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USING THE LOGIT ANALYSIS TO ESTIMATE THE OUTPUT'S PROFITABILITY OF PARTICULAR PRODUCTION TYPES ACCORDING TO THE ECONOMIC SIZE IN THE EUROPEAN UNION (ON THE BASIS OF FADN DATA)

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Abstract. In this article an attempt was made to use logit analysis to measure and evaluate the output's profitability of particular production types according to the economic size. Research was based on FADN database that included information about 615 production types according to the economic size from the European Union in the years 2004-2005.

Key words: logit analysis, output's profitability, production type, economic size

INTRODUCTION

As it is known, the family farm income is defined as a difference between a value of total output and the costs in the period. Its volume has an influence on a level of consumption and on a growth of production in the next period [Stępień 2007]. The main source of incomes is a production process. In this process, the specified products are obtained thanks to live and material inputs [Wojtasik 2006. In the agriculture, the same as in other branch of material production, the essence economic activity is the production [Poczta and Średzińska 2007].

Many groups of factors have an influence on farms' profitability. They act both directly and indirectly on the level of production and incomes [Kołoszko-Chomentowska 2007]. The estimation of this profitability requires appropriate methods to be applied, which make processing the data from agricultural accountancy possible. The

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data concerns for example such characteristics of farms as output, income, debt or assets[1].

The main aim of this article is to explore the possibility of the use of the logit analysis for the estimation of output's profitability of production types of farms according to the economic size from each country of the European Union (EU). Special attention was paid to Poland.

MATERIAL AND METHODS

Research was based on the data obtained from Farm Accountancy Data Network (FADN). These data include basic information about economic situation of more than 600 production types according to the economic size in the EU in the years 2004-2005. A particular production type according to the economic size is an aggregate unit. This average volume is calculated on the basis of many individual farms with the same production direction and economic size in each country in the EU[2].

A whole database consists of 24 countries (there was no information about Malta in the year 2004, so this country was excluded from further analysis). As analysed base of production types according to the economic size included data of about 615 units in each year, so the whole database consisted of 1230 the so-called "object-years".

In order to conduct logit analysis, an analysed data set should be divided into two classes, for the purposes of receiving two sets of data: first characterized with better properties, and second – with worse properties [Norusis 1999][3]. Hence, the analysed class of aggregate units was split into two classes according to average level of output's profitability observed in the EU in the year 2005 (Table 1). The output's profitability is

[1] It is worth to emphasize, that for many years, the profitability of Polish farms has been worse than those from the European Union. This phenomenon manifests itself, among other things, in lower incomes gained by individual farms in Poland [Zegar 2003, Czyżewski and Henisz-Matuszczak 2004]. These incomes are a matter of agricultural policy interest in all countries [Kołoszko-Chomentowska 2007].

[2] According to research conducted in Poland, farms that were keeping the accounts were systematically in better situation than the rest of farms in the whole country. Hence, the results of the analysis conducted on the basis of these farms were higher by c.a. 30%, than those obtained while considering all farms in Poland. So the FADN data are burdened with measurement bias. However, data from this network are at the moment the only available ones that can serve as a source of standardized information about farms in Poland. Then, with the abovementioned reservation, they can serve as a base for a comparison of Poland with other EU countries, while pondering the situation of agriculture [Błąd 2000, Woś 2000].

[3] In case of economic situation estimation of economic subject, the threat of bankruptcy is the best criterion of the preliminary division. But for farms, such term as bankruptcy does not exist, because a precondition to bankrupt is to keep accountancy. Hence, an announcement of individual farm's bankruptcy in light of law Ustawa... [2003] is not possible. Moreover, sector of individual farms in Poland is characterized by social character, because the financial means are destined for social payments to a higher degree than for structural changes. The pensionable payments mitigate the decrease of incomes from agricultural activity, but it is not compensated in full range. They were and they still are a significant source of incomes and they assure financial liquidity and supplement of the agricultural production [compare: Czyżewski and Sapa 2003, Ryś-Jurek 2008].

understanding as a relation of family farm income to the total farm's output and is measured in percentages. So, the dividing value was set at the level of 27.54%.

The first class includes 785 production types according to the economic size of which output's profitability was higher than 27.54%, while the second one consists of 445 production types according to the economic size of output's profitability lower than 27.54%. On the basis of this division the assumption was made that class 1 includes types with higher output's profitability. Consequently, class 2 consists of types with lower output's profitability.

Table 1. The distribution of analysed sample of production types according to the economic size according to output's profitability
Tabela 1. Rozkład badanej próby typów produkcyjnych według wielkości ekonomicznej według dochodowości produkcji

Class Klasa	Output's profitability Dochodowość produkcji	Number of farms Liczba gospodarstw
1 – Types with higher output's profitability 1 – Typy o wyższej dochodowości produkcji	≥ 27.54%	785
2 – Types with lower output's profitability 2 – Typy o niższej dochodowości produkcji	< 27.54%	445
Overall – Ogółem	–	1 230

Source: own calculations based on FADN data.
Źródło: opracowanie własne na podstawie danych FADN.

A model of logit analysis is a special kind of regression model, in which a dependent variable y_i* is called a "latent" variable [Maddala 2001]

$$y_i^* = \beta_0 + \sum_{j=1}^{k} \beta_j x_{ij} + \varepsilon_i \tag{1}$$

In the equation (1), i – is the number of statistical unit (production types according to the economic size), j – number of independent variables, β_j (j = 0, 1, 2,... k) – unknown structural parameters that define the strength and direction of influence of independent variables x_j (j = 1, 2 ,... k) on variable y_i*, ε_i is a random error for i-th unit. A "latent" variable y_i* is continuous variable, which is not observed, from range from $-\infty$ to $+\infty$. The variable y_i* generates a binary (0-1) variable y_i, which takes values:

$$y_i = \begin{cases} 1 & \text{if } y_i^* > 0, \\ 0 & \text{otherwise.} \end{cases} \tag{2}$$

In the case concerning the research of production types according to the economic size according to their output's profitability, the equation (2) is defined as:

$$y_i = \begin{cases} 1 & \text{if i-th type is recognized as type with higher output's profitability,} \\ 0 & \text{if i-th type is recognized as type with lower output's profitability.} \end{cases} \tag{3}$$

The probability that the i-th type will be recognized as type with higher output's profitability, $P(y_i= 1/X) = P_i$, is calculated on the basis of the following model of logit regression:

$$P(y_i = 1/X) = \frac{e^{\beta_0+\beta_1X_1+\ldots+\beta_kX_k}}{1+e^{\beta_0+\beta_1X_1+\ldots+b_kX_k}} \quad (4)$$

The transformation of logit function $P(y_i = 1/X)$ is specified as logit transformation, where expression $\ln(P_i/1\text{-}P_i)$ is called a logit (logit takes values in range from $-\infty$ to $+\infty$).

$$\ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1X_1 + \ldots + \beta_kX_k \quad (5)$$

Using an estimated model, values of the odds ratio (*Odds*) can be calculated according to the following equation:

$$\text{Odds} = \frac{P_i}{1-P_i} \quad (6)$$

The odds of an event occurring are defined as a ratio of the probability P_i (i = 1, 2,... n) that the event will occur to the probability that it will not occur in the i-th unit (the situation when the event not occurs is opposite to the situation that type is recognized as type with higher output's profitability). The odds takes on values in range from 0 to $+\infty$, what allows defining the odds of the type's recognition as type with higher output's profitability. The higher the value of odds, the higher chance that type will be recognized as type with higher output's profitability [Ryś-Jurek 2008].

RESULTS

The main target of research is to obtain the model that classifies production types according to the economic size and which can be then used to evaluate their output's profitability. In order to specify the model, a set of variables presented in Table 2 was used. Selection of variables in attempt to obtain a desirable effect of logit analysis was based on statistical and common sense factors alike[4].

The grouping variable introduced to the model takes on value 1 for the class 1 and 0 for class 2. Using the STATISTICA program, forward stepwise variable selection was introduced. As a result, the logit model P_i was obtained. Results of the estimation of its parameters are presented in Table 3. In the obtained model, all variables and constant were characterized by level of significance close to zero (Table 3). The logit model was prepared in such way that P_i function values that are approximated to 1 refer to class 1 – that is to types with higher output's profitability, whereas P_i function values approximated to 0 refer to class 2 – that is to types with lower output's profitability.

[4] The economic size (X_1) and agricultural area (X_3) are placed among the potential variables. The Pearson's linear correlation coefficient estimated for these two variables equalled to 0.63, so they are correlated at medium level. So they were not excluded [Wysocki and Lira 2005].

Table 2. The characteristic of potential variables used in logit analysis
Tabela 2. Charakterystyka potencjalnych zmiennych wykorzystanych do analizy logitowej

Variable symbol Symbol zmiennej	Variable name Nazwa zmiennej	Variable characteristic (measurement units) Obliczanie wartości zmiennej (jednostki miary)
Y	output's profitability dochodowość produkcji	binary variable (output's profitability ≥ 27.54% = 1, output's profitability < 27.54% = 0) zmienna zero-jedynkowa (dochodowość produkcji ≥ 27.54% = 1, dochodowość produkcji < 27.54% = 0)
X_1	economic size wielkość ekonomiczna	economic size to 1 type (ESU[a])/1 type) wielkości ekonomiczna przypadająca na 1 typ (ESU[a])/1 typ)
X_2	labour input nakład pracy	total labour input to 1 type (AWU[b])/1 type) nakład pracy ogółem, przypadający na 1 typ (AWU[b])/1 typ)
X_3	agricultural area powierzchnia gospodarstwa	total utilised agricultural area to 1 type (ha/1 type) całkowita użytkowana powierzchnia użytków rolnych, przypadająca na 1 typ (ha/1 typ)
X_4	value of fixed assets wartość środków trwałych	value of fixed assets to 1 type (euro/1 type) wartość środków trwałych, przypadająca na 1 typ (euro/1 typ)
X_5	value of current assets wartość środków obrotowych	value of current assets to 1 type (euro/1 type) wartość środków obrotowych, przypadająca na 1 typ (euro/1 typ)
X_6	effectiveness of management efektywność gospodarowania	relation of total output to total inputs of farm (euro/euro) relacja produkcji ogółem do kosztów ogółem typu (euro/euro)
X_7	current ratio wskaźnik bieżącej płynności	ratio of current assets to short-term loans (%) relacja aktywów krótkoterminowych do zobowiązań krótkoterminowych (%)
X_8	quick ratio wskaźnik wysokiej płynności	ratio of current assets without stocks to short-term loans (%) relacja aktywów krótkoterminowych pomniejszonych o zapasy do zobowiązań krótkoterminowych (%)
X_9	overall debt ratio wskaźnik ogólnego poziomu zadłużenia	ratio of total liabilities to type's total assets (%) relacja zadłużenia ogółem do aktywów ogółem typu (%)
X_{10}	long-term debt ratio wskaźnik zadłużenia długoterminowego	ratio of long-term debt to type's equity (%) relacja zadłużenia długoterminowego do kapitału własnego typu (%)
X_{11}	return on assets wskaźnik dochodowości aktywów	ratio of family farm income to type's total assets (%) relacja dochodu z gospodarstwa rolnego do aktywów ogółem typu (%)
X_{12}	return on equity wskaźnik dochodowości kapitału własnego	ratio of family farm income to type's equity (%) relacja dochodu z gospodarstwa rolnego do kapitału własnego typu (%)
X_{13}	assets turnover ratio rotacja aktywów ogółem	ratio of total output to total assets (%) relacja produkcji ogółem do aktywów ogółem typu (%)
X_{14}	tangible assets turnover ratio rotacja majątku trwałego	ratio of total output to tangible fixed assets (%) relacja produkcji ogółem do majątku trwałego typu (%)

[a)]ESU – European Size Unit, [b)]AWU – Annual Work Unit.

Source: own preparations based on: Kulawik [1995], Poczta and Kołodziejczak [2004], Ryś-Jurek [2008], Tatka [1999], Wyniki standardowe... [2006].

[a)]ESU – europejska jednostka wielkości, [b)]AWU – roczna jednostka pracy.

Źródło: opracowanie własne na podstawie: Kulawik [1995], Poczta i Kołodziejczak [2004], Ryś-Jurek [2008], Tatka [1999], Wyniki standardowe... [2006].

Table 3. The parameter estimation for the logistic model P_i
Tabela 3. Oceny parametrów modelu logitowego P_i

Variable symbol Symbol zmiennej	Variable name Nazwa zmiennej	Coefficient (b) Ocena parametru (b)	Exp (b)
X_2	labour input nakład pracy	–0.2215	0.8013
X_3	agricultural area powierzchnia gospodarstwa	0.0035	1.0035
X_9	overall debt ratio wskaźnik ogólnego poziomu zadłużenia	–0.1235	0.8838
X_{13}	assets turnover ratio rotacja aktywów ogółem	0.0155	1.0156
–	variable standing by constant zmienna jedynkowa przy wyrazie wolnym	–2.3591	–

Source: own calculations based on FADN data.
Źródło: obliczenia własne na podstawie danych FADN.

Two variables have positive, and statistically significant influence on results obtained from the logit model, namely: agricultural area and assets turnover ratio. This means that the higher the value that these variables take on, the higher the probability that a chosen type is going to be included in class that contains types with higher output's profitability. The highest positive influence on a function value has assets turnover ratio. Whereas negative influence on classification type to the class that contains types with higher output's profitability have variables: labour input and overall debt ratio.

Number exp(b) that stands by i-th variable, is the factor by which the odds of being in better economic situation change, if the i-th independent variable increases by one unit and other variables remain unchanged. For example, if assets turnover ratio (X_{13}) increases by 1%, the odds *ceteris paribus* grow by 1.56%.

Overall correctness of classification amounted to 77.21% (Table 4). Especially types from class 1 – with higher output's profitability were classified with high degree of correctness (higher than 90.00%).

Table 4. The correctness of classification of the P_i logit model
Tabela 4. Trafność klasyfikacji modelu logitowego P_i

Observed Rzeczywiste		Predicted – Modelowe	
		class 1 – klasa 1	class 2 – klasa 2
Class 1 Klasa 1	higher output's profitability wyższa dochodowość produkcji	713 (90.82%)	72
Class 2 Klasa 2	lower output's profitability niższa dochodowość produkcji	162	283 (63.60%)
Overall correctness of classification Ogólna trafność klasyfikacji		77.21%	

Source: own calculations based on FADN data.
Źródło: obliczenia własne na podstawie danych FADN.

Development of probability of higher output's profitability for a production type according to four significant variables changes is presented on Figures 1-4. The answer for question was searching: which independent variable has the most strong influence for probability of higher output's profitability for a production type?

Figure 1 indicates that probability of having higher output's profitability for a type is only slight connected with labour input's changes. Similarly situation is observed in case of agricultural area. The probability of higher output's profitability for a type slight grows as its area grows (Fig. 2). For example, the probability for a type with 100 ha of agricultural area is equal to 0.62, for a type with 200 ha of area amounts to 0.70 and with 300 ha amounts to 0.77. Whereas probability of higher output's profitability for a type is strongly dependent on overall debt ratio (Fig. 3). When the value of overall debt ratio is equal to 5%, the probability of higher output's profitability for a type amounts to 0.85. Nevertheless, as the value of overall debt ratio exceeds 40%, this probability is close to 0. The assets turnover ratio has also a significance influence on this probability. Figure 4 indicates that probability of higher output's profitability for a type grows as its assets turnover ratio grows. This probability is close to 1 for types that achieve more than 90% of this indicator's value.

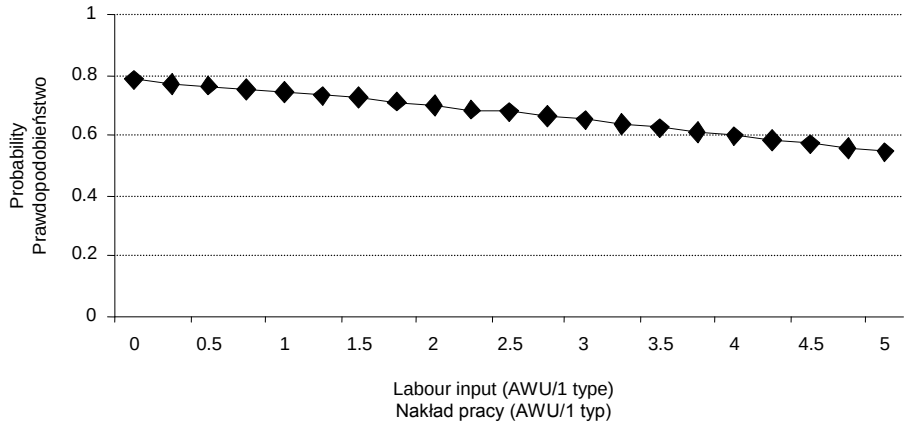

Fig. 1. Probability of higher output's profitability for production type according to economic size depending on labour input (X_2) (AWU/1 type – mean values of X_3, X_9, X_{13})
Source: own calculations based on FADN data.
Rys. 1. Prawdopodobieństwo uznania za typ o wyższej dochodowości produkcji dla typu produkcyjnego według wielkości ekonomicznej w zależności od nakładu pracy (X_2) (AWU/1 typ – przyjęto wartości średnie zmiennych X_3, X_9, X_{13})
Źródło: obliczenia własne na podstawie danych FADN.

Using the estimated logit model P_i, a ranking of production types according to the economic size from the EU countries in the year 2005 can be prepared. This ranking classifies types according to probability of being included in the class of types with higher output's profitability (Table 5).

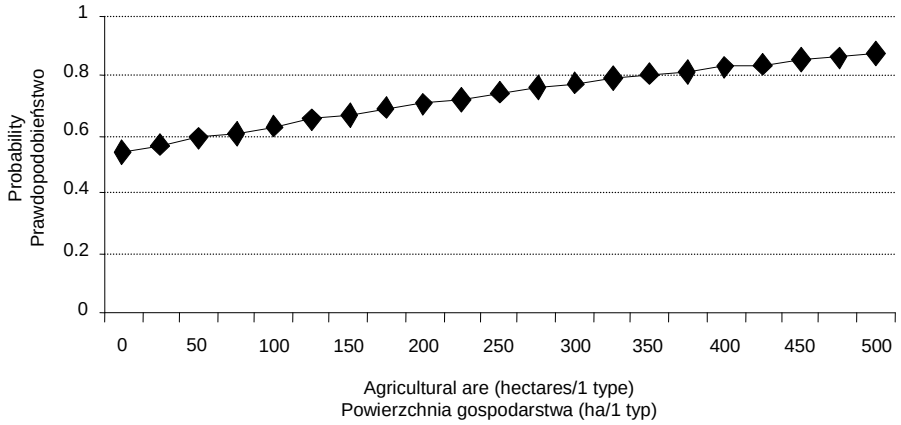

Fig. 2. Probability of higher output's profitability for production type according to economic size depending on agricultural area (X_3) (hectares/1 type – mean values of X_2, X_9, X_{13})
Source: own calculations based on FADN data.
Rys. 2. Prawdopodobieństwo uznania za typ o wyższej dochodowości produkcji dla typu produkcyjnego według wielkości ekonomicznej w zależności od powierzchni gospodarstwa (X_3) (ha/1 typ – przyjęto wartości średnie zmiennych X_2, X_9, X_{13})
Źródło: obliczenia własne na podstawie danych FADN.

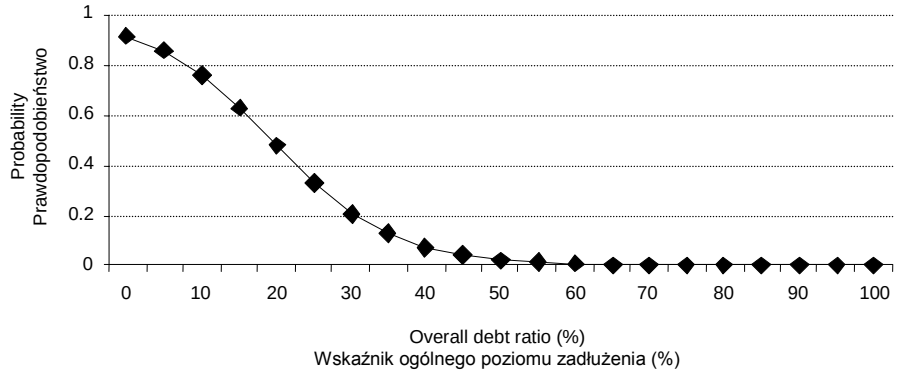

Fig. 3. Probability of higher output's profitability for production type according to economic size depending on overall debt ratio (X_9) (%) – mean values of X_2, X_3, X_{13}
Source: own calculations based on FADN data.
Rys. 3. Prawdopodobieństwo uznania za typ o wyższej dochodowości produkcji dla typu produkcyjnego według wielkości ekonomicznej w zależności od wskaźnika ogólnego poziomu zadłużenia (X_9) (%) – przyjęto wartości średnie zmiennych X_2, X_3, X_{13}
Źródło: obliczenia własne na podstawie danych FADN.

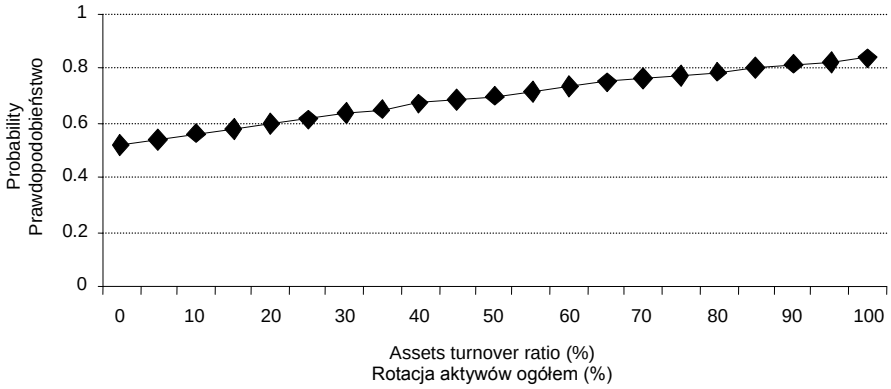

Fig. 4. Probability of higher output's profitability for production type according to economic size depending on assets turnover ratio (X_{13}) (%) – mean values of X_2, X_3, X_9

Source: own calculations based on FADN data.

Rys. 4. Prawdopodobieństwo uznania za typ o wyższej dochodowości produkcji dla typu produkcyjnego według wielkości ekonomicznej w zależności od rotacji aktywów ogółem (X_{13}) (%) – przyjęto wartości średnie zmiennych X_2, X_3, X_9

Źródło: obliczenia własne na podstawie danych FADN.

The first place in this ranking, with value of logit model equals to 0.97, is taken by Spanish type with specialist cereals, oilseed and protein crops production (Table 5). The odds for having a higher output's profitability are the highest among other 615 production types according to the economic size and amounts to 36.48. This type is characterized by big economic size (143.8 ESU) and big agricultural area almost 515 hectares. The labour input of this type amounts to about 2 AWU, and this type has a low level of debt (about 2%). The output's profitability of this type equals to almost 68%, while the value of total output exceeds 99 900 euro and family farm income exceeds 67 600 euro. Moreover, the highest results from logit model P_i are obtained by production types according to the economic size from Southern Europe's countries (Spain, Greece and Italy). These types have a high probability of being a type with higher output's profitability (more than 0.93). Their characteristic are different. For example: their economic size is contained in the range from about 6 ESU to about 123 ESU, labour input from about 1 AWU to about 2.3 AWU, agricultural area from about 0.5 hectares to about 260 hectares, assets turnover ratio from 15% to 60%. The common feature of these types is a low degree of debt (below 3%). These types' total output is equalled from about 18 000 euro to about 160 000 euro and they achieve the family farm income between 7300 euro and 106 000 euro (Table 5). As well these types are characterized by high output's profitability (between 40-68%).

The last, 615th place in the European production types according to the economic size on the basis on values from logit model P_i in the year 2005, was taken by Czech type with mixed cropping production. The economic size of this type is equalled to above 1070 ESU, agricultural area above 2160 hectares, and the labour input till 82.2 AWU. His debt exceeds 28%. The value of total output of this type amounts above 2.6 million euro, and the family farm income only about 18 800 euro. So his output's profitability is equalled only to 0.7%. Moreover, the lowest results from logit model P_i are

Table 5. Ranking of production types according to the economic size from the EU countries according to probability of being a type with higher output's profitability in the year 2005

Tabela 5. Ranking typów produkcyjnych według wielkości ekonomicznej z krajów UE według prawdopodobieństwa uznania za typ o wyższej dochodowości produkcji w 2005 roku

Place Miejsce	P_i	Odds Wskaźnik szans	Country Kraj	Direction of production[a] Kierunek produkcji[a]	Economic size (ESU[b]/1 type) Wielkość ekonomiczna (ESU[b]/1 typ)	Labour input (AWU[c]/1 type) Nakład pracy (AWU[c]/1 typ)	Agricultural area (ha/1 type) Powierzchnia gospodarstwa (ha/1 typ)	Overall debt ratio Wsk. ogólnego poziomu zadłużenia (%)	Assets turnover ratio Rotacja aktywów ogółem (%)	Total output (euro/1 type) Produkcja ogółem (euro/1 typ)	Family farm income (euro/1 type) Dochód z gosp. rolnego (euro/1 typ)	Output's profitability Dochodowość produkcji (%)
1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.97	36.48	Spain Hiszpania	specialist cereals, oilseed and protein crops zboża, rośliny oleiste i strączkowe	143.80	2.06	514.60	1.99	8.92	99 910	67 617	67.68
2	0.95	18.10	Spain Hiszpania	mixed with crops production mieszany z przewagą upraw	123.20	2.29	260.80	0.92	15.80	160 379	106 212	66.23
3	0.94	15.32	Spain Hiszpania	specialist granivores zwierzęta żywione paszami treściwymi	6.10	0.99	1.90	0.09	38.32	97 485	50 960	52.27
4	0.94	15.30	Greece Grecja	sheep, goats and other grazing livestock owce, kozy i inne zwierzęta żywione w systemie wypasowym	11.80	1.55	5.70	0.42	47.99	26 346	18 423	69.93
5	0.94	15.08	Greece Grecja	specialist horticulture uprawy ogrodnicze	12.20	1.48	1.90	0.19	45.11	23 449	10 785	45.99
6	0.94	14.92	Greece Grecja	sheep, goats and other grazing livestock owce, kozy i inne zwierzęta żywione w systemie wypasowym	6.00	1.45	3.90	0.00	41.99	15 211	9 337	61.38
7	0.94	14.70	Spain Hiszpania	specialist granivores zwierzęta żywione paszami treściwymi	12.00	1.04	2.70	0.73	41.33	49 606	27 426	55.29
8	0.93	14.18	Greece Grecja	specialist cereals, oilseed and protein crops zboża, rośliny oleiste i strączkowe	53.30	1.14	89.10	2.85	37.78	52 617	31 204	59.30
9	0.93	13.91	Italy Włochy	specialist horticulture uprawy ogrodnicze	5.80	1.12	0.50	0.04	33.85	18 180	7 303	40.17

10	0.93	13.74	Greece Grecja	specialist horticulture uprawy ogrodnicze	23.60	2.14	2.30	1.65	60.06	54 984	26 326	47.88
…	…	…	…	…	…	…	…	…	…	…	…	…
606	~0	~0	Czech Republic Czechy	specialist dairying bydło mleczne	338.20	39.24	969.30	30.50	35.24	936 806	58 903	6.29
607	~0	~0	Denmark Dania	specialist granivores zwierzęta żywione paszami treściwymi	332.40	3.48	112.30	74.18	28.67	800 176	25 597	3.20
608	~0	~0	Czech Republic Czechy	mixed with crops production mieszany z przewagą upraw	585.40	51.56	1 418.40	27.81	38.86	1 507 132	46 014	3.05
609	~0	~0	Hungary Węgry	specialist dairying bydło mleczne	401.10	33.63	529.70	39.21	65.01	1 427 744	132 044	9.25
610	~0	~0	Hungary Węgry	mixed with crops production mieszany z przewagą upraw	567.60	48.66	1 444.00	38.56	62.38	1 718 835	48 837	2.84
611	~0	~0	Czech Republic Czechy	mixed with crops production mieszany z przewagą upraw	474.20	71.69	1 728.90	2.62	23.81	1 471 145	-80 033	-5.44
612	~0	~0	Czech Republic Czechy	mixed cropping mieszane uprawy polowe ogrodnicze i trwałe	544.70	68.02	1 452.40	4.04	28.01	1 550 553	-34 060	-2.20
613	~0	~0	Czech Republic Czechy	mixed with livestock production mieszany z przewagą zwierząt	620.60	57.42	1 292.10	20.87	41.61	1 736 845	129 887	7.48
614	~0	~0	Hungary Węgry	specialist granivores zwierzęta żywione paszami treściwymi	346.40	23.89	69.00	55.40	100.49	1 487 970	157 571	10.59
615	~0	~0	Czech Republic Czechy	mixed cropping mieszane uprawy polowe ogrodnicze i trwałe	1 070.80	82.22	2 161.50	28.21	39.00	2 642 593	18 835	0.71

[a)]Names of production directions are compatible with the farms' classification according to agricultural type TF8.
[b)]ESU – European Size Unit.
[c)]AWU – Annual Work Unit.
Source: own calculations based on FADN data.
[a)]Nazwy kierunków produkcji zgodne są z klasyfikacją gospodarstw rolnych według typów rolniczych TF8.
[b)]ESU – europejska jednostka wielkości.
[c)]AWU – roczna jednostka pracy.
Źródło: obliczenia własne na podstawie danych FADN.

Table 6. Ranking of Polish production types according to the economic size and according to probability of being a type with higher output's profitability in the year 2005

Tabela 6. Ranking polskich typów produkcyjnych według wielkości ekonomicznej według prawdopodobieństwa uznania za typ o wyższej dochodowości produkcji w 2005 roku

Place Miej-sce	Place in EU's ranking Miejsce w rankingu UE	P_i	Odds Wskaźnik szans	Direction of production [a] Kierunek produkcji[a]	Economic size (ESU[b]/ 1 type) Wielkość ekonomiczna (ESU[b]/1 typ)	Labour input (AWU[c]/ 1 type) Nakład pracy (AWU[c]/ 1 typ)	Agricultural area (ha/1 type) Powierzchnia gospdarstwa (ha/1 typ)	Overall debt ratio Wsk. ogólnego poziomu zadłużenia (%)	Assets turnover ratio Rotacja aktywów ogółem (%)	Total output (euro/1 type) Produkcja ogółem (euro/1 typ)	Family farm income (euro/1 type) Dochód z gosp. rolnego (euro/1 typ)	Output's profitability Dochodo-wość produkcji (%)
1	142	0.90	9.25	mixed with livestock production mieszany z przewagą zwierząt	3.20	1.32	6.30	1.18	18.20	5 811	1 714	29.50
2	158	0.90	9.04	specialist dairying bydło mleczne	3.20	1.54	8.20	1.11	18.84	6 525	3 640	55.79
3	176	0.90	8.63	cattle-dairying, rearing and fattening combined bydło mleczne, hodowlane, tucznik	5.70	1.57	11.40	1.69	20.21	9 170	4 163	45.40
4	182	0.89	8.47	mixed with crops production mieszany z przewagą upraw	3.10	1.32	7.60	2.04	19.05	6 295	2 056	32.66
5	189	0.89	8.24	mixed with livestock production mieszany z przewagą zwierząt	5.40	1.50	9.70	2.08	19.71	8 461	2 757	32.58
…	…	…	…	…	…	…	…	…	…	…	…	…
46	477	0.33	0.50	general field cropping inne uprawy polowe	353.30	11.40	586.20	28.16	58.06	484 094	111 786	23.09
47	482	0.31	0.45	specialist horticulture uprawy ogrodnicze	26.30	3.63	4.30	24.59	43.47	69 020	15 827	22.93
48	494	0.29	0.41	specialist cereals, oilseed and protein crops zboża, rośliny oleiste i strączkowe	220.40	11.33	843.30	36.19	49.86	538 622	98 025	18.20
49	531	0.13	0.15	mixed with crops production mieszany z przewagą upraw	321.20	15.35	593.60	31.15	58.84	655 401	84 410	12.88
50	538	0.10	0.11	specialist horticulture uprawy ogrodnicze	59.30	6.37	3.60	30.54	37.67	164 827	33 797	20.50

[a]Names of production directions are compatible with the farms' classification according to agricultural type TF8; [b]ESU – European Size Unit; [c]AWU – Annual Work Unit.
Source: own calculations based on FADN data.

[a]Nazwy kierunków produkcji są zgodne z klasyfikacją gospodarstw rolnych według typów rolniczych TF8; [b]ESU – europejska jednostka wielkości; [c]AWU – roczna jednostka pracy.
Źródło: obliczenia własne na podstawie danych FADN.

obtained by production types according to the economic size from the Central Europe's countries (Czech Republic, Hungary) and from Denmark. The probability of being included in the class of types with higher output's profitability for these types is close 0. Their odds for having a higher output's profitability are also close to 0. These types are very big with economic size about 330-620 ESU, agricultural area about 70-1730 hectares and high labour input (3.4-57.4 AWU). The common feature of these types is a considerable degree of debt (30-75%). These types have a high value of total output (from about 800 000 euro to about 1 740 000 euro), but they achieve relatively (also negative) low family farm income. So they are characterized by low output's profitability (to about 10.5%).

Also, a ranking of production types according to the economic size exclusively from Poland in the year 2005 according to probability of being included in the class of types with higher output's profitability was prepared (Table 6)[5]. The Polish types take places between 142 and 538 in the European ranking. The best results are obtained by very small and small types (their area not exceeds 12 hectares) with the economic size between 3.1 ESU and 5.4 ESU. They mostly deal with the livestock production. These types are characterized by low labour input (1.32-1.57 AWU) and low degree of debt (about 2%). Their total output achieve value about 5800-9100 euro, and family farm income contains between 1700-4100 euro. So their output's profitability amounts to about 30-56%. Their odds for having a higher output's profitability are medium among 615 production types according to the economic size in the EU and equal to 8.2-9.3 (Table 6). The lowest results among the Polish types are obtained by types with crops production, in majority very big (with the economic size to 353 ESU and agricultural area to about 844 hectares), with high labour input (to 15.3 AWU). These types are burden with the considerable debt (24-36%) and they have a high assets turnover ratio (43-58%). These types have a value of total output between about 69 000 euro to about 655 000 euro and achieves the family farm income between 15 800 euro and 111 000 euro. Also they are characterized by output's profitability below 23%. Their odds for having a higher output's profitability are low among 615 types in the EU and are equal to below 1 (Table 6).

CONCLUSIONS

1. Presented logit model P_i can be used as a tool to evaluate the output's profitability of production types according to the economic size. It is characterized by high statistical significance of classification results.

2. The estimated model P_i allows to evaluate a probability whether a particular type has a higher output's profitability. The highest results obtained types without the debt and with high assets turnover ratio.

3. The estimated model P_i was used to making 2 rankings of production types according to the economic size in the year 2005 – in the EU and in Poland. These rankings classified types according to the probability whether a particular type has a higher output's profitability. So:

[5] In the FADN database, Polish production types according to the economic size are represented by 50 observed agregate units in each year.

a) in the European ranking, the highest probability was obtained by types from the Southern Europe with different characteristic. For example, they achieve: economic size 6-123 ESU, agricultural area 0.5-260 hectares, labour input 1-2.3 AWU, assets turnover ratio 15-60%, but they have a debt below 3%. These types have a value of total output 18 000-160 000 euro, family farm income 7300-106 000 euro, so their output's profitability is equal between 40-68%. While, the lowest results was obtained by types from the Central Europe. They are very big with the economic size about 330-1070 ESU, agricultural area about 70-2160 hectares, high labour input (3.4-82.2 AWU) and debt (28-75%). These types' value of total output is equal to 800 000-2.6 million euro, but they achieve relatively low family farm income, so their output's profitability is equal below 11%.
b) in the Polish ranking, the highest probability was obtained by very small and small types (agricultural area below 12 hectares and economic size 3.1-5.4 ESU), with mostly livestock production. These types are characterized by: low labour inputs (1.32-1.57 AWU), low degree of debt (about 2%), total output about 5800-9100 euro, family farm income 1700-4100 euro and output's profitability between 30-56%. The lowest results was obtained by types with crops production, in the majority very big (economic size below 353 ESU and agricultural area to about 844 hectares), with high labour input (to 15.3 AWU), assets turnover ratio (43-58%) and considerable debt (24-36%). These types achieve: total output about 69 000-655 000 euro, family farm income 15 800-111 000 euro and output's profitability below 23%.

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ZASTOSOWANIE ANALIZY LOGITOWEJ DO OCENY DOCHODOWOŚCI PRODUKCJI TYPÓW PRODUKCYJNYCH WEDŁUG WIELKOŚCI EKONOMICZNEJ W UNII EUROPEJSKIEJ (NA PODSTAWIE DANYCH FADN)

Streszczenie. W pracy podjęto próbę zastosowania analizy logitowej do pomiaru i oceny dochodowości produkcji poszczególnych typów produkcyjnych według wielkości ekonomicznej. Badania zostały oparte na danych źródłowych pochodzących z bazy FADN, obejmującej 615 typów produkcyjnych według wielkości ekonomicznej z krajów Unii Europejskiej w latach 2004-2005. Prezentowany model logitowy może być zastosowany jako narzędzie diagnozowania oceny dochodowości produkcji poszczególnych typów produkcyjnych według wielkości ekonomicznej. Charakteryzuje go wysoka statystyczna istotność wyników klasyfikacji. Model ten pozwala również sporządzić rankingi typów produkcyjnych według wielkości ekonomicznej zgodnie z prawdopodobieństwem uznania za typ o wyższej dochodowości produkcji.

Słowa kluczowe: analiza logitowa, dochodowość produkcji, typ produkcyjny, wielkość ekonomiczna

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