

**USING THE DISCRIMINANT ANALYSIS TO ESTIMATE
THE PROFITABILITY OF PRODUCTION TYPES
ACCORDING TO THE ECONOMIC SIZE IN THE
EUROPEAN UNION (WITH THE USE OF FADN DATA)**

Roma Ryś-Jurek

Poznan University of Life Sciences

Abstract. In this article an attempt was made to use the discriminant analysis to measure and evaluate the profitability of 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: discriminant analysis, production types according to the economic size, estimation, profitability

INTRODUCTION

The profitability of Polish farms in comparison with the profitability of other farms from Western Europe, has been situated on a lower level for many years [Zegar 2003, Czyżewski and Hennisz-Matuszczak 2004]. Since Poland became the member of the European Union (EU), the necessity of comparison of Polish farms' profitability with the profitability of other EU's membership farms, has increased significantly. The exploration of appropriate methods making such comparison possible, has occurred to be the urgent need.

The main aim of this article is to explore the possibility of the use of the discriminant analysis for the estimation of profitability of various production types according to the economic size from each country of the EU. The special attention was paid to Poland.

MATERIAL AND METHODS

To conduct the research of profitability of various production types according to the economic size, data obtained from Farm Accountancy Data Network (FADN) were used. 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 2004-2005¹. The whole database consists of 24 countries (there was no data from Malta in the year 2004, so this country was excluded from further analysis). The types according to the direction of production and according to the economic size are an aggregate units, which characterise the production and economic types of farms in particular countries in the EU. Finally, analysed base included data about 615 production types according to the economic size in each year, so the whole database consisted of 1230 so-called "object-years".

An indispensable condition of discriminant analysis, is a initial division of analysed data set into two classes: first characterised with better properties, and second – with worse properties [Ryś-Jurek and Walczak 2003]².

Hence, the analysed class of production types according to the economic size was split into two classes according to average annual family farm income gained by individual farm in the EU in the year 2005 (Table 1). So, the dividing value was set at the level of 16 547 euro.

Table 1. The distribution of analysed sample of production types according to the economic size according to annual family farm income

Tabela 1. Rozkład badanej próby typów produkcyjnych według wielkości ekonomicznej i rocznego dochodu z gospodarstwa rolnego

Class Klasa	Annual family farm income Roczny dochód z indywidualnego gospodarstwa rolnego	Number of production types according to the economic size Liczba typów produkcyjnych według wielkości ekonomicznej
1 – Types with higher profitability 1 – Typy o wyższej dochodowości	≥ 16 547 euro	668
2 – Types with lower profitability 2 – Typy o niższej dochodowości	< 16 547 euro	562
Overall Ogółem	–	1 230

Source: own calculations based on FADN [2007] data.

Źródło: opracowanie własne na podstawie danych FADN [2007].

¹ In Poland the researchers observed that 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 these 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 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].

² When the statistical units are divided for more than two classes, discriminant analysis have a multiplicative character [Mierzwa 2002].

The first class includes 668 production types according to the economic size of annual family farm income higher than 16 547 euro, while the second one consists of 562 production types according to the economic size of annual family farm incomes lower than 16 547 euro. On the basis of this division the assumption was made that class 1 includes types with higher profitability. Consequently, class 2 consists of types with lower profitability.

In order to conduct further analysis, including the discriminant analysis, a set of twelve variables characterising the profitability and the economic situation of types was used. This set is presented in Table 2. Selection of variables was based on statistical and common sense factors alike.

Table 2. The characteristic of variables used in research
Tabela 2. Charakterystyka zmiennych wykorzystanych w badaniach

Variable symbol Symbol zmiennej	Variable name Nazwa zmiennej	Variable characteristic (measure's units) Obliczanie wartości zmiennej (jednostki miary)
1	2	3
Y	Annual family farm income Roczny dochód z gospodarstwa rolnego	Binary variable (family farm income \geq 16 547 = 1, family farm income $<$ 16 547 = 0) Zmienna zero-jedynkowa (dochód z indywidualnego gospodarstwa rolnego \geq 16 547 = 1, dochód z indywidualnego gospodarstwa rolnego $<$ 16 547 = 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	Agricultural area Powierzchnia gospodarstwa	Total utilized agricultural area to 1 type (ha/1 type) Całkowita użytkowana powierzchnia użytków rolnych przypadająca na 1 typ (ha/1 typ)
X ₃	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 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	Effectiveness of management Efektywność gospodarowania	Relation of total output to total inputs of type (euro/euro) Relacja produkcji ogółem do nakładów ogółem typu (euro/euro)
X ₆	Current ratio Wskaźnik bieżącej płynności	Ratio of current assets to short-term loans (euro/euro) Relacja aktywów krótkoterminowych do zobowiązań krótkoterminowych (euro/euro)
X ₇	Quick ratio Wskaźnik wysokiej płynności	Ratio of current assets without stocks to short-term loans (euro/euro) Relacja aktywów krótkoterminowych bez zapasów do zobowiązań krótkoterminowych (euro/euro)
X ₈	Overall debt ratio Wskaźnik ogólnego poziomu zadłużenia	Ratio of total liabilities to type's total assets (euro/euro) Relacja zadłużenia ogółem do aktywów ogółem typu (euro/euro)
X ₉	Return on assets Wskaźnik dochodowości aktywów	Ratio of family farm income to type's total assets (euro/euro) Relacja dochodu z gospodarstwa rolnego do aktywów ogółem typu (euro/euro)

Table 2 – cont. / Tabela 2 – cd.

1	2	3
X ₁₀	Income net ratio Wskaźnik dochodowości netto	Ratio of family farm income to type's total output (euro/euro) Relacja dochodu z gospodarstwa rolnego do produkcji ogółem typu (euro/euro)
X ₁₁	Assets turnover ratio Rotacja aktywów ogółem	Ratio of type's total output to type's total assets (euro/euro) Relacja produkcji ogółem do aktywów ogółem typu (euro/euro)
X ₁₂	Fixed assets turnover ratio Rotacja aktywów trwałych	Ratio of type's total output to type's fixed assets (euro/euro) Relacja produkcji ogółem do aktywów trwałych typu (euro/euro)

ESU – European Size Unit.

AWU – Annual Work Unit.

Source: own preparations based on: Kulawik [1995], Poczta and Kołodziejczak [2004], Tatka [1999].

ESU – europejska jednostka wielkości.

AWU – roczna jednostka pracy.

Źródło: opracowanie własne na podstawie: Kulawik [1995], Poczta i Kołodziejczak [2004], Tatka [1999].

The basic methods of research were methods of descriptive analysis, comparative analysis and chosen methods of descriptive analysis, and last but not least – the discriminant analysis.

The discriminant analysis is a statistical method, which is used when the dependent variable is a not measured feature whereas the independent variables can be measured. The discriminant function is a formal notation of chosen combination of independent variables. This function separates (discriminates) in the best way the set of statistical units into two or more groups. In practice, the linear discriminant function is commonly used, in form [Siemińska 2002]:

$$f_D(X) = b_0 + b_1X_1 + b_2X_2 + \dots + b_kX_k$$

where:

X – a vector of independent variables [X_i],

b₀ – a constant of the discriminant function,

b_i – coefficients (weights) of discriminant function.

From the practical viewpoint, the construction and utilization of discriminant function makes sense only when the correctness of classification of this function is significantly higher (in statistical sense) comparing with an accidental allocation of statistical units to the given class [Hadasik 1998, Siemińska 2002].

RESULTS

The principal target of research is to obtain the model of discriminant function that classifies production types according to the economic size from the EU countries according to the profitability. The depending (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 discriminant analysis was introduced. As a result, obtained discriminant function $f_D(X)$ is presented in Table 3.

Table 3. Parameters of discriminant function's model $f_D(X)$ and their statistical significance
 Tabela 3. Oceny parametrów modelu funkcji dyskryminacyjnej $f_D(X)$ i ich statystyczna istotność

Variable symbol Symbol zmiennej	Variable name Nazwa zmiennej	Coefficient (b) Ocena parametru (b)	p level Poziom p	Tolerance coefficient T Współczynnik tolerancji T
X ₁	Economic size Wielkość ekonomiczna	0.0121	0.0000	0.4628
X ₂	Agricultural area Powierzchnia gospodarstwa	0.0041	0.0000	0.2194
X ₃	Labour input Nakład pracy	-0.1869	0.0000	0.1751
X ₅	Effectiveness of management Efektywność gospodarowania	1.1452	0.0000	0.8902
-	Constant Stała	-2.0418	-	-

Source: own calculations based on FADN [2007] data.
 Źródło: obliczenia własne na podstawie danych FADN [2007].

The variables that can be treat as insignificant are: X₄, X₆-X₁₂. So presented discriminant function $f_D(X)$ contains only statistically significant variables with p level close to 0. The calculated value of F statistic is equal to 79.308, when the critical value $F_{0,05;4;1225} = 2.379$. Hence, the estimated function in statistically significant manner diversifies units into separated classes. Also, the value of tolerance coefficient T is calculated for each variable in model³. This coefficient takes values from the range (0.1751; 0.8902), so variables in model aren't correlated strongly with each other.

Overall correctness of classification takes on value above 75% (Table 4). Both classes of production types according to the economic size with higher and lower profitability are classified with high degree of correctness (higher than 70%).

Three variables have positive influence on values of discriminant function $f_D(X)$. These variables are: economic size (X₁), agricultural area (X₂) and effectiveness of management (X₅). 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 profitability. The opposite influence on type's classification has a labour input (X₃). The highest influence on a function value has the effectiveness of management.

The estimated model of the discriminant function was prepared in such way that obtained value $f_D(X) \geq 0$ refers to class 1, that is to types with higher profitability. Consequently, value $f_D(X) < 0$ refers to class 2 – types with lower profitability.

³ We can take cognisance that the value of tolerance coefficient T for any variable in discriminant function's model shouldn't be less than 0,05. The closer the value of tolerance coefficient T to 0, the more correlated is the variable with other variables in model. This situation has a negative influence on model's quality [Hadasik 1998].

Table 4. The correctness of classification of discriminant function's model $f_D(X)$
 Tabela 4. Trafność klasyfikacji modelu funkcji dyskryminacyjnej $f_D(X)$

Observed affiliation of object-years Rzeczywista przynależność obiektolat		Predicted affiliation of object-years Modelowa przynależność obiektolat		Correctness of classification Trafność klasyfikacji
		class 1 klasa 1	class 2 klasa 2	
Class 1 Klasa 1	higher profitability wyższa dochodowość	475	193	71.11%
Class 2 Klasa 2	lower profitability niższa dochodowość	114	448	79.71%
Overall Ogółem		589	641	75.41%

Source: own calculations based on FADN [2007] data.
 Źródło: obliczenia własne na podstawie danych FADN [2007].

The obtained model $f_D(X)$ was used in order to evaluate the profitability of five European production types according to the economic size in the years 2004-2005 (Table 5 and Fig. 1). These types were chosen randomly in order to obtain 1 production type according to the economic size from the Eastern, Northern, Western, Southern and Central Europe.

Table 5. The chosen characteristics of five production types according to the economic size chosen randomly from the EU countries and the results from discriminant function's model $f_D(X)$ in the years 2004-2005

Tabela 5. Wybrane charakterystyki pięciu wylosowanych typów produkcyjnych według wielkości ekonomicznej z krajów UE i ich wyniki z modelu funkcji dyskryminacyjnej $f_D(X)$ w latach 2004-2005

Data Wyszczególnienie	Production types according to the economic size Typy produkcyjnych według wielkości ekonomicznej				
	A	B	C	D	F
1	2	3	4	5	6
Code of type Kod typu	*21	*367	*470	*415	*612
Country Kraj	Cyprus Cypr	Lithuania Litwa	Poland Polska	The Netherlands Holandia	Great Britain Wielka Brytania
Direction of production ³⁾ Kierunek produkcji ³⁾	specialist fruit and citrus fruit drzewa i krzewy owocowe (razem z cytrusowymi)	mixed with crops production mieszany z przewagą upraw	cattle-dairying, rearing and fattening combined bydło mleczne i hodowlane, tucznik, łącznie	general field cropping inne uprawy polowe	sheep, goats and other grazing livestock owce, kozy i inne zwierzęta żywione w systemie wypasowym

Table 5 – cont. / Tabela 5 – cd.

1	2	3	4	5	6
2004					
Value of discriminant function $f_D(X)$ Wartość funkcji dyskryminacyjnej $f_D(X)$	-1.01	-0.71	-0.56	1.38	1.94
Economic size (ESU ^b /1 type) Wielkość ekonomiczna (ESU ^b /1 typ)	10.80	3.20	12.00	191.10	144.30
Agricultural area (ha/1 type) Powierzchnia gospodarstwa (ha/1 typ)	2.70	26.20	15.90	110.60	456.50
Labour input (AWU ^c /1 type) Nakład pracy (AWU ^c /1 typ)	1.08	1.76	1.87	2.50	3.01
Effectiveness of management (euro/euro) Efektywność gospodarowania (euro/euro)	0.96	1.32	1.42	0.98	0.81
Current ratio (euro/euro) Wskaźnik bieżącej płynności (euro/euro)	14.12	55.51	6.14	3.73	1.92
Overall debt ratio (euro/euro) Wskaźnik ogólnego poziomu zadłużenia (euro/euro)	0.01	0.00	0.03	0.33	0.14
Total output (euro/1 type) Produkcja ogółem (euro/1 typ)	10 083.00	9 343.00	17 625.00	352 142.00	230 483.00
Family farm income (euro/1 type) Dochód z gospodarstwa rolnego (euro/1 typ)	2 584.00	5 497.00	7 183.00	25 119.00	84 362.00
2005					
Value of discriminant function $f_D(X)$ Wartość funkcji dyskryminacyjnej $f_D(X)$	-0.72	-0.83	-0.50	1.62	1.98
Economic size (ESU/1 type) Wielkość ekonomiczna (ESU/1 typ)	10.50	3.10	12.00	193.30	133.00
Agricultural area (ha/1 type) Powierzchnia gospodarstwa (ha/1 typ)	3.30	22.70	18.80	113.80	508.10
Labour input (AWU/1 type) Nakład pracy (AWU/1 typ)	0.94	1.61	1.89	2.37	2.98
Effectiveness of management (euro/euro) Efektywność gospodarowania (euro/euro)	1.19	1.21	1.46	1.13	0.77
Current ratio (euro/euro) Wskaźnik bieżącej płynności (euro/euro)	18.06	10.76	5.70	3.25	2.24

Table 5 – cont. / Tabela 5 – cd.

1	2	3	4	5	6
Overall debt ratio (euro/euro) Wskaźnik ogólnego poziomu zadłużenia (euro/euro)	0.01	0.03	0.07	0.36	0.11
Total output (euro/1 type) Produkcja ogółem (euro/1 typ)	9 013.00	9 205.00	20 166.00	403 935.00	213 743.00
Family farm income (euro/1 type) Dochód z gospodarstwa rolnego (euro/1 typ)	3 977.00	5 274.00	9 281.00	74 932.00	75 045.00

^{a)}Names of production's 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 [2007] 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 [2007].

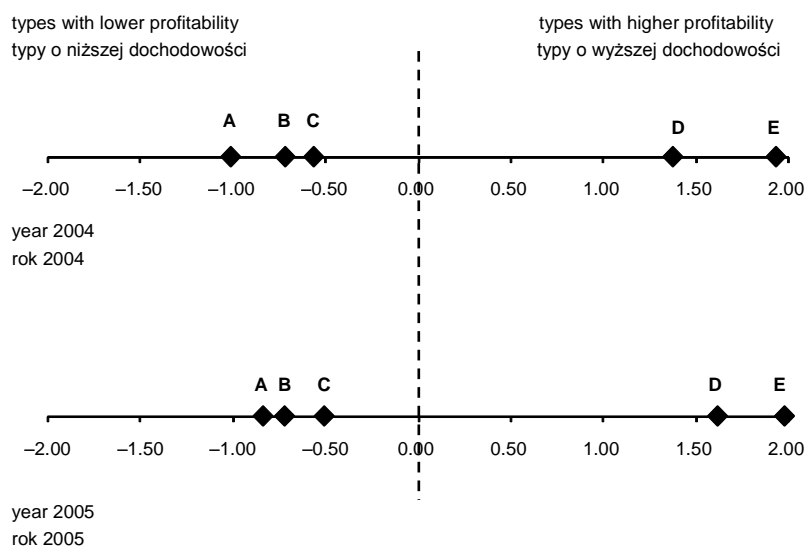


Fig. 1. Projections of values of the discriminant function $f_D(X)$ onto straight lines for five production types according to the economic size chosen randomly in the years 2004-2005

Source: own preparation based on Table 5.

Rys. 1. Rzutowanie wartości funkcji dyskryminacyjnej $f_D(X)$ na proste dla wylosowanych pięciu typów produkcyjnych według wielkości ekonomicznej w latach 2004-2005

Źródło: opracowanie własne na podstawie tabeli 5.

The model classified 3 production types according to the economic size as types with lower profitability. In the year 2004 these were: Cyprian type A (specialist fruit and citrus fruit production, agricultural area of 2.70 hectares), Lithuanian type B (mixed with crops production, agricultural area of 26.20 hectares) and Polish farm C (cattle-dairying, rearing and fattening combined, agricultural area of 15.90 hectares). These types obtained negative results of discriminant function in the year 2004. They were characterised by low economic size (to 12 ESU), low value of total output (to 18 000 euro). Annual family farm incomes of types A, B, C was lower than 7500 euro.

Two types were classified by the model $f_D(X)$ as a type with higher profitability in the year 2004. These types were: D from the Netherlands (general field cropping, agricultural area of 110.60 hectares) and E from the Great Britain (sheep, goats and other grazing livestock, agricultural area of 456.50 hectares). They were both characterised by higher values of economic size (above 140 ESU), agricultural area, labour input, total output (above 230 000 euro) and family farm income (above 25 000 euro), than types A, B and C. It's worth to emphasize, that all 5 types sustained a high level of liquidity and low level of liabilities.

The profitability of five randomly chosen production types according to the economic size didn't change much in the year 2005 (Table 5 and Fig. 1). Four types (apart from B) increased their agricultural area, but it didn't change considerably their economic size measured in ESU. Only two types (C and D) gained higher value of total output and family farm income in the year 2005 than in the former year, but it also didn't change significantly their profitability.

Using the estimated discriminant function $f_D(X)$, a ranking of production types according to the economic size from the EU countries in the year 2005 can be prepared (Table 6). This ranking presents the most profitable and the less profitable production and economic types of farms in the EU. The best results achieved production types according to the economic size of more than 300 ESU of economic size and of agricultural area more than 45 hectares (except the types with specialist horticulture production). The highest labour input and effectiveness of management was typical to these very big types. Their production fluctuated between the range of 484 000 euro and 1 441 000 euro, and their family farm income amounted took on values from 52 000 euro to 304 000 euro. At the same time, small types obtained the worst results. They were characterised by economic size below 12 ESU, agricultural area below 18 hectares, total output less than 35 500 euro and family farm income not exceeding 8000 euro.

Also, a ranking of production types according to the economic size exclusively from Poland in the year 2005 was prepared (Table 7)⁴. This ranking presents the most profitably and the less profitably production and economic types of farms in Poland. It's worth to notice, that only 12% of Polish production types according to the economic size obtained positive values of the discriminant function⁵. The first place in this ranking with the value $f_D(X)$ equalled to 3.77, was taken by very big production type according to the economic size with general field cropping production. This type (353.3 ESU

⁴ In the FADN database, Polish production types according to the economic size are represented by 50 observed units – production types according to the economic size in the years 2004-2005.

⁵ 12% of 50 production types according to the economic size is equal to 6 types.

Table 6. Ranking of production types according to the economic size from the EU countries according to values of discriminant function $f_D(X)$ in the year 2005Tabela 6. Ranking typów produkcyjnych według wielkości ekonomicznej z krajów UE według wartości funkcji dyskryminacyjnej $f_D(X)$ w 2005 roku

Place Miej- sce	$f_D(X)$	Country Kraj	Direction of production ^{a)} Kierunek produkcji ^{b)}	Economic size (ESU ^{b)} / 1 type) Wielkość ekono- miczna (ESU ^{b)} / 1 typ)	Agricul- tural area (ha/1 type) Po- wierzchnia gospodar- stwa (ha/1 typ)	Labour input (AWU ^{c)} / 1 type) Nakład pracy (AWU ^{c)} / 1 typ)	Effective- ness of manage- ment (euro/euro) Efektyw- ność gospoda- rowania (euro/euro)	Total output (euro/ 1 type) Produkcja ogółem (euro/ 1 typ)	Family farm income (euro/ 1 type) Dochód z gospo- darstwa rolnego (euro/ 1 typ)
1	2	3	4	5	6	7	8	9	10
1	7.50	Italy Włochy	specialist granivores zwierzęta żywione paszami treściwymi	711.70	47.90	4.63	1.40	932 494	304 085
2	6.14	Great Britain Wielka Brytania	specialist horticulture uprawy ogrodnicze	861.90	48.30	19.72	1.08	1 440 550	117 387
3	4.37	Denmark Dania	various permanent crops combined pozostałe uprawy trwale	564.40	51.80	9.94	1.07	788 164	60 208
4	4.36	Great Britain Wielka Brytania	general field cropping inne uprawy polowe	393.00	345.00	4.87	0.99	583 870	87 996
5	3.77	Poland Polska	general field cropping inne uprawy polowe	353.30	586.20	11.40	1.11	484 094	111 786
6	3.73	Hungary Węgry	specialist cereals, oilseed and protein crops zboża, rośliny oleiste i strączkowe	307.40	11 53.70	19.32	0.81	777 116	68 912
7	3.55	Denmark Dania	specialist horticulture uprawy ogrodnicze	507.20	19.30	9.82	1.05	994 621	63 699
8	3.17	The Netherlands Holandia	various permanent crops combined pozostałe uprawy trwale	383.20	24.70	4.75	1.19	526 185	159 970
9	3.04	The Netherlands Holandia	specialist horticulture uprawy ogrodnicze	437.10	10.00	7.85	1.07	906 588	52 280
10	2.82	Italy Włochy	cattle-dairying, rearing and fattening com- bined bydło mleczne i ho- dowlane, tucznik	303.00	83.90	3.14	1.26	651 313	213 023
...
606	-1.24	Slovenia Słowenia	cattle-dairying, rearing and fattening com- bined bydło mleczne i ho- dowlane, tucznik	5.50	15.00	1.33	0.81	11 785	7 828

Table 6 – cont. / Tabela 6 – cd.

1	2	3	4	5	6	7	8	9	10
607	-1.24	Slovenia Słowenia	specialist dairying bydło mleczne	5.90	7.50	1.78	0.90	9 558	1 276
608	-1.26	Denmark Dania	mixed with crops production mieszany z przewagą upraw	11.70	16.80	0.49	0.58	20 230	-7 245
609	-1.32	Portugal Portugalia	cattle-dairying, rearing and fattening com- bined bydło mleczne i ho- dowlane, tucznik	3.00	14.40	1.41	0.78	6 281	3 328
610	-1.32	Portugal Portugalia	mixed cropping mieszane uprawy polowe ogrodnicze i trwałe	2.80	6.10	1.25	0.78	5 134	110
611	-1.41	Ireland Irlandia	cattle-dairying, rearing and fattening com- bined bydło mleczne i ho- dowlane, tucznik	3.00	17.60	0.73	0.57	4 067	3 351
612	-1.44	Hungary Węgry	specialist vineyards winnice	11.80	13.40	2.42	0.75	35 198	-10 293
613	-1.48	Portugal Portugalia	specialist fruit and citrus fruit drzewa i krzewy owocowe (razem z cytrusowymi)	5.70	6.30	1.23	0.61	7 162	-2 819
614	-1.50	Slovenia Słowenia	cattle-dairying, rearing and fattening com- bined bydło mleczne i ho- dowlane, tucznik	3.00	11.60	1.80	0.70	7 269	2 557
615	-1.24	Slovenia Słowenia	specialist dairying bydło mleczne	5.90	7.50	1.78	0.90	9 558	1 276

^{a)}Names of production's 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 [2007] 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 [2007].

of economic size, 586.2 hectares of agricultural area) produced more than 484 000 euro of total output and gained almost 112 000 euro of family farm income. It is worth underlining, that in the ranking of production types according to the economic size from the EU countries, this farm took the fifth place (Table 6). Moreover, the best results obtained production types according to the economic size with economic size more than 220 ESU, agricultural area above 115 hectares, high labour input and effectiveness of

Table 7. Ranking of Polish production types according to the economic size according to values of discriminant function $f_D(X)$ in the year 2005Tabela 7. Ranking polskich typów produkcyjnych według wielkości ekonomicznej według wartości funkcji dyskryminacyjnej $f_D(X)$ w 2005 roku

Place (place in the EU's ranking) Miejsce (miejsce w unijnym rankingu)	$f_D(X)$	Direction of production ^{a)} Kierunek produkcji ^{a)}	Economic size (ESU ^{b)} /1 type) Wielkość ekonomiczna (ESU ^{b)} /1 typ)	Agricultural area (ha/1 type) Powierzchnia gospodarstwa (ha/1 typ)	Labour input (AWU ^{c)} /1 type) Nakład pracy (AWU ^{c)} /1 typ)	Effectiveness of management (euro/euro) Efektywność gospodarowania (euro/euro)	Total output (euro/1 type) Produkcja ogółem (euro/1 typ)	Family farm income (euro/1 type) Dochód z gospodarstwa rolnego (euro/1 typ)
1 (5)	3.77	general field cropping inne uprawy polowe	353.30	586.20	11.40	1.11	484 094	111 786
2 (12)	3.09	specialist cereals, oilseed and protein crops zboża, rośliny oleiste i strączkowe	220.40	843.30	11.33	0.98	538 622	98 025
3 (23)	2.57	mixed with crops production mieszany z przewagą upraw	321.20	593.60	15.35	1.01	655 401	84 410
4 (43)	1.96	specialist granivores zwierzęta żywione paszami treściwymi	248.10	115.00	5.69	1.39	413 991	137 660
5 (138)	0.31	specialist cereals, oilseed and protein crops zboża, rośliny oleiste i strączkowe	60.70	242.70	3.28	1.08	125 110	48 872
...
46 (558)	-0.96	mixed with crops production mieszany z przewagą upraw	3.10	7.60	1.32	1.10	6 295	2 056
47 (560)	-0.97	mixed with livestock production mieszany z przewagą zwierząt	3.20	6.30	1.32	1.09	5 811	1 714
48 (564)	-0.98	mixed cropping mieszane uprawy polowe ogrodnicze i trwałe	3.00	7.40	1.41	1.10	6 137	2 063
49 (590)	-1.10	specialist cereals, oilseed and protein crops zboża, rośliny oleiste i strączkowe	3.00	12.80	1.00	0.91	5 873	1 923
50 (596)	-1.20	cattle-dairying, rearing and fattening combined bydło mleczne i hodowlane, tucznik	3.20	7.80	1.48	0.91	4 715	1 190

^{a)}Names of production's 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 [2007] 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 [2007].

management⁶. Their production exceeded 410 000 euro, their family farm income was higher than 84 400 euro. The worst results in the ranking of Polish production types according to the economic size obtained small types (their agricultural area was smaller than 13 hectares), characterised by economic size of about 3 ESU. Their total output not achieved a value of 6300 euro and family farm income equalled to about 2000 euro. These types are classified among 10% of least profitable production types according to the economic size in the EU, taken places in the last 60th.

CONCLUSIONS

1. Presented model of the discriminant function $f_D(X)$ can be used as a tool to evaluate the profitability of production types according to the economic size. It is characterised by high statistical significance of classification results.

2. Estimated model of discriminant function $f_D(X)$ allowed the preparation of rankings of production types according to the economic size according to their profitability. As a result:

- a) among production types according to the economic size from the EU countries in the year 2005, the best results achieved types that contained more than 300 ESU of economic size and agricultural area of more than 45 hectares (except types with specialist horticulture production). The value of their production was higher than 484 000 euro and family farm income amounted to above 52 000 euro. The worst results obtained small types, characterised by economic size remaining below 12 ESU and agricultural area – below 18 hectares. Their total output was less than 35 500 euro and family farm income not exceeded 8000 euro;
- b) among production types according to the economic size from Poland in the year 2005, the best results obtained types with economic size more than 220 ESU and agricultural area exceeding 115 hectares. Their production exceeded 410 000 euro, their family farm income was higher than 84 400 euro. The worst results obtained small types (of their agricultural area smaller than 13 hectares), characterised by economic size equal to about 3 ESU. Their total output not achieved a value of 6300 euro and family farm income was equal to about 2000 euro.

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ZASTOSOWANIE ANALIZY DISKRYMINACYJNEJ DO OCENY DOCHODOWOŚCI TYPÓW PRODUKCYJNYCH WEDŁUG WIELKOŚCI EKONOMICZNEJ W UNII EUROPEJSKIEJ (W ŚWIETLE DANYCH FADN)

Streszczenie. W pracy podjęto próbę zastosowania analizy dyskryminacyjnej do pomiaru i oceny dochodowości 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 funkcji dyskryminacyjnej może być zastosowany jako narzędzie diagnozowania dochodowości typów produkcyjnych według wielkości ekonomicznej. Charakteryzuje go wysoka statystyczna istotność wyników klasyfikacji. Model ten pozwala również sporządzić rankingi typów produkcyjnych według wielkości ekonomicznej.

Słowa kluczowe: analiza dyskryminacyjna, typ produkcyjny według wielkości ekonomicznej, ocena, dochodowość

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