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## THE IMPACT OF FIXED ASSETS ON POLISH AGRICULTURAL PRODUCTION

### VPLYV DLHODOBÉHO HMOTNÉHO MAJETKU NA POĽSKÚ POĽNOHOSPODÁRSKU PRODUKCIU

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The power function was used to show the dependence of gross, final and sold output on the gross value of total fixed assets and on the ratios of this value to the productivity of these three production categories. Further elaboration included the characteristics of variable features. The system of independent variables employed in the study allowed for the estimation of both extensive and intensive utilisation of fixed assets in Polish agriculture from 2002–2005. The study showed the diminishing impact of the productivity of fixed assets and the decreasing productive efficiency of Polish agriculture from 2002–2005. This situation was caused by the relative stability in the generic structure of fixed assets and by a slow average annual rate of increase in new fixed assets (8.74 %).

**Key words:** production, productivity, impact, extensive and intensive utilisation of fixed assets

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This paper examines the potential of fixed assets on Polish agriculture during the period 2002–2005. Poland's accession to the EU (Lissitsa and Balmann, 2003) in May 2004 induced several changes in Polish agricultural development. This study reveals the extent of these changes on the utilisation of fixed assets in agricultural production.

The potential of fixed assets includes information on their quantitative and qualitative impact as well as their utilisation. This makes it possible to use a conventional system of interpretation to explain changes in the quantitative and qualitative impact of fixed assets in determining the comparative levels of gross, final and sold output in Polish agriculture from 2002–2005.

## Material and methods

The power function was the basic method of deriving the functional model<sup>1/</sup> showing the dependence of gross, final

<sup>1/</sup> Verification of the lowest squares assumptions method was conducted basing on the rests being estimations of random components in econometric model. The survey of random deviations attributes was conducted using tests. Random surveying-test of numbers series. Normality survey-test of Shapiro-Wilk. Auto-correlation survey-test of Durbin-Watson. Survey of homoscedasticity-test Goldfeld-Quandt.

**Table 1** Statistical characteristics of the variables under study in Polish agriculture from 2002–2005 (2002 prices)

Symbol (1)	Units (2)	Arithmetic mean (3)	Range (4)		Variation coefficient in % (5)
			min	max	
2002					
Y1	zl	3,481,625,000	1,106,302,135	8,574,057,420	61.57
Y2	zl	2,531,062,500	802,160,910	6,406,243,717	64.19
Y3	zl	2,171,206,250	704,927,270	5,440,659,976	63.90
X1	zl	6,904,968,750	2,293,274,445	14,459,864,729	47.46
X2	zl/zl	0.485	0.364	0.648	17.57
X3	zl/zl	0.351	0.241	0.476	19.53
X4	zl/zl	0.301	0.200	0.404	19.68
2003					
Y1	zl	3,453,772,000	938,090,582	8,300,424,467	62.08
Y2	zl	2,594,339,063	719,448,152	6,412,939,814	64.75
Y3	zl	2,284,108,975	680,013,472	5,884,011,509	64.95
X1	zl	6,822,109,125	2,274,689,794	14,423,867,848	48.01
X2	zl/zl	0.484	0.365	0.621	17.18
X3	zl/zl	0.362	0.251	0.480	18.52
X4	zl/zl	0.319	0.204	0.440	18.98
2004					
Y1	zl	3,712,804,919	1,316,605,280	9,122,675,512	60.09
Y2	zl	2,801,886,188	1,038,485,707	7,043,273,821	62.77
Y3	zl	2,359,362,366	833,624,865	5,988,260,625	63.86
X1	zl	6,787,998,228	2,295,543,011	14,332,925,458	47.84
X2	zl/zl	0.531	0.395	0.686	15.92
X3	zl/zl	0.400	0.260	0.529	18.08
X4	zl/zl	0.335	0.198	0.450	19.67
2005					
Y1	zl	3,556,867,094	1,264,788,878	10,009,618,667	66.67
Y2	zl	2,681,459,133	942,409,907	7,846,616,135	71.37
Y3	zl	2,260,386,219	810,895,724	6,735,017,060	71.59
X1	zl	6,787,998,579	2,213,233,586	15,832,104,345	53.41
X2	zl/zl	0.511	0.374	0.770	19.46
X3	zl/zl	0.380	0.250	0.604	22.01
X4	zl/zl	0.323	0.190	0.518	24.79

Y1 – value of gross production, Y2 – value of final production, Y3 – value of sold production, X1 – gross value of total fixed assets, X2 – ratio of the productivity of total fixed assets to gross production, X3 – ratio of the productivity of total fixed assets to final production, X4 – ratio of the productivity of total fixed assets to sold production

Y1 – hodnota hrubej produkcie, Y2 – hodnota finálnej produkcie, Y3 – hodnota predanej produkcie, X1 – hrubá hodnota celkového dlhodobého hmotného majetku – CDHM, X2 – pomer produktivity CDHM k hrubej produkcii, X3 – pomer produktivity CDHM k finálnej produkcii, X4 – pomer produktivity CDHM k predanej produkcii  
Source: Central Statistical Office in Warsaw. The calculations are the researchers' own

Zdroj: Centrálly štatistický úrad vo Varšave, autorove vlastné výpočty

**Tabulka 1** Štatistické charakteristiky premenných skúmaných v poľskom poľnohospodárstve v rokoch 2002–2005

(1) symbol, (2) jednotky, (3) aritmetický priemer, (4) rozsah, (5) variačný koeficient

and sold output on the gross value of fixed assets and the ratios of this value to the productivity of these three production categories in agriculture during the period 2002–2005. Some descriptive statistical measures were also used to describe variable features as required.

Empirical data were taken from the statistical yearbooks of the Central Statistical Office and the regional Statistical Yearbooks of the Central Statistical Office for the period under

investigation. These latter include numerical data from the Central Bureau of the Polish Hunting Union in Warsaw.<sup>2/</sup> Data are expressed in 2002 prices.

<sup>2/</sup> Percentage share of fixed assets gross values in hunting within 1995–2003 hesitated from 0.01–0.04 %. Annex to the letter dated on 8. 10. 2005 from The Central Bureau of Polish Hunting Union in Warsaw. It shows that their share in fixed assets gross value totally for agriculture had no impact on shaping surveyed economic occurrences.

**Table 2** The dependence of gross, final and sold production (Y1, Y2 and Y3) on the gross value of total fixed assets in Polish agriculture from 2002–2005

Year (1)	Regression coefficient (2)		Standard error (3)		Test t (4)		R <sup>2</sup>
	A	X1	A	X1	A	X1	
Gross Production (5)							
2002	0.0146	1.1548	2.0799	0.0922	-2.03	12.53	0.92
2003	0.0049	1.2034	1.9102	0.0845	-2.78	14.21	0.94
2004	0.0179	1.1056	2.0231	0.0897	-2.05	12.32	0.92
2005	0.0282	1.0569	2.0254	0.0979	-2.09	10.79	0.90
Final Production (6)							
2002	0.0080	1.1692	2.3386	0.1037	-2.06	11.25	0.90
2003	0.0029	1.2129	2.0755	0.0920	-2.81	13.18	0.93
2004	0.0144	1.1023	2.3880	0.1059	-2.04	10.41	0.89
2005	0.0293	1.0907	2.4793	0.1101	-2.01	9.99	0.88
Sold Production (7)							
2002	0.0065	1.1691	2.4158	0.1071	-2.08	10.92	0.90
2003	0.0037	1.1968	2.2347	0.0991	-2.50	12.08	0.91
2004	0.0079	1.1341	2.4222	0.1163	-2.06	9.75	0.87
2005	0.0103	1.0629	2.2673	0.1317	-2.48	8.07	0.83

significance level &lt; 0.05; a – absolute value (without logarithm; other determinations as per Table 1

úroveň signifikancie &lt; 0,05; a – absolútna hodnota (bez algoritmu); ostatné ako v Tabuľke 1

Source: arithmetic calculations

Zdroj: aritmetické výpočty

**Tabuľka 2** Závislosť hrubej, finálnej a predanej produkcie (Y1, Y2, Y3) od hrubej hodnoty celkového dlhodobého hmotného majetku v poľskom poľnohospodárstve v rokoch 2002–2005

(1) rok, (2) regresný koeficient, (3) štandardná odchýlka, (4) T test, (5) hrubá produkcia, (6) finálna produkcia, (7) predaná produkcia

The examined variables are characterised by arithmetic mean, range and variation coefficient. These are presented in Table 1.

Table 1 shows that despite the decrease in the range and average value of variables related to sold production, its variability has been increasing in recent years. The growth of dispersion within variables was not high enough to alter their role significantly during the period under investigation. Material differences in dispersion were only observed between quantitative variables and quantitative variables with qualitative features.

### Research issues

The study attempted to show how changes in the quantitative and qualitative impact of total fixed assets determined the variability in gross, final and sold production in Polish agriculture from 2002–2005. The study simultaneously attempted to identify that portion of production obtained through the quantitative (extensive) and qualitative (intensive) utilisation of fixed assets in agriculture. Later synthesis of these research issues made it possible to assess the use of fixed assets in agriculture and indicated the directions in which they are developing. The results are presented more accurately in the Conclusions section. The conventional system of interpreting the role of fixed assets in agriculture was the basis on which these research goals were established.

### Presentation

Table 2 illustrates the functional dependence of gross, final and sold production on the gross value of total fixed assets.

The data from Table 2 show that the gross value of total fixed assets explains 83–94 % of the variation in the production categories under investigation. The significance level of

0.00–0.05 was very high. On the other hand the standard errors in the regression coefficients were less than 50 % of their absolute values and the test t values exceeded their critical levels. Fixed assets regression coefficients increased for each of the production categories under investigation during 2002 and 2003 but decreased during 2004 and 2005. However, gross, final and sold production all increased more rapidly than fixed assets between 2002 and 2005. The absolute values (a) of overall production efficiency exhibited a slight increase (Vizvari and Bacsí, 2002). This implies that the application of the gross value of fixed assets was relatively low in Polish agriculture over the period under study (Zwolak, 2001).

Table 3 illustrates the dependence of gross, final and sold production on the overall productivity of fixed assets for each of these three production categories.

The data from Table 3 show that the degree to which the variation in the examined variables could be explained was a relatively low 0.00–0.05. The Standard errors in the regression coefficients were less than 50 % of their absolute values and the test t values exceeded their critical levels. Fixed assets productivity regression coefficients increased for each of the production categories under investigation during 2002 and 2003 but decreased in 2004 and 2005 (Oehmke, 2004). This mirrors the changes in the fixed assets regression coefficients between 2002–2005 (refer Table 2). Comparing the fixed assets productivity regression coefficients reveals that both fixed assets and the production categories under investigation were increasing more rapidly than fixed assets productivity from 2002–2005. The changes in the fixed assets productivity regression coefficients correlated to the changes in production efficiency for the period under investigation (Carlaw and Lipsky, 2003). This decreasing elasticity in the production categories under investigation relative to the productivity of fixed assets

**Table 3** Dependence of gross, final and sold production (Y1, Y2 and Y3) on overall productivity of fixed assets for each production category in Polish agriculture from 2002–2005

Year (1)	Regression coefficient (2)		Standard error (3)		Test t (4)		R <sup>2</sup>
	A	X2, X3 and X4	A	X2, X3 and X4	A	X2, X3 and X4	
Gross Production (5)							
2002	13,916,823,782	2.0828	0.4876	0.6449	47.90	3.23	0.43
2003	17,830,817,591	2.4339	0.4526	0.5973	52.15	4.07	0.54
2004	10,665,226,947	1.8524	0.4806	0.7243	48.04	2.56	0.30
2005	8,019,361,643	1.4138	0.5064	0.7124	45.04	1.98	0.30
Final Production (6)							
2002	16,969,851,338	1.9393	0.6283	0.5814	37.49	3.33	0.44
2003	23,627,660,866	2.2988	0.5884	0.5614	40.59	4.09	0.54
2004	10,883,943,368	1.6108	0.6011	0.6322	36.44	2.55	0.32
2005	9,984,547,778	1.5101	0.6241	0.6189	36.89	2.44	0.30
Sold Production (7)							
2002	18,621,712,832	1.8941	0.6989	0.5662	33.85	3.35	0.44
2003	22,552,549,684	2.1166	0.6605	0.5624	36.09	3.76	0.51
2004	12,646,601,421	1.6465	0.6350	0.5609	36.63	2.93	0.38
2005	8106845399	1.2549	0.6317	0.5335	36.12	2.35	0.30

significance level &lt; 0.05; a – absolute value (without logarithm; other determinations as per Table 1

úroveň signifikancie &lt; 0,05; a – absolútna hodnota (bez algoritmu); ostatné ako v Tabuľke 1

Source: arithmetic calculations

Zdroj: aritmetické výpočty

**Tabuľka 3** Závislosť hrubej, finálnej a predanej produkcie (Y1, Y2, Y3) od celkovej produktivity celkového dlhodobého hmotného majetku pre každú kategóriu produkcie v poľskom poľnohospodárstve v rokoch 2002–2005

(1) rok, (2) regresný koeficient, (3) štandardná odchýlka, (4) t test, (5) hrubá produkcia, (6) finálna produkcia, (7) predaná produkcia

**Table 4** The impact of the gross value of total fixed assets and the ratios of their productivity to gross, final and sold production on the relative growth in production for these three categories in Polish agriculture in the years 2002–2005 in %

Years (1)	Gross (2)		Final (3)		Sold (3)	
	X1	X2	X1	X3	X1	X4
2002	35.67	64.33	37.61	62.39	38.17	61.83
2003	33.08	66.92	34.54	65.46	36.12	63.88
2004	37.38	62.62	40.63	59.37	40.79	59.21
2005	42.78	57.22	41.94	58.06	45.86	54.14

Source: derived from Tables 2 and 3. The calculations are the researchers' own

Zdroj: odvodené z tabuliek 2 a 3. Výpočty autora

**Tabuľka 4** Dopad hrubej hodnoty dlhodobého hmotného majetku a pomeru jeho produktivity k hrubej, finálnej a predanej produkcii na relatívny rast produkcie pre tieto tri kategórie v poľskom poľnohospodárstve v rokoch 2002–2005 v %

(1) hrubá, (2) finálna, (3) predaná

explains the decrease in production efficiency independently of the production category for the period under investigation. Table 4 illustrates the synthesis of the research.

The data from Table 4 show that refining gross production in the direction of sold production brought about a growth in the quantitative share (extensive) of fixed assets utilised in agriculture. Similar types of changes took place during the period under investigation. The extensive utilisation of fixed assets was increasing while their intensive utilisation was decreasing. The relatively stable structure of fixed assets can explain this<sup>3/</sup> as their gross value decreased by only about 1.69 % between 2002 and 2004 and remained constant in 2004 and 2005 (2002 prices) (Zwolak, 2005). But their amortisation between 2002 and 2005 rose 2.1 percentage points while the

average annual rate of increase in new fixed assets was 8.74 %.<sup>4/</sup> This is three times lower than “normal” in agriculture. This inevitably led to a loss of both features and functions in fixed assets which in turn brought about a decrease in their intensive utilisation in Polish agriculture.

### Conclusions

The foregoing enables the following conclusions to be drawn.

1. The gross value of total fixed assets explained 83–94 % of the variation in gross, final and sold production in Polish agriculture from 2002–2005. But the overall productivity of fixed assets only explained 30–54 % of the variation in these three categories of production. This was reflected in

<sup>3/</sup> Fixed assets structure in 2002, 2003, 2004 and 2005 amounted like follows; farm buildings 61%, machines technical equipment and tools 13%, transport means 12% and other fixed assets 14%.

<sup>4/</sup> Regarding prices from 2002 one counted the share of new fixed assets values in total fixed assets in surveyed years, and next the dynamics towards previous year and estimated their average annual growth rate. Source; Statistical Yearbook of Central Statistical Office-respective years.



the greater dispersion within the gross values of fixed assets than their productivity in agriculture for the period under investigation.

2. Decreases in the impact of fixed assets productivity were found to correspond with decreasing productive efficiency in Polish agriculture from 2002–2005. This can be explained by the stability in the state and generic structure of fixed assets in 2004 and 2005. These were partially replaced by new fixed assets. The rate of increase in new fixed assets within this stable situation was three times lower than "normal" (8.74 %).
3. Taking 50 % as a basis for elementary intensive and extensive utilisation of fixed assets, it has to be said that the utilisation of intensive fixed assets was only about 10 percentage points higher and was decreasing over time. This was a result of the inability to intensively engage fixed assets in Polish agricultural production. This makes the need to accelerate the renewal of fixed assets in Polish agriculture all the more urgent.

### Súhrn

Na preukázanie závislosti hrubej, finálnej a predanej produkcie od hrubej hodnoty celkového dlhodobého hmotného majetku a vzťahov tejto hodnoty k produktivite týchto troch výrobných kategórií bola použitá mocninová funkcia. Ďalej boli podrobne spracované charakteristiky vlastností premenných. Systém nezávislých premenných použitých v práci umožnil odhad aj extenzívneho aj intenzívneho využitia dlhodobého hmotného majetku v poľskom poľnohospodárstve v období 2002–2005. Táto situácia bola zapríčinená relatívnou stabilitou generickej štruktúry dlhodobého hmotného majetku a pomalou ročnou mierou rastu nového dlhodobého majetku (8,74 %).

**Kľúčové slová:** produkcia, produktivita, dopad, extenzívne a intenzívne využitie dlhodobého hmotného majetku

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