decisions about investing into farm equipment, which results a lower efficiency of farm assets as well as unnecessary payoffs of government.

The production and investment subsidies significantly affect the actual payoffs and payoffs that are imagined by the farmer. The actual service sector prices result lower balance fees for services and relatively great income difference may occur among parties, therefore those not having machinery are stimulated to invest in equipment.

Regarding machine purchases, the distributors count the second-hand machine with significant residual value (as we saw it is about 30% of the original purchase price) and many farmers take this into consideration in investment decisions, but not calculating with the time value of money. In case of this latter attitude (decision-making method) the one without machinery can increase his payoff if investing, which does not encourage cooperation. The optimum of the rate of the equipped farms depends on its capacity surpluses (Fig. 3).

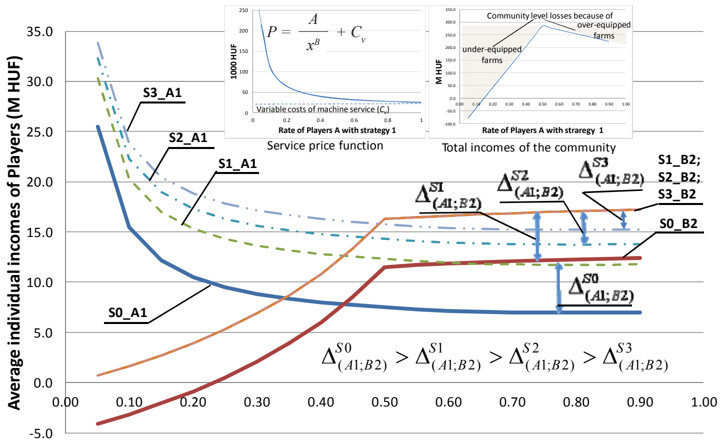
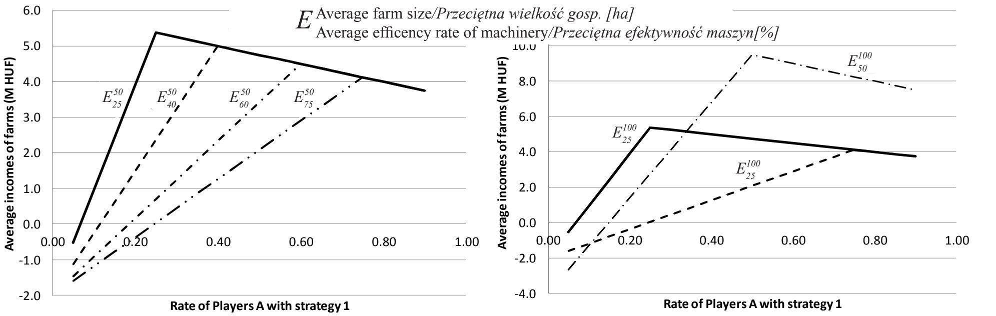


Figure 2. Payoffs of players (farms) in relation to machine service fees depending on the rate of players with the same strategy, by modelling the supporting impacts (Strategy of players: A –Invests and offers services; B – has no equipment, does not invest, looks for services (wants to cooperate)

Rysunek 2. Wynagrodzenie dla graczy (gospodarstw rolnych) w odniesieniu do cen za usługi maszynami uzależnione od pozycji gracza z tą samą strategią, przez modelowanie wpływu wsparcia (strategie graczy A – zainwestować i oferować usługi, B – brak wyposażenia, nie inwestować, nie świadczyć usług (chce współpracować)

Source: own study

Źródło: opracowanie własne



Average farm incomes depending on average efficiency rate of farm machinery (average farm size is 25 ha)

Średnie dochody z gospodarstwa rolnego w zależności od średnego wskaźnika efektywności maszyn rolniczych (średnia pow. gosp. 25 ha)

Average farm incomes depending on average efficiency rate of farm machinery and average farm size

Średnie dochody z gosp. rolnego w zależności od średniego wskaźnika efektywności maszyn rolniczych i średniej powierzchni gospodarstwa (średnia pow. gosp. 25 ha)

Figure 3. Aggregated payoffs of community (settlement) in relation to machine service fees depending on the rate of players with the same strategy, by modelling the impacts of the rate of the capacity surplus

Rysunek 3. Zagregowane wynagrodzenie społeczności w odniesieniu do opłat za wynajem maszyn uzależnione od pozycji graczy z tą samą strategią przez modelowanie wpływu wysokości nadwyżki mocy produkcyjnych

Source: own study

Źródło: opracowanie własne

Conclusions

The research – with the tools of game theory supporting economic analysis – tries to explore the explanatory factors in the investment decisions of farmers, which help to understand the low cooperation willingness of farmers and the impetus in most of the farmers to perform production with own machinery. It can be stated that:

1. The game theory models have confirmed that the current subsidy system affects the investment decisions of farmers (as *homo economicus*), increases the willingness to invest and implicitly reduces the consideration of efficiency criteria.

2. The differences in payoffs among observed farmers (since the payoff pairs are not fair in many market situations) encourage the party with no equipment to invest until his payoff becomes fairly equal.

3. The low machine service supply, the high service fees (the relatively considerable difference between the yields of the two strategies and the losses of farmers because of the inadequate operation), as well as the current risks and individual benefits encourage investment (see the dilemma in Stag hunt: sure rabbit or unsure stag (deer).
4. Considering all the above – explained also with rational decisions – the Hungarian agricultural producers are in the trap of Prisoner's dilemma and thus they fail the maximum payoff that could be realized together in case of efficient, well-coordinated joint machine investments and machinery sharing.

The title of the paper is reworking of a part of Hamlet's famous monologue, but it should be realized that in the long run, the question of "to cooperate or not to cooperate" will in fact mean „to be or not to be" for most of the agricultural producers. At the same time, under the current conditions it is not the cooperation that ensures the highest payoff for the rationally *deciding homo economicus*, although the payoff is the key factor in deliberation.

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Streszczenie

Oznaki kryzysu węgierskiego rolnictwa wynikają głównie z przyjętego modelu społecznego i gospodarczego, który w ostatnich dwóch dekadach został „zamrożony". Mimo to ewoluowała struktura gospodarstw rolnych, zrestrukturyzowano powiązania społeczno-gospodarcze wśród rolników, szczególnie w zakresie wzajemnej współpracy. Ze względu na niejednakowy dostęp rolników do informacji i brak zaufania w działaniach kooperacyjnych stwierdzono, iż wydatki w gospodarstwach indywidualnych i uspołecznionych są wyższe niż byłoby to ekonomicznie uzasadnione. Opierając się na modelu symulacyjnym podjęto próbę oceny wynagrodzenia dla indywidualnych i uspołecznionych gospodarstw pod kątem wykorzystania parku maszynowego i wdrażanych strategii inwestycyjnych.

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