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THE PROCESSES OF REPRODUCTION OF ASSETS AND THEIR SELECTED DETERMINANTS IN FARMS ENGAGED IN AGRICULTURAL ACCOUNTANCY (FADN) IN POLAND

Aleksander Grzelak✉

Uniwersytet Ekonomiczny w Poznaniu

Abstract. The main aim of this article is to identify the dynamics of the processes of reproduction of assets (fixed assets excluding land) and the importance of determinants influencing this processes in agricultural holdings in Poland engaged in agricultural accountancy of the FADN. Recognized in the study is the domination of the processes of narrow reproduction of fixed assets in the examined group of farms. In terms of economic recovery, there has been an improvement in the range of the reproduction of assets during the downturn of the dominance of narrow reproduction. The impact of resource factors on the processes of reproduction are more clear in the case of exclusion from surveys farms in which the processes of reproduction do not indicate opportunities for their further development (reproduction indicator below 0.5). It may mean that in the other units, use of resources better served the agricultural purposes of and they were effectively used.

Keywords: business outlook, agricultural holding, reproduction of fixed assets

INTRODUCTION

One of the conditions for the development of farms is the reproduction of assets which means renewing fixed assets (other than land) with investments made during repeated production cycles. In an environment conducive to progress, the flow of new investments usually involves quality improvements in the manufacturing facilities, and therefore even simple reproduction generally leads to an increase in resource productivity.

Asset reproduction is an important issue from the perspective of the farms' development outlooks. Also, that topic is not well enough understood, especially as regards the determinants for the relevant processes. Therefore, the main purpose of this paper is to explore the dynamics of asset reproduction processes (in respect to fixed assets other than land) and to discover the importance of selected determinants for these processes in Polish farms who hold accounts for FADN purposes.

RESEARCH METHODOLOGY

This paper is based on individual results of farms holding accounts in accordance with FADN requirements. Note that this is microeconomic data for an average farm[1] of the group under consideration. It should be emphasized that the group of farms covered by this study usually demonstrate better economic and production performance compared to average levels in the total

[1] Based on arithmetic means from a specific group of farms covered by this study.

✉dr hab. Aleksander Grzelak, prof. nadzw. UEP, Katedra Makroekonomii i Gospodarki Żywnościowej, Uniwersytet Ekonomiczny w Poznaniu, al. Niepodległości 10, 61-875 Poznań, Poland, e-mail: agrzelak@interia.pl

population of Polish farms and to average results reported by farms covered by the FADN[2].

The group of farms under consideration was reduced due to existence of outliers and atypical observations[3]. The total population of farms considered was at an average level of 11,600 (from 10,500 farms in 2004 to 12,500 in 2005). The reproduction processes were analyzed with the reproduction indicator defined as gross investments (other than land purchase) in relation to depreciation, and with the gross investments amount (other than land purchase). In the second case, a simplistic assumption was made that the investment value could be the measure of the scale of reproduction processes. This is also due to the fact that fixed assets are reproduced through investments. Also, the regression analyses used mean values of logarithmic data of single farms from the group under consideration, which implies the use of non-negative data[4]. The time scope of the analyses is the 2004–2013 period.

To specify the importance of selected determinants for the development of asset reproduction processes, the farms were classified into 5 groups by the reproduction indicator[5]. The period covered (2004–2013) was split into three sub-periods: 2004–2007: favorable economic conditions; 2008–2009: economic downturn; 2010–2012: economic upturn in the agriculture sector. 2013 was excluded from the analyses as it marked the beginning of another downturn period and, thus, did not fit the previous sub-period. This classification reflects the relatively homogeneous sub-periods of agricultural market conditions and results from other relevant studies based on economic indicators provided both by the Institute of Agricultural and Food Economics and by the Economic Growth Institute of the Warsaw School of Economics (Grzelak and Seremak-Bulge, 2014). At the same time, this will allow to assess the importance of economic conditions for the aspects under consideration.

REPRODUCTION PROCESSES: A THEORETICAL PERSPECTIVE

The issue of reproduction processes in the agriculture sector was directly addressed on several occasions, especially in Poland in the era of centrally planned economy. An interesting approach to reproduction processes may be found in Grabowski, 1991. The paper addresses the efficiency of reproduction processes, primarily including the determinants of the farm's reproduction capacity, and especially the relationships that illustrate the impact

[2] Each farm that holds accounts within the Polish FADN represents a number of similar farms from the same category defined by the economic size, production type and location in macroregions. Therefore, the results of each farm are multiplied by adequate weights corresponding to the size of the represented category. This is the reason why the multiplied results are representative of more than 700,000 commodity farms in Poland, even though approximately 11,000–12,000 of them hold accounts within the agricultural accounting system. This is how the entire population participates in the Polish FADN. For instance, in 2011, there was 738,000 farms while the sample considered in this paper covered 10,500 farms who held accounts within the agricultural accounting system (upon removal of outliers and atypical observations). This paper is based on individual data from farms who hold accounts within the agricultural accounting system. Their results were weighted with SYS02. The agricultural area of farms from the 1st group (covered by FADN; this means weighted data of farms who hold accounts within the agricultural accounting system) was 55% of the average size of farms analyzed in this paper. The ratios for production values and incomes are 48% and 42%, respectively. On the other hand, note that the 738,000 farms covered by (represented in) the Polish FADN are economically stronger than the population of beneficiaries of direct payments (1,400,000 farms approximately).

[3] The first step was to eliminate the outliers in terms of the reproduction indicator (gross investments/depreciation). Therefore, the farms where the recorded indicator values were more than twice the standard deviation (as calculated for the group) above or below the average, are considered to be outliers. In practice, this means that some farms demonstrating significant deviations (especially in the case of upward deviations) were excluded from the population. Extremely high values, strongly diverging from the average levels, were recorded in these farms. In turn, atypical observations mean farms with a zero value of current assets. The elimination of outliers and atypical observations helped approximating the distributions of parameters under consideration to the normal distribution, and therefore the "average" category could be used.

[4] This is why gross investments were the dependent variable used in regression models instead of the reproduction indicator which, in some cases, was negative.

[5] The first group below the 0.5 level is composed of farms which demonstrate clear signs of underinvestment (with a reproduction indicator below 0.5). The second group covers farms which, while demonstrating narrow reproduction patterns, are likely to reach simple reproduction or higher levels. The next group includes farms with reproduction levels close to the simple asset reproduction pattern. The fourth group represents farms which demonstrate enhanced reproduction. In turn, the fifth group is composed of farms with extremely dynamic reproduction processes and advanced stages of asset modernization.

of prices and loans on reproduction processes in a centrally planned economy. It seems that recently, i.e. in the 1990s and later on, the studies on reproduction processes have been significantly limited or even discontinued. An exception is the research by Zwolak (2007), Józwiak (2003) and Woś (2000). The first of them analyzes the processes in the context of interdependencies between productive resources. In turn, the second author evaluates the reproduction processes from the perspective of the farm's competitiveness. Woś notes the importance of agricultural market conditions for the development of the farmers' investment capacity. Meanwhile, Juszczyk (2013) provides a comprehensive assessment of depreciation-related issues in the agri-business economics. In his studies, reproduction processes are analyzed in the context of the reproductive function of the depreciation and of capital creation in the enterprise. The research on reproduction processes is also difficult to find in papers by foreign authors, even though these aspects are independent of the economic system.

In Poland, following the integration with the EU, the agricultural sector was covered by CAP instruments, and asset reproduction became a more dynamic process in the agriculture. CAP instruments enabled support for agricultural holdings, resulting in increased capital accumulation. It could be concluded that today, public support for investments is a major driver of agricultural modernization in Poland. In turn Józwiak et al. (2012) conclude that the EU funds supporting the investments resulted in increased expenditure on fixed assets, triggering the implementation of innovations.

The reproduction processes in farms were driven by the favorable economic conditions, including in the agriculture sector. This means, in particular, the price relationships between products purchased and sold by the farmers which are a decisive factor for the profitability of agricultural activities and for investment processes. Disadvantageous price relationships act as a brake on investments (Chand, 2000). On the other hand, favorable market conditions are not only a modernization accelerator but also enable the outflow of labor resources to non-agricultural sectors. To a certain extent, the evolution of the economic situation (within the economic cycles) allows for assessing the soundness of investments. The reproduction processes need to be traced throughout the economic cycle in order to provide a full picture. According to this approach, a decline in reproduction levels during economic downturns should not be regarded as a purely adverse event, provided that during the upturn the investment expenditure more than compensates the consumption of assets (Grzelak, 2015b).

Depreciation is one of the funding sources for the reproduction of assets. Its importance grows as the production scale increases, and therefore the vast majority of Polish farms use it on a limited basis. As a consequence, there are insufficient amounts of capital in the agriculture sector which are excessively used in short periods (Fousekis and Papakonstantinou, 1997). These phenomena are reinforced by the relatively frequent and steep changes in the agricultural market conditions, resulting in unstable processes of assets reproduction in that sector.

Although the integration with the EU brought an improvement in the reproduction of agricultural assets, the fixed assets usage ratio in the Polish agriculture sector continues to be high[6]. The usage period of fixed assets often extends beyond their full depreciation and beyond the applicable standards, especially in smaller farms. This hampers the effective reproduction of fixed assets (Grzelak, 2014). However, the farms demonstrate specific adjustment capabilities which means they generate economic outcomes based on fixed assets of marginal importance (in the accounting sense). As a consequence, such farms may survive despite experiencing negative incomes, narrow reproduction patterns and underinvestment for many years (Czyżewski, 1995).

The dynamics of reproduction processes depends on the scale of productive resources. In the case of larger farms, it is easier to optimize the assets reproduction processes which are therefore more dynamic. Adding to this is the fact that, as the agriculture represents the prevailing source of their income, the farmers are under a greater pressure to renew their productive assets. Note however that in the case of highly capital-intensive production processes, it is increasingly difficult for the farms to reach the levels of extended reproduction of assets because of environmental restrictions. In this situation, the reproduction processes are more likely to enhance the non-production functions related to improved environmental protection or occupational safety and ergonomics. Note also that reproduction processes are linked to land rent (the surplus of income over the value

[6] In 2013, according to aggregated data of the Central Statistical Office, the fixed assets usage ratio was around 74% (GUS, 2014).

of labor of the farmer and his/her family and the opportunity cost of equity engaged in the production, except for land). The occurrence of extended reproduction in the agriculture is accompanied by the land rent which is discounted in the price of land (Czyżewski, 2012), partially because of the support for agriculture, including direct payments.

DYNAMICS OF REPRODUCTION PROCESSES

In the Polish farms under consideration, the scale of reproduction processes was quite variable (with a coefficient of variation of 25%) in the 2004–2012 period (Fig. 1). This was mainly due to the agricultural market conditions, primarily including the price relationships (margin squeeze), a decisive factor for profitability. As a result, the indicator covered by this analysis grew in the first sub-period (2004–2007). Afterwards (2008–2009), a decline was recorded due to economic downturn. It went up again in 2010–2012, and fell in 2013. As regards the group considered, enhanced reproduction was observed in the average farm only in 2006–2007. In 2011–2012, a pattern similar to simple reproduction was reported. In total, during the economically sound periods, the farms were unable to compensate

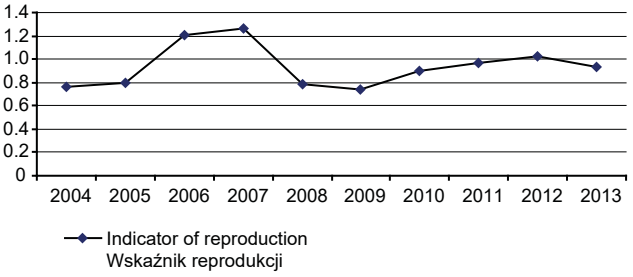

Fig. 1. Indicator of reproduction (gross investment excluding the purchase of land/depreciation) for agricultural holdings (2004–2013) engaged in agricultural accountancy of the FADN (for the average holding)
Source: own elaboration based on the data base of the FADN in Poland for the years 2004–2013.
Rys. 1. Wskaźnik reprodukcji majątku (inwestycje brutto z wyłączeniem zakupu ziemi/amortyzacja) gospodarstw rolnych (w latach 2004–2013) prowadzących rachunkowość rolną FADN (dla przeciętnego gospodarstwa)
Źródło: opracowanie własne na podstawie bazy danych systemu FADN w Polsce za lata 2004–2013.

for the lower scale of reproduction processes in the period under analysis. Having in mind that the group consists of stronger (cf. footnote 1) farms, the above means that the asset reproduction activities remain at a relatively low level in the Polish agriculture sector as a whole.

The trends affecting the dynamics of the reproduction processes were reinforced by the mobilization of funds within two successive investment support programs under the CAP (the following measures: "Investments in agricultural holding" (2004–2006), "Modernization of farms" and "Setting up of young farmers" (2007–2013)). As regards the first measure (Modernization...), five calls for applications were organized under the 2007–2013 RDP. A total of 96,000 applications were submitted, and an amount of PLN 8.6 billion was disbursed to 51,000 beneficiaries. 91% of eligible investments were made in mobile and fixed equipment[7]. Thus, while the impact of the programs on asset reproduction processes was moderate in the entire population of farms, it was definitely noticeable in economically stronger farms, especially as regards agricultural machines and equipment. Also apparent was a specific periodicity of changes to the asset reproduction indicator (Fig. 1), resulting from the impact of economic factors. The fluctuations of the reproduction indicator would certainly be stronger without the investment support instruments under the CAP or without direct payments. This would have a destabilizing effect on the assets reproduction processes (Grzelak, 2015a).

DETERMINANTS OF REPRODUCTION PROCESSES

In the population of farms under consideration, the groups with a higher reproduction indicator also demonstrated higher production values, higher incomes per FTE and higher levels of technical equipment of labor (Table 1). Therefore, the production volume, workforce productivity and investments in workforce equipment are decisive for the scale of the assets reproduction process. This is because large operators may more easily

[7] In 2004–2006, 42,600 applications were submitted and 24,000 agreements worth PLN 2 billion were implemented under the "Investments in agricultural holding" program. 88% of the investments were made in mobile and fixed equipment.

optimize the use of owned productive resources[8], and because a direct relationship exists between these determinants and the economic effects of agricultural management. These processes promote the development. However, it is difficult to make unequivocal generalizations when it comes to the capital/land relationship. Most probably, clear patterns exist in this area because of the farms' production profile. In turn, the labor/land ratio was found to decline as the reproduction indicator increases. This is implied by a better use of labor resources as the production scale grows; and by the ability to implement labor mechanization solutions more easily in the case of larger farms (which also means the increase of workforce productivity).

According to Table 1, the increased production value in the group of farms considered was independent from the evolution of the economic trends. The farmers extended their production scale irrespectively of the farming conditions. In turn, the economic indicators clearly proved to be important for the reproduction indicator itself and for the technical equipment of labor. In the case of a decline in the rural economy, there was a reduction in the scale of assets reproduction. In turn, under favorable market conditions, extended reproduction was more likely to be encountered. The support for farms' investments under the EU's CAP instruments was also of importance to the development of reproduction conditions by maintaining the reproduction processes and by making it easier to increase the value of assets. The investments in agricultural production machines, equipment and tools were prevalent, not least because the procedure for raising and clearing the relevant investment funds from the EU was less risky and easier (Poczta and Czubak, 2007). Probably, some of the farms overinvested in that group of fixed assets. This could be true especially for smaller (but not the smallest) operators who face more difficulties in optimizing the fixed costs involved in the operation of machines and equipment.

Further in this study, the regression models were created (Table 2), having regard to the levels of the

[8] According to other studies (Grzelak, 2014, p. 57), after 2004, the most dynamic asset reproduction processes in Poland (in the group of farms holding accounts within the FADN agricultural accounting system) were implemented by operators specializing in dairy and bovine production and in field-scale crops. Relatively moderate levels were reported by horticultural holdings and farms specialized in permanent crops. Non-specialized farms demonstrated the lowest levels.

Table 1. The selected resource characteristics of farms due to the level of the indicator of reproduction of agricultural holdings (for selected periods 2004–2012)
Tabela 1. Wybrane charakterystyki ekonomiczne gospodarstw rolnych ze względu na poziom wskaźnika reprodukcji gospodarstw rolnych (w wybranych podokresach lat 2004–2012)

Specification Wyszczególnienie	The level of reproduction indicator (gross investments (excluding the purchase of land)/depreciation) Poziom wskaźnika reprodukcji majątku (inwestycje brutto z wyłączeniem zakupów ziemi/amortyzacji)				
	< 0.5	0.5–0.9	0.91–1.1	1.11–1.5	> 1.5
1	2	3	4	5	6
	2004–2007				
The indicator of reproduction* Wskaźnik reprodukcji*	–0.03	0.73	0.99	1.33	3.87
SE131	148.2	185.9	193.2	220.7	236.7
SE420/SE010	27 462	33 003	33 516	35 342	39 505
(SE436-SE446)/SE025	15 253	17 213	15 461	17 320	15 674
(SE436-SE446)/SE010	231 458	273 811	265 550	297 826	310 473
SE010/SE025	0.07	0.06	0.06	0.06	0.05

Table 1 cont. – Tabela 1 cd.

1	2	3	4	5	6
			2008–2009		
The indicator of reproduction* Wskaźnik reprodukcji*	–0.05	0.70	0.96	1.30	3.55
SE131	165.1	203.2	145.7	239.5	268.4
SE420/SE010	25 829	31 130	33 584	36 416	40 578
(SE436-SE446)/SE025	13 123	14 373	14 561	14 206	14 639
(SE436-SE446)/SE010	187 962	204 521	212 836	215 526	248 370
SE010/SE025	0.07	0.07	0.07	0.07	0.06
			2010–2012		
The indicator of reproduction* Wskaźnik reprodukcji*	–0.04	0.71	0.99	1.31	3.59
SE131	193.1	232.3	291.2	294.7	344.6
SE420/SE010	41 261	49 481	53 250	56 004	68 575
(SE436-SE446)/SE025	20 301	22 160	20 282	23 464	22 851
(SE436-SE446)/SE010	332 713	374 085	369 399	421 088	493 125
SE010/SE025	0.06	0.06	0.05	0.06	0.05

* The indicator of reproduction = investments (excluding the purchase of land)/depreciation.
SE025 – total utilised agricultural area (hectars), SE010 – total labour input (AWU), SE131 – total output, SE420 – farm net income, SE436 – value of total assets, SE446 – value of land.
Source: own elaboration based on the data base of the FADN in Poland for the years 2004–2012.
* Wskaźnik reprodukcji = inwestycje (z wyłączeniem ziemi)/amortyzacja.
SE025 – areał gruntów rolnych (ha), SE010 – zasoby pracy (AWU), SE131 – wartość produkcji rolnej, SE420 – dochód rolniczy, SE436 – wartość aktywów, SE446 – wartość ziemi.
Źródło: opracowanie własne na podstawie bazy danych systemu FADN w Polsce za lata 2004–2012.

reproduction indicator (cf. Table 1), based on variables that represent the resources of productive inputs. The regression models were found to be poorly fitted only in the case of the farm group with the lowest reproduction level[9] (below 0.5). In other cases, the model's fitting to the empirical variables was definitely better and could be considered satisfactory. These results could suggest that productive resources play a major role for the reproduction of assets in farms attaining at least a reproduction level that offers prospects for further growth. This could be related to a more reasonable use of resources and to a greater likelihood of achieving economies of scale[10]. Note that in smaller farms, the relatively low levels of the reproduction indicator are explained by the fact that the reproduction of their assets is limited due to difficulties in investment funding, whether with their own incomes or external sources, e.g. loans. In parallel, only the larger farms are usually able to effectively use the machines and equipment purchased as a part of investment support with the EU's CAP instruments (Defrancesco et al., 2008).

[9] 63% in the group of farms under consideration.

[10] According to studies (Czyżewski and Smędzik-Ambroży, 2013), the economies of scale enable a better use of productive resources and a highly environmentally sustainable production.

Table 2. The coefficient of determination for the regression models[1] for farms engaged in agricultural accountancy FADN in Poland due the level of indicator of reproduction (for the average farm) in the selected sub-periods 2004–2012

Tabela 2. Współczynniki determinacji dla modeli regresji[1] dla gospodarstw rolnych prowadzących rachunkowość rolną FADN w Polsce ze względu na poziom wskaźnika reprodukcji (dla przeciętnego gospodarstwa) w wybranych podokresach 2004–2012

The level of reproduction indicator (gross investments excluding the purchase of land/depreciation) Poziom wskaźnika reprodukcji majątku (inwestycje brutto z wyłączeniem zakupów ziemi/amortyzacji)				
< 0.5	0.5–0.9	0.91–1.1	1.11–1.5	> 1.5
		2004–2007		
0.23 (0.22–0.24)[2]	0.67 (0.65–0.69)	0.73 (0.71–0.75)	0.75 (0.73–0.76)	0.64 (0.63–0.65)
		2008–2009		
0.26 (0.25–0.27)	0.70 (0.69–0.71)	0.76 (0.75–0.77)	0.77 (0.76–0.78)	0.69 (0.68–0.70)
		2010–2012		
0.29 (0.28–0.31)	0.69 (0.68–0.70)	0.79 (0.77–0.80)	0.80 (0.78–0.81)	0.68 (0.67–0.69)

[1]These models are based of the following variables: gross investments excluding the purchase of land (lnSE516 – dependent variable) and land (lnSE025), work (lnSE010), capital (ln(SE441-SE446)) as independent variables.
[2]In cells, mean values of determination coefficient were estimated for the regression models in the individual years of the studied subperiods. Only medium means could cause methodological doubts due to the lack of information on the distribution of these quantities, so the stretch of values are given in parentheses (max and min values) for the coefficients of determination of the estimated regression models in the studied subperiods. The data show that stretch marks were small and generally symmetrical with respect to the mean.
Source: own elaboration based on the data base of the FADN in Poland for 2004–2012.
[1]Modele te bazują na następujących zmiennych: inwestycje brutto z wyłączeniem zakupu gruntów (lnSE516 – zmienna zależna) oraz gruntów (lnSE025), pracy (lnSE010), kapitału (lnSE441-SE446) jako zmiennych niezależnych.
[2]W komórkach podano wartości średnie współczynników determinacji oszacowane dla modeli regresji w poszczególnych latach badanych podokresów. Podanie wyłącznie średnich mogłoby wywoływać wątpliwości metodyczne ze względu na brak informacji o rozkładzie tych wielkości, dlatego w nawiasach podano rozstępy (wartości max. i min.) dla wartości współczynników determinacji oszacowanych modeli regresji w badanych podokresach. Z zawartych danych wynika, że rozstępy były niewielkie i na ogół symetryczne względem wartości średniej.
Źródło: opracowanie własne na podstawie bazy danych systemu FADN w Polsce za lata 2004–2012.

FINAL CONCLUSIONS

The following conclusions may be drawn from the considerations on the farms covered by this study:

- Narrow asset reproduction processes were prevalent in the group of farms considered. Having in mind that the group was composed of economically strong operators (when assessed against the national background), this offers a sad illustration of the condition of the Polish agricultural sector. However, on the other hand, the situation has manifestly improved after the EU integration.
- Cyclical market factors clearly affect the scale of reproduction processes. The economic upturn boosted the dynamics of assets reproduction in the group under consideration, whereas the economic

downturn had a restricting effect on these processes and resulted in the domination of narrow reproduction patterns. This is explained by the fact that more favorable price relationships increased the farmers' incomes, encouraging them to step up their investment activities.

- The production volume, workforce productivity and technical equipment of labor are decisive for the scale of the assets reproduction processes in the group of farms considered. Increasing these factors allows for boosting the dynamics of assets reproduction processes. This is because of their key role in the development of incomes and, as a consequence, in the level of investment activities.
- The resources have a noticeably greater effect on reproduction processes (an R2 above 0.64) if the scope of this survey excludes farms unable to further develop their activity due to insufficient reproduction (a reproduction indicator below 0.5). This is the case if the agricultural incomes have a relatively lower share. This could also mean that in the farms which reproduce at least one half of their assets, the productive resources are used more efficiently and serve the agricultural purposes to a greater extent.

In order to create conditions for increasing the asset reproduction rates in the Polish agriculture sector, the investment support for farmers under the EU's CAP should be selectively targeted at the farms that are likely to achieve the simple reproduction stage while excluding the operators who report extended levels of reproduction on a permanent basis.

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PROCESY REPRODUKCJI MAJĄTKU I ICH WYBRANE DETERMINANTY W GOSPODARSTWACH ROLNYCH PROWADZĄCYCH RACHUNKOWOŚĆ ROLNĄ (FADN) W POLSCE

Streszczenie. Głównym celem artykułu jest rozpoznanie dynamiki procesów reprodukcji majątku (środków trwałych z wyłączeniem ziemi) oraz znaczenia wybranych kształtujących je determinant w gospodarstwach rolnych w Polsce prowadzących rachunkowość rolną FADN. W trakcie badań stwierdzono, że w tej grupie gospodarstw rolnych dominowały procesy reprodukcji zawężonej majątku. W sytuacji poprawy koniunktury miała miejsce wyraźna poprawa, jeśli chodzi o dynamikę reprodukcji majątku, natomiast pogorszeniu koniunktury towarzyszyło osłabienie tych procesów i dominacja reprodukcji zawężonej. Oddziaływanie czynników zasobowych na procesy reprodukcji jest wyraźniejsze w przypadku wyłączenia z badań gospodarstw rolnych, w których procesy reprodukcji nie rokują szans na ich dalszy rozwój (wskaźnik reprodukcji poniżej 0,5). Może to również oznaczać, że w pozostałych jednostkach wykorzystanie zasobów produkcyjnych bardziej służyło celom rolniczym i były one bardziej efektywne.

Słowa kluczowe: koniunktura, gospodarstwo rolne, reprodukcja środków trwałych

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