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Economic size of farms and adjustments of the total factor productivity to the business cycle in Polish agriculture

Bazyli CZYZEWSKI*, Adam MAJCHRZAK

Poznan University of Economics and Business, Poznan, Poland

*Corresponding author: b.czyzewski@ue.poznan.pl

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Abstract: The article presents an approach to changes in the total factor productivity (TFP) which differs from that generally found in the literature. Changes are calculated in the real terms using the detailed input-output matrices for representative farms in Poland, for different economic size classes, in the years 2007–2013. Input-output matrices were used for the decomposition of the Hicks-Moorsteen TFP index. The goal is to evaluate changes in the real TFP in the downturn and recovery phases of the business cycle in agriculture. It was found that the reaction of TFP to business cycle changes on "small", "medium" and even "large" family farms in Poland is diametrically opposite to that observed in the case of large-scale farms. More than 90% of farms in Poland (except for the largest) increase technical productivity in the conditions of the economic downturn and lower it in the conditions of the economic recovery. Such behaviour is pro-cyclic and irrational, alluding to the 17th-century King's effect, which is vanishing in the agricultural systems of highly developed countries. The hypothesis is proposed that the size of the price expectation error which causes that effect is negatively correlated with the economic size of the farm, but at the same time it is proportional to the percentage of agricultural income obtained from subsidies and other payments under the SAPS system.

Keywords: agriculture, business cycle, CAP, input-output analysis, TFP

Agriculture is changing. Under the sustainable agriculture paradigm being promoted in the EU, land provides new utilities which are of the nature of public goods. Not only is the European agriculture responsible for providing food and material to be further processed, but it also occupies around 40% of land. As a consequence, it has a huge impact on the condition of the environment in the rural areas as well as the capabilities to use the environment (Buckwell 2009; Baldock et al. 2010). Thus, European agriculture and rural areas are the key elements creating public goods based on the natural environment. However, as a result of the multifunctional model of agriculture, different forms of public goods are also provided. Vatn includes among them not only the environmental aspects (landscape, biodiversity, pollution, recreation, cultural heritage, food safety), but also the food security and the aspects connected with the rural lifestyle (settlement models, tradition and culture, local economic and social activities) (Vatn 2010: 53–58).

It is therefore necessary to address the question of market failure in agriculture from a new angle. In the sustainable agriculture model, such failures are inevitable, because, by assumption, the market does not value public goods. An attempt to make such a valuation is, nonetheless, provided by the new instruments of the European Union Common Agricultural Policy (CAP), financed out of the taxes paid by the society in the EU countries. More generally, this has been the direction of evolution of the CAP since the early 1990s, replacing production subsidies with the uniform and area-based payments. The question nevertheless remains of how these attempts to make up for the deficiencies in the market affect the mechanisms by which agricultural prices and income are

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shaped, including the King's Law, which dates from the 17th century (Heberton Evans 1967). According to this law, the income in agriculture falls when the agricultural production rises, and vice versa. This effect is linked to the low price elasticity of demand for agricultural products, and can be reduced by decreasing the asymmetry of information and price uncertainty in agriculture (for instance, as a result of the development of forward and futures contracts, or the agricultural insurance), but also by the use of instruments of an anticyclic agricultural policy (such as the CAP intervention prices). In the agricultural systems of Western Europe and the USA, the King's effect has been significantly reduced, and for more than a decade, there have been few publications on the subject. The attention is drawn, however, to the inverse farm size-productivity relationship in the low-income countries which may also result from the King effects. For example Christoper B. Barrett proves that farmers in the low-income countries cannot hedge uncertain crop prices through futures or insurance contracts, nor by forward sales, and for that reason they are more vulnerable to the diminishing returns while the harvest increases (Barrett 1993). However, other researchers do not confirm the inverse farm size-productivity relationship arguing that it disappears after considering the fact of satisfying own nutritional needs by semi-subsistence farms (Chen et al. 2011).

The authors have decided to investigate the above problem, studying changes in the real TFP in different economic size classes of farms in Poland, but in relation to the downturn and recovery phases of the business cycle in agriculture. The hypothesis being tested states that the size of the error in farms' price expectations is negatively correlated with the economic size of a farm, but at the same time increases proportionally to the percentage of the agricultural income accounted for by the subsidies and payments from the CAP under the SAPS system operating in Poland. If this hypothesis were true, the recent decoupling reforms of the CAP would negatively influence the market mechanism in the UE member countries with the fragmented agrarian structure. The opinions of other researchers concerning the positive and negative market effects of the decoupling reforms are divided. Kazukauskas carried out a study in the EU15 countries, showing that the probability of a farm disinvesting decreased due to the policy change for most farms (Kazukauskas et al. 2013). In turn, Yanwen shows that there exists a negative relation between the subsidy and the TFP, if the subsidies are associated with the acreage in low per capita income countries (Yanwen et al. 2013).

MATERIALS AND METHODS

In this work, a different approach is taken to changes in the total factor productivity (TFP) than that generally found in the literature. There are two groups of approaches to measure or to compare the TFP changes between production units (PU). In the first one, to measure the TFP we can aggregate various agricultural outputs into an index of the output and compare this to an index of the total input. The ratio of these two indexes provides the index of the TFP, and the fluctuations in the TFP index over time reflect the changes in productivity. However, multiple approaches can be used to aggregate outputs and inputs. The direct methods use the corresponding prices (or values) as weights. The indirect methods aim at obtaining an average price, and then the volume index is derived indirectly by dividing the total revenue/cost by the average price (Zhao et al. 2012; Yu Sheng et al. 2013).

The second group of method engages the Malmquist index which measures the TFP change between two data points and several PU by calculating the ratio of the distance of each data point relative to a common technological frontier (usually using the DEA approach). The Malmquist index has become extensively used in the international comparisons of agricultural productivity, since it does not require prices for its estimation, which are normally not available. Even though a priori price information is not needed, the DEA procedure calculates a posteriori prices to estimate the efficiency and non-parametric Malmquist indices. In fact it defines a set of weights for the inputs and outputs which minimize the distance to the technological frontier. These weights can be interpreted as the implicit "shadow prices" but these shadow prices usually do not reveal the underlying real economic prices (Nin-Pratt and Yu 2009).

The approaches mentioned above are not sufficient to achieve the assumed objective for the following reasons:

– The authors look for a method estimating the real TFP changes in absolute (monetary) values in order to distinguish the value of the TFP growth/fall, but also the value of rents (economic surplus) which flows out of the PU (or flow in) through the changes of agricultural prices in different turns

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of the business cycle. An interesting question is which markets (products) are usually responsible for the drainage or inflow of rents from or to the agricultural sector?
– The absolute values of the TFP changes are also needed to compare these changes with the value of the price effect (the outflow or inflow of surplus) and the value of subsidies from agricultural policy. The question is: Does the agricultural policy manage to correct the unfavourable terms of trade which occur during the downturn in agriculture?

In the article, the changes in the TFP are calculated in the real terms (after the elimination of the effects of prices, subsidies and other payments from the CAP), not on the basis of the Malmquist Productivity Index, but using the input-output matrices (60 input-output variables * 6 SO classes * 6 years) for the representative farms according to the Polish FADN system, in various economic size (SO) classes. In this case the authors had at their disposal a complete matrix of price indices for 60 input-output variables (cf. codes in Table 1, compare the full variables names at http://ec.europa.eu/agriculture/rica/database/database_en.cfm), produced using the Eurostat data. The input-output matrices were used for the decomposition of the Hicks-Moorsteen TFP index (HM TFP Index).

The aforementioned economic size criterion of Standard Output (SO) is the average monetary value of the agricultural output of an agricultural product (crop or livestock) over the reference period of 5 years, per 1 ha or 1 head of livestock per year, in the average production conditions in the particular geographical units (regions). According to the FADN methodology, farms with the SO value in the range € 2000–8000 are "very small" farms, those above € 8000 up to € 25 000 are "small", those above € 25 000 up to € 50 000 are "average small", those above € 50 000 up to € 100 000 are "average large", those above € 100 000 up to € 500 000 are "large", and those above € 500 000 are "very large".

The studied sample is representative of approximately 750 000 individual farms in Poland (cf. Tables 2 and 3). The sampling was performed at the request of authors by the Polish FADN Liaison Agency (The Institute of Agricultural and Food Economics-National Research Institute in Warsaw), according to the Classification rules defined and formally established by the Commission Regulation (EC) No 1242/2008 of 8 December 2008 establishing the Community typology for agricultural holdings (Official Journal of the European Union 2008: 3).

The HM TFP Index in the original form is as following (Coelli et al. 2005; Paradysz 2005; Kalińska and Wrzeszcz 2007):

$$\text{HM TFP Index} = \frac{\sum_{i=1}^{n} P_{i0} \times Q_{i1}}{\sum_{i=1}^{m} P_{i0} \times Q_{i0}} \div \frac{\sum_{i=1}^{m} R_{i0} \times F_{i1}}{\sum_{i=1}^{m} R_{i0} \times F_{i0}} \qquad (1)$$

It was transformed into the form where:

$$\Delta TFP = \left(\sum_{i=1}^{n} Q_{it} \times P_{it-1} - \sum_{i=1}^{n} Q_{it-1} \times P_{it-1} \right) - \left(\sum_{i=1}^{n} F_{jt} \times R_{jt-1} - \sum_{i=1}^{n} F_{jt-1} \times R_{jt-1} \right)$$

where:
Q_i = the quantity of product i in successive years (t – 1, t)
F_j = the quantity of external input j in successive years (t – 1, t)
P_i = the price of product i in successive years (t – 1, t)
F_j = the price of external input j in successive years (t – 1, t)
ΔTFP = the change in the productivity of production factors in monetary units resulting from the change in the real values of outputs and inputs (*excluding subsidies and other payments from the CAP*).

The input-output matrix contained the variables according to the FADN classification pointed out in Table 1.

We next computed the change in the value of the sector's economic rents (surplus) resulting exclusively from the change in the prices of products sold and of

Table 1. Variables according to the FADN classification used in the input-output matrix creation

Variable type	FADN codes of variables
Outputs:	SE140, SE146, SE145, SE150, SE155, SE160, SE165, SE170, SE175, SE180, SE185, SE190, SE195, SE200, SE216, SE220, SE225, SE230, SE235, SE240, SE245, SE251, SE256, SE 395
Inputs:	SE285, SE295, SE300, SE305, SE310, SE320, SE330, SE331, SE340, SE345, SE350, SE356, SE360, SE370, SE375, SE380, SE390, SE408
Subsidies:	SE611, SE612, SE613, SE616, SE617, SE618, SE619, SE621, SE622, SE623, SE625, SE626, SE631, SE632, SE640, SE650, SE699, SE406, SE407

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the externally supplied means of production purchased (including taxes), using the equation:

$$\Delta A_{St} = \left[\sum_{i=1}^{n}\left(\frac{Q_{it} \times P_{it}}{HICP} - Q_{it} \times P_{it-1}\right)\right] + \left[\sum_{j=1}^{m}\left(\frac{F_{jt} \times R_{jt}}{HICP} - F_{jt} \times R_{jt-1}\right)\right] \quad (2)$$

where:
$HICP$ = the inflation rate,
ΔA_{St} = the change in the sector's economic rents in period t relative to t – 1 (the drainage or inflow of the economic surplus through prices) other symbols have the same meanings as in Equation (3).

Having on mind that the price expectations in agriculture are adaptive, we assume, that:

ΔTFP = *expected change of income* (while the prices expected in period t are those from t – 1)

$\Delta TFP + \Delta A_s$ = *actual change of income* (*in real prices*)

In accordance with the above methodology, the calculations were made of ΔTFP and ΔA_{St} for the representative farms in various economic size categories (SO classes) in Poland for each year for the period 2008–2013, relative to the previous year, based on data from the FADN.

Next the results were summed for two separate periods, 2008–2009 and 2010–2013, which correspond respectively to the economic downturn and recovery in Polish agriculture, and cover one complete business cycle. This cycle is shown in Figure 1, based on the data that have been produced since the early 1990s by the Collegium of Economic Analysis at the Warsaw School of Economics. The period under analysis is marked with a box. Its boundaries are determined by the turning points (upper and lower) of the "cyclic component of economic activity" (the thin line in Figure 1).

RESULTS AND DISCUSSION

TFP vs. farm economic size and business cycle

The TFP changes in relation to the economic size of farms and to the phases of the business cycle in Polish agriculture are presented in Tables 2 and 3. We begin our analysis by considering the interpretation of columns 6 and 7. During the downturn of 2008–2009, in the case of farms in the SO classes II–V, the total factor productivity (TFP) increased from 1.4% to 5% (cf. column 6 of Table 2) of the total agricultural income in that period. The decomposition of the index of the total productivity shows that this was linked primarily to the growth in the real production (chiefly of grains), and not, for example, to savings on the input side. In spite of the improvement in the technical productivity in these classes of farms, in the whole of the period 2008–2009 the

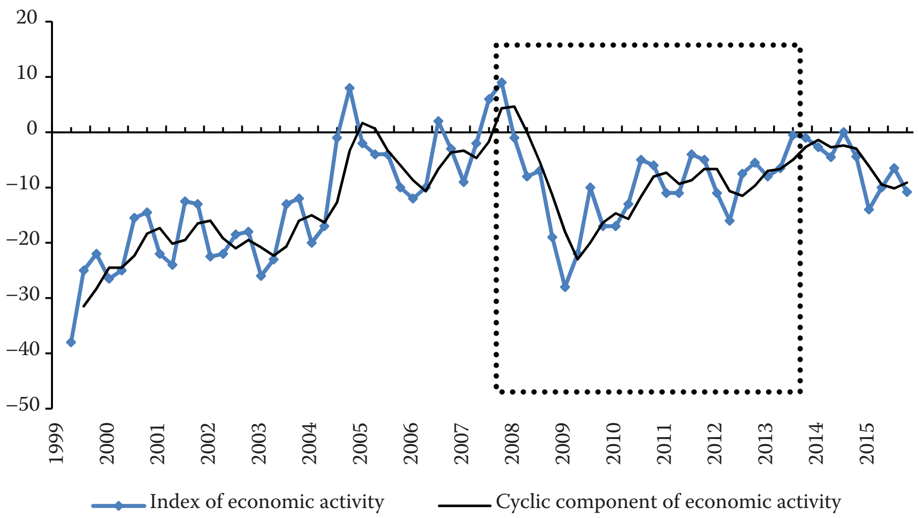

Figure 1. Index of economic activity in agriculture

Source: Collegium of Economic Analysis, Warsaw School of Economics Available at http://kolegia.sgh.waw.pl/pl/KAE/struktura/IRG/koniunktura/Strony/rolnictwo.aspx (accessed May 14, 2015)

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unfavourable price changes caused between 33% and 25% of their income to drain out to other sectors of agribusiness (cf. column 7).

We propose the following interpretation of the data in Tables 2 and 3: On the assumption that the prices do not change (that is, in the period t they remain at the same level as in t – 1), column 6 corresponds to the expected change in the real income under those price conditions, equal to the change in the real TFP. However, unexpected price changes cause economic rents to flow either into or out of agriculture – these flows are shown in column 7. As a result, the actual change in income is the sum of columns 7 and 8. The error in the farms´ price expectation (columns 9) was calculated assuming that the TFP change in the monetary value equals an expected income change. Thus, a value of an expected income change minus the real income change equals the error in the price expectation. The analysis of Table 2 leads to several interesting conclusions:

(1) During the period of the economic downturn, the adjustments of the TFP on farms in the SO classes I–V are diametrically opposite to those in the class VI. In classes II–V, the real productivity increases (chiefly as a result of the growth in the real production), while in the class containing the largest farms, it decreases (column 6 of Table 2). The growth in the real productivity under the conditions of falling agricultural prices is a pro-cyclic phenomenon which exacerbates the falls in prices. The largest farms behave more rationally. The expected changes in income in this class are almost equal to the actual changes (cf. columns 6 and 8 of Table 2).

(2) Changes in the TFP in the SO class I (the smallest farms) should be considered separately, because in the period of the downturn, the farms in that class supported themselves exclusively from the CAP assistance, which amounted to more than 130% of income.

(3) The smaller the farm, the greater the drainage of the economic surplus through the unexpected price changes (from c. 42% in class I to c. 6% in class VI – cf. column 7 of Table 2).

The changes in TFP and flows of surplus in the period of economic recovery (Table 3) are to a certain extent a “mirror image” of those appearing in Table 2:

(1) TFP decreases in the case of farms in classes I–V, whereas in class VI it increases. Again it can be stated that a fall in productivity (caused primarily by a fall in production) in conditions of economic recovery is a pro-cyclic phenomenon, causing an increase in the surplus of demand in the market for raw products, while expected changes in income are not borne out by the actual changes.

(2) The smaller the farm, the greater the inflow of economic surplus caused by the unexpected price

Table 2. TFP changes, flows of economic surplus, and the CAP support during the economic downturn in agriculture in Poland (totals for the period 2008–2009)

1. SO class	2. Average number of represented farms	3. Total incomes from family farm (incl. subsidies and other CAP payments) [PLN][1]	4. Total subsidies and other CAP payments [PLN]	5. Total subsidies and other CAP payments relative to income [4:3]	6. Total TFP changes, t – 1 = 100, relative to total income, i.e. *expected change in income*	7. Total drainage/inflow of economic surplus through unexpected changes of prices, t – 1 = 100, relative to total income	8. *Actual change in income*	9. *Price expectations error* [ABS of 7]
I	175 347	14 423	18 993	**131.7%**	**–4.5%**	–41.6%	–46.0%	41.6%
II	431 586	33 276	29 577	**88.9%**	**1.4%**	–32.9%	–31.5%	32.9%
III	97 158	87 447	56 518	**64.6%**	**3.5%**	–29.9%	–26.4%	29.9%
IV	36 312	184 690	95 224	**51.6%**	**4.7%**	–24.8%	–20.1%	24.8%
V	10 761	471 371	199 445	**42.3%**	**5.0%**	–24.5%	–19.5%	24.5%
VI	404	1 474 357	460 227	**31.2%**	**–27.3%**	–6.4%	–33.7%	6.4%

[1]The average exchange rate for 2008–2009 was €1 = 3.9198 PLN

Source: own analysis based on data from the Polish FADN Liaison Agency (The Institute of Agricultural and Food Economics – National Research Institute in Warsaw)

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Table 3. TFP changes, flows of economic surplus, and the CAP support during the economic recovery in agriculture in Poland (totals for the period 2010–2013)

1. SO class	2. Average number of represented farms	3. Total incomes from family farm (incl. subsidies and other CAP payments) [PLN][1]	4. Total subsidies and other CAP payments [PLN]	5. Total subsidies and other CAP payments relative to income [4:3]	6. Total TFP changes, t – 1 = 100,, relative to total income, i.e. *expected change in income*	7. Total drainage/inflow of economic surplus through unexpected changes of prices, t – 1 = 100, relative to total income	8. *Actual change in income*	9. *Price expectations error* [ABS of 7]
I	182 214	43 454	41 629	**95.8%**	**–4.4%**	10.6%	6.2%	10.6%
II	404 083	105 406	73 760	**70.0%**	**–0.3%**	6.9%	6.7%	6.9%
III	100 296	277 777	141 230	**50.8%**	**–2.6%**	8.6%	6.0%	8.6%
IV	34 111	550 044	249 181	**45.3%**	**–5.0%**	9.3%	4.3%	9.3%
V	12 493	1 306 489	483 070	**37.0%**	**–2.5%**	6.0%	3.5%	6.0%
VI	464	3 306 172	590 967	**17.9%**	**14.3%**	–7.7%	6.6%	7.7%

[1]The average exchange rate for 2010–2013 was €1 = 4.1244 PLN

Source: own analysis based on data from the Polish FADN Liaison Agency (The Institute of Agricultural and Food Economics – National Research Institute in Warsaw)

changes (from c. 11% in the class I to c. –8% in the class VI – cf. column 7 of Table 3).

(3) Although it was observed that changes in the TFP and the surplus flows in the economic recovery phase are in a certain sense a mirror image of those seen in the period of the downturn, the scale of the changes is not symmetric. The inflows of economic surplus shown in Table 3 (column 7) resulting from the favourable price changes are much smaller than the outflows shown in Table 2. This means that on balance, over a complete cycle, agriculture is depreciated by the market.

In relation to the complete cycle, it is also possible to confirm with a high probability an observation that has been made by other authors, that a farm's size exerts a positive impact on its technical efficiency, while the government subsidies influence it negatively (cf. columns 5 and 6 of Tables 2 and 3). Similar conclusions were reached by S. Bojnec and I. Ferto, who studied the productivity of farms in Slovenia (Bojnec and Ferto 2013).

The analysis conducted here can be considered reliable in that to a large extent it confirms the results of similar studies on the adjustments of the TFP to business cycle changes during the previous cycle in Poland in the period 1995–2007. These are described in detail in (Czyżewski 2013).

Price expectations vs. the CAP support

As was previously mentioned, price expectations in agriculture, particularly in the case of small farms, are adaptive in nature. This means that the farm adjusts its price expectations based on the current sale prices and the prices of the means of production, according to the equation:

$$p_t^e = p_{t-1}^e + \lambda(p_{t-1} - p_{t-1}^e)\text{, where } \lambda \in (0,1) \qquad (3)$$

p_t^e = expected prices within the period t
p_{t-1}^e = expected prices within the period $t-1$
p_{t-1} = prices within the period $t-1$
λ = parameter

If it behaves rationally, it strives to optimise the structure of production and the growth in productivity. When a farm improves its technological productivity, in the conditions of adaptive expectations, it expects an analogous growth in its agricultural income. However, production decisions are taken in the conditions of uncertainty as to future prices, and also as to the production effects, which will not become known until the following season. It may turn out that the expected growth in income, due to the unfavourable price changes which could not have been foreseen when the production structure was being planned, is entirely lost through the drainage to other sectors of agribusiness (the drainage may even exceed the expected income growth). Nonetheless,

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the fact that the surplus productivity in agriculture is drained through prices in the given year does not in itself constitute a market failure, provided that it is of a short-term nature. Expectations in agriculture are adaptive, hence in the following year; the farmer will again attempt to optimise the production structure based on the existing sale prices and the prices of materials. This is a rational behaviour, forced by the market conditions. The problem is that under the SAPS system, the farmer receives the CAP subsidies which are dissociated from production and to a certain extent serve as the remuneration for the supply of public goods. These goods are not valued by the market, and this undoubtedly represents a market failure. We believe, however, that the greater is the share of such payments in the agricultural income, the more distorted are the price expectations of the producers in a period of the downturn, because of the absence of the aforementioned stimuli to optimise the structure of production. This is confirmed by the data in Table 2 (cf. columns 5 and 9). The ratio of the CAP support to agricultural income in the downturn phase ranges from 132% in the SO class I to 31% in the class VI. An exact correlation is visible here – the larger the farm, the lower the ratio of the CAP support to income. At the same time, there is a close correlation, in the period of the downturn, between the ratio of subsidies and support payments to income and the “price expectation error” – cf. column 9 of Table 2 (that is, the higher the level of support, the greater the error). This means that the hypothesis put forward at the outset has been partially confirmed. In the conditions of the economic recovery, the situation is more complicated, because there is an absence of stimuli to optimise the structure of production, and it is a “supplier’s market”. It is nonetheless a fact that the anticyclic behaviour as regards the TFP is observed only in the case of the largest farms (class VI). It is hard to say why, in this case, these too formulate the erroneous price expectations. In spite of the growth in the real TFP by approximately 14% (for SO class VI), almost 8% of the resulting surplus is drained through prices (cf. columns 6 and 7 of Table 3). We believe that this is because in the recovery period there is also a rise in the prices of the means of production in agriculture, and this increase hits the largest farms the hardest. Their price expectations are thus no doubt correct, but only in relation to the sale prices of agricultural products. This reasoning is confirmed by the decomposition of the TFP index in the input-output table.

TFP index decomposition – empirical facts

The detailed input-output matrices for the representative farms made it possible to decompose the index of the total factor productivity, and to evaluate which production tendencies caused changes in that index and what were the sources of the previously mentioned price expectation errors. The facts are as follows: in 2008–2013, the leading role in Polish agricultural markets was played by the changes in grain prices, which fell in 2008, 2009 and 2013 and rose in 2010–2012. While for the whole of the studied period the grain price index reached 1.10, in the period of the downturn (2008–2009) it amounted to 0.58 overall, after which it increased in 2010–2013 by 91.66%. In spite of the unfavourable price relations in 2008–2009, the index of the grain volume stood at around 1.3 in that period, in all SO classes except for the class VI (where it was about 0.8). Moreover, in the period of the downturn, there was also a fall in the fruit prices by more than 30% and in the prices of milk and dairy produce by more than 15%. There were favourable changes, however, in the prices of live pigs (up by almost 30%), eggs (by around 20%) and live cattle (by over 16%). It should also be noted that the years 2008–2009 saw an increase in the fertiliser prices by approximately 40% and in the prices of pesticides by almost 13%, as well as rises in the costs of labour and of the maintaining machinery and buildings. In turn, the period of the economic upturn, apart from the changes in the market for grains, also brought an increase by more than 50% in the prices of milk and dairy produce, while the potato prices rose by almost 45% and the prices of oil crops by more than 35%. Prices fell only in the case of pulses, for which the price index stood at 0.88. It should also be noted that in 2010–2013, the economic improvement in agriculture occurred in spite of the rising costs of production, including especially the increasing prices of feed (by more than 30%) and energy (index equal to 1.28).

Analysing the individual years of the cycle, it is seen that in 2008, for farms in all SO classes, as we have shown, there was a surplus outflow from the agricultural sector. This was caused firstly by the losses incurred by the producers due to the fall in grain prices, which was accompanied by an increase in the prices of feed. In 2008 producers enjoyed favourable prices for live pigs (and also for the oil crops in the case of farms in the classes IV, V and VI), but these did not make up for the negative changes, which also

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affected the markets for potatoes and live poultry, and on the production factors side, for fertilisers.

The year 2009 saw a continuation of the drainage of surplus through prices, again caused by the fall in the prices of grain, as well as those of milk and dairy produce. In the case of farms in the size class VI, however, the losses on this account were offset by the lower feed prices and rising prices paid for live pigs.

In 2010, there was an improvement in the situation as regards the income of agricultural producers. Price changes caused farms in all economic classes to enjoy an unexpected surplus. This was again chiefly a result of growth in the revenue from the grain production, but also from the production of milk and dairy produce, and of vegetables and flowers in the case of farms in the classes III–VI. Prices of fertilisers were also lower.

The realisation of an economic surplus due to the changes in prices continued in 2011, although not in the case of farms of the largest economic size. There were favourable changes in the prices of grains and live pigs, which were offset by the increases in feed prices (by more than 17%). On farms in the class VI, the surplus drainage resulted primarily from the prices of feed, but also the fall in the prices of vegetables and flowers (by around 17%) and eggs (8%), and higher costs of seeds and seedlings (by 26%). The greatest benefits to farms resulted from the prices of live pigs (in spite of the increase in the feed prices), and also those of grains and oil crops.

The year 2012 saw another change in the income position of farms. This time only those in the SO class VI enjoyed benefits on account of the price changes, chiefly due to an increase in the prices of eggs (by almost 50%) and live pigs (by more than 10%). Due to the tendencies in production, farms in the other classes suffered losses – surplus drainage – with regard to the changes in the prices of potatoes (down by 45%), fruit (by around 5%) and pulses (by 34%), as well as the rising costs of energy (by 10%), fertilisers (10%) and feed (7.6%).

Although 2013 was part of the economic recovery phase in agriculture, it should be noted that the surplus drainage occurred in all economic size classes of farms, auguring a change in the economic situation. In the SO classes I–V, this drainage resulted from losses on the production of grains, which were almost 12% cheaper than one year previously, fruit (prices down by 23%) and oil crops (down by almost 26%), offset by the increases in prices of potatoes (price index 1.89 relative to the previous year) and of the milk and dairy produce (prices up by 13%). In turn, the condition of farms with SO above € 500 000 was adversely affected by falls in the prices of eggs (by 21%) and fruit, and the rise of almost 4% in the feed prices.

CONCLUSIONS

Several general conclusions can be drawn from the study:

(1) Changes in the real TFP of family farms in Poland, in different phases of the business cycle, depend on the farm's economic size. In the case of 99% of the represented population in Poland, changes in the TFP are pro-cyclic. Only in the largest farms (SO class VI) are the changes in the real TFP anticyclic. This applies to both phases of the business cycle.

(2) There are indications that the SAPS system distorts price expectations, particularly in the phase of the economic downturn. In this period, the ratio of the CAP support to agricultural income was precisely correlated with the size of the error in the farms' price expectations. The same conclusion also holds in the economic recovery phase, but only in relation to the sale prices of raw agricultural products.

(3) If this is the case, it should be considered whether the CAP shift in emphasis towards payments dissociated from production may have a negative effect on the cyclic fluctuations in prices and agricultural production in the long term, in countries with the fragmented agrarian structure (the majority of the EU12 group of the new member states). This is an argument in support of the idea, not popular in those countries, of gradually modifying the structure of the CAP by way of "modulation", namely by transferring funds from the first to the second pillar of the CAP.

(4) Direct payments considerably reduce the influence of the "price gap" on agricultural incomes, but at the same time reinforce the King's effect. That is, they make it possible for farmers to sell products far below the costs of their production, a fact of which the purchasers of raw materials take advantage. The contemporary production subsidies – the Rural Development Plan from the CAP second pillar – are more effective. The European Union agricultural policy should aim towards the market valorisation of the public

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goods provided by agriculture, and towards a decrease in the price flexibility of agricultural raw materials at the processing stage (Tomek and Robinson 2001). This can be achieved by, among other things, stimulating integration processes in agriculture, developing organic farming and improving the image of the traditional agriculture. A subsidized agricultural insurance system, not the area payments, should be used as a counterweight to the expanding price gap.

(5) Promoting an industrial model of agriculture in Poland (Kowalski et al. 2011) and pushing the growth of efficiency of production factors "at all costs" mainly serves the food industry, which appropriates the rents from the growing productivity of agriculture. The evolution of the European model of agriculture towards sustainable agriculture is therefore justified (Brelik and Grzelak 2011). Methods of supporting agriculture should, nonetheless, compensate for the market failures, not reinforce the mechanisms of their formation.

In the light of the above considerations, it is timely to take a look at the available study results concerning the aforementioned problems in Poland. We admit that there are not many papers discussing these problems. According to some of them, the wrong price expectations in the agriculture in Poland result from a low price elasticity of demand for the massively produced food which dominates the food market in Poland (Daszkowska 2008). Demand elasticity is also lower in the case of products which have been granted the institutional support (Tweeten and Zulauf 2008). It is also suggested that, because of the international integration, which allows the export of the surplus production of food products or the import of goods in the deficit periods, it is possible to lower the elasticity of supply in Poland (Musiał and Wojewodzic 2013). This phenomenon is identifiable today in reference to the EU member states. The lower price elasticity of supply has a negative influence on shaping of the rational price expectations in agriculture (they are less rational and more adaptive), particularly under the conditions of a declining trend in prices of agricultural products. Summing up, there are evidences for doubting that that direct payments reduce the market influence on farmers' incomes, as some authors claim (Cunha and Swinbank 2011; Rembisz and Sielska 2013). If they do, it is to some extent an ostensible effect, because they simultaneously reinforce the King's Law.

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