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SUBSIDIES, FINANCIAL AND ECONOMIC EFFICIENCY AND THE TYPE OF AGRICULTURAL PRODUCTION OF FARMS OWNED BY NATURAL PERSONS

Abstract

The type of agricultural production pursued by a family farm very clearly differentiates its economic and financial efficiency and the possibility to use budget support. The performed calculations of multiple regression showed that the subsidy rate in the form of the ratio of the sum of financial support received and the income of a family farm influenced the effectiveness mostly negatively, significantly statistically. The impact that other variables from the "subsidising holdings" category had on economic and financial indices was not so clear as regards the direction of the interdependence, although it met the generally accepted criteria for statistical significance in most of the cases. The same phenomenon was observed with the technical and economic production characteristics as a determinant of efficiency. In this context, it still remains a major challenge to identify the factors that influence the operating efficiency of family farms.

Keywords: ubsidies, financial efficiency, economic efficiency, agricultural production, farm, natural person, field crops, granivores.

Introduction

National research conducted so far demonstrates that the type of production pursued by agricultural holdings is one of important determinants of their dependence on subsidies and it may have multidirectional impact on financial and economic indicators achieved by such holdings (Dopłaty bezpośrednie... 2011, 2012, 2013; Kulawik J., Płonka R. 2013).

Also foreign authors have come to similar conclusions (Barry P. et al. 2012; Dabbert S. et al. 2012; Doluschitz R. et al. 2011; Kay R.D. et al. 2012; Muβhoff O. et al. 2011; Olson D.K. 2011; Zhu X. et al. 2010). On the other hand, however, an analysis based on the multiple regression has revealed diversified interdependencies between subsidies, efficiency and the type of production conducted by agricultural holdings. This applies to the direction, strength and statistical significance of correlations and estimations of the parameters in regression equations. Therefore, the main aim of this paper is an attempt to make such parameters objective. Another aim is to answer the question whether the type of production alone – as a dummy variable in multiple regression models – is a sufficient determinant of efficiency or if it would be better to estimate parameters separately for selected types. In other words, this paper attempts to use the notion of type for a sensitivity analysis of regression equations.

Methodological notes

Currently, no generally accepted definition of financial and economic efficiency of agricultural holdings exists. For the purposes of this paper, it has been assumed that financial and economic efficiency of agricultural holdings is the degree of achievement of monetary goals, in terms of equity exposure, total assets under control, production achieved, and generated cash flows, expressed in relative values, namely by indicators. Theoretically, there exist many relations satisfying the above definition. The following have been selected:

1. Return on equity capital (1) (%):

$$\frac{income\ from\ a\ family\ farm - cost\ of\ own\ labour^{a}}{yearly\ average\ of\ equity^{b}} \times 100$$

2. Return on equity capital (2) (%):

$$\frac{profit\ of\ entrepreneur^{a}}{yearly\ average\ of\ equity^{b}} \times 100$$

3. Return on assets (1) (%):

$$\frac{(income\ from\ a\ family\ farm\ +\ interest) - cost\ of\ own\ labour}{yearly\ average\ of\ total\ assets^{c}} \times 100$$

4. Return on assets (2) (%):

$$\frac{profit\ of\ entrepreneur^{a}}{yearly\ average\ of\ total\ assets^{c}} \times 100$$

5. Cash return on equity capital invested (%):

$$\frac{cash\ flows\ (1)}{yearly\ average\ of\ equity} \times 100$$

6. Cash return on assets (%):

$$\frac{cash\ flows\ (1)}{yearly\ average\ of\ total\ assets} \times 100$$

7. Share of gross margin in agricultural production (%):

$$\frac{gross\ margin^{d}}{agricultural\ production^{e}} \times 100$$

Explanatory notes:

[a] The cost of own labour and the profit of entrepreneur were calculated using the method devised by L. Goraj and S. Mańko (2011),

[b] Yearly average of equity = (equity as at the beginning of the year + equity as at the end of the year)/2,

[c] Yearly average of total assets = (total assets as at the beginning of the year + total assets as at the end of the year)/2,

[d] Gross margin = the value of agricultural production minus the direct costs and direct costs of forest production,

[e] Agricultural production = plant production + animal production.

In regression calculations, the interdependence between return on equity capital (1) and return on total assets (2) was not analysed, since these ratios were highly correlated with returns on capital (2) and on assets (1).

Even more that in the case of financial and economic efficiency, the lack of generally accepted relations describing the dependence of agricultural holdings run by natural persons on subsidies is apparent. However, the authors' experiences to date, as well as the studies by Breen et al. (2005) and by German economists (EU-Agrarpolitik nach 2013), demonstrate that this function results in the following set:

1. Subsidy rate (1) (%):

$$\frac{subsidies\ to\ operations + investment\ grants + milk\ subsidy}{income\ of\ a\ family\ farm} \times 100$$

2. Subsidy rate (2) (%):

$$\frac{subsidies\ to\ operations + investment\ grants + milk\ subsidy}{income\ of\ a\ family\ farm - cost\ of\ own\ labour^{a}} \times 100$$

3. Subsidy rate (3) (%):

$$\frac{subsidies\ to\ operations\ +\ investment\ grants\ +\ milk\ subsidy}{profit\ of\ entrepreneur^{a}} \times 100$$

4. Degree of decoupling II payments and subsidies from production (%):

$$\frac{decoupled\ payments +\ LFA\ +\ agri-env.programmes\ +\ investment\ subsidies}{subsidies\ to\ operations\ +\ investment\ grants\ +\ milk\ subsidy} \times 100$$

5. Share of subsidies on operations in total subsidies (%):

$$\frac{subsidies\ on\ operations}{subsidies\ on\ operations\ +\ investment\ grants\ +\ milk\ subsidy} \times 100$$

Explanatory notes:

[a] The costs of own labour and the profit of entrepreneur were calculated using a method devised by L. Goraj and S. Mańko (2010).

The entire analysis is based on data provided by Polish FADN for 2005-2011, reflecting the situation in a balanced panel, consistently comprising the same 5,586 holdings. Thus the methodology developed specifically for the needs of this network was used for distinguishing the types of production (Goraj L. et al. 2012, 2010; Commission Regulation No 1242/2008). Since agricultural holdings classified to the "dairy cows" type and to the "herbivorous animals" type keep many dairy cows, they were combined for the needs of this analysis into one type: "grazing livestock". The following six types have been analysed in total (their numerical markings, as used in Polish FADN, are given in the brackets):

– (1) field crops,
– (2) horticulture,
– (4) permanent crops,
– (5, 6) grazing livestock,
– (7) granivores,
– (8) mixed.

Ratio analysis

Table 1 presents indicators describing the dependencies of the analysed production types on subsidies. It should be noted that in almost all cases the three subsidy rates in 2011 were higher than the average determined for the 2005-2007 three-year period, i.e. immediately after covering the Polish agriculture by the CAP mechanisms. If we exclude horticultural holdings, in 2011 such rates were usually lower compared to the 2008-2010 average. It should be pointed out, however, that the situation of horticultural holdings in 2011 was unusual. In 2011, many of such holdings received compensation from the Agricultural Market Agency to finance their losses caused by the E. coli outbreak. According to FADN

such a support is considered a subsidy. This, however, does not change the fact that after the EU accession horticultural producers have been the least subsidised group among Polish agricultural producers. On the other end of the spectrum, there are holdings specialising in field crops, followed by mixed holdings, which for years have received the highest subsidies.

Throughout the entire analysed seven-year period, the share of subsidies to operations in the total amount of aid received from the budget has been decreasing. This concerned all the types of agricultural production. Generally, the changes have been slight, and they should not significantly affect the functioning of agricultural holdings, their economics and finance.

In 2005-2011, the degree of decoupling subsidies and grants from production has increased in all groups, except for horticultural holdings. This phenomenon should be assessed as positive as it shows that farmers have had to respond to a greater degree to the signals coming from the market. Obviously, agricultural holdings have been also increasingly frequently affected by disruptions (shocks) of national, European and even global nature. This may have led to an increased changeability of major economic categories describing the functioning and achievements of agricultural holdings. This situation doubtless indicates that we should focus on the necessity of constantly improving the risk management in individual holdings and at the sector level. The issue of decoupling subsidies from agricultural production, or to put it more precisely, from the current production decisions, is closely associated with capitalisation of subsidies in the value of land and tangible assets, as well as lease rates. The general rule that applies in this case is quite simple: the higher the degree of decoupling subsidies from production, the higher the capitalisation rate, if all other conditions remain unchanged (ceteris paribus). In practice, i.e., in empirical studies, however, the above rule does not apply automatically or generally.

Capitalisation needs to be paid attention to all the time since it increases the already high rigidity of the market of agricultural land, thus reducing its transfer from less efficient to more efficient holdings. On the other hand, incomplete decoupling of budgetary support from agricultural production justifies the legitimacy of analysing the interdependencies between decoupling and various categories and relations in terms of financial/economic and economic efficiency, including its components, such as technical efficiency and allocation efficiency. This comment is also valid for productivity.

Table 1

Dependence on production subsidies in 2005-2011

Type of agricultural production	Description	M.U.	Years 2005-2007	Years 2008-2010	2011
Field crops (1)	Subsidy rate (1)	%	6.8	29.5	12.9
	Subsidy rate (2)	%	17.0	26.0	24.9
	Subsidy rate (3)	%	32.0	55.7	40.0
	Share of subsidies to operations in total subsidies	%	96.7	95.5	94.3
	Degree of decoupling payments II from production	%	51.9	56.5	64.1
Horticulture (2)	Subsidy rate (1)	%	0.6	2.4	1.2
	Subsidy rate (2)	%	2.2	4.3	5.6
	Subsidy rate (3)	%	4.7	13.3	18.4
	Share of subsidies to operations in total subsidies	%	95.6	83.5	92.0
	Degree of decoupling payments II from production	%	41.0	69.9	29.8
Permanent crops (4)	Subsidy rate (1)	%	1.9	7.6	3.9
	Subsidy rate (2)	%	4.8	13.8	10.0
	Subsidy rate (3)	%	12.7	-58.3	27.3
	Share of subsidies to operations in total subsidies	%	95.1	88.3	80.7
	Degree of decoupling payments II from production	%	57.7	82.9	86.6
Grazing livestock (5;6)	Subsidy rate (1)	%	12.8	19.6	7.4
	Subsidy rate (2)	%	9.0	17.6	15.6
	Subsidy rate (3)	%	22.8	116.4	35.4
	Share of subsidies to operations in total subsidies	%	95.6	90.8	89.3
	Degree of decoupling payments II from production	%	56.6	63.4	69.2
Granivores (7)	Subsidy rate (1)	%	2.5	9.6	4.1
	Subsidy rate (2)	%	9.7	13.3	14.8
	Subsidy rate (3)	%	24.5	33.6	29.3
	Share of subsidies to operations in total subsidies	%	95.7	89.7	88.3
	Degree of decoupling payments II from production	%	54.3	63.8	69.1
Mixed holdings (8)	Subsidy rate (1)	%	4.9	24.0	9.5
	Subsidy rate (2)	%	14.2	24.5	22.6
	Subsidy rate (3)	%	79.5	391.1	66.1
	Share of subsidies to operations in total subsidies	%	97.3	94.5	93.6
	Degree of decoupling payments II from production	%	52.3	58.8	64.8

Source: own compilation.

Table 2

Financial and economic efficiency by types of production in 2005-2011

Type of agricultural production	Description	M.U.	Years 2005-2007	Years 2008-2010	2011
Field crops (1)	Return on equity capital (1)	%	11.9	11.5	17.1
	Return on equity capital (2)	%	8.2	7.4	13.2
	Return on total assets (1)	%	10.4	10.2	14.9
	Return on total assets (2)	%	6.8	6.2	11.1
	Cash return on equity capital invested	%	18.1	19.5	22.3
	Cash return on total assets	%	15.0	16.4	18.8
	Share of gross margin in agricultural production	%	63.9	60.6	65.2
Horticulture (2)	Return on equity capital (1)	%	11.8	9.5	8.6
	Return on equity capital (2)	%	7.6	4.8	4.3
	Return on total assets (1)	%	9.7	8.2	7.5
	Return on total assets (2)	%	5.9	3.8	3.5
	Cash return on equity capital invested	%	20.6	20.9	19.8
	Cash return on total assets	%	15.9	16.5	15.8
	Share of gross margin in agricultural production	%	72.2	71.4	70.6
Permanent crops (4)	Return on equity capital (1)	%	8.2	2.8	8.8
	Return on equity capital (2)	%	4.3	-1.7	4.9
	Return on total assets (1)	%	7.5	2.7	8.2
	Return on total assets (2)	%	3.8	-1.5	4.3
	Cash return on equity capital invested	%	16.0	13.5	18.8
	Cash return on total assets	%	14.1	11.6	16.6
	Share of gross margin in agricultural production	%	84.6	80.6	81.6
Grazing livestock (5;6)	Return on equity capital (1)	%	9.8	6.4	11.9
	Return on equity capital (2)	%	5.7	1.8	7.7
	Return on total assets (1)	%	8.9	60	10.9
	Return on total assets (2)	%	5.1	1.6	6.8
	Cash return on equity capital invested	%	15.3	15.0	17.0
	Cash return on total assets	%	13.4	13.1	15.0
	Share of gross margin in agricultural production	%	65.7	59.0	63.9
Granivores (7)	Return on equity capital (1)	%	9.7	11.0	13.6
	Return on equity capital (2)	%	5.4	6.2	9.2
	Return on total assets (1)	%	8.6	9.7	12.1
	Return on total assets (2)	%	4.6	5.2	7.8
	Cash return on equity capital invested	%	15.4	18.0	18.6
	Cash return on total assets	%	13.1	15.2	15.8
	Share of gross margin in agricultural production	%	41.3	38.8	39.0
Mixed holdings (8)	Return on equity capital (1)	%	6.0	5.2	9.7
	Return on equity capital (2)	%	2.1	0.8	5.6
	Return on total assets (1)	%	5.7	5.0	9.1
	Return on total assets (2)	%	1.9	0.7	5.0
	Cash return on equity capital invested	%	13.0	15.2	16.4
	Cash return on total assets	%	11.9	13.5	14.7
	Share of gross margin in agricultural production	%	56.3	52.4	56.3

Source: own compilation.

Table 2 summarises the analysed indicators of financial and economic efficiency in 2005-2011. It is noticeable that they are highly varied, even though the interdependencies are very logical. It appears that, except for the share of gross margin in the value of agricultural production, all the maximum values of the remaining indicators are found in holdings specialising in field crops, that is the most highly subsidised group. On the other end of the spectrum, there are horticultural holdings, in the case of which the average budgetary support was the lowest. It also needs to be added that in 2011 all the efficiency indicators for horticultural holdings were lower, compared to the average for both earlier three-year sub-periods. As regards the remaining five types, in the analysed seven-year period, the efficiency of almost all of them kept improving. This is generally an optimistic conclusion, proving that progress is possible with a relatively lower level of subsidies. The best example in this context are the achievements of holdings that keep granivores, which are overall less efficient only than farms specialising in field crops, whereas the former must relay much more on generating revenues and income from market transactions than the latter.

Results of multiple regression

The multiple regression models used for our analysis have been constructed in such a way that the key independent variable is always the subsidy rate (1), that is a variable in which the total budgetary support is referred to the income of a family farm. Other kinds of subsidies may have been included when they successfully passed the econometric and statistical testing procedure. Such additional, independent variables were used as dummy variables and included: supplementary payment, investment grants and agri-environmental payments, or as measures: single area payment and total subsidies. As has already been pointed out, return on equity capital (1) and total return on assets (2) were removed from the set of dependent variables, as these indicators are highly correlated with other efficiency indicators. The set of independent control variables included a wide range of generally known technical, production and economic characteristics of the analysed holdings. Besides, horticultural holdings were combined with holdings with permanent crops.

Table 3

Results of multiple regressions for holdings specialising in field crops

Independent variables	Dependent variables														
	Return on equity capital (2)			Total return on assets (1)			Cash return on equity			Total cash return on assets			Share of gross margin in agricultural production		
	regression coefficient	*t-Student test*	*P*	regression coefficient	*t-Student test*	*P*	regression coefficient	*t-Student test*	*P*	regression coefficient	*t-Student test*	*p*	regression coefficient	*t-Student test*	*p*
Subsidy rate (1)	-0.109	-2.780	0.006	-0.086	-2.679	0.008	0.011	0.256	0.798	-0.013	-0.361	0.718	-0.187	-5.922	0.000
Supplementary payment	6.081	4.459	0.000	5.255	4.670	0.000									
Investment grants							-11.895	-5.874	0.000	-12.127	-7.125	0.000			
Single area payment							1.000E-04	6.067	0.000	1.000E-04	5.718	0.000			
Total subsidies	9.000E-05	11.780	0.000	7.000E-05	12.085	0.000									
Economic size							0.000E+00	3.493	0.001	0.000E+0	3.479	0.001			
Equity	-1.000E-05	-6.407	0.000	0.000E+00	-5.827	0.000	0.000E+00	-8.739	0.000	0.000E+00	-7.410	0.000			
Cash flows (2)							0.000E+00	-4.343	0.000						
Soil bonitation indicator	7.126	5.304	0.000	4.977	4.478	0.000	4.841	3.164	0.002						
Investment rate										0.005	4.676	0.000			
Share of leased land	0.097	5.865	0.000	0.083	6.048	0.000	0.072	3.776	0.000	0.074	4.530	0.000			
Current assets to fixed assets ratio	10.792	8.588	0.000	8.616	8.348	0.000									
Equity to assets ratio	-0.213	-6.689	0.000				-0.207	-5.480	0.000	0.177	5.108	0.000			
Free term	9.846	2.880	0.004	-3.320	-1.989	0.047	35.101	8.619	0.000	1.733	0.516	0.606	67.556	103.432	0.000
Number of observations	925			925			925			925			925		
Determination coefficient R^2	0.377			0.336			0.264			0.202			0.036		

Source: own compilation.

Table 4

Results of multiple regressions for horticultural holdings and holdings with permanent crops

Independent variables	Dependent variables														
	Return on equity capital (2)			Total return on assets (1)			Cash return on equity			Total cash return on assets			Share of gross margin in agricultural production		
	regression coefficient	*t-Student test*	*p*	regression coefficient	*t-Student test*	*p*	regression coefficient	*t-Student test*	*P*	regression coefficient	*t-Student test*	*p*	regression coefficient	*t-Student test*	*p*
Subsidy rate (1)	-0.394	-4.097	0.000	-0.374	-4.284	0.000	-0.259	-2.989	0.003	-0.233	-2.905	0.004	-0.227		0.001
Single area payment	0.001	4.306	0.000	0.001	4.821	0.000									
Economic size							2.000E-05	3.553	0.000				-2.000E-05	-6.016	0.000
Equity							-1.000E-05	-7.582	0.000	-1.000E-05	-5.777	0.000			
Cash flows (2)							-7.000E-05	-5.184	0.000	-5.000E-05	-4.032	0.000			
Investment rate							-0.017	-4.753	0.000	-0.011	-3.457	0.001			
Current assets to fixed assets ratio	17.910	4.196	0.000	13.069	3.403	0.001									
Equity to assets ratio	-0.281	-4.156	0.000				-0.331	-4.766	0.000						
Free term	22.279	3.559	0.000	0.760	0.541	0.589	58.809	8.727	0.000	26.252	19.889	0.000	82.005	81.582	0.000
Number of observations	350			350			350			350			350		
Determination coefficient R^2	0.155			0.110			0.230			0.112			0.111		

Source: own compilation.

Table 5

Results of multiple regressions for holdings with grazing livestock

Independent variables	Dependent variables														
	Return on equity capital (2)			Total return on assets (1)			Cash return on equity			Total cash return on assets			Share of gross margin in agricultural production		
	regression coefficient	*t-Student test*	*P*	regression coefficient	*t-Student test*	*P*	regression coefficient	*t-Student test*	*P*	regression coefficient	*t-Student test*	*p*	regression coefficient	*t-Student test*	*p*
Subsidy rate (1)	-0.059	-5.850	0.000	-0.049	-5.361	0.000	0.017	2.139	0.033	0.015	2.099	0.036	-0.047	-4.119	0.000
Supplementary payment	7.843	9.577	0.000	7.011	9.390	0.000	5.213	7.728	0.000	4.558	7.376	0.000			
Agri--environmental payment													2.660	3.254	0.001
Investment grants							-5.327	-5.790	0.000	-4.485	-5.321	0.000			
Single area payment	-3.000E-04	-7.120	0.000	-2.700E-04	-7.851	0.000									
Total subsidies	2.000E-04	9.015	0.000	1.600E-04	9.582	0.000									
Economic size	0.000E+00	12.567	0.000	3.000E-05	10.655	0.000	4.000E-05	13.588	0.000	4.000E-05	12.901	0.000			
Equity	0.000E+00	-7.070	0.000	0.000E+00	-5.756	0.000	-1.000E-05	-15.059	0.000	-1.000E-05	-14.051	0.000			
Cash flows (2)							-4.000E-05	-10.585	0.000	-3.000E-05	-9.450	0.000			
Investment rate	0.004	5.199	0.000	0.003	4.502	0.000									
Current assets to fixed assets ratio	14.840	8.694	0.000	13.557	8.747	0.000									
Equity to assets ratio		-					-0.101	-4.412	0.000	0.139	6.666	0.000			
Non-agricultural income				-1.678	-3.422	0.001									
Free term	-10.808	-11.423	0.000	-4.899	-5.478	0.000	21.205	9.270	0.000	-2.052	-0.980	0.327	64.234	157.861	0.000
Number of observations	1502			1502			1502			1502			1502		
Determination coefficient R^2	0.343			0.318			0.295			0.221			0.012		

Source: own compilation.

Table 6

Results of multiple regressions for holdings with granivores

Independent variables	Dependent variables														
	Return on equity capital (2)			Total return on assets (1)			Cash return on equity			Total cash return on assets			Share of gross margin in agricultural production		
	regression coefficient	*t-Student test*	*P*	regression coefficient	*t-Student test*	*P*	regression coefficient	*t-Student test*	*P*	regression coefficient	*t-Student test*	*p*	regression coefficient	*t-Student test*	*p*
Subsidy rate (1)	-0.879	-8.037	0.000	-0.779	-8.516	0.000	-0.489	-4.176	0.000	-0.386	-3.947	0.000	0.002	0.023	0.982
Supplementary payment	4.682	3.269	0.001	4.508	3.710	0.000									
Investment grants							-11.008	-5.936		-10.413	-6.824	0.000			
Single area payment							1.000E-04	4.549		1.000E-04	4.293	0.000			
Total subsidies	1.100E-04	8.415	0.000	9.000E-05	8.555	0.000									
Economic size	1.000E-05	4.483	0.000	1.000E-05	4.138	0.000	0.000E+00	6.287	0.000	0.000E+00	6.061	0.000	0.000E+00	-4.232	0.000
Equity	-1.000E-05	-5.835	0.000	-1.000E-05	-5.150	0.000	0.000E+00	-8.940	0.000	0.000E+00	-7.317	0.000			
Cash flows (2)							0.000E+00	-4.306	0.000		-				
Current assets to fixed assets ratio	17.678	7.692	0.000	15.345	8.062	0.000									
Equity to assets ratio	-0.188	-5.200	0.000				-0.221	-5.643	0.000						
Free term	16.887	4.910	0.000	3.340	2.676	0.008	43.338	11.729	0.000	19.507	21.6960	0.000	43.565	50.169	0.000
Number of observations	838			838			838			838			838		
Determination coefficient R^2	0.286			0.245			0.210			0.130			0.020		

Source: own compilation.

Table 7

Results of multiple regressions for mixed holdings

Independent variables	Dependent variables														
	Return on equity capital (2)			Total return on assets (1)			Cash return on equity			Total cash return on assets			Share of gross margin in agricultural production		
	regression coefficient	*t-Student test*	*P*	regression coefficient	*t-Student test*	*P*	regression coefficient	*t-Student test*	*P*	regression coefficient	*t-Student test*	*p*	regression coefficient	*t-Student test*	*p*
Subsidy rate (1)	-0.178	-6.712	0.000	-0.124	-4.660	0.000	-0.029	-1.066	0.287	-0.018	-0.723	0.470	-0.192	-5.646	0.000
Supplementary payment	5.530	7.410	0.000	5.147	7.355	0.000	4.082	5.644	0.000	3.411	5.234	0.000			
Agri-environ-mentalpayment							1.728	3.330	0.001	1.649	3.530	0.000			
Investment grants							-14,291	-11.763	0.000	-13.979	-11.438	0.000			
Single area payment				-1.000E-04	-3.768	0.000	1.000E-04	4.554	0.000	1.000E-04	3.807	0.000			
Total subsidies	1.100E-04	19.059	0.000	1.200E-04	9.951	0.000							4.000E-05	4.203	0.000
Economic size				1.000E-05	3.838	0.000	0.000E+00	8.012	0.000	0.000E+00	8.704	0.000			
Equity							0.000E+00	-12.856	0.000	0.000E+00	-12.024	0.000	-2.000E-05	5.288	0.000
Cash flows (2)	2.000E-05	4.503	0.000	2.000-E-05	4.347	0.000	0.000E+00	-6.832	0.000	0.000E+00	-4.612	0.000			
Soil bonitation indicator	4.933	7.546	0.000	3.794	6.281	0.000	3.659	5.770	0.000	3.383	5.926	0.000			
Investment rate	0.004	5.000	0.000	0.005	6.581	0.000				0.003	3.822	0.000			
Share of leased land	0.054	5.167	0.000	0.043	4.403	0.000									
Current assets to fixed assets ratio	10.379	11.012	0.000	9.077	10.428	0.000	5.418	5.997	0.000	5.264	6.474	0.000	4.165	3.435	0.001
Equity to total assets ratio	-0.175	-6.723	0.000				-0.24	-8.355	0.000	0.092	4.007	0.000			
Non agricultural income	-1.759	-3.557	0.000	-1.864	-4.043	0.000							2.302	3.539	0.000
Free term	3.082	1.171	0.242	-8.828	-9.593	0.000	27.450	10.931	0.000	-1.633	-0.693	0.488	50.052	45.639	0.000
Number of observations	1971			1971			1971			1971			1971		
Determination coefficient R^2	0.370			0.342			0.292			0.239			0.076		

Source: own compilation.

The final estimated multiple regression models have been presented in Tables 3-7. They can be summarised as follows:

1. Subsidy rate, with very few exceptions (cash return on equity capital in holdings specialising in field crops; both cash returns in the "grazing livestock" type; share of gross margin in the value of agricultural production in holdings specialising in pigs and poultry rearing), had a negative impact on efficiency. Only in three cases interdependencies were observed statistically insignificant.

2. Among the three dummy variables describing dedicated budgetary support, (i.e. supplementary payments, investment grants and agri-environmental payments), the first one was used most frequently in our regression models. Except for holdings specialising in field crops, where supplementary payments had a statistically significant negative effect on the total return on assets, in all other types the impact of supplementary payments on efficiency was positive, in all cases at a statistically acceptable significance level. On the other hand, the negative interdependencies between investment grants and both cash returns came as a surprise, especially since they were statistically significant. Probably it would be necessary to analyse separately the relations that would have appeared if such subsidies had been treated as time-delayed variables. It should be added that support for investments was not at all included in the estimation models for the population of horticulture and permanent crops. Agri-environmental payments, on the other hand, had a positive impact on cash returns only in holdings rearing granivores as well as on the share of gross margin in the value of agricultural production in holdings rearing ruminants. This should be associated with the improved liquidity, which subsequently translated into higher efficiency. The same mechanism was observed for supplementary payments.

3. The amounts of support received as a single area payment and the sum of all kinds of support had no impact on the efficiency of population created by combining the "horticulture" and "permanent crops" types. In the remaining types, however, the interdependencies were not unidirectional. This applies in particular to SAPs, which improved cash returns but at the same time reduced both kinds of returns (ROC and ROA). The "total subsidies" variable had in all cases a positive impact on ROC and ROA, always statistically significant, but had a negative impact on the share of gross margin in the value of agricultural production, which may be regarded as a kind of operational efficiency, i.e. achieved in purely market transactions. Obviously, the two above-mentioned independent variables may also be treated as characteristics of the scale of activity in the analysed holdings. The positive impact of these variables on some efficiency indicators is then easily understood, i.a., as a concretisation of the rule of the gradual decrease of fixed costs as a consequence of the increasing scale of activity.

4. The impact that the "economic value" independent variable had on efficiency was quite consistent with the impact mechanisms of "SAP" and "total subsidies" variables. The difference is that the "economic value" occurred in all

production types, improving in a statistically significant way the profitability and cash returns, but at the same time reducing the share of gross margin in the value of agricultural production.

5. The impact of independent variables "equity" and "equity to total assets ratio" is also interesting. The first one increased and also decreased the profitability and cash returns. Thus it should be concluded that the mechanism/channels defined as wealth effect are ambiguous, as well as the mechanisms/channels of mitigating risk by this source of financing. Surely, such ambiguities resulted in a situation where the increasing level of self-financing of the activity led most frequently to a drop in profitability and in cash return on equity, but at the same time to an increase in cash return on assets. Such interdependencies between the analysed variables may also suggest that the decreasing share of outside capital may weaken its positive impact on efficiency, which would be in line with the consensus dominating in the theory of agricultural finance (Barry P. et al. 2012; Kay R.D. et al. 2012; Muβhoff O. et al. 2011; Olson D.K. 2011).

6. In all five analysed production types, the current assets to fixed assets ratio occurred as an independent variable. This ratio is an opposite of the fixed assets to current assets ratio. It should be said that the above-mentioned variable highly improved profitability, and in mixed holdings it also improved the remaining three efficiency indicators. This suggests that it is of crucial importance to find the optimal proportions between fixed and current assets, as this burdens the holdings with fixed costs, thus affecting their flexibility and security. Such impacts are presented in an aggregate manner as the so-called operating leverage. In this context, it should be added that in holdings specialising in field crops as well as in mixed holdings an increase in the share of leased land also improved the profitability and cash returns. This could be a proof that leases – like outside capital – embed in them some effective pro-efficiency mechanisms. For the sake of completeness, it is worth mentioning that for the two above-mentioned types, also the growing soil quality indicator had a positive impact on profitability, on cash returns and on operating efficiency, which seems rather apparent.

7. Cash flows (2), i.e. operating flows (1) increased by proceeds from the sale of fixed assets and liabilities as at the end of year, and on the other hand reduced by investment outlays and liabilities as at the beginning of year, appeared as independent variables in all five production types. Such variables affected first of all the cash returns; their impact was highly varied and always significant statistically. Also the impact of investment rate varied, however in most cases the impact of this variable on efficiency was positive. For more firm conclusions, it would probably be necessary to use a technique of delaying this variable and/or to use more advanced concepts (for example, the accelerator-multiplier mechanism or multi-equation econometric models). For the sake of completeness, it should also be added that in holdings rearing granivores and in mixed holdings, a dummy independent variable occurred, namely "non-agricultural

income". This variable reduced returns but improved operating efficiency in mixed holdings only. Since this variable was rarely used in final regression models, it is difficult to formulate any unequivocal opinions what is the importance of diversifying the sources of income for efficiency. This problem surely deserves a separate analysis, considering the importance given in Polish RDP to the issue of diversifying the sources of agricultural income.

8. The multiple determination coefficients (R2) for the profitability indicators and cash returns may be considered as acceptable for the empirical research conducted if we refer to relevant econometric literature (Carter Hill R. et al. 2012; *Ekonometria*... 2009; Greene H.W. 2012). Unfortunately, the same cannot be said about the share of gross margin in the value of agricultural production indicator. Probably any different approach is required for establishing the determinants of operational efficiency. It seems that the usefulness of tools applied to the research on market, competition and economics of the sector should be tested. It would be useful to consider such independent variables as for example price scissors indices, more disaggregated price indices, the macroeconomic situation, as well as the nature of economic and agricultural policies.

Summary

A traditional ratio analysis has revealed that in the set of production types there exist logical, even intuitive, interdependencies between subsidy rates and financial and economic efficiency. To put it short, higher subsidy rates have usually translated into better efficiency indicators. However, the multiple regression calculations have revealed that the key subsidy rate – the relation of the sum of support to income from a family farm – most frequently reduced such efficiency. This shows that, if one does not make any major mistakes, the production type may be introduced as a dummy variable to multiple regression equations to examine the results of the changing level of subsidies.

In econometric modelling with the use of multiple regression technique, dummy variables describing dedicated subsidies (LFA and agri-environmental payments, investment grants) may also be useful. However, one should not limit the analysis to such variables. This is true in particular for investment grants and compensation for internalisation of external effects and for delivery of public goods. In such cases, it is necessary to make use of tools specifically designed for the purpose (adjustment techniques, difference of differences, instrumental variables, discontinuity regression, random instruments of control and multi-equation econometric models). Also using absolute amounts of subsidies as independent variables requires further studies.

Technical/production and economic characteristics of agricultural holdings may contribute to clarifying the changeability of various efficiency categories. The set used for our analysis and presented in this article certainly needs to be verified and supplemented. It is also highly desirable to give this set more solid theoretical grounds so as to be able to precede the regression calculations proper with a stage of forecasting the impact on independent variables on efficiency. It is also a considerable challenge to improve explanations of the changeability of operational efficiency.

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