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Subsidies versus economics, finances and income of farms (1)

INSTITUTE OF AGRICULTURAL
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Subsidies versus economics, finances and income of farms (1)

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The paper was prepared under the research subject **Financial and fiscal factors in the improvement of efficiency, sustainability and competitiveness of the Polish agriculture**, in the task: *Subsidies versus economics, finances and incomes of farms*.

The paper aimed at *ex-post* analysis of impact of subsides on the economic situation of farms, with special emphasis on the impact of direct payments.

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Introduction

Direct payments are the basic instrument of CAP and they are the foundation of a safety net in the agricultural sector, serving the stabilization of farmers' revenues. The subsidies are integrated in the character of budget policy, which has an allocation, a stabilization and redistribution function. They are an element in a farm income statement and thus they deserve special recognition at the time of testing the financial situation of agricultural farms or their development possibilities.

Since 2014, the payments have been granted to the so-called active farmers. The limitation aims to eliminate entities for which agricultural activity is not the major area of economic activity. The key change is the replacement of SAPS and SPS direct payment systems, operating so far, with the BPS system (Basic Payment Scheme).

"Greening" of direct payments took the form of payments for agricultural activities beneficial for the climate and the environment. The payments are granted if strictly defined requirements are fulfilled by the given farm.

Direct payments as the instrument of CAP supporting revenues proved more effective than the previously used instruments of price support. The issue was discussed in more detail in this publication. This means that the funds are to a smaller extent intercepted by other agribusiness sectors (the phenomenon defined as a support outflow taking place mostly for the benefit of suppliers of production means and recipients). Using the direct subsidy system leads to more rational, application of funds from CAP, consistent with the primary intended use.

This publication is fully devoted to the assessment of the impact of the subsidies, which is the first in the whole series of *Subsidies versus economics, finances and income of farms (1)*, planned for the coming years of a new Multi--Annual Programme.

1. Mechanisms and effects of agricultural subsidies – a theoretical depiction

1.1. Introduction

The notion of agricultural subsidies may be broadly understood as every action or lack thereof on the side of state institutions, which affects the level of income/profit of the producer (Schrank, Keithly 1999). In a narrower sense, agricultural subsidies mean budget payments transferred to agricultural producers in order to stabilize food prices, provide adequate supply of food, increase farmer income or to provide economic reinforcement of the agricultural sector. Presently, the notion of agricultural subsidies often refers to direct subsidies, particularly to direct income payments or even decoupled direct subsidies.

In order to present the mechanisms and effects of agricultural subsidies, the first part of the chapter includes indications for their introduction with a subsequent ordering of their forms. The types and effects of instruments restricting access to the market and export subsidies have been briefly discussed, with more attention being paid to internal support instruments and their consequences, depending on their connection with current production levels.

The second part discusses the impact of direct subsidies, particularly decoupled payments, on economic decisions of producers, as it is with them that the notion of agricultural subsidies is most often associated. The wealth and confidence effect, the increased liquidity effect and the expectations effect have all been explained, with an additional discussion on the impact of direct payments on agriculture productivity and presentation of the effects of their capitalization.

The third part presents the experiences of developed countries (the USA and the EU) regarding the use of instruments of direct support for agriculture. A short explanation is given on the most important reforms of agricultural policy introduced in those countries in the last thirty years, along with the resulting changes in the support structure for agricultural producers.

1. Premises and forms of intervention in agriculture

The essence of state interventions in the market economy is the creation of favourable conditions for development of those parts of the economy, which, for objective reasons, are not able to keep pace with its general growth rate without external help. One of those parts is agriculture. State interventionism in agriculture is, thus, a part of the economic policy and consists of conscious and purposeful activities aiming at correcting the market mechanism, its supplementation and, in some cases, deactivation (Wilkin 2003). The presence of state interventionism in agriculture is an effect of particular features of the agricultural sector and the resulting limited possibility of economic competition, as com-

pared to non-agricultural activities. These characteristics can be divided into four groups distinguished by: the land factor, agricultural production, agricultural markets, and the labour factor.

a) The land factor

One of the basic features of the agricultural sector determining its special nature, is the close relation of production processes with land which, as a production factor, has different features than labour and capital. For instance, the **inelasticity of supply** of land and **lack of substitutes,** which could replace land in the production process. Possibilities of increasing production and optimizing operations based on the land factor are limited. Land is also **immobile**, which means that there is no possibility to transfer it to a location, where it could be utilized more effectively. The exceptional character of the agricultural land factor is also determined by the fact of it performing two functions, i.e. apart from participating in food production, land also performs **environmental and natural functions**, which often find themselves in direct opposition.

b) Agricultural production

The connection between agricultural production and the land factor and its dependency on the laws of nature, increases the degree of **risk** and **uncertainty,** as compared to other sectors of the economy. In addition, agricultural production is characterized by **seasonality**, **capital turnover is slower** than in other sectors, which results in reducing effectiveness of the involved production factors. The uniqueness of agricultural production is also reflected in the structure of production entities: agricultural production is conducted by a large number of **minor and scattered** entities, **distant from the final buyer**, while the market of processors and intermediaries' displays a tendency towards **oligopolysation**.

c) Agricultural markets

Development problems in agriculture also result from the unique nature of agricultural markets, which are characterized by a relatively **inelastic demand** both towards price changes and income. It is also assumed that in the short term, **price elasticity of supply** of agricultural products is greater than that of the demand, resulting in a growth of purchase prices of agricultural goods, a relatively large growth in supply thereof on the market, as compared with the growth in demand for foodstuffs caused by the drop in prices. However, limited possibilities of shifting agricultural production, even in the long run, cause the supply of agricultural products in relation to the supply of industrial products also to remain relatively inelastic. Agricultural markets are also characterized by the so-called **extension of price scissors** phenomenon, which means that prices of industrial goods and means of agricultural production are

growing faster than the prices of agricultural goods; and the **King effect**, which states that low harvests often result in higher income for farmers than in times of high harvests, which stems from low price elasticity of food demand.

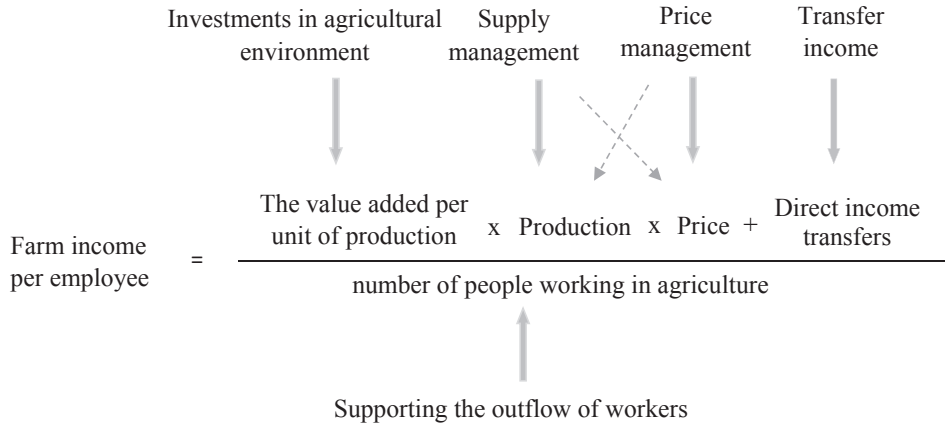
d) The labour factor

Another group of determinants of agricultural policy is a result of involving a specific production factor in the production process, i.e. the farming community. The dilemma of many farmers lies in the agricultural holding combining **the functions of a company and a household**. The response to economic incentives is, thus, different for agricultural holdings than in the industrial and services sectors. The labour factor in agriculture is characterized by a **specific (familial) employment structure** and its **limited mobility**. This means that despite the decline of production profitability of family farms, limiting production costs by employment reduction is not possible. For farmers working with their family, continuing operations makes sense even when no profits are gained, and only elementary needs of the family are catered to (Czyżewski, Matuszczak 2004).

The above-mentioned specific properties of the agricultural sector are the reason, particularly in developed countries, for it to be covered by a vast and complex system of financial policy intervention instruments. Traditionally literature on the subject divides the tools of agricultural policy into market instruments – which include measures affecting supply and demand of agricultural goods, their prices – and extra-market instruments, which most often include measures affecting the supply of agricultural goods and farmers' income (Pohorille 1964; Skawińska 1991; Klawe 1981). Additionally, in the case of many instruments, a problem arises of clearly qualifying them as part of one of the above-mentioned groups, because measures affecting prices influence, at the same time, the supply and demand of agricultural goods (Przygodzka 2006). Farmers' income depends, therefore, on a wide set of instruments affecting the value added created in agriculture, production volume, price levels, workforce, as well as the amount of profit transfers (Fig. 1).

All of the indicated intervention measures are not without impact on market processes, although the interference of some instruments in the market remains weaker than others. Presently, a tendency emerges for gradual abandonment of price support and supply stimulation instruments which are considered as measures strongly interfering in the market and accumulating problems in the form of high fiscal costs and overproduction, in favour of direct income subsidies, production limiting, infrastructural investments, and support for outflow of persons employed in agriculture.

Figure 1. The impact of agricultural policy instruments on farm income



Source: own study based on (Orłowski 1996).

Another, currently often applied, classification of support instruments in agriculture is that suggested during the agricultural negotiations within the WTO. These instruments have been divided into three basic groups: export subsidies, instruments limiting market access, internal support instruments[1].

a) Export subsidies

Export subsidies may take on the form of open instruments, e.g. budget subsidies to prices on the global market, export credits and guarantees, or the form of hidden instruments, e.g. cost refunds, market research or advertising, professional training, relief for conducting non-agricultural operations, food aid, etc. (Adamowicz 1988). The result of introduction of export subsidies is the increase in product prices, reduction of consumption levels, and supply growth on the domestic market. Export subsidies also deform competition conditions on third markets, because they enable exporters from developed countries to sell agricultural goods on global markets at lower prices. Thus, they are particularly difficult in the case of poorer countries, which cannot afford to subsidize their export. Export subsidies in the form of export refunds were used mainly by developed countries[2], enduring problems with management of supply surpluses of

[1] Additionally, the WTO distinguishes measures of sanitary and phytosanitary policy and technical standards, but they have been included in other agreements.

[2] Until 2013, export subsidies were mainly employed by the European Union. In 2011-2012, the total value of export subsidies in the world amounted to USD 500 million, 190 million of which came from the EU (Díaz-Bonilla, Harris 2014). The amount of export subsidies in the EU was determined as the same for all Member States and administrative control was exercised with export licenses. Subsidies included, e.g., cereals, dairy products, pork, rice, beef and veal, sugar, fruit and vegetables.

agricultural goods. At present, they mainly remain hidden in the form of competition and international cooperation support, government and non-government export guarantees, as well as food aid.

b) Instruments limiting market access

Instruments blocking access to the market are tools of agricultural policy limiting the influx of imports to a given country. These barriers may take on a form of customs protection, constraints and quantitative contingents, embargoes, compensations, voluntary export limitations, discretionary import licensing, administrative and commercial difficulties. Currently, the most frequently used means of market protection are import tariffs and customs para-quotas. The purpose of introducing customs tariffs is to maintain internal prices at a level higher than world average. In other words, the use of customs tariffs consists in raising the prices of imported goods to gain a competitive advantage on the domestic market and ensure sales priority for national products. This is the most widely used agent of trade policy in relation to all products, including agricultural goods.

From an economic viewpoint, customs tariffs cause negative effects for social welfare, both in the importing and exporting states, because production factors are located in places, where they are not utilized to their full extent. However, this instrument is more favourably assessed than other instruments restricting market access, which was directly reflected in the pursuit of WTO members of the so-called tariffication, namely replacing all instruments of protection with their customs equivalent. Also, the essence of customs para-quotas means allowing for the importation of some quantities (sometimes values) of goods from select countries, using a preferential customs rate or even completely tariff free. Import of goods above the volume of para-quotas and import from countries not covered by tariffication is subject to levying, according to the basic customs rate.

c) Instruments for internal support and their effect on economic decisions of agricultural producers

The third group of agricultural policy measures are instruments of internal support for agriculture. This is the largest group of agricultural policy tools, focused mainly on regulating market relations in a given country and, to a lesser extent, on regulating commercial relations with third states. As a consequence market volumes are generated which are different than it would seem from the market mechanism. A set of internal support means for agriculture contains both mechanisms affecting the supply of agricultural goods, their prices, demand and farmers' income.

The most important instruments in this group include: the purchase and warehousing of surpluses, limiting production, subsidizing consumption, a system of guaranteed prices, direct subsidies, and funding agricultural credits. Internal

support instruments also include means supporting the sector in its entirety, but not directly interfering in the functioning of the market mechanism. These are mainly instruments supporting infrastructure and the rural environment, as well as structural transformations of rural areas. These include: support for biological progress, agricultural consulting, research and education, marketing and promotional services, retirement programmes, environmental protection, structural adjustment, regional aid, etc. Expenses for these instruments are still a small share in public expenses on agricultural policy, although in developed countries this share is still growing.

As part of negotiations on the WTO forums, instruments of internal policy for supporting agriculture have been divided into three main groups called the three "boxes". They were labelled "amber", "blue" and "green", depending on their impact on producer decisions and market equilibrium, as well as different obligations for reduction. The "amber box" includes impact measures on the level of production, directly distorting market processes. These include, e.g.: intervention prices, subsidies to production means and other instruments directly affecting the production volume.

The "blue box" includes direct support for farmers, provided it is tied to production restriction programmes, e.g.: payments under exclusion of land from cultivation. It has been assumed that these subsidies must be: based on agreed land areas and yield sizes, or paid for at most 85% of the initial production level, or based on permanent numbers of farm animals. On the other hand, instruments from the "green box" do not have a direct effect or have only a minimal effect, on free trade and market processes[3]. These subsidies must be drawn from budget sources, may not be a result of quoting higher product prices to consumers and they cannot involve a mechanism supporting market prices.

The impact of instruments of internal support on economic decisions of agricultural producers varies depending on the form of received subsidies, i.e. their association with particular "boxes". Each producer, who maximizes their profits, tries to answer two questions: is production profitable, and what is the

[3] This group of instruments includes: direct income payments for producers of a decoupled nature; assistance in structural adaptations, rendered by means of investment support; payments under environmental protection programmes; payments under regional aid; assistance for the purposes of structural adaptations, rendered under pension programmes; assistance for the purposes of structural adaptations, rendered under production factor withdrawing programmes; domestic food aid, financial participation of the government in programmes of income insurance and other income protection programmes; payments in connection with natural disasters (made directly or via government measures in harvest insurance); public services programmes – research, protection against parasites and diseases, trainings, counselling, and the popularization of agrotechnical knowledge, inspectorial, marke-ting and promotional services, services of an infrastructural character, public stocks for alimentation safety purposes.

optimal level thereof? Farmers' revenue may be of a variable nature, i.e. connected with current production levels, or constant, which is not the result of sales and consequently is not connected with current production levels. Also, costs of conducted operations may be divided into variable and fixed. In the short term, when a part of costs takes on a fixed form and there is no possibility to change the fixed part of a farmer's revenue, economic decisions of agricultural producers are taken on the basis of relations between the variable expense and the variable revenue. In the long term, when all costs and revenues adopt the variable form, the producer makes decisions on the basis of relations between the total expense and total revenue.

If the difference between the variable revenue and the variable expense is, in the short term, positive, the producer decides to continue operations, even when the difference between the total revenue and the total expense is negative. In the long term, the farmer determines continuance of production only if the difference between the total revenue and the total expense is positive (Galperin, Doporto Miguez 2009). Subsidies related with current production levels should be, therefore, treated as variable revenue, while subsidies not related to production levels, as fixed revenue. As such, the former affect short-term decisions of agricultural entrepreneurs', the latter are associated with long-term decisions. Thus, both kinds of subsidies may distort economic decisions of farmers and resource allocation. The force of this impact is related with the degree of linkages of a given support instrument, with the level of production. Payments, to a greater extent decoupled from current production levels, are assumed to distort farmers' economic decisions to a lesser extent.

Internal support instruments may have three kinds of effects related to agricultural producers' decisions (Anton 2001):

- a static effect – a change of a relative price level of products and/or outlay prices, leading to changes in resource allocation and thus affects farmer's production decisions;
- a risk effect – limiting the instability of income and the higher level thereof reduce aversion to risk, which affects a farmer's production decisions;
- a dynamic effect – some current instruments may affect current or future decisions of farmers, which may result in a change in future production volume[4].

Considering solely the static effect, decisions of agricultural producers are to the greatest extent distorted by price support instruments. They directly encourage agricultural producers to increase production. Since the consumer price,

[4] This concerns mainly two relations: increased guarantee of revenue in the future stimulates higher investment outlays; expectations regarding future support programmes and updating reference yields incentivises producers to increase current production levels.

is higher, the consumption level drops and may cause a problem with supply surpluses. Direct subsidies, based on current production volume, increase revenue and stimulate agricultural producers to increase supply, they do not however, increase consumer prices. Payments not related to current production levels, increase producer revenue, they do not, however, directly incentivise the farmer to increase supply.

The evaluation of the influence of internal agriculture support mechanisms on producer decisions is becoming more complicated if the farmer produces different goods supported by instruments with different static effects, the risk effect varies depending on the amount of received subsidies or when all three effects are present simultaneously. The OECD research (2001a; 2005) indicates that farmers' economic decisions are to the greatest extent affected by subsidies based on the use of variable outlays, price support and by subsidies related with current production levels, while production levels are least affected by subsidies based on historical rights and the cultivation area.

Additionally, individual instruments of agricultural policy may also have an indirect influence on economic decisions of agricultural producers, and to identify and understand these mechanisms should only be possible after their implementation and adequately long experience in their application. Such instruments unquestionably include direct subsidies, which, although not a new instrument, have never been used before as part of the agricultural policy of developed countries on such a large scale and in such a diversified form.

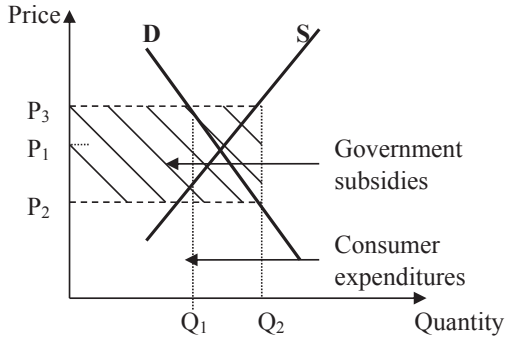
1.2. Impact of direct subsidies on economic decisions of agricultural producers

The system of direct subsidies for agriculture consists of direct fund transfers from the state budget to farmers bypassing the market. They may assume many forms depending on their connection with current production or current price levels. Direct subsidies are usually paid in relation to specific results of production operations (e.g. the number of animals, sowing area), or assume the form of subsidies to prices.

Direct subsidies are most often limited. Support will be given only to select products, and the funds for subsidies are limited, both with regard to the level per production unit or area, and as a total amount for individual farmers. This system enables maintaining the desired level of agricultural income, as well as low food prices, which positively affects the volume of food demand. Subsidies are given to farmers directly and therefore allow a more free operation of the market mechanism. These programmes reduce the demand for other forms of government assistance, such as surplus purchases or limiting production (Tomek, Robinson 2001).

One of the first forms of direct subsidies were compensations, the idea of which consisted in payments of the difference between the lower market price and the state-guaranteed price, provided that produce is sold on the domestic market. The economic effects of introducing compensations are presented in Figure 2. The guaranteed price for producers P_3 is at a level above the equilibrium price P_1, resulting from the work of the market mechanism. At the same time, the guaranteed price corresponds to the volume of supply $(Q)_2$ and consumption $(Q)_1$. To increase the demand volume to the level $(Q)_2$, the price must drop to the level P_2. Thus, the amount of compensations to production units is the difference between the price guaranteed for producers P_3 and the price P_2 ensuring an appropriate consumption level. Consumers will benefit from formation of a price lower than the equilibrium price, while producers will benefit from the increase in production volume and receive subsidies from the state.

Figure 2. The economic effects of introduction of compensatory subsidies



Source: own study based on (Tomek, Robinson 2001).

Since payments coupled with the current production level, such as compensations, lead to the formation of supply surpluses and promote large and strong agricultural holdings, their social validity is limited and governments find it progressively more difficult to persuade consumers and taxpayers that there is the need to support the agricultural sector. In order to neutralize the impact of direct subsidies on the agricultural production increase, they may be realized with regard to the specified production volume or acreage during a fixed base period. These are the so-called decoupled payments. The idea is to pay direct subsidies to the production volume or area, most often determined on the basis of the average from previous years, allowing the farmer freedom of decision on current production, which due to this mechanism is not related with the level of subsidies.

The purpose of these payments is to provide support to agricultural producers in a manner which would not distort the levels of prices, production, consumption, and turnover in foreign trade. Decoupled payments are, therefore,

increasing market orientation of producers, reducing distortions in supply and trade and are more environmentally friendly, raise competitiveness within the sector as well as improve effectiveness of income support. The decoupling of agricultural policy means changing it in the direction of separation of production decisions and the support level. Therefore, the idea of decoupling means reforming policies so as to limit their distortion of production and trade but, at the same time, to preserve their properties regarding income transfers.

Decoupling is, however, perceived differently from the perspective of WTO negotiators, politicians and economists (Baffes, de Gorter 2005). WTO negotiators discern in decoupling, the possibility to level competition between countries supporting and not supporting the agricultural sector. Politicians oftentimes treat decoupling as an alternative form of subsidizing agricultural producers, which makes it possible to fulfil international obligations, and simultaneously keep support at a similar level.

Economists are discussing the impact of decoupled programmes on economic decisions of farmers and agricultural production. In the 1990s, many economists claimed that these payments do not affect current production decisions (Alston, Hurd 1990; Blandford, de Gorter, Harvey 1989; Borges and Thurman 1994; Sumner, Wolf 1996). However, presently, as a result of increasing experience with direct payments, these views have changed. Decoupled payments could be unrelated with producer decisions, only assuming that agricultural markets are perfect, permanent scale effects and a neutral attitude towards risk are in place (Sipiläinen, Kumbhakar 2010). Therefore, most economists now express the view that decoupled payments and production decisions of farmers are related, due to, e.g., a raise in land purchase and lease prices, an increase in financial liquidity of farmers, resulting in a raise in solvency, a reduction in the aversion to risk-taking, and affect investment decisions as well as change expectations connected with future government policy, etc. (UNCTAD 2007; Sumner 2005). Subject literature provides no common definition of decoupling. A narrow interpretation defines decoupled payments as not causing any changes in producer and consumer decisions. This means that supply and demand curves on a given market, after introducing payments, are not subject to change. A broad definition of decoupled payments states that the size of supply and trade remain the same as with no payments present, however, the shape of the curves for supply and demand can change (OECD 2001b).

Discussed below are selected effects of the impact of decoupled payments on current economic decisions of agricultural producers: wealth and confidence effects; increased liquidity effect; expectations effect; impact of payments on productivity and the capitalization effect.

a) The wealth effect, confidence effect and the reluctance to take risks

Impact of direct payments on production decisions of a farmer depends on their tendency to take risks. In the case of farmers who are reluctant to take risks, direct payments can lead to the so-called wealth effect, i.e. payments increase farmers' wealth and change their attitude to risk-taking. Thanks to the payments, the farmer may be more willing to increase production and employ additional production factors, which, in a situation of lack of payments, would prove too risky (Roche, McQuinn 2004).

The wealth effect can be explained using basic microeconomic concepts. In a classic problem of profit maximization:

$$Max_Q \pi = P_T \cdot Q_T - C(Q_T) + S(Q_B)$$

where:
π – is profit,
$P_T \times (Q)_T$ – is the total revenue in time T,
$C\ (Q_T)$ – is the total cost in time T,
$S\ (Q_B)$ – is the value of subsidies based on production size in the base period B.

Producer profit is calculated as the difference between total revenue and total expenses, plus the total value of subsidies. The producer will maximize profit when the marginal revenue (MR) will equal the marginal cost (MC):

$$MR - MC = P - \frac{\partial C}{\partial Q} = 0$$

Since the value of subsidies is based on production volume in the base period $(Q)_B$, it is treated as a fixed constant value and is not part of the condition of profit maximization. Producer decision may, however, differ, if we consider a slightly more complicated case of decision optimization, i.e. decision-making in risky conditions. According to the expected utility theory[5], the entrepreneurs including risk in their decision-making process, will operate so as to maximize the expected value of the utility function from profit:

$$Max_Q EU(\pi) = E[U\{P_T \cdot Q_T - C(Q_T) + S(Q_B)\}]$$

Then, the maximization condition:

$$MR - MC = E\left[U'(\pi)(P - \frac{\partial C}{\partial Q})\right] = 0$$

[5] The Expected Utility Hypothesis explains the behaviour of entities operating in risky conditions. It assumes that these entities perform a utilitarian function, defined on a set of alternatives, and under risky conditions must choose random events, so as to maximize the expected value from the function U.

will include the value of subsidies. Since the value of subsidies has not been eliminated from the condition for profit maximization during differentiation, it can affect the decision concerning production volume in risky conditions (UNCTAD 2007). This means that decoupled payments are increasing farmers' wealth and make them more willing to take risks (Hennessy 1998).

Farmers' reluctance to take risks may also be limited through reducing income instability, i.e. the so-called confidence effect. As a result of a steady stream of direct income, decoupled payments reduce uncertainty of management, which would make them a form of insurance (Banga 2014). Numerous empirical research (Anton, le Mouel 2004; Sckokai, Moro 2006; Serra, Goodwin, Featherstone 2011; Just 2011) confirms that direct subsidies, including decoupled payments, may affect economic decisions of agricultural producers, reducing their aversion to take risks, but most of the mentioned authors believe that such effects are weak. On the other hand, the OECD research (2005) indicates that the confidence effect has a greater impact on farmer decisions than the wealth effect and in some cases may even be stronger than the price support effect.

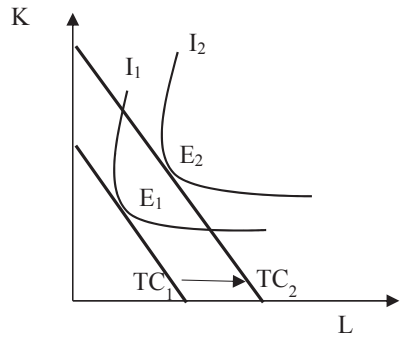
b) Financial liquidity and budget limitations

Direct payments may also affect the decisions of the producer representing a neutral attitude towards risk, since decoupled payments increase farmer solvency. As they are a constant stream of revenue, independent from the market conditions and production level, they increase farmer access to credit/capital and may, therefore, change their current production decisions. Furthermore, increasing financial liquidity, thereby limiting costs related to production crediting, which in connection with the decreasing tendency to consumption during conditions of income growth, is a stimulus for investments (Roe, Somwaru, Diao 2002; Sumner 2005). Numerous empirical research (Rude 2000; Benjamin, Phimister 2002; Vercammen 2003) confirmed a positive relation between the level of investments in agricultural holdings, and cash flows and lowered credit cost.

Direct subsidies, increasing the farmer's income, but also allowing for the acquisition of additional funding, enable to purchase more production factors, therefore, reducing the limitation of production potential of an agricultural holding, which may in consequence increase the level of production. Figure 3 shows the effect of direct payments on the producer's optimum in the long term. Direct payments move the farmer's budget limitations from the level of TC_1 to TC_2 in the direction opposite to the beginning of the coordinate system, and allow for achieving a higher production isoquant I_2 or other combinations of work and

capital located on the isoquant I_1. Assuming that the costs of capital and labour should remain constant, the farmer has the option to purchase more capital (K) and/or labour (L), which will lead to an increase in production levels[6].

Figure 3. Change of the optimum of producer after the implementation of compensatory subsidies



Source: UNCTAD 2007.

Decoupled direct payments may also keep in the sector, farmers who find themselves on the edge of profitability. They continue production because direct subsidies allow them to quickly cover fixed costs. If not for the payments, they would make the decision to discontinue agricultural production and transfer production factors to other applications (Chau, de Gorter 2005; Kropp, Katchova 2011). This phenomenon results in the delay of structural changes in the agricultural sector.

c) Expectation effect

Farmers also formulate expectations towards future support programmes and assume that yields/base area for direct payments may be updated in the future. Since a higher level of current production may constitute a point of reference for future payments, in order to maximize the payment value in the future farmers, may make a decision to increase production (Banga 2014). An example are the actions of the American government, which in the Farm Bill 2002 and Farm Bill 2008 increased expenses for the agricultural sector and allowed for the update of base yields (referential)[7]. The result is that farmers anticipate further,

[6] Higher levels of financial capital in relation to its price and greater perspectives for production indicate the possibility of increasing investments in physical capital (modern machines and related technologies of production (Rembisz, Sielska 2015)).

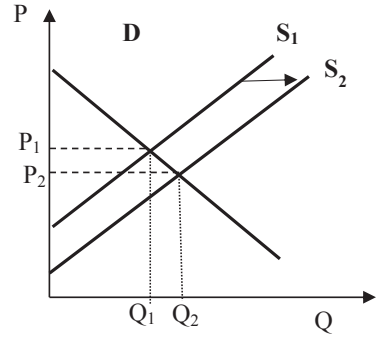
[7] N. Key, M. Roberts and E. O'Donoghue (2006) proved that American farmers participating in government programmes have increased the area of cultivations covered by these programmes by 38% to 59%, as compared to farmers not participating in the programmes. But then again P. Sckokai and J. Anton (2005), in their studies concerning decoupled payments in the EU

similar actions, which may influence their current production decisions. The expectations with regard to future support programmes and their possible modifications can encourage farmers to increase production and purchase of land (Goodwin, Mishra 2006; Bhaskar, Beghin 2010).

d) Productivity/Technological Effectiveness

Direct subsidies, such as support for investments, environmental payments, structural programmes, advisory services or R&D funding may, in the long term, affect productivity of agricultural holdings. If production costs do not change, the increase in productivity will lead to an increase in supply, as shown in Figure 4. Growth in productivity will result in a shift of the supply curve from S_1 to S_2, and an increase in production levels from Q_1, to Q_2. However, greater supply will lead to a price decrease to the level of P_2[8], which, in the case of food products often characterized by low price elasticity of demand, will lead to a reduction in the agricultural producer's revenue.

Figure 4. The effects of productivity growth of farm as a result of the obtainment of investment-direct payments



Source: UNCTAD 2007.

Empirical research (Rizov, Pokrivcak, Ciaian 2013) still indicates that income type decoupled payments lead to a growth in production as a result of improving management effectiveness. This positive impact on the increase of productivity is a result of increasing investment outlays in connection with the wealth and confidence effects and increasing solvency, especially in farms with limited access to capital. S. Mary (2013), while examining the impact of various types of agricultural subsidies on the productivity of French cereal holdings in

Member States, went so far as to prove that area payments have a greater positive effect on increasing the holding area than an equivalent price support.

[8] If a country subsidizing agricultural producers is also a sizable economy, the price on the global market will also be reduced.

1996-2003, demonstrated that the CAP reform of 2000 (i.e. the introduction of partial decoupling) had a positive impact on the total productivity of these holdings, which resulted in higher production.

Nonetheless, direct subsidies decoupled from the current production levels may be responsible for reduced technical effectiveness, which may occur mainly in smaller holdings. If receiving payments is not conditioned by the volumes of current production, farmers may attribute less importance to achieved production size, and then agricultural subsidies cease to be a factor stimulating improvement in efficiency (Sipiläinen, Kumbhakar 2010).

e) Capitalization of direct payments

One of the consequences of introducing direct payments is also their capitalization, which consists in accumulation of parts of their value in the fixed asset and rent values. Currently, economists debate on the extent to which direct subsidies are capitalized in the growth of land and rent values[9]. The capitalization rate depends on the adopted support model of the economic situation in Poland as well as the structure of agricultural holdings and production direction (Góral, Kulawik 2015).

The phenomenon of capitalization limits the impact of subsidies on agricultural income, as the support goes, through higher rent to land owners, who are not always the persons conducting agricultural operations (Van Herck, Swinnen, Vranken 2013). One of the consequences of capitalization of agricultural subsidies is also the limitation of mobility of production factors. Since direct subsidies are capitalized by land and rent value, novice farmers are facing higher costs of entering the market (Goodwin, Mishra, Ortalo-Magne 2011). Also, farmers already conducting activities are facing higher barriers for developing their operations with regard to high purchase or land lease costs. This means lower mobility of land and other production factors, which in turn impairs structural transformations in agriculture. On the other hand, the higher value of owned fixed assets raises farmer solvency and reduces the cost of capital acquisition[10]. This in turn may lead to the acceleration of technological changes in agriculture.

[9] S. Lence and A. Mishra (2003) claim that out of every dollar of direct payments as much as 86% goes to land owners in the form of higher rent. B. Kirwan (2009) and K. van Herck, J. Swinnen and L. Vranken (2013) claim this to be ca. 15-25%. But N. Hendricks, J. Janzen and K. Dhuyvetter attempt to prove that short-term decoupled payment capitalization rate is 12%, but the long-term may reach as much as 37%.

[10] J. Kropp and B. Whitaker (2011) proved that with the increase of the relations of the base area for payments to the total area of cultivations of a holding, farmers are able to acquire lower interest short-term loans. The lower operating cost decreases the relative cost of expenditures, therefore, changing the levels of current production.

1.3. Experiences of developed countries with regard to direct subsidization of agriculture

The process of decoupling direct payments from the current production levels begun in 1985 in the USA, under the Farm Bill, along with the introduction of direct payments for cereal producers based on historical yields[11]. In the EU, the decoupling of agricultural policy begun along with the McSharry reform in 1992, which saw the introduction of the so-called: compensations for agricultural producers. Since then, the agricultural policy in the US, the EU and other developed countries is constantly evolving in the direction of further direct support of agriculture and the separation of agricultural subsidies from current production levels. On the one hand, this process is the effect of internal pressure (the need to restrict unfavourable effects of support, related to current production level, leading to surpluses in food supply) and, on the other, the pressure of international institutions, including the WTO (the need for introducing instruments which do not distort prices and commercial exchange on the global markets).

Although first decoupled payments appeared in the USA in 1985, they saw common use no sooner than 1996 in the FAIR Act[12]. The basic assumption of this bill, was the reform of agricultural policy in the direction consistent with the provisions of the agricultural agreement of the WTO Uruguay Round. Support instruments for market prices and compensations were in part replaced by the programme of direct PFC subsidies[13] based on historical cultivation areas. These subsidies were rendered for 85% of the approved area, but payment was not dependent upon the size of current production.

Another Farm Bill was introduced in 2002. This act was a surprise, as it stood in opposition to the further limitation of support for the agricultural sector declared by the USA on the WTO forum. It continued many programmes first introduced in 1996, with particular focus on direct PFC payments, but it also introduced new forms of support for farmers related to current production and price levels. The PFC payments enabled farmers to update the reference area or yields, which constituted a basis for payments received, which in principle stood in conflict with the idea behind decoupled instruments.

[11] First attempts of introducing decoupled payments were undertaken as early as 1949 in the USA, under the so-called Brannan plan. It proposed introducing payments for producers whose income would be below a certain, specified level. The idea was, however, rejected by the Congress.

[12] FAIR Act – Federal Agriculture Improvement and Reform Act.

[13] PFC – Production Flexibility Contract. Initially these payments were called AMTA, due to a part of the Act entitled the "Agricultural Market Transition Act Payments", while from 2002 they are more often defined as direct subsidies (Ahearn, El-Osta, Dewbre 2006).

The Farm Bill of 2008 continued most of the assumptions of the previous act, including the direct subsidies programme, but again, farmers were allowed to update referential yields. Additionally, new aid schemes have been introduced in case of natural disasters, as well as long-term cultivation insurance programmes. One of the most important changes was the introduction of new ACRE payments for plant production[14], which depended on the level of current income, and which could be chosen by farmers as an alternative to current subsidies based on target prices. It was another step towards reducing price support for direct subsidies in favour of assistance of a more market nature.

Quite surprising, on the other hand, was the latest Farm Bill of 2014, introduced with a two-year delay, which completely withdrew direct decoupled payments. New programmes were introduced in their place[15], depending mainly on the income level of farmers, which, in the case of drops of sales prices in agricultural markets, may result in increasing the support assigned to the "amber box".

Figure 5 presents changes in the structure of support granted to agricultural producers in the US[16] in 1986-2014. The introduction in 1996 of direct PFC payments was reflected in an increase in the share of payments based on historical privileges. However, the introduction in 2008 of the ACRE programme resulted in an increase in the share of payments based on current acreage, associated with the requirement of conducting crop cultivation. Throughout the presented period a clear tendency can be observed, though, for restricting price and production related support for direct subsidies of a more or less decoupled nature.

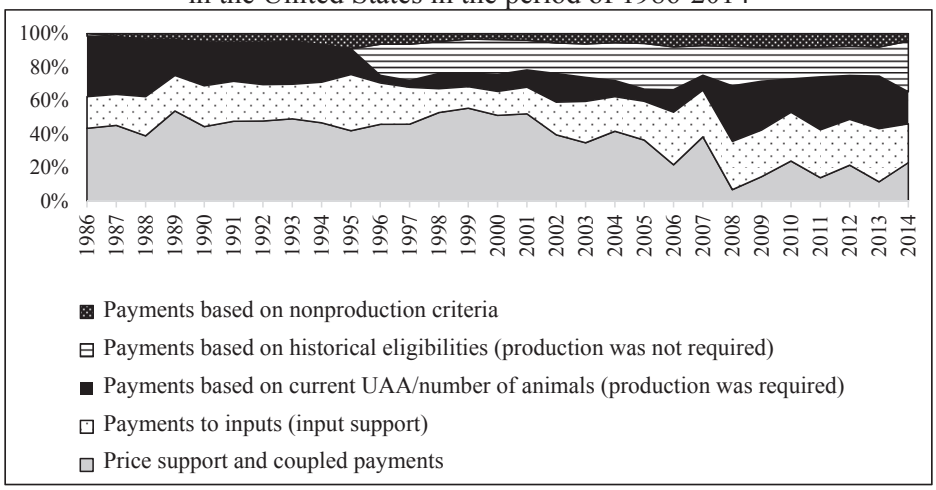
The EU also observed that payments related to current production have negative consequences in the form of supply surplus. In 1986, Mansholt proposed to introduce the first decoupled instruments in the form of pensions for senior farmers. This plan, however, had not been implemented. A step towards decoupling has been taken in 1992, as part of the McSharry reform, partially replacing the mechanism of intervention prices with compensations. But this was not a full decoupling because producers, in order to receive payments, were required to cultivate crops within the reference area and the amount of payments was different, depending on the type of production (Baffes, de Gorter 2005).

[14] ACRE – Average Crop Revenue Election.

[15] New programmes include: Price Loss Coverage (PLC) wherein payments depend on low cereals prices; Agricultural Risk Coverage (ARC), wherein payments are rendered in the case of a moderate drop in income per hectare; and two strongly subsidized insurance programmes (SCO and STAX).

[16] While analyzing agricultural support policy in the USA, it is worth remembering that more than 80% of the total amount spent to support agriculture is rendered in the form of internal food aid. These expenses are not included within the PSE ratio structure.

Figure 5. The structure of Percentage Producer Support Estimate (%PSE) in the United States in the period of 1986-2014



Source: OECD 2015.

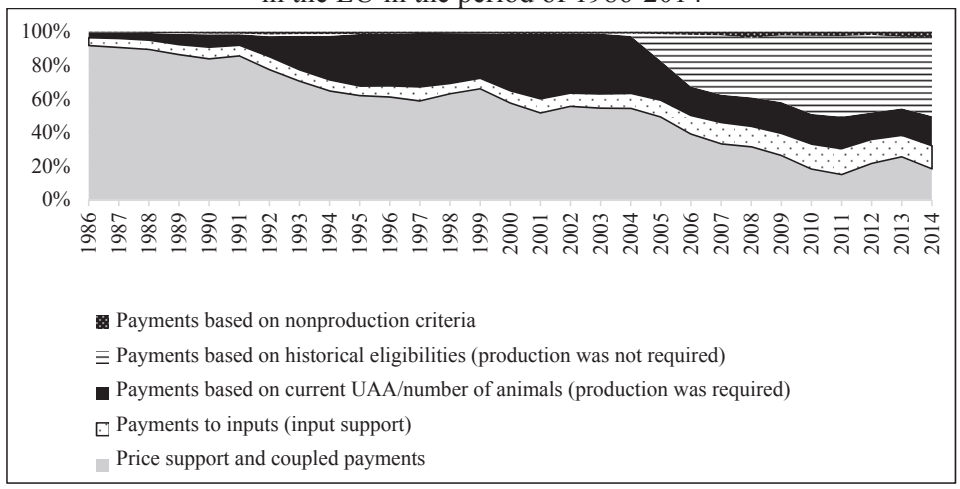
Payments not related with current production were introduced no sooner than within a new CAP reform in 2003[17]. A key element of the new CAP was the introduction of the single payment system (SPS) in the so-called "Old Union" Member States and a simplified SAPS system in newer Member States. SPS payments were largely independent from current production volume, except for production which was under the risk of cessation[18]. It allowed farmers more freedom with regard to deciding on the use of available land, assuming, however, that it will be used for agricultural production. Newer Member States, where the SAPS system was introduced, were subject to a uniform payment for decoupled farms and a supplementary payment, connected with the type of production. The introduction of a new formula of direct payments, where the level of payments was separated from current production levels and structure, allowed for their qualification into the "green box", according to the WTO criteria. (Buckwell 2008). Under the CAP "Health Check" review in 2008, the decoupling scope was deepened the SPS system[19], it was decided to withdraw the milk quotas by 2015 as well as considerably decrease the price support on the sugar market.

[17] The reform of 2003 is said to be "the most radical CAP reform in history" (Tangermann 2014).
[18] Member States have the possibility to use specific payments resulting from a willingness to maintain specified directions of production and rendering to farmers additional payments as incentives for maintaining directions of production important from the environmental protection perspective. This possibility was used to its fullest extent in, e.g., France, while the full separation of payments from production was introduced only in England, Germany and Ireland.
[19] Utilizing specific payments only for suckler cows, goats and sheep.

In 2013, the EU decided on the shape of the CAP in 2014-2020. It was decided that the new EU agricultural policy will be continued with solutions introduced in 2003 and 2008. The direct payments system was upheld, and the changes introduced were related to their division scheme[20]. A novelty, however, is the so-called "CAP greening", which associated the right to receive direct payments with taking actions beneficial for the natural environment and the climate. Also, it was decided that sugar quotas will be withdrawn by 2017. Some changes have been made to rural development programmes (RDP). Member States can, e.g., utilize risk management tools in order to stabilize agricultural income (Tangermann 2014).

The impact of individual CAP reforms on the structure of support for agricultural producers in the EU is presented in Figure 6. It indicates that after introducing the reform in 1992, the support structure underwent fundamental changes. Price support was decreased in favour of payments based on current acreage / number of animals, which corresponds to compensations. Nonetheless, the 2003 reform caused a significant increase in the share of payments based on historical amounts, i.e. decoupled payments.

Figure 6. The structure of Percentage Producer Support Estimate (%PSE) in the EU in the period of 1986-2014



Source: OECD 2015.

Thus the EU CAP exhibits a clear and consistent evolution of the agricultural policy from price support transferred via the market, through budget support in the form of partially decoupled direct payments, to SPS payments decoupled from current production levels.

[20] Member States also have the possibility to divert 13% of direct payments, to subsidies related to current production.

1.4. Summary

The agricultural sector, particularly in developed countries, is the part of the economy covered by an advanced intervention system. The tools of the agricultural policy include both instruments of trade policy, as well as domestic policy. Additionally, this policy is often subject to change, which is a result of searching for a support model with the least possible amount of negative effects, and, at the same time, meeting the basic goal, which is to ensure appropriate income levels for agricultural producers.

In the last 30 years, developed countries have been consequently seeking to decouple the agricultural subsidies system from current production levels and, at the same time, minimize their impact on agricultural producers decisions. Literary works on the subject, however, suggest that even direct subsidies of a theoretically decoupled nature, may affect economic decisions of agricultural producers. The reason is that they increase both the income and wealth of farmers, positively influencing their financial liquidity and raising solvency. In turn, the material effect reduces aversion to risk-taking, which promotes increasing the level of investments and production. Economic decisions of agricultural producers may also be affected by farmers' expectations towards future support programmes. Direct subsidies are also capitalized in land prices and lease costs. These mechanisms are complex, often multi-directional, and depend on various conditions. The same instrument may positively affect the economics of an agricultural holding in one country and be detrimental for holdings in another country. Precise determination of the effects of agricultural subsidies requires in depth empirical research and continuous verification of theoretical knowledge.

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2. Impact of the CAP reforms on income volatility and income risk of individual agricultural holdings – research concept

Agricultural holdings are exposed to many types of risks such as, e.g.: personal risk, low crops, price, institutional and financial risk[1,2]. Traditionally, a risk typical of agricultural production is production risk resulting mostly from biological nature of production, which largely depends on factors beyond the manufacturer's control[3], e.g. weather factors, condition of cultivations and healthy growth of animals.

In addition to production risk, like in other sectors of the economy, farms must cope with price, financial, property or personal risks as well[4,5,6].

However, it should be noted that, owing to the high level of support for agriculture, the farmers' income more and more often depends on the amount of obtained state aid. Additionally, frequent reforms of the CAP and growing uncertainty of its future shape, changing methods of distributing assistance funds and imposed additional requirements and constraints result in additional risk for future agricultural income.

Research concerning the impact of agricultural policy reforms on the results of farms has been carried out for a long time. It was also the object of concern during works conducted under the Multi-Annual Programme 2011-2014 (Polish: *Program Wieloletni*)[7]. The then used methodology focused on determin-

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ation of changes in the structure of sowings and estimation of the average income fluctuations in particular types of the FADN farms and regions as a result of the CAP greening. This research, however, did not analyse income risk of farms but only changes in the average level of income expected as a result of agricultural policy reforms.

Other available studies concerning income volatility and income risk of agricultural farms do not take into account conditions characteristic for Poland[8], they do not apply to the latest assumptions of the CAP reform[9] or they describe only theoretical aspects of the impact of aversion and perception of risk on effectiveness of agricultural farms (Sulewski 2015[10]). In order to supplement the emergent gap, the research concept has been prepared with an effort to estimate the impact of the most recent CAP reforms on volatility and income risk for Polish agricultural farms.

The primary purpose of this study is to present the concept of measuring income risk fluctuations resulting from changes in the CAP, which will constitute a supplementation of the so far described effects of introduction of the last CAP reform. A simulative farm model using Monte Carlo method was used as a basic tool for implementation of the objective. The analyses are based primarily on accounting database of the FADN farms and results of the FARM_OPTY optimisation model for farms, used in order to determine adjustments within the structure of production taking place in the examined farms. A significant difference as compared to the so far available studies utilizing this source is consideration of weights assigned to particular farms from the FADN base, while estimating simulation model parameters. This is described in the part concerning research methodology.

2.1. Methodological assumptions

The conducted research assumed the use of two mathematical models:

- simulation model based on the Monte Carlo method,
- optimisation model using the Positive Programming Mathematical technique.

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The drawn up model chain enables to estimate income volatility for the analysed types of farms for baseline situation, before introduction of requirements related to implementation of the CAP greening, then to determine optimal structure of production, suitable for requirements of the reform and to redetermine income volatility.

Conducting research required preparation of scenarios describing the basic CAP assumptions. Drawing on the examples of research conducted in 2014[11], the following scenarios were used: Base12, Base, Green, No Green.

Adopted scenarios concerning the future (Base, Green, No Green) do not assume a precise timeframe. Calculations were made using current prices, and estimated effects assume a full implementation of assumptions of every scenario.

A. The Base12 scenario and the Base scenario

The above scenarios assume continuation of the CAP reform 2007-2014. The Base (Base12) scenario was used solely to calibrate optimisation model, based upon the FADN data from 2012. This model has been adopted as a starting one for further research. Then the Base scenario constitutes a benchmark for other scenarios of the reformed CAP. The Base scenario assumed maintenance of the existing CAP mechanisms unchanged, understanding that the model will use rates of direct payments at the level of that binding in Poland in 2013.

B. The Green scenario

This scenario assumes implementation of the CAP reform adopted in 2015 with the use of rates of direct subsidies in the amount of EUR 184 per ha, including 30% "green payment" – EUR 74 per ha. The adjustment of modelled farms to the requirements resulting from "the CAP greening" was assumed in the scenario, i.e. crop diversification, maintenance of required EFA (Ecological Focus Area – surface of ecological compensation) and preservation of at least 95% of the reference area of permanent grasslands.

The Green scenario assumed the reduction in agri-environmental payment rates, planned in connection with inclusion of a "greening" component to the direct payment system and reduction in financing agri-environmental activities under the II Pillar from EUR 2,304 billion in the RDP 2007-2013 to EUR 1,060 billion in the RDP 2014-2020. The sum of agri-environmental payments received so far per modelled average farm were reduced in the models by 46%.

[11] *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (scientific ed. J. Kulawik), Program Wieloletni 2011-2014, no. 120, IERiGŻ-PIB, Warsaw 2014.

The Green scenario considers new kinds of payments introduced in 2015[12]:

- The payment for young farmers (up to 40 years of age) who run their farm not longer than for 5 years. This payment has the form of an area payment with the rate of 25% of the average national payment per hectare, which is approximately EUR 62 per ha. It is granted for the area not greater than 50 hectares.
- The additional payment – granted to all farmers for the land areas between 3.01 ha and 30 ha. It means that this support is focused on the group of small and medium-sized farms which do not benefit from the scale of production as the largest farms do, but have development opportunities. The rate of payment has been adopted at the level of EUR 41 per ha.
- Coupled payments:

  • Payment for cattle – has been applied in farms having at least 3 heads of cattle aged below 24 months, for all animals from 1st to 30th head. This support will be granted maximum two times during the animal's life and no more than once every year (for instance in the age of 6-8 months and 12-24 months). The support covered cattle, regardless of sex, meeting requirements regarding animal identification and registration in the amount of EUR 70 per head.

  • Payment for cows – granted to farmers having at least 3 cows aged below 24 months, for cows from 1st to 30th head. Payment covers cows meeting requirements for animal identification and registration in the amount of EUR 70 per head.

  • Payment for sheep – granted to farmers having at least 10 ewes aged at least 12 months, for all heads of these animals in the farm in the amount of EUR 25 per head.

  • Payment for goats – granted to farmers having at least 5 female goats, for all goats in the farm. Payment will cover female goats aged at least 12 months in the amount of EUR 15 per head.

  • Payment for soft fruit – the cultivation area of strawberries and raspberries qualified for granting a uniform area payment shall be entitled to additional payment in the amount of EUR 250 per ha.

  • Payment for protein crops – for the cultivation area of legumes and small-seeded legumes in the main crop, qualified for granting a uniform area payment. The rate degressiveness will be used in the following hectare ranges:

[12] Information materials of ARMA http://www.arimr.gov.pl/pomoc-unijna/platnosci-bezposrednie/stawki-platnosci-bezposrednich-obowiazujace-w-roku-2015.html.

- 0-50 ha 100% of the basic rate (EUR 326 per ha),
- 50.01-100 ha 50% of the basic rate (EUR 163 per ha),
- 100.01-150 ha 25% of the basic rate (EUR 81.5 per ha),
- more than 150 ha no payment.

C. The No_Green scenario

The scenario assumes resignation from additional payment resulting from rejection of the proposal concerning the CAP greening by farms not adjusted to this requirement. They would be "penalised" with reduction in direct payments by the amount of green payment, i.e. EUR 74 per ha, obtaining the rate of direct subsidies at the level of EUR 110 per ha. It has been assumed that the farms exempted from "greening" and the "green" farms, i.e. farms meeting all the requirements, will receive direct payments equal to the ones assumed in the Green_2020 scenario. Similarly to the Green scenario, the newly introduced payments for selected operations and for young farmers have been considered with reductions in average payment rates under the agri-environmental programmes (by 46%).

In practice, it should be assumed as improbable that all the farmers from not adjusted farms will resign from payments for "greening". Therefore, a solution for the No Green scenario may constitute only a benchmark for comparisons, setting limits of income changes concerning agricultural farms, caused by introduction of the CAP reforms. The LFA payments in all the analysed scenarios have been adopted at the level valid so far.

Assumptions for determination of the level of future crops and prices included, in variants of the scenarios, the expected indices in changes of prices and crops specified in solutions of the sectoral model of partial equilibrium – CAPRI, taking account of the introduction of the greening principles (Table 1).

Based on the assumptions adopted for different scenarios, the calculations and analysis of the received results were made for the selected farm types. A typology assumed for grouping of farms was similar as for the research conducted under the Multi-Annual Programme 2011-14[13]. Due to the impact of changes in the CAP the following criteria were used in order to select relatively homogenous farm groups:

- area of farms in ha of the UAA (utilised agricultural area),
- production type of farms (according to nTF 14),
- degree of adjustment to the "greening" requirements.

[13] *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (scientific ed. J. Kulawik), Program Wieloletni 2011-2014, no. 120, IERiGŻ-PIB, Warsaw 2014.

Table 1. Changes of prices and crops of basic agricultural products according to the CAPRI model in the analysed Green scenario

Agricultural products	Base20=100	
	Crops	Prices
Wheat	101.3	103.3
Rye and triticale	101.0	103.4
Barley	101.3	103.8
Oat	101.4	104.1
Maize	101.3	103.1
Other cereals	101.1	103.5
Rape	100.1	104.3
Legumes	100.5	104.4
Potatoes	100.2	100.9
Sugar beets	99.9	102.3
Beef	100.0	101.2
Pork	100.0	100.7
Poultry	100.0	100.8
Milk	100.0	101.8

Source: own study based on: (Majewski et al. 2014) with the use of CAPRI model[14].

Detailed assumptions of grouping farms from the FADN community are presented below.

Criterion 1 – division of farms according to the area of arable lands:

- Group I → farms with the area of up to 10 ha,
- Group II → farms with the area of 10 up to 15 ha,
- Group III → farms with the area of 15 up to 30 ha,
- Group IV → farms with the area of above 30 ha.

Determination of such ranges is dictated by the previously presented requirements of cultivation diversification and separation of the areas of ecological compensation (EFA). The first group includes the farms exempted from the compliance with the "greening" requirements. The second group includes the entities which must cultivate at least 2 types of plants, but are obliged to separate the ecological compensation areas. The third group covers the farms which are obliged to fulfil the same requirements as that of the previous group in terms of cultivation diversification, however, they must additionally plan at least 5% of arable lands for EFA. The last, fourth group includes the farms for which it is expected to keep at least 3 types of plants in the structure of sowings and to separate 5% for EFA.

[14] W. Britz, P. Witzke, CAPRI model documentation http://www.capri-model.org/docs/capri_docu-mentation.pdf, 2012.

Criterion 2 – Division of farms according to dominant direction of production. The division was made after generalisation of breakdown into production types (according to nTF 14) used in the FADN. The farms were separated where dominant direction of production was:

- vegetables,
- cattle,
- pigs,
- mixed,
- other.

Detailed information regarding assignment of the FADN types to separated types of production are presented in Table 2.

Table 2. Classes of farms selected in terms of production direction in accordance with the Community Typology for Agricultural Holdings

Direction of production	nTF14	
Field crops	15	Specialist cereals, oilseed and protein crops
	16	General field cropping
	61	Mixed cropping
Cattle	45	Specialist dairy
	46	Specialist cattle-rearing and fattening
Pigs	51	Specialist pigs
Mixed	73 and 74	Mixed livestock
	83 and 84	Mixed crops and livestock
Other	20	Specialist horticulture
	35	Specialist vineyards
	36	Specialist fruit and citrus fruit
	37	Specialist olives
	38	Various permanent crops combined
	48	Sheep, goats and other grazing livestock
	52	Specialist poultry
	53	Various granivores combined

Source: own study based on (Goraj et al. 2011) and the FADN data[15].

Criterion 3 – Division of farms according to the degree of adjustment to the "greening" requirements:

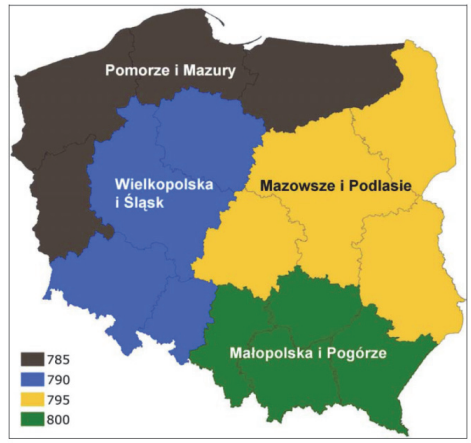
- exempted – arable land and organic farms with total area of up to 10 ha,
- adjusted – meeting all "greening" requirements,
- diversification deficit – not meeting crop diversification requirement,
- EFA deficit – without sufficient area of ecological compensation,

[15] L. Goraj et al., *Analiza skutków zmian we Wspólnotowej Typologii Gospodarstw Rolnych*, Warsaw 2010, p. 11.

– EFA and diversification deficits – not meeting both of the above-mentioned requirements.

The results of farm grouping obtained after the application of these criteria have been grouped according to the particular FADN regions (Fig. 1).

Figure 1. The FADN Regions



Source: Commission Regulation (EU) No 1291/2009 of 18 December 2009 concerning the selection of returning holdings for the purpose of determining incomes of agricultural holdings.

Analyses used individual data of farms prepared on the basis of the FADN 2012 sample. The total of 10,909 farms were grouped according to the above typology, distinguishing 229 types of homogenous farms in terms of their affiliation to the area group, adjustment to the greening requirements, production type and the FADN region. Then, in order to test the methodology of calculations proposed below, the group of plant farms from the Mazowsze and Podlasie regions was selected using purposive selection method. This selection was due to a relatively great number of such farms in the FADN sample and the occurrence of regional farms representing all the area groups considered for "the CAP greening", including the farms with the area of arable lands both below 10 ha and above 30 ha.

Optimisation model

To determine potential effects of changes the optimisation model of agricultural holding FARM-OPTY was used, expanded by non-linear function of costs that uses the PMP (Positive Mathematical Programming). The main assumption underlying the model is rational, from the economic point of view, behaviour of farmers that aim at maximisation of the financial result. It means that the objective function assumes maximisation of agricultural income and the following equation presents its general form:

$$\underset{x_i \geq 0}{DR} = \mathbf{p}^T (\mathbf{x} \bullet \mathbf{y}) + \mathbf{s}^T \mathbf{x} + fs - fc - \mathbf{d}^{\mathbf{T}} \mathbf{x} - \mathbf{x}^{\mathbf{T}} \mathbf{Q} \mathbf{x}$$

Provided that $Ax \leq B$, where:

DR	–	agricultural income (numeric value of the objective function),
p	–	products price vector (n x 1),
y	–	yield and productivity vector (n x 1),
x	–	non-negative vector of optimum levels of production activities (n x 1),
x•y	–	Hanamard's product,
s	–	vector of payments for production activities (n x 1),
f_c	–	relatively fixed costs value,
f_s	–	value of the payments for operating activities which are relatively independent of the level of production,
A	–	resource utilization coefficients matrix (m x n),
B	–	vector of available resources (m x 1),
d'x - x'Qx	–	non-linear element of the objective function determined in the course of model calibration[16].

The model took into account 25 activities related to plant production: spring wheat, winter wheat, rye spring barley, winter barley, oat, triticale, cereal mixes, maize for grains, legumes for seeds, cover crops and green fertilisers, sugar beets, rapeseed, industrial plants, potatoes, fodder plants for green forage, grass in field cultivation, legumes for green forage, permanent grasslands, horticultural crops, orchards, soft fruit, other crops, fallow lands.

In the case of activities which constituted the group of several plants, e.g. horticultural crops, the model parameters were introduced in value perspective, assuming average values describing these crops in particular types of modelled farms. Eight animal activities were included in the model: milk cows, cattle, horses, pigs, chickens, ducks and geese, laying hens, sheep and goats. In the case of milk cows, the account of revenues considers milk efficiency and price of milk characteristic for each of the modelled types of farms. As for other animals the model parameters were introduced in value perspective, by multiplying both revenues and outlays on livestock units (LU).

The above model is a developed version of classic linear optimisation problem used in the farm models[17,18]. The linear optimisation models normally require numerous data and often provide results removed from reality, due to

[16] R.E. Howitt, *Positive Mathematical Programming*, „American Journal of Agricultural Economics", 77(2), 1995a, pp. 329-342.
[17] A. Wąs, *Model optymalizacyjny rolnictwa (na przykładzie gminy Kobylnica)*, Wydawnictwo SGGW, Warsaw 2005, pp. 1-144.
[18] W. Ziętara, *Plan roczny i koncepcja systemu kontroli jego realizacji w państwowym przedsiębiorstwie rolniczym*, SGGW, Warsaw, 1989.

their tendency to simplify production structure too much. It results from the fact that substantively justified number of restricting conditions is far smaller than the number of the observed activities.

Significant differences between the results of the linear models and the observed values hinder transfer of the results to potential recipients, even if the models properly respond to stimuli assumed in the scenarios. This results in the need of their calibration by adding various kinds of constraints. These most often are the so-called crop rotation restrictions determining maximum or minimum share of particular crops in the structure of sowings. Even ignoring poor theoretical or empirical justification for such constraints, in the case of constructing the models for farm aggregates (e.g. for the type, according to the FADN), they often excessively limit the scope of acceptable solutions for the simulated scenarios.

The Positive Mathematical Programming (PMP) has several significant advantages as compared to the classic models of the linear programming:

- used calibration procedure enables easy and accurate reflection of the observed actual values of the modelled features[19];
- supplementation of the linear model with non-linear elements results in overcoming problems of an excessive simplification of the solutions (*overspecialisation*), the solutions include a greater number of activities without the necessity of introducing additional "artificial" restrictions;
- the PMP makes it possible to avoid dramatic changes in the solutions, disproportionate to the scale of changes in external conditions introduced in the analysed scenarios;
- applied modifications of the model at the stage of model calibration to a much lower degree affect behaviour of the model during simulation than calibration restrictions used in the linear programming models;
- non-linear (quadratic) function of the objective demonstrates the growth in unit production costs resulting from the increased level of conducted operations, which may result from insufficient equipment resources, insufficient organisational abilities and reduction in crops, due to the need to use lower quality lands[20].

[19] P.B. Hazell, R.D. Norton, *Mathematical Programming for Economic Analysis in Agriculture*, MacMillan, New York, 1986.
[20] R.E. Howitt, *A Calibration Method for Agricultural Economic Production Models*, [in:] "Journal of Agricultural Economics", 46, 1995b, pp. 147-159.

The PMP approach was formalised and described for the first time in Howitt's study[21]. However, the previous expert studies supporting political decision-making already succeed in using similar techniques[22,23,24]. In most cases of this type of applications a new technique has been introduced to the already existing linear models as a substitute of numerous calibration constraints.

The method published by Howitt has immediately gained in popularity, which is proved by numerous works using this new approach[25,26,27].

Simulation model

For the purpose of estimating income volatility an agricultural farm simulation model using the Monte Carlo method was developed. The basic function of the created model was to examine the impact of volatility of particular input parameters, such as crops and prices, on income volatility of the examined farms. Input parameters were sampled as a result of the model's operation based on probability distributions specified for different stochastic variables. Then the value of the resulting category – agricultural income – was determined on their basis (Fig. 2). This process was repeated many times in order to determine volatility of agricultural income typical of the type of farm and the adopted scenario. In order to ensure repeatability of obtained solutions, it was accepted that the solutions will be generated on the basis of 100,000 replications. Adoption of such assumption ensured repeatability of the generated solutions.

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[21] R.E. Howitt, *Positive Mathematical Programming*, "American Journal of Agricultural Economics", 77(2), 1995a, pp. 329-342.

[22] R.E. Howitt, B.D. Gardner, *Cropping Production and Resource Interrelationships among California Crops in Response to the 1985 Food Security Act*, [in:] Impacts of Farm Policy and Technical Change on US and Californian Agriculture, Davis, 1986, pp. 271-290.

[23] H. Kasnakoglu, S. Bauer, *Concept and Application of an Agricultural Sector Model for Policy Analysis in Turkey*, [in:] Agricultural Sector Modelling, S. Bauer und W. Henrichsmeyer (ed.), Vauk Verlag, Kiel, 1988.

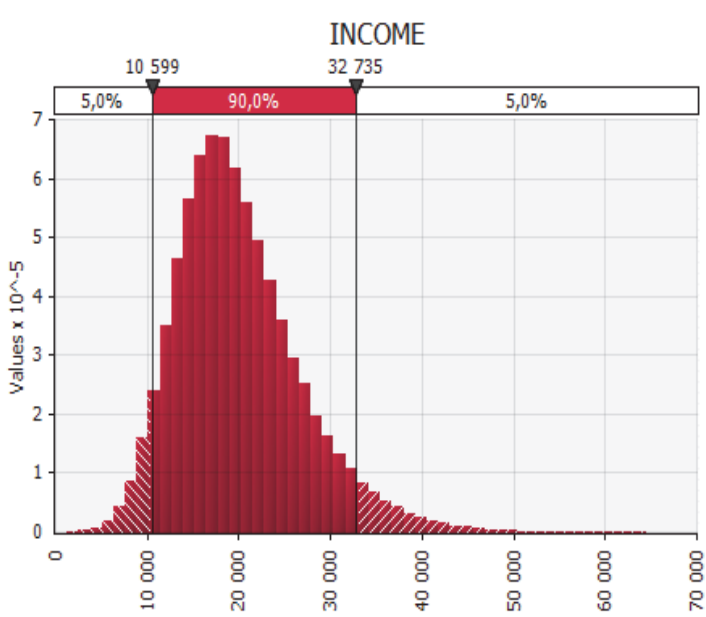
[24] H.J. Schmitz, *Entwicklungsperspektiven der Landwirtschaft in den neuen Bundesländern – Regionaldifferenzierte Simulationsanalysen Alternativer Agrarpolitischer Scenarien, Studien zur Wirtschafts- und Agrarpolitik,* Witterschlick/Bonn, M. Wehle, 1994.

[25] F. Arfini, *The Effect of CAP Reform: A Positive Mathematical Programming Application,* Paper presented at an International Conference on 'What Future for the CAP', Padova, 1996.

[26] C. Graindorge, B. Henryde Frahan, R.E. Howitt, *Analysing the effects of Agenda 2000 Using a CES Calibrated Model of Belgian Agriculture*, [in:] T. Heckelei, H.P. Witzke and W. Henrichsmeyer (ed.): Agricultural Sector Modelling and Policy Information Systems, Proceedings of the 65th EAAE Seminar, March 29-31, 2000 at Bonn University, Vauk Verlag Kiel, 2001, pp. 177-186.

[27] J.F. Helming, L. Peeters, P.J.J. Veendendaal, *Assessing the Consequences of Environmental Policy Scenarios in Flemish Agriculture*, [in:]: T. Heckelei, H.P. Witzke, W. Henrichsmeyer (ed.), Agricultural Sector Modelling and Policy Information Systems. Proceedings of the 65th EAAE Seminar, March 29-31, 2000 at Bonn University, Vauk Verlag, Kiel 2001, pp. 237-245.

Figure 2. Sample result of simulation model – agricultural income distribution



Statistics

	INCOME
Cell	INCOME!D21
Minimum	1 267,30
Maximum	64 621,64
Mean	20 027,07
Mode	17 203,42
Median	19 071,57
Std Dev	6 796,34
Skewness	0,8378
Kurtosis	4,1597
Values	100000
Errors	0
Filtered	0
Left X	10 599
Left P	5,0%
Right X	32 735
Right P	95,0%
Dif. X	22 135,86
Dif. P	90,0%

Source: own calculations.

The built model is static and does not endogenously change the production structure and it does not introduce other adjustments, e.g. investments. Operation of the model is limited to determination of volatility of resulting category for which agricultural income was assumed. In this case, the variables concerning production structure have an exogenous nature and were determined using another model – FARM-OPTY. For each of the considered scenarios the relevant data were used, describing the structure of production, adapted to the requirements of the examined scenarios.

The agricultural farm simulation model used for analyses consist of four basic elements:

I. Structural variables,
II. Value and costs of production,
III. Volatility of account basic parameters,
IV. Correlations between parameters of the model.

Methodical approach discussed below was used to estimate parameters of the model.

I. Structural variables. They apply to basic characteristics of the modelled farms, which include the use of basic resources of the farm – land and livestock sites. Structural variables constituted the basis of simulation both in the base scenario and in the remaining scenarios of the agricultural policy, at the same

time, keeping their values as amended by the optimisation model. Similarly as for the FARM-OPTY model referred to before, the simulation model considers 25 plant activities and 8 animal activities.

The value of particular parameters (e.g. the area of single plant crops, number of animals of a given species) has been defined by means of optimisation taking into account constraints typical of particular scenarios. It was assumed that there are no significant short-term changes concerning the amount of production factors in the farms and that estimation of structural variables on the basis of a greater number of observations will eliminate the impact of deviating values in case the farms different from typical in terms of resources will occur in the sample.

II. Value and costs of production. The following variables of the base model were defined as average values for different types: units of efficiency, product sales prices and production costs and expenses. The process of determining averages used, as the weight, the FADN variable – SYS 02 – number of represented farms[28]. Owing to the stratified random selection of farms for the FADN sample and, as a consequence, each farm in the sample representing a different number of farms from general population, application of suitable weights is necessary for proper estimation of average values typical of the general population. Additionally, in the case of estimating crops of particular cultivations, the weights were supplemented with the sown area of particular plants. In such a case average crops were determined according to the formula:

$$\bar{p}_j = \frac{\sum_{ij} p_i SYS02_i ar_{ij}}{\sum_{ij} SYS02_i ar_{ij}}$$

where:

i – farm in the FADN sample representing one of the analysed types,
j – another cultivation,
$\bar{p}_j$ – average crops of j-th cultivation,
p_{ij} – crops of j-th cultivation of i-th farm,
ar_{ij} – area of the j-th crop plant of i-th farm,
$SYS02_i$ – number of farms of the general population represented by the i-th farm from the FADN sample.

[28] Z. Floriańczyk et al., *Wyniki Standardowe 2012 uzyskane przez gospodarstwa rolne uczestniczące w Polskim FADN*, Warsaw 2013.

In the case of evaluation of the average value of prices, the weights were supplemented with the volume of sales of different products, using the formula:

$$\bar{c}_j = \frac{\sum_{ij} c_{ij} SYS02_i sp_{ij}}{\sum_{ij} SYS02_i sp_{ij}}$$

where:

i – farm in the FADN sample representing one of the analysed types,
j – another product,
$\bar{c}_j$ – average price of j-th product,
c_{ji} – price of the j-th product of i-th farm,
sp_{ij} – the volume of sales j-th product of i-th farm,
$SYS02_i$ – number of farms of the general population represented by the i-th farm from the FADN sample.

III. Standard deviations for the model parameters. The volatility of prices and crops was expressed in the model with the value of standard deviation. It was used as one of the probability distribution parameters determining the possible scope of volatility of input parameters of the model. The base model assumed the level of volatility of prices and crops in the analysed types of the farms determined on the basis of the FADN 2012 data. Owing to an insufficient number of observations, it was decided to adopt the assumptions with regard to the type of probability distributions characterising crops and prices. It was assumed that crops of grown plants are characterised by normal distribution. On the other hand, for prices, due to the asymmetric character of their volatility, the use of log--normal distribution was assumed. As it has been already mentioned, a novelty, so far unprecedented in the studies based on the FADN data, was the estimation of standard deviations with the use of, as in the case of average values, the weights taking account of the number of farms from the general population represented by each of the analysed farms from the FADN sample. In the case of standard deviation for crops of particular cultivations the following way of calculating standard deviation was used:

$$SDp_j = \sqrt{\frac{\sum_{ij} (\bar{p}_j - p_{ij})^2 SYS02_i ar_{ij}}{\sum_{ij} SYS02_i ar_{ij}}}$$

where:
$SDpj$ – weighted standard deviation of crops of j-th cultivation,
Other symbols – as mentioned above.

As for the prices, the same formula was used, however, the selling price observed on the farms was logarithmised using natural logarithm both for average values and standard deviation, owing to assumption of the log-normal distribution in the simulation model.

After sampling of the price value the logarithmic process based on estimated log-normal distribution was reversed in the simulation model using exponential function with the base of the *e* number.

The models for future scenarios of the agricultural policy assumed that the volatility of crops and prices measured by the value of standard deviation will be at the same level as in the base year.

IV. Correlations between the model parameters ensure more realistic reflection of relations between particular variables and prevent generation of parameters which have values that are not in reality associated with the level of other variables (e.g. in practice high crops rule out equally high prices of products).

Owing to limited availability of data (outlays are not allocated in the FADN system for different crops), correlations determined on the basis of outlays--production dependencies were not applied.

The result of operation of the simulation model is a series of agricultural income values possible to be obtained at the assumed volatility of the input parameters. The simulation model's operation results in 100,000 agricultural income values possible to be obtained for each of the analysed farms. On the basis of these results, basic statistical measures were calculated which describe the volatility of agricultural income: average, standard deviation, volatility index (quotient of standard deviation and the average value) and the percentile value of 5% and 95%. Additionally, it was estimated that some of the received results exceed assumed threshold values. Normal threshold value in this type of deliberations is 0. Achieving lower income means loss, while participation in the results of simulation above zero is interpreted as the probability of obtaining income higher than 0. In the case of agricultural income, which does not take account of own labour costs and alternative employed capital costs, while including extra subsidies received by the farmers, adoption of threshold value at the level of 0 would be pointless as the risk of losses in average farm would be in such situation close to none. For this reason three threshold values were assumed in the research, agreed individually for each of the analysed types of farms as a product of declared resources of own workforce and its potential remuneration fixed at minimum subsistence level (PLN 1,084.48 per month[29] – June 2015) of

[29] Instytut Pracy i Spraw Socjalnych, *Informacja o wysokości minimum socjalnego w czerwcu 2015 r.*, Warsaw, 15 September 2015.

minimum wage (PLN 1,750 per month – for 2015[30]) and the average wage in the national economy (PLN 3,854 per month – for the 2nd quarter of 2015[31]). Considering the fact that the data concerning volatility of the input parameters came from of one-year observations, the results obtained can be interpreted as a participation of the farms of a given type, which have reached income higher than the threshold value.

2.2. Analysis of the obtained results

The outcome of application of the adopted typology of the farms was classification of the FADN sample for 229 types of farms different in terms of the UAA, production direction, adjustment to the greening requirements and affiliation to the FADN region. The number of the farms representing different groups is presented in Table 3.

Table 3. The number of farms in the FADN sample according to the adopted division according to production direction and the FADN region

FADN region	Direction of production					
	Field crops	Cattle	Pigs	Mixed	Other	Total
"Pomorze i Mazury" (785)	560	444	88	537	83	1,712
"Wielkopolska i Śląsk" (790)	1,168	581	381	1,629	192	3,951
"Mazowsze i Podlasie" (795)	753	1,337	245	1,206	456	3,997
"Małopolska i Pogórze" (800)	333	195	42	483	196	1,249
POLAND	2,814	2,557	756	3,855	927	10,909

Source: own calculations.

Then the group of plant farms from the 795 region – "Mazowsze i Podlasie" – selected for testings was divided, taking into consideration the arable land areas and the level of adjustment to the CAP greening requirements. The number of farms from the FADN sample representing particular types of the farms is presented in Table 4. In accordance with the requirements valid in the FADN system, further analyses and presentation of results could concern only the types represented by at least 15 farms. For this reason, ultimately only 9 of 13 selected types – marked in bold in Table 4 – were used for construction of the models. The use of minimum size of farm groups, set by the FADN, for construction of stochastic models seems fully justified, as estimation of the parameters for few farm groups is burdened with very large error.

[30] Journal of Laws, item 1220, Regulation of the Council of Ministers of 11 September 2014 on the average wage in 2015.

[31] Announcement of the President of the Central Statistical Office of 11 August 2015 on the average wage in the second quarter of 2015.

Table 4. The number of crop plant farms from the "Mazowsze i Podlasie" region in the FADN sample according to the UAA and the level of adjustment to the CAP greening criteria

Farm type according to arable land area	Degree of adjustment of the farms to the CAP greening requirements				
	Exempted	Adjusted	With EFA deficit	With crop diversification deficit	With EFA and crop diversification deficits
I. (<10 ha of UAA)	**145**	-	-	-	-
II. (10-15 ha)	**18**	**121**	-	7	-
III. (25-30 ha)	5	**53**	**147**	1	**16**
IV. (> 30 ha)	8	**32**	**178**	-	**22**

Source: own calculations.

The basic characteristics of the selected farms, including base and target production structure, has been summarised and presented in Table 5.

For the farms adjusted to the greening requirements the results were not presented for the No Green scenario. It was assumed that the farmers of exempted and already adapted holdings will apply for the full amount of subsidies to which they will be entitled.

Changes in the structure of sowings, taking place as a result of adjusting the farms to the greening requirements, have evolutionary nature, as it was described in the Multi-Annual Programme 2011-2014 monograph[32]. Some particularly visible regularities can be noticed when analysing types of farms selected for testing. The area of leguminous plants noticeably increases in almost all examined types of farms. In the adjusted farms this takes place to the detriment of the least profitable cultivations and fallows, whose share is greater than the required EFA. In the farms not adjusted to the greening requirements, leguminous plants fulfil a dual role. Owing to additional subsidies they contribute to increase of the income and, on the other hand, facilitate fulfilment of the requirements in this respect, serving as the EFA equivalent.

Because of the specialisation of plant farms selected for modelling, animal production does not play a key role therein, often constituting remnants after once kept livestock, now being a hobby. The greening requirements do not refer directly to animal production and necessary area of fodder cultivation is greater than it results from stocking density. Therefore, the fodder cultivation area in the non-adjusted farms is transformed into the EFA. It is one of the least expensive ways of preserving the ecological compensation area.

[32] *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (scientific ed. J. Kulawik), Program Wieloletni 2011-2014, no. 120, IERiGŻ-PIB, Warsaw 2014.

Additionally, it can be observed that on the farms not adjusted due to both requirements of the GREEN scenario, the area of cereals, in particular those least profitable, decreases. They are set aside on the area obtained in this manner.

Introduction of the greening requirements affects cultivation areas of the most intensive, profitable plants to a small degree. The areas of fields of sugar beets, potatoes, rapeseed or horticultural cultivations change to an unnoticeable degree.

Production structures corresponding to the cut-off conditions specified in the scenarios, obtained by means of the optimisation model, were used as input parameters in the simulation model.

The crops and prices of grown plants were introduced in the simulation model as stochastic variables. In spite of a relatively limited number of farms, it was possible to determine basic parameters of distributions for selected plant activities. Because of a limited amount of farms keeping all animal species, only efficiency of cows and price of milk were introduced for animal activity as stochastic variables, while other activities were assigned average values of revenues (weighted means from the FADN sample) used also in the optimisation model. The values of medium and standard deviations for selected crops and prices of the analysed farms are presented in Table 6. According to the adopted methodology, the crops have been described assuming that they have distribution similar to normal. Then the use of the log-normal distribution was assumed in the case of prices.

Table 5. The optimisation model results – base and target structure of sowing

Farm type according to adjustment to the requirements of the CAP and the UAA (I-IV)	Scenario	The area of cultivations [ha]														Stocking density [LU]			
		Spring wheat	Winter wheat	Rye	Barley	Other cereals	Maize	Legumes	Sugar beets	Rape	Potatoes	Fodder and permanent grasslands	Horticultural crops	Fallows	CULTIVA-TIONS IN TOTAL	Cattle and horses	Pigs	Poultry	ANIMALS IN TOTAL
EXEMPTED (I)	BASE	0.64	0.47	0.6	0.53	2.05	0.3	0.25	0.07	0.13	0.49	1.25	2.03	0.47	9.28	0.6	0.83	0.03	1.46
	GREEN	0.65	0.48	0.61	0.54	2.07	0.31	0.36	0.07	0.14	0.49	1.18	2.04	0.33	9.27	0.62	0.83	0.03	1.48
ADJUSTED (II)	BASE	1.38	1.61	0.79	1.24	3.79	0.15	0.18	0.21	0.42	0.93	1.52	1.69	0	13.91	1.1	0.99	0.01	2.1
	GREEN	1.38	1.61	0.76	1.24	3.62	0.16	0.37	0.21	0.42	0.92	1.38	1.69	0.16	13.92	1.14	1	0.01	2.15
EXEMPTED (II)	BASE	0.22	0.58	0.62	0.34	4.53	0	1.57	0.08	0	0.33	2.9	2.87	0.95	14.99	1.65	0.69	0	2.34
	GREEN	0.21	0.57	0.6	0.33	4.37	0	2.1	0.08	0	0.32	2.68	2.89	0.84	14.99	1.66	0.68	0	2.34
EFA DEFICIT (III)	BASE	2.82	3.21	1.24	1.99	4.62	0.61	0.08	0.61	1.94	1.09	1.67	1.65	0	21.53	1.38	0.89	0.01	2.28
	GREEN	2.74	3.14	1.15	1.92	4.31	0.6	0.24	0.61	1.93	1.06	1.46	1.63	0.72	21.51	1.47	0.89	0.01	2.37
	NoGREEN	2.81	3.2	1.23	1.98	4.61	0.6	0.13	0.61	1.94	1.08	1.66	1.66	0	21.51	1.45	0.89	0.01	2.35
EFA AND DIVERSIFICATION DEFICITS (III)	BASE	1.25	3.67	2.15	2.74	1.83	4.05	0	0	0.83	1.11	0.8	3.15	0.02	21.60	2.14	0.13	0	2.27
	GREEN	1.17	3.52	1.88	2.63	1.56	4	0.01	0	0.81	1.05	0.87	3.1	1	21.60	2.14	0.13	0	2.27
	NoGREEN	1.25	3.67	2.15	2.74	1.83	4.05	0	0	0.83	1.11	0.8	3.15	0.02	21.60	2.14	0.13	0	2.27
ADJUSTED (III)	BASE	1.84	2.11	1.58	2.2	3.91	0.43	3.25	0.12	0.7	0.82	1.49	1.76	1.84	22.05	0.67	2.05	0.23	2.95
	GREEN	1.85	2.13	1.57	2.2	3.85	0.44	4.58	0.12	0.71	0.81	1.43	1.74	0.63	22.06	0.69	2.06	0.23	2.98
EFA DEFICIT (IV)	BASE	8.01	13.82	2.92	5.81	8.44	8.06	0.38	3.68	10.21	1.58	3.32	3.13	0	69.36	3.04	1.79	0.02	4.85
	GREEN	7.77	13.54	2.57	5.54	7.28	8.05	1.38	3.64	10.14	1.53	2.92	3.09	1.91	69.36	3.08	1.76	0.02	4.86
	NoGREEN	7.98	13.77	2.89	5.78	8.35	8.04	0.7	3.68	10.19	1.58	3.27	3.13	0	69.36	3.08	1.76	0.02	4.86
EFA AND DIVERSIFICATION DEFICITS (IV)	BASE	4.83	17.3	0	2.47	6.42	11.83	0	0.4	9.39	1.07	0.77	6.3	0.13	60.91	0.23	0.07	0	0.3
	GREEN	4.55	16.61	0	2.27	5.61	11.53	0	0.39	9.18	1.04	0.7	6.11	2.93	60.92	0.23	0.07	0	0.3
	NoGREEN	4.83	17.3	0	2.47	6.42	11.83	0	0.4	9.39	1.07	0.77	6.3	0.13	60.91	0.23	0.07	0	0.3
ADJUSTED (IV)	BASE	5.27	8.41	4.74	4.21	9.72	2.07	7.1	1.2	5.19	0.22	2.46	1.95	2.87	55.41	2.14	0.13	0	2.27
	GREEN	5.17	8.37	4.51	4.08	9.14	2.07	11.28	1.2	5.19	0.22	2.11	1.92	0.16	55.42	2.14	0.13	0	2.27

Source: own calculations.

Table 6. Selected parameters of the simulation model

Farm type according to adjustment to the requirements of the CAP and the arable land areas (I-IV)	Crops in dt/ha (normal distribution)					
	Winter wheat		Oat		Rape	
	average	σ*	average	σ*	average	σ*
EXEMPTED (I)	40.0	10.0	30.3	4.0	28.8	2.2
ADJUSTED (II)	41.4	9.2	26.7	4.7	21.8	3.8
EXEMPTED (II)	33.7	14.6	42.6	14.5	16.4	3.8
EFA DEFICIT (III)	44.9	12.3	30.4	3.1	26.3	5.0
EFA AND DIVERSIFICATION DEFICITS (III)	54.9	11.1	30.0	3.1	35.7	1.2
ADJUSTED (III)	45.0	16.6	28.6	3.0	24.2	5.3
EFA DEFICIT (IV)	52.7	16.3	30.7	3.0	29.4	7.9
EFA AND DIVERSIFICATION DEFICITS (IV)	52.2	18.9	30.0	3.0	30.7	11.6
ADJUSTED (IV)	51.2	17.6	29.7	2.6	27.1	4.9
	Natural logarithm of prices in PLN/dt (log-normal distribution)					
EXEMPTED (I)	4.4	0.2	4.1	0.5	5.3	1.9
ADJUSTED (II)	4.5	0.1	4.0	0.6	5.0	1.2
EXEMPTED (II)	4.4	0.2	4.1	0.5	5.2	1.9
EFA DEFICIT (III)	4.3	0.2	4.1	0.5	5.0	1.8
EFA AND DIVERSIFICATION DEFICITS (III)	4.4	0.2	4.2	0.4	5.2	1.9
ADJUSTED (III)	4.5	0.1	3.9	0.4	5.2	1.2
EFA DEFICIT (IV)	4.4	0.2	3.9	0.4	5.0	1.2
EFA AND DIVERSIFICATION DEFICITS (IV)	4.4	0.2	4.1	0.5	5.2	1.9
ADJUSTED (IV)	4.2	0.4	4.2	0.4	5.0	1.2

* Standard deviation.

Source: own calculations.

To prepare parameters of distributions characterising the selling price, the data for particular farms from the FADN sample were logarithmised. On the basis of calculated logarithmic values, distribution characteristics were determined, using formulas presented in the methodology description.

In the case of all the farms it can be noticed that winter wheat yields better than oat but its crops were usually characterised by larger volatility. In the case of prices a great difference in scope of variability can be observed between cereals and rapeseed, whose prices show much more volatility.

In accordance with the methodology described before, the scope of income volatility was estimated subsequently in conditions assumed in the analysed scenarios using the abovementioned input data for the particular types of farms. Sample results of the simulation model are presented in Figure 3. It presents obtained probability distributions for agricultural income in the Green and No Green scenarios for one of the analysed farms. Both obtained distributions are inclined to the right. The scope of volatility for both distributions is similar,

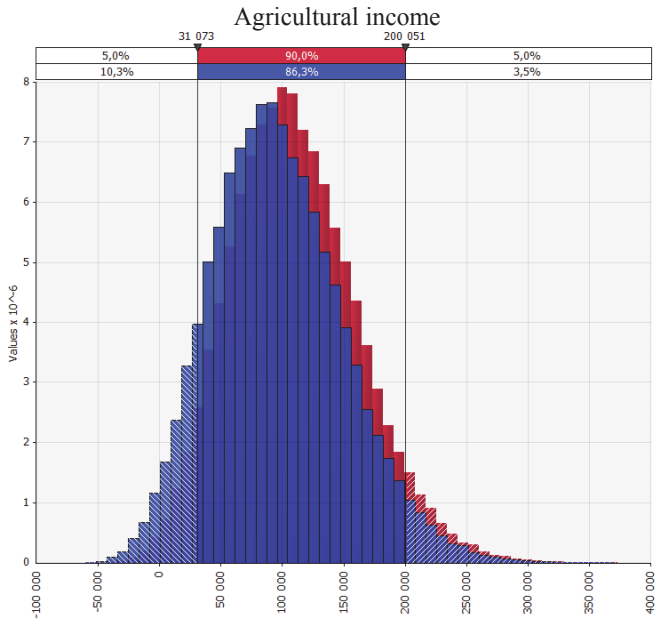
although standard deviation of agricultural income is slightly larger in the No Green scenario. Income distribution for the No Green scenario (blue) is shifted to the left as compared to the Green scenario (red). In spite of relatively high values of incomes in both scenarios, the analysed farm should clearly indicate higher income risk occurring in the case of the No Green scenario. It seems from the descriptive statistics presented in the figure that the risk of incurring loss for the Green scenario is lower than 1%. The basic cause of this situation, is of course reduced amount of aid in the No Green scenario, on account of non-adjustment of the farms to the greening requirements. When analysing the extreme income values, it can be noted that the difference between the scenarios is not identical on both sides of the charts. The 5% difference between percentiles amounts to ca. PLN 16,000, namely little less than the reduction of subsidies which in this case amounted to PLN 18,800. At unfavourable coincidence resulting in low income, no environmental limitations can to a small degree compensate for payment reduction. However, when comparing percentile values of 95%, it can be noted that the difference in income between the scenarios is slightly smaller and is less than PLN 11,000. Therefore, in the case of fostering circumstances, when achieving income similar to the maximum values, benefits under non-adjustment of the structure of sowings to the greening requirements are larger than in the case of low level of income, although they still do not justify abandonment of adjustments.

The simulation model results for all analysed farms are presented in Table 7. The Table, apart from the basic characteristics of the farms (the UAA and LU number) contains characteristics of the level and agricultural income volatility. In addition, the probability of labour factor payment in the analysed farms was determined at the level of minimum subsistence and minimum and average wage.

It can be noted among the observed farms that in all the cases implementation of the Green scenario results in obtaining slightly higher, as compared to the BASE scenario, average agricultural income with lower volatility index. This proves the stabilising effect the new support system for farmers has on agricultural income. This results from replacing risky, profitable activities by activities less profitable and compensating differences in income by payment of slightly higher subsidies.

Due to similar labour resources in all the farms it is very difficult to obtain satisfactory remuneration on the smallest farms. Zero probability can be noted on the smallest farms as regards payment of labour resources at the level of minimum subsistence. This results from having too large labour resources in relation to the owned lands.

Figure 3. Sample results of the simulation model for the crop plant farms from the FADN 795 region (Mazowsze i Podlasie) of total area of over 30 ha (group IV) not adjusted due to diversification and the EFA criterion – difference in income distribution for the Green (red) and No_Green 2020 (blue) scenarios



Statistics

	GREEN	NOGREEN
Cell	INCOME!E21	INCOME!F21
Minimum	-41 252,50	-60 238,82
Maximum	373 035,25	367 931,87
Mean	109 779,52	96 280,12
Mode	104 511,02	89 567,49
Median	106 404,86	92 799,31
Std Dev	51 488,59	53 072,62
Skewness	0,3852	0,3832
Kurtosis	3,1320	3,1299
Values	100000	100000
Errors	0	0
Filtered	0	0
Left X	31 073	31 073
Left P	5,0%	10,3%
Right X	200 051	200 051
Right P	95,0%	96,5%
Dif. X	168 977,48	168 977,48
Dif. P	90,0%	86,3%
1%	6 243,54	-10 505,00
5%	31 073,14	15 076,69
10%	45 926,85	30 444,26
15%	56 498,50	41 381,12
20%	65 391,31	50 524,76
25%	73 006,82	58 392,09
30%	80 331,28	65 913,53
35%	87 078,69	72 884,75
40%	93 694,81	79 731,59
45%	100 060,45	86 278,05
50%	106 404,86	92 799,31
55%	112 848,53	99 462,85
60%	119 764,36	106 597,12
65%	126 936,34	113 984,40
70%	134 538,73	121 813,19
75%	142 835,99	130 357,17
80%	152 286,78	140 140,36
85%	163 179,75	151 363,42
90%	177 434,07	166 016,63
95%	200 050,62	189 416,50
99%	243 306,91	233 821,82

Source: own calculations.

Only in the farms from the III area group (15-30 ha arable lands) it is possible for them to achieve income at the level of PLN 1,048 per month per AWU. On the largest farms (Group IV –> 30 ha) payment for labour resources at the level of minimum subsistence is almost sure, the vast majority of the farms has the opportunity to obtain labour payment at the minimum wage level, and some even to labour resources remuneration payment at the national average level. In all types of farms, except for the smallest farms, conditions adopted for construction of the Green scenario increase opportunities to obtain particular threshold values. The loss of part of subsidies along with increased volatility of revenues results in decrease of probability to achieve 3 assumed threshold values in the No Green scenario. It should be, however, noted that the farms initially not adjusted to the greening requirements obtain higher average income than the farms exempted or adjusted. Even their rejection of the Green scenario and continuation of operations with reduced level of support means obtaining average income higher than in the case of similar exempted or adjusted farms. However, it should be noted that because of the fact that growth in income volatility in the No Green scenario on the farms not adjusted, despite higher average income, minimum income may prove to be lower than in minimum income in similar farms adjusted to the greening requirements.

Table 7. The simulation model results – level and volatility of agricultural income in the analysed groups

Farm type according to adjustment to the requirements of the CAP and arable land area (I-IV)	Scenario	The area of cultivations in total [ha]	Stocking density in total [LU]	Agricultural income [PLN/farm]					Labour resources (AWU)	Probability of labour factor payment on level [0-1]		
				Average	Standard deviation	Volatility index	5% percentile	95% percentile		Minimum subsistence	Minimum wage	Average wage
EXEMPTED (I)	BASE	9.28	1.46	11,937	4,740	40%	4,788	20,249	2.49	0.00	0.00	0.00
	GREEN	9.27	1.48	14,368	4,822	34%	7,093	22,829	2.49	0.00	0.00	0.00
ADJUSTED (II)	BASE	13.91	2.1	19,988	6,770	34%	10,598	32,602	2.58	0.04	0.00	0.00
	GREEN	13.92	2.15	23,669	6,842	29%	14,140	36,396	2.58	0.09	0.00	0.00
EXEMPTED (II)	BASE	14.99	2.34	23,540	4,775	20%	16,240	31,859	2.34	0.08	0.00	0.00
	GREEN	14.99	2.34	25,861	4,956	19%	18,268	34,515	2.34	0.17	0.00	0.00
EFA DEFICIT (III)	BASE	21.53	2.28	30,020	9,504	32%	15,609	46,803	2.35	0.45	0.03	0.00
	GREEN	21.51	2.37	34,413	9,607	28%	19,792	51,334	2.35	0.63	0.07	0.00
	NoGREEN	21.51	2.35	28,393	9,787	34%	13,514	45,641	2.35	0.38	0.03	0.00
EFA AND DIVERSIFICATION DEFICITS (III)	BASE	21.60	2.27	42,721	16,787	39%	16,958	71,901	2.31	0.76	0.35	0.00
	GREEN	21.60	2.27	46,974	17,104	36%	20,747	76,708	2.31	0.83	0.44	0.00
	NoGREEN	21.60	2.27	42,398	17,440	41%	15,643	72,722	2.31	0.74	0.35	0.00
ADJUSTED (III)	BASE	22.05	2.95	36,676	8,991	25%	23,077	52,423	2.48	0.67	0.05	0.00
	GREEN	22.06	2.98	48,040	10,607	22%	32,418	66,951	2.48	0.95	0.32	0.00
EFA DEFICIT (IV)	BASE	69.36	4.85	155,979	44,611	29%	87,561	233,996	2.34	1.00	1.00	0.86
	GREEN	69.36	4.86	164,360	45,810	28%	94,048	244,456	2.34	1.00	1.00	0.90
	NoGREEN	69.36	4.86	144,893	46,226	32%	73,971	225,767	2.34	1.00	0.99	0.78
EFA AND DIVERSIFICATION DEFICITS (IV)	BASE	60.91	0.3	104,642	51,222	49%	26,786	194,567	1.92	0.95	0.90	0.60
	GREEN	60.92	0.3	109,763	51,863	47%	31,028	200,859	1.92	0.96	0.92	0.63
	NoGREEN	60.91	0.3	96,260	53,457	56%	15,047	190,087	1.92	0.92	0.85	0.53
ADJUSTED (IV)	BASE	55.41	2.27	89,158	21,957	25%	55,028	127,182	2.47	1.00	0.97	0.13
	GREEN	55.42	2.27	111,966	24,834	22%	73,778	155,186	2.47	1.00	1.00	0.44

Source: own calculations.

2.3. Summary

The purpose of the research described in this chapter was to develop the concept of research concerning changes in the income risk level under the effect of the agricultural policy. Two models were used – optimisation and simulation model – the objective of which was to define the future production of the farms and identify changes in level and volatility of agricultural income for the sample farms. Additionally, the process of determining simulation model parameters uses a method evaluating volatility of the parameters, taking into account the number of farms from the general population, represented by each of the farms from the FADN sample. This allowed for limitation of the effect on assumed parameter values for the non-standard farms rarely present in the general population.

Due to the pilot character of research and selection of relatively small group of farms, the results have limited application in the cognitive layer. It is clear that implementation of the CAP greening scenario means reduction of income risk for all analysed types of farms. Small farms achieve relatively the highest benefits as subsidies constitute an important component of their income, however, to achieve benefits in the absolute perspective it is necessary to have the land resources for which support is granted. For this reason an absolute improvement in the income situation was observed in the farms with the total area of over 15 ha. It should be noted that the farms with the total area of over 15 ha which initially did not meet the reform conditions were achieving significantly higher income than the adjusted farms belonging to the same area groups. The difference was such as to make average income still higher than in the case of the farms adjusted from the beginning, even in the event of their rejection of adjustments and resignation from a part of subsidies. However, even for these farms, adjustments of the structure to meet the requirements should be considered as economically justified.

To sum up, it should be emphasised that, however, promising the results are, it is necessary to continue works on development of the proposed method. In order to estimate the income risk fluctuations on the scale of commercial farm sector it is necessary to select relevant methods of aggregating the simulation model results. Furthermore, it seems reasonable to consider the use of data from several years in order to preclude the impact of seasonal fluctuations on the results of the models. At the same time, the application of typology leading to evaluation of the simulation model parameters can be considered practical for more numerous farm groups.

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3. Value-based management and assessment of financial situation – selected problems of finance management of family farms

3.1. Economic value added (EVA) in value-based management of a farm

Value is one of the fundamental, though very ambiguous, categories in economic sciences[1]. Particularly important was operationalisation of this category as part of the so-called management through value/value-based management. Initially, an output ratio constituting the basis for the development of finance management support tools was EVA index, popularised by an American company Stern Stewart[2].

A set of measures/ratios describing different dimensions of business entity value has been significantly broadened with the passage of time. It should be noted that certain measures (e.g. WAI – wealth added index, RVA – relative wealth added) may have a very limited application with regard to business entities of the agricultural sector[3]. M. Hodak states that the factors which potentially determine the effectiveness of EVA's adaptation by finance management should include:

- use of EVA's modified version (EP, economic profit or NAV, net asset value);
- "investing" in financial literacy of employees;
- entering of a set of ratios and measures of finance management as a list of incentives for management staff.

[1] "Value of the company is the best measure for its evaluation, due to its information capacity concerning functioning of the company in a longer perspective"; M. Siudak, *Zarządzanie wartością przedsiębiorstwa*, Oficyna Wydawnicza Politechniki Warszawskiej, Warsaw 2001, p. 42, quot. after: A. Surmacz, *Wartość przedsiębiorstwa*, [in:] Ekonomika przedsiębiorstwa, joint paper ed. by J. Engelhardt, Wydawnictwo CeDeWu, Warsaw 2011, p. 177.

[2] See Stern Value Management, *Proprietary Tools*, http://sternvaluemanagement.com/intellectual-property-joel-stern/proprietary-tools-value-creation/ (date of access: 2.11.2015); G.B. Stewart, *Best-Practice EVA: The Definitive Guide to Measuring and Maximizing Shareholder Value,* John Wiley & Sons, Hoboken 2013.

[3] Theoretical assumptions of the structure of "measures of company's value creation" have been presented in more details in the literature concerning financial management or managerial accounting: see R.A. Brealey, S.C. Myers, *Podstawy finansów przedsiębiorstw* (vol. 1-2), Wydawnictwo Naukowe PWN, Warsaw 1999; Z. Bodie, R. Merton, *Finanse*, PWE, Warsaw 2013; E. Nowak, *Zaawansowana rachunkowość zarządcza*, Warsaw 2003. Empirical studies (including model considerations) with the use of EVA measure (concerning mainly stock market companies) are quite popular in the Polish literature on corporate finances, e.g. A. Duliniec, *Koszt kapitału w teorii i praktyce przedsiębiorstw*, "Gospodarka Narodowa", No. 3, 2012, pp. 1-18; E. Maćkowiak, *Ekonomiczna wartość dodana jako jedna z metod wyceny wartości przedsiębiorstwa*, "Zeszyty Teoretyczne Rachunkowości", 2009, vol. 53, no. 109, pp. 103-121; A. Cwynar, W. Cwynar, *EVA i wartość przyszłego wzrostu*: *Casus Giełdy Papierów Wartościowych,* "Przegląd Organizacji", no. 3, 2006, pp. 35-38; A. Cwynar, W. Cwynar, *Użytkowanie zysku rezydualnego*, "Ekonomika i Organizacja Przedsiębiorstwa", no. 7, 2006, pp. 5-14.

In the case of family farms characterised by much more simplified organisational and legal structure as well as by firm economic character as compared to companies[4], the above determinants have a very limited application.

N. Purves, S.J. Niblock and K. Sloan[5] attempted to identify the interrelations between financial and non-financial factors determining firm survival of the Australian agricultural companies as well as a determinant of financial success of these entities. The authors have used integrated multi-measured approach. Detailed empirical research made it possible to conclude that non-financial factors associated, e.g. with the staff's commitment in implementation of projects, can significantly impact the shaping of beneficial financial situation of the agricultural entities.

Table 1 presents key measures and ratios used in the value-based management system[6]. Additionally, potential possibilities and difficulties of their use in agriculture have been indicated. The use of, e.g. CFROI or CVA, based on cash basis accounting, does not fully reflect the philosophy of management through value for the owners of economic organisations. Only residual income (RI), economic profit (EP), as well as economic value added (EVA) meet a number of the criteria proposed by Holler, such as: (1) compliance with accrual basis accounting, (2) logic consistency, (3) objectiveness, (4) ease of implementation into the company management system. German economist observed that in the practice of German and American companies obliged to prepare financial statements the most popular ratio was EVA. Perhaps, the lower popularity of CVA should be associated with cash approach accounting which performs auxiliary operations insofar as the reporting is concerned. As stated by M. Geyser and I.E. Liebenberg[7] the structure of EVA measure refers to the residual income category, however, it emphasises corrections concerning capital calculation to a greater extent[8].

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[4] See R. Weber, O. Musshoff, *Is agricultural microcredit really more risky? Evidence from Tanzania,* "Agricultural Finance Review", vol. 72, issue 3, 2012, pp. 416-435; R. Weber, O. Musshoff, *Can flexible microfinance loans improve credit access for farmers?*, "Agricultural Finance Review", vol. 73, issue 2, 2013, pp. 255-271; M.Soliwoda, *Finanse rolnictwa wobec współczesnych wyzwań gospodarczych i społecznych – perspektywy rozwoju*, "Zagadnienia Ekonomiki Rolnej", no. 4, 2014, pp. 68-86.

[5] N. Purves, S.J. Niblock, K. Sloan, *On the relationship between financial and non-financial factors: A case study analysis of financial failure predictors of agribusiness firms in Australia,* "Agricultural Finance Review", vol. 75, issue 2, 2015, pp. 282-300.

[6] A. Holler assesses the possibility of using various measures and ratios constituting the instruments of value-based management of the companies.

[7] M. Geyser, I.E. Liebenberg, *Creating A New Valuation Tool For South African Agricultural Co--Operatives*, "Agrekon", vol. 42, no. 2 (June 2003), 2003.

[8] Geyser and Liebenberg rightly notice that the EVA concept enables operationalisation of the strategy as a tool of financial performance management. Enterprises assume this concept so as to monitor financial situation as well as to make decisions concerning resource allocation, management, capital budgeting and analyses of purchase of other companies. See: ibid., pp. 108.

Table 1. Selected measures and ratios related to value-based management – review

Measure/ ratio	Explanations	Comments used in agriculture
EVA (economic value added)	Measure of economic profit: EVA = NOPAT - WACC*IC where: NOPAT (Net Operating Profit After Tax) – operating profit after taxation, WACC – Weighted Average Cost of Capital, IC – invested capital.	Difficulty in measurement with cost of capital in the entities of the agricultural sector*. Fuller consideration of cost of conducted operations (compared with other ratios, for example: EPS, EBITDA or ROIC).
FGV (future growth value)	It is used to measure a part of the market value achieved by increase of EVA. Increase in the level of ratios may occur, e.g. by improving productivity.	Possibilities of using in benchmarking statements relating to "plans for growth", assessment of the investors plans concerning various strategy of increasing the value.
MVA (market value added)	MVA is the present value of expected EVA.	Creation of MVA rankings (e.g. a list of the best farms of a particular type).
COV (current operations value)	COV is used to measure the market value which was obtained by using the current level of profitability and assets. COV includes the present value of EVA approaching infinity (a perpetuity) + capital (on site).	Limited possibility of application. COV level depends on the maturity of markets (it has rather limited application in agribusiness).
CVA (cash value added)	CVA as a measure of residual income (on cash basis, based on cash flow statement) $CVA = OGCF - ED - WACC_t \bullet GI_{t-1} = (CFROI-WACCt) \bullet GI_{t-1}$ where: OGCF – operating gross cash flows, ED (economic depreciation) – depreciation from the economic point of view, GI (gross investments) – gross capital expenses for investments.	Cash basis – possibilities of use with simplified methods of accounting and financial reporting.

* Problem concerning evaluation of the cost of equity in entities of the agricultural sector has been discussed in the article: J. Franc-Dąbrowska, P. Kobus, *Koszt kapitału własnego – dylematy wyceny*, "Zagadnienia Eko-nomiki Rolnej", no. 1, 2012, pp. 77-89.

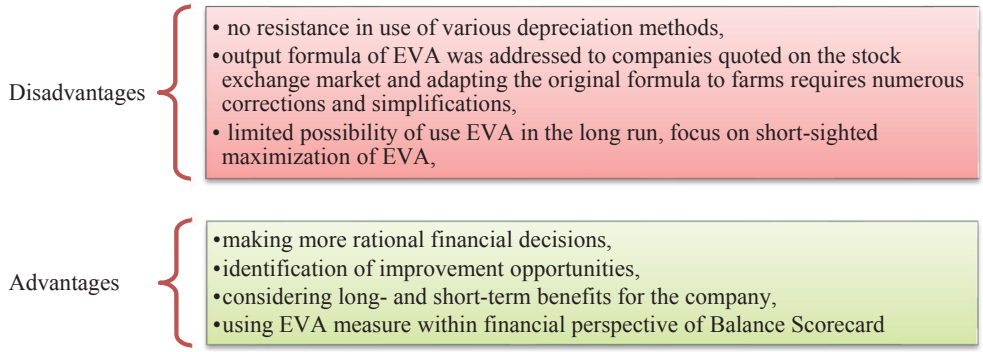
Source: based on Stern Value Management, Proprietary Tools, http://sternvaluemana-gement.com/intellectual-property-joel-stern/proprietary-tools-value-creation/, (date of access: 2.11.2015); A. Holler, New Metrics for Value-Based Management. Enhancement of Performance Measurement and Empirical Evidence on Value-Relevance, Gabler, GWV Fachverlage GmbH, Wiesbaden 2009.

J.H. Hall and J.M. Geyser believe that EVA measure may have, however, limited application as regards agricultural co-operatives. They justify it by the fact that (1) co-operatives aim at reduction in weighted average cost of capital (WACC) by obtaining most available (the cheapest) financing as well as changing the capital structure, taking into consideration the fact that the debt is the cheapest form of financing; (2) increase in rate of return by increase in the operational

margin, (3) greater flexibility of decisions concerning participation in projects, based on comparison of rate of return from WACC. It is advised to improve the structure of ratios adapted to the specific nature of a cooperative so that it is characterised by higher information capacity. It is important to remember that EVA is not only financial effectiveness measure, but may also be applied as a tool of strategic plan evaluation and identification of unprofitable production lines. Hall and Geyser postulate application of more sophisticated measures and ratios, taking into account the main purpose of cooperatives (i.e. maximisation of benefits for cooperative members), which remains the same even in the 21st century[9].

Figure 1 presents a set of potential advantages and disadvantages related to the use of the EVA concept in finance management of farms. It should be noted that relatively high sensitivity of EVA measure on different accounting operations (e.g. depreciation methods) is a significant defect.

Figure 1. Advantages and disadvantages of the EVA (for farms)



Source: adaptation of considerations of J.H. Hall, J.M. Geyser, The Financial Performance Of Farming Co-Operatives: Economic Value Added vs Traditional Measures, Working paper: 2004-02, Department of Agricultural Economics, Extension and Rural Development, University of Pretoria, Pretoria, 0002, South Africa, 2004, http://ageconsearch.umn.edu/bitstream/18084/1/wp040002.pdf; M. Geyser, I.E. Liebenberg, Creating A New Valuation Tool For South African Agricultural Co-Operatives, Agrekon, Vol. 42, No. 2 (June 2003); K. Jagiełło, Ekonomiczna wartość dodana EVA w systemie mierników finansowych wykorzystywanych w zrównoważonej karcie wyników, "Zeszyty MWSE", no. 6, 2006, , pp. 51-65.

To sum up, operationalisation of the value-based management concepts, subject to the specific nature of small business entities, involves adoption of a slightly different system of measures and ratios that the one adopted in the traditional financial analysis of enterprises. Use of the added value, namely

[9] J.H. Hall, J.M. Geyser, *The Financial Performance Of Farming Co-Operatives: Economic Value Added Vs Traditional Measures*, Working paper: 2004-02, Department of Agricultural Economics, Extension and Rural Development, University of Pretoria, Pretoria, 0002, South Africa, 2004 http://ageconsearch.umn.edu/bitstream/18084/1/wp040002.pdf.

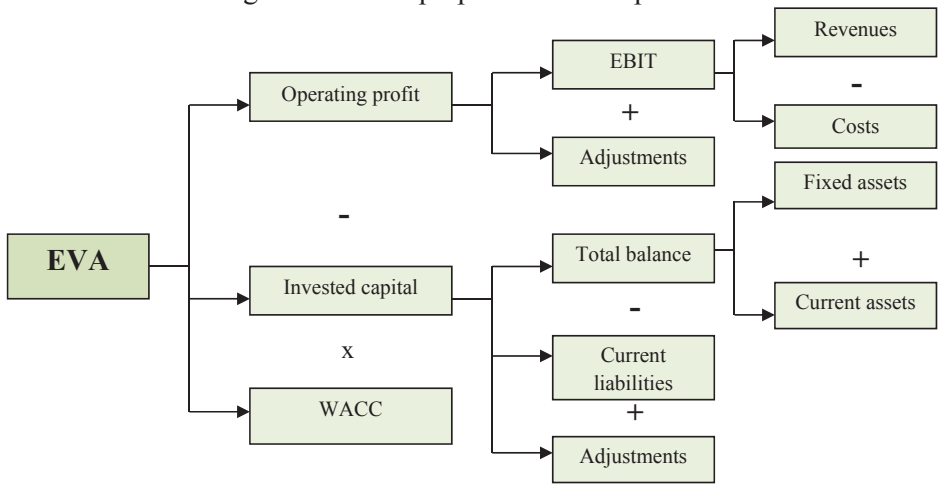
EVA, as a component of the financial monitoring system (in finance management) becomes very challenging – not only in terms of methodology, but – above all – it is difficult to apply in practice. The "alignment" concept adapted from the experience of large companies in connection with strategy map and Balanced Scorecard may facilitate initiatives related to the construction of the value-based management system[10].

3.1.1. Measurement of EVA of family farms in Poland

Initially, EVA measure was used in monitoring system of value-based management of large US economic organisations, therefore, the first studies of methodical character were related to capital companies, mainly listed companies[11]. Along with development of the VBM concept an attempt was made to adapt EVA measure for companies from the SME sector or family companies.

Figure 2 presents procedure of EVA calculation. This is, at the same time, decomposition of EVA measure, which indicates the need for considering various corrections (adjustments), in particular for NOPAT calculation. They can even discourage managers (finance managers) to use EVA.

Figure 2. EVA – proposal of decomposition



Source: C. Gatzki, Jak w praktyce obliczać i optymalizować ekonomiczną wartość dodaną (EVA), "Controlling i Rachunkowość Zarządcza", no. 10, 2005.

[10] See R.S. Kaplan, D.P. Norton, *Dopasowanie w biznesie. Jak stosować strategiczną kartę wyników?*, Gdańskie Wydawnictwo Psychologiczne, Sopot 2011.

[11] K. Jagiełło, *Ekonomiczna wartość dodana EVA w systemie mierników finansowych wykorzystywanych w zrównowazonej karcie wyników*, "Zeszyty MWSE" No. 6, 2006, pp. 51-65.

Adaptation of the EVA concept to the specific nature of entities of the agricultural sector in Poland was presented in convincing manner by IERiGŻ-PIB (Institute of Agricultural and Food Economics – National Research Institute) team, e.g., for agricultural companies being part of the database of the Economics of Farm Holding Department of IERiGŻ-PIB. Similar studies were undertaken by J. Franc-Dąbrowska[12]. For the needs of calculations the modified methodical assumptions have been adopted, already used in the Agricultural Finance Department of IERiGŻ-PIB[13] (with regard to agricultural enterprises), subject to the specific nature of family farms.

1. Agricultural or income tax from special departments does not burden excessively the result of a farm, therefore, it has been omitted in further calculations (for simplification purposes).
2. Invested capital was treated as the difference of total assets and current liabilities[14] (i.e. short-term liabilities, in simplification), while the cost of external capital was treated as the quotient of financial costs (on account of credits and loans incurred before) and total liabilities[15].
3. Similarly to the Czech economists, estimation of beta coefficient was adopted by A. Damodaran for "Farming/Agriculture" industry for the so-called emerging markets[16]. W. Patena approach (with some modifications) has been used, adapting the "classic" CAPM algorithm from before the global financial crisis[17] to the conditions of greater instability of financial markets. The so-called global long-run risk premium was adopted (its value has been assumed according to the Global Investment Returns Yearbook – 3.50%). Then this value has been in-

[12] J. Franc-Dąbrowska, *Rynkowa wartość dodana oraz ekonomiczna wartość dodana i ich praktyczna przydatność w ocenie przedsiębiorstw rolniczych*, "Przegląd Organizacji", no. 2, 2006, pp. 31-34.

[13] See J. Kulawik (ed.), *Analiza efektywności ekonomicznej i finansowej przedsiębiorstw rolnych powstałych na bazie majątku WRSP*, IERiGŻ-PIB, Warsaw 2009; J. Kulawik (ed.), *Analiza efektywności ekonomicznej i finansowej przedsiębiorstw rolnych powstałych na bazie majątku WRSP*, IERiGŻ-PIB, Warsaw 2008; J. Smolik, *Możliwości zastosowania koncepcji ekonomicznej wartości dodanej w przedsiębirostwach*, "Zagadnienia Ekonomiki Rolnej", no. 2, 2008, pp. 69-87.

[14] According to an approach presented by G. Gołębiowski and P. Szczepankowski, G. Gołębiowski, P. Szczepankowski, *Analiza wartości przedsiębiorstwa*, Difin, Warsaw, 2007.

[15] This is a sort of simplification, the relation: interest in the period t/interest-bearing liabilities at the end of period (t-1) or annual average is more accurate.

[16] Beta was adopted on the basis of previous data (prepared by prof. Aswath Damodaran), A. Damodaran, *Data*, http://pages.stern.nyu.edu/~adamodar/ (date of access: 20.11.2015).

[17] A traditional approach to calculating the risk-free bonus the CAPM method are presented in the study: W. Cwynar, A. Cwynar, *Model wyceny aktywów kapitałowych – problemy stosowania w praktyce. Rynkowa premia za ryzyko*, "Przegląd organizacji", no. 9, 2007, pp. 31-36.

creased by the national risk premium according to Country Risk Premiums Damodaran (1.65%). In general, the model for estimation of the cost of equity was as follows[18]:

$$k_e = r_{rf} + \beta_i (k_m - r_{rf}) \quad (1)$$

where:

k_e – cost of equity (estimated),
r_{rf} – risk-free rate (for example the profitability of treasury securities),
$k_m - r_{rf}$ – market risk premium (here: the global risk premium + domestic risk premium).

4. Economic value added was calculated with the use of net value added (NVA) as a fixed estimation of EBIT. Taking into account the fact that costs of depreciation were not deducted on one of stages of NVA calculation, presented perspective is closer to money-based approach.

Table 2. Estimation of the cost of equity and factors affecting its size in farms of FADN panel

Category	Value
Expected ling-term risk rate (global)*	3.50
Domestic risk premium (according to A. Damodaran as at: 1.07.2013)	1.65
Risk-free rate**: profitability of 10-year treasury bonds in Poland***	4.08
The beta coefficient of equity (according to A. Damodaran for Agriculture, Emerging Markets 1.07.2013)	0.98
Cost of equity ****	9.13

* It has been assumed according to estimation stated in: Credit Suisse Global Investment Returns Yearbook 2009; ** after the Global Financial Crisis (GFC) and its implications in Europe risk-free rate is doubtful even when referring to treasury bonds; *** in 2013, there was no auction concerning quotations of 52-week treasury bonds, an average from the last quotation was assumed, therefore, an average from the annual period was adopted, calculated by Poland 10-year bond yield historical data, http://pl.investing.com/rates-bonds/poland-10-year-bond-yield-historical-date (date of access: 10.11.2015); **** it was calculated as follows: 4.08 + 0.98 (3.50+1.65).
Source: prepared by the author.

Tables 3 and 4 present basic EVA descriptive statistics for farms from the FADN panel[19] according to two standard classification perspectives (i.e. according to TF8 production type and ES6 SO economic volume) in 2013. Although these are test results based on methodical approach and refer to sample selected in a purposeful manner, initial results of undertaken empirical studies indicate substantial difficulties the family farms have in generating economic value added. This is signifi-

[18] Table 2 contains basic components and values necessary for calculation of the cost of equity.
[19] The panel of farms covered only those entities (farms of natural persons), whose accounting data have been uninterruptedly gathered in the FADN system for 2007-2013. Owing to the pilot nature related to presentation of the EVA concept for family agricultural farms, studies concerned only 2013. Descriptive statistics of key measures and ratios are presented in Table 1A of the Annex (Annex to Chapter 1).

cantly affected by the group of mixed type farms, dominant in the structure of family farms in Poland. When focusing on these entities, attention should be paid to the lowest EVA obtained among the analysed production types. Interesting information is provided by analysis of the minimum and maximum value (the highest value of EVA in the examined community was generated by field farms), as well as standard deviation. Positive EVA was generated by more than 50% of farms of "horticultural crops", "permanent cultivation" as well as "mixed" type farms. According to forecasts, only farms with considerable production ("high" and "very high") were able to obtain positive EVA. Presented descriptive statistics are the basis for further and in-depth analysis (e.g. value creation index – VCI and identification of EVA determinant), also in a dynamic approach.

Table 3. EVA descriptive statistics for farms according to the production types in 2013

Specification [in thousand zlotys]	Field crops (1)	Specialist horticulture (2)	Permanent crops (4)	Herbivores (5;6)	Granivores (7)	Mixed (8)	Total
Minimum	-206.4	-181.3	-190.5	-187.2	-199.5	-206.0	-206.4
Median	-10.5	9.6	6.0	-0.3	3.1	-9.9	-6.6
Maximum	471.8	183.0	198.5	243.6	191.7	195.4	471.8
Arithmetic mean	-9.0	19.5	8.7	3.1	12.0	-10.4	-3.9
Standard deviation	65.4	61.4	63.1	53.5	69.4	49.4	57.6

Source: own calculations based on the FADN data.

Table 4. EVA descriptive statistics for farms according to economic size in 2013

Specification [in thousand zlotys]	Very small (A)	Small (B)	Medium--small (C)	Medium--large (D)	Large (E; F)	Total
Minimum	-56.4	-156.1	-206.4	-206.0	-204.9	-206.4
Median	-7.2	-9.3	-5.9	1.0	13.3	-6.6
Maximum	20.3	139.5	198.5	243.6	471.8	471.8
Arithmetic mean	-9.2	-10.7	-6.0	0.9	10.5	-3.9
Standard deviation	14.2	27.2	45.9	73.4	95.8	57.6

Source: own calculations based on the FADN data.

3.2. The Du Pont model – possibility of application for evaluation of financial situation of family farms

The Du Pont model – as synthetic structure enabling evaluation of the profitability of companies[20] – may be used as a tool of financial analysis of farms. The beginnings of this model date back to the first half of the 20th century[21], when by means of trial-and-error method basic tools of financial analysis were introduced[22].

[20] See E. Brigham, M. Ehrhardt, *Financial Management: Theory & Practice.* Twelfth Edition. Thomson Higher Education, Mason, 2008.
[21] J.B. Guerard Jr., E. Schwartz*, Quantitative Corporate Finance*, Springer Science + Business Media, LLC, p. 90.
[22] For instance, General Electric calculated profitability/rate of return by dividing earnings by sales or costs.

Low profitability (returns) of production factors in the USA (observed particularly after oil crisis in the 1970s)[23] and boom/bust cycles[24] as well as credit restrictions encountered by farms were a premise for identification of key factors affecting profitability of agricultural farms. Comprehensive study concerning decomposition from the Du Pont model, adapted to the specific nature of American farms, was presented in 2009 by the team of A.K. Mishra[25] which – as the starting point – chose to decompose the ROE ratio:

$$\frac{R}{E} = \left(\frac{R}{A}\right) \cdot \left(\frac{A}{E}\right) \tag{2}$$

where:

R (returns) – returns from agricultural activities,
E (equity) – equities,
A (assets) – total assets.

Subsequent transformations resulted in logarythming the popular form of the Du Pont model as presented below:

$$\ln\left(\frac{R}{E}\right) = \ln\left(\frac{S-C}{S}\right) + \ln\left(\frac{S}{A}\right) + \ln\left(\frac{A}{E}\right) \tag{3}$$

where:

S – sales,
C – costs of production.

Mishra et al. identified a set of key factors forming profit margin level, namely education of farm operators, production type of farm, specialisation and level of received governmental payments. Asset turnover was most significantly influenced by: (1) farm specialisation, (2) age of farm operator, (3) degree of subsidising by means of governmental payments. Attention should be paid to the conclusion that at farms, members of which generate the so-called off-farm income, total asset turnover was substantially lower.

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[23] See A.K. Mishra, M.J. Morehart, *Factors affecting returns to labor and management on U.S. dairy farms*, "Agricultural Finance Review", vol. 61, issue 2, 2001, pp. 123-140; A. Schmitz, Ch.B. Moss, T.G. Schmitz, H. Furtan, *Agricultural Policy, Rent Seeking, and Global Interdependence*, University of Toronto Press, Toronto 2009.

[24] See A. Schmitz, *Boom/bust cycles and Richardean rent*, American Journal of Agricultural Economics, vol. 7, no. 5, 1995, pp. 1110-1125; J. Beckman, D. Schimmelpfennig, *Determinants of farm income*, Agricultural Finance Review, vol. 75, issue 3, 2015, pp. 385-402; B.C. Briggeman, S.R. Koenig, Ch.B. Moss, *US farm debt: the role of ARMS,* "Agricultural Finance Review", vol. 72, issue 2, 2012, pp. 254-261.

[25] A.K. Mishra, Ch. B. Moss, K.W. Erickson, *Regional differences in agricultural profitability, government payments, and farmland values: implications of DuPont expansion,* "Agricultural Finance Review", vol. 6, no. 1, 2009, pp. 49-66.

A. Katchova and S.J. Enlow[26], for evaluation of financial situation of agribusiness enterprises, used an approach based on decomposition of the Du Pont model. Their research covered a relatively long timeline (1961-2011). Two American researchers used ratios normally used to measure the success of companies. This analysis was focused on identifying differences in the financial situation of agribusiness entities and enterprises in general.

The Du Pont analysis related to three elements: (1) profitability, (2) operational effectiveness and (3) financial leverage. Agribusiness entities were characterised by a higher return on own equities and profit margin (Table 5). Achieving a relatively high level of ROE in agribusiness resulted directly from high value of the total asset turnover. Results of Katchova's and Enlow's studies are consistent with the trend of research on identification of "success factors" of enterprises in general, subject to the specific nature of agribusiness. According to the researchers, it is necessary to broaden the frame of analysis by assessment of financial "robustness" of the agricultural and food sector at various macroeconomic conditions[27].

Table 5. Decomposition of the Du Pont model: agribusiness entities vs enterprises in general

Financial ratios	Calculation formula	25th percentile	Median	75th percentile
Agribusiness entities				
Return of equity (ROE)	Net income/equities	0.004	0.028	0.059
Profit margin	Net income/net sales revenue	-0.003	0.051	0.101
Total asset turnover	Net sales revenue/assets	0.157	0.274	0.409
Equity multiplier	Assets/equities	1.351	1.796	0.409
Enterprises in general				
Return of equity (ROE)	Net income/equities	-0.010	0.019	0.044
Profit margin	Net income/net sales revenue	-0.062	0.042	0.123
Total asset turnover	Net sales revenue/total assets	0.022	0.127	0.274
Equity multiplier	Assets/equities	1.213	1.807	3.247

Source: A.L. Katchova, S.J. Enlow, Financial performance of publicly-traded agribusinesses, "Agricultural Finance Review", vol. 7,3 issue 1, 2013, p. 70.

Although B. Schaufele and D. Sparling[28] oriented the purpose of their empirical studies at identification of dependencies between regulatory amendments, ROE level and evaluation of stock exchange price of companies, they

[26] A.L. Katchova, S.J. Enlow, *Financial performance of publicly-traded agribusinesses*, "Agricultural Finance Review", vol. 73, issue 1, 2013, pp. 58-73.
[27] Ibid.
[28] B. Schaufele, D. Sparling, *Regulation and the financial performance of Canadian agribusinesses*, "Agricultural Finance Review", vol. 71, issue 2, 2011, pp. 201-217

used the approach of A.K. Mishra et al.[29] in which the system of three logarithmised equations plays the main role, the "starting" decomposition result of the Du Pont model in the following form:

$$\begin{aligned}
\ln PM_{it} &= \sum_i v_{1i} + \psi_1 \cdot Year + \sum_j \gamma_{1j} \cdot Food \cdot regulation_j + \sum_k \phi_{1k} Z_k + \varepsilon_1 \\
\ln TAT_{it} &= \sum_i v_{2i} + \psi_2 \cdot Year + \sum_j \gamma_{2j} \cdot Food \cdot regulation_j + \sum_k \phi_{2k} Z_k + \varepsilon_2 \\
\ln EM_{it} &= \sum_i v_{3i} + \psi_3 \cdot Year + \sum_j \gamma_{3j} \cdot Food \cdot regulation_j + \sum_k \phi_{3k} Z_k + \varepsilon_3
\end{aligned} \tag{4}$$

where:

PM – profit margin (calculated as net income to total sales),

TAT – total asset turnover [turnover of assets (sales revenue/assets)],

EM – equity multiplier [equity multiplier ((1 + (debt/equities))],

v_{ki} – second terms (dependent on the specific nature of a business entity),

Z_k – control variables (e.g. size of company).

Results from decomposed Du Pont model indicate that regulations with regard to the food law have significant impact on financial situation of agribusiness entities. This resulted probably from emergence of "administrative costs" in "profit margin" ratio. It should be pointed out that information in profit margin may be assigned to the difference between generally diversified and specialised agriculture. Assuming that more specialised agricultural production corresponds to markets close to perfect competition, where profit is entirely distributed on different factors of production. Product specialisation may justify agricultural policy of the USA[30].

Results of studies conducted by Ch.B. Moss et al. indicated that the majority of variabilities in return on equities (ROE) can be explained by the changeability of asset turnover and profit margin, both at the regional and national level. The fixed effect estimation confirmed that asset turnover explained ROE variability to a slightly greater degree (49%) than profit margin (44%). But the results of estimation by means of *pool* type model confirmed that profit margin to a greater extent explains the variability[31].

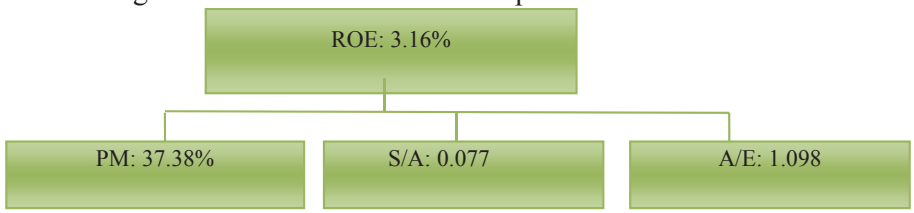
[29] See A.K. Mishra, J.M. Harris, K. Erickson, C. Hallahan, *What drives agricultural profitability in the US: application of the DuPont expansion method,* Paper presented at the Agricultural and Applied Economic Association Annual Meeting, Orlando, FL, July 27-29, 2008.

[30] Ch.B. Moss, A.K. Mishra, Ch. Dedah, *Decomposing Agricultural Profitability Using DuPont Expansion and Theil's Information Approach*, Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meetings, Milwaukee, Wisconsin, July 26-28, 2009.

[31] Ch.B. Moss, A.K. Mishra, Ch. Dedah, *Decomposing Agricultural Profitability*…, op. cit.

Figures 3-7 present modified (by A.K. Mishra) and simplified[32] Du Pont decomposition for farms from the FADN panel in total and selected groups of farms according to adopted classification approaches (in 2013). It should be added that all the presented measures were calculated as an average for individual data from entities of relevant groups, while – in the case of ratios – weighted averages were used. Presented pyramid analyses of the equity profitability ratio indicates that operators of small farms were not in a condition to generate positive income from family farms. As a consequence, negative ROS and, as a result, ROE ratios were obtained. Therefore, it is necessary to attempt to undertake restructuring actions (including termination of operations or more well thought-out succession processes) to achieve the ability to create ownership value. Attention should be paid for improving profitability of sales in "horticultural crops" type, which is also related to market conditions affecting obtained price-cost relations, beyond the control of operators. Operators of farms of "granivores" type used external capital (it indicates the value of multiplier of equity) as a source of financing to a slightly greater degree than, e.g. operators of entities specialised in gardening production. Financial planning, both in long- and short-term perspective, focused on revenue stabilisation, assuming that sustainable growth may support farm operators in activities aimed at improvement of equity profitability.

Figure 3. Modified Du Pont decomposition for farms in total



Source: own calculations on the basis of the FADN data.

ROE (return on equity) – ratio of return on equity,

PM (profit margin; income net/sale) – $\frac{\text{income from family agricultural farm - cost of family}}{\text{value of production - total intermediate consumption}}$,

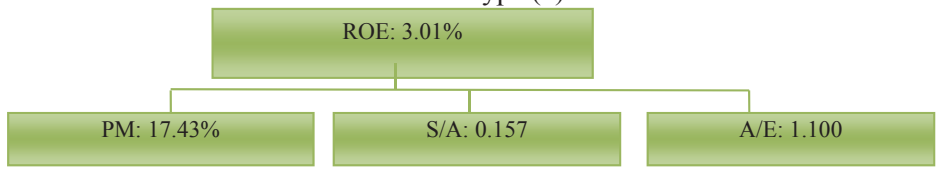
where: FWU - Family Work Units (FWU = Family AWU), unpaid labour input.

S/A (sales/assets) – total asset turnover (production reduced by indirect use/annual average total assets),

A/E (assets/equity) – equity multiplier (total assets/annual average total equity).

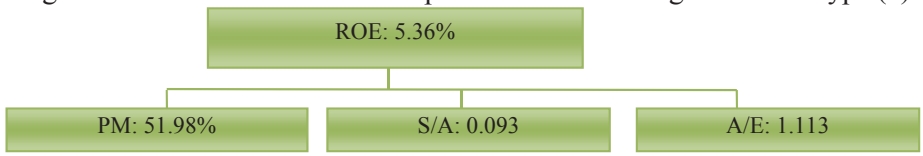
[32] Attention was paid to direct ROE determinants, without presentation of lower decomposition levels.

Figure 4. Modified Du Pont decomposition for specialist horticulture farms – type (2)



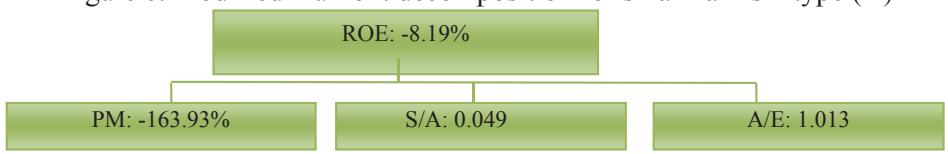
Source and markings: as for Figure 3.

Figure 5. Modified Du Pont decomposition for farms of granivores – type (7)



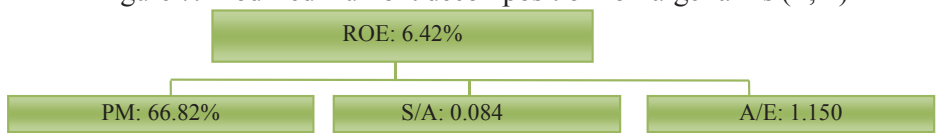
Source and markings: as for Figure 3.

Figure 6. Modified Du Pont decomposition for small farms – type (A)



Source and markings: as for Figure 3.

Figure 7. Modified Du Pont decomposition for large farms (E, F)



Source and markings: as for Figure 3.

3.3. Model inequalities in finance management of family farms

Rapid development of financial analysis tools connected with the progress of information technology (IT) made it possible to identify a very significant problem concerning financial growth of enterprises[33]. Considering that economic development, also development of the agricultural sector as its significant section, should rely on knowledge (the idea of the so-called knowledge-based economy[34]), it is important to take account of the factors determining financial growth of eco-

[33] The notion of "financial growth" – with regard to agricultural enterprises – has not been clearly defined. More details concerning this issue are to be found in the study of M. Soliwoda, *Dylematy wokół wymiaru finansowego zrównoważenia gospodarstw rolniczych*, "Zagadnie-nia Ekonomiki Rolnej", no. 3, 2015, pp. 112-128.

[34] OECD, *Knowledge-based economy*, General Distribution OCDE/GD(96)102, Paris 1996.

nomic organisations. W. Janik and K. Paździor[35] rightly notice that "increase in profit does not have to mean a growth in management intensity", as it can be achieved "as a result of the use of extensive factors with a simultaneous decrease in impact of intensive factors"[36].

Theoretical deliberations concerning sustainable growth as well as numerous empirical studies contributed to the development of model depiction. Two models have gained the largest popularity: (1) Higgins sustainable growth model[37] and (2) optimal growth model, developed by the team of German economists[38]. Higgins model assumes that "sustainable growth" should be identified with the annual percentage growth in sales revenue under the adopted financial policy (i.e. adopted relation of debt to own equities, profit margin, relation of total assets to sales revenue, dividend payout ratio). The second concept to a greater extent considers the perspective of creating capacity return of rate for shareholders as well as profitability, regardless of the adopted financial policy.

It should be noted that both growth models may be the object of criticism of the management staff, as they do not take into account the possibility of changing stakeholders enterprises over time. In addition, "growth challenge" is interpreted in different ways, depending on the specific nature of the sector[39], and in the case of the agricultural sector, too little attention is paid to diversification of the portfolio of farm's agricultural products delivered to the market[40].

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[35] W. Janik, A. Paździor, *Zarządzanie finansowe w przedsiębiorstwie*, Politechnika Lubelska, Lublin 2011, p. 13.

[36] Janik and Paździor give here an example of sales growth (related to production growth) which can result from increasing the number of the employed, while being accompanied by decrease in work efficiency. Ibid., pp. 13-14.

[37] Higgins model (from 1977) has been adapted for the specific nature of farms by the team of American economists (C. Escalante et al.), see: C.L. Escalante, C.G. Turvey, P.J. Barry, *Farm business decisions and the sustainable growth challenge paradigm*, "Agricultural Finance Review", vol. 69, issue 2, 2009, pp. 228-257.

[38] M. Handschuh, H. Dringenberg, G. Jonk, D. Maaß, S. Niewiem, T. Rasker, C. Velthuis, A.T. Kearney, *Optimales Wachstum*, [in:] Exzellente Manangementscheidungen: Methoden, Handlungsempfehlungen. Best Practices (ed. P.F.J. Niermann, A.M. Schmutte). Springer Fachmedien, Wiesbaden 2014, pp. 301-311.

[39] *Sustainable Growth,* http://www.inc.com/encyclopedia/sustainable-growth.html (date of access: 17.11.2015).

[40] See D. Thiele, Ch.R. Weiss, *Diversifikation und Wachstum landwirtschaftlicher Unternehmen*, Working Paper EWP 0201 Department of Food Economics and Consumption Studies University of Kiel, January 2002.

Table 6 presents the typical systems of model inequalities used in the financial analysis of enterprises. According to A. Kopiński[41] model inequalities (namely "model systems of inequalities expressed by means of dynamics indices") are used to monitor tendencies in finances of enterprise[42]. However, a measure of caution is necessary when interpreting model systems, because, as Kopiński rightly notices, "it is difficult to subject such complex financial activities of enterprise to strictly deterministic rules, being aware that they are affected by such risk factors"[43]. L. Bednarski[44] rightly states that "systems of inequality" should not be treated as universal. He draws attention to the relative character of model inequalities, emphasising, e.g. the need for consideration of deflation/inflation effects on prices. Using the system of model inequalities in the financial analysis is favourable in terms of making more rational economic decisions[45].

Empirical studies conducted by A. Kopiński proves that unfavourable macroeconomic situation (recession phase) – in most companies of the food industry located in Lower Silesia, as well as stock market companies quoted on the Warsaw Stock Exchange – affected difficulties in satisfying model inequalities[46]. An in depth analysis of descriptive statistics (above all standard deviations or kurtosis) for a set of entities from a given industry (which may have reference to farms economic and financial data which are collected by the FADN system) may serve as preventive tool (identification of any hazard for financial condition).

[41] A. Kopiński, *Analiza finansowa grupy przedsiębiorstw za pomocą wzorcowych układów nierówności*, Zeszyty Naukowe Uniwersytetu Szczecińskiego, no. 768, Finanse, Rynki Finansowe, Ubezpieczenia no. 63, 2013, pp. 261-276

[42] A. Kopiński believes even that the analysis of inequality systems ("analysis of relations of measures in the context of model system inequalities") constitutes an important element of control--warning system in finance management of enterprises. A. Kopiński, *Elementy systemu kontrolno-ostrzegawczego w zarządzaniu finansami*, Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego, "Ekonomika i Organizacja Gospodarki Żywnościowej", no. 88, 2011, pp. 59-70.

[43] A. Kopiński, *Analiza finansowa…*, op. cit., p. 265.

[44] L. Bednarski, *Analiza finansowa w przedsiębiorstwie*, PWE Warsaw 2007.

[45] This very important, key issue for finance management is described in English literature addressed to the group of professional "financial controllers" (analysts with some rights to make financial decisions); see P.P. Peterson, F.J. Fabozzi, *Analysis of Financial Statements*, John Wiley & Sons, Hoboken 2012; S.M. Bragg, *Financial Analysis: A Controller's Guide,* John Wiley & Sons, Hoboken 2012.

[46] Ibid.

Table 6. Example of systems of model inequalities used in the financial analysis of enterprises

No.	System of inequalities	Explanation
1.	*index of equity dynamics < index of profit dynamics*	Inequalities of fundamental importance. It is used to assess purposefulness of company operations
2.	$i_{Ko} < i_{Pn} < i_{Zo} < i_{Zg} < i_{Zb} < i_{Zn}$ where: i_{Ko} – index of dynamics of costs i_{Pn} – index of dynamics of revenues i_{Zo} – index of dynamics of profit from operating activities i_{Zg} – index of dynamics of profit on business operations i_{Zb} – index of dynamics of gross profit i_{Zn} – index of dynamics of net profit	It applies to companies, which differ in terms of type of used production factors (work, equity) as well as their resources.
3.	$ROE > ROA > ROS_n$ where: *ROE* – return on equity *ROA* – return on assets *ROSn* – return on net sales (rate of return from sales)	
4.	$I\frac{Aogół}{WACC} < I\frac{ZN}{WACC} < I\frac{CF}{WACC}$ where: *I* – index of dynamics *Aogół* – total assets *WACC* – weighted average cost of capital *ZN* – net profit *CF* – financial flows *Aogół/WACC* – cash expenditure of owned assets in the company in terms of used equities *ZN/WACC* – profitability of incurred costs of using equities in business operations *CF/WACC* – financial liquidity as compared to incurred costs of using equities in business operations	First inequality monitors (statically) productivity of assets which enterprises have, the other in turn, identifies whether generated (accounting) profit promotes the development of business entity

Source: prepared by the author on the basis of: A. Kopiński, Analiza finansowa grupy przedsiębiorstw za pomocą wzorcowych układów nierówności, Zeszyty Naukowe Uniwersytetu Szczecińskiego, no. 768, Finanse, Rynki Finansowe, Ubezpieczenia, no. 63 2013, pp. 261-276; M. Krajewski, System wczesnego ostrzegania w aspekcie kondycji finansowej przedsiębiorstwa, Zeszyty Naukowe Uniwersytetu Szczecińskiego no. 802, Finanse, Rynki Finansowe, Ubezpieczenia, no. 65, 2014, pp. 1-7.

Analysed model inequality concerning profitability (ROE> ROA) was met, on average, for 2/3 of all farms included in the panel (Tables 7 and 8).

Table 7. Satisfying of model inequalities by the farms of the FADN panel – according to the production types

Inequality ROE> ROA	2010	2011	2012	2013
Field crops (1)				
% of cases of preserving inequality	42.1	41.1	42.9	35.0
% of cases of no inequality	57.9	58.9	57.1	65.0
Dynamics of preserving inequality (YOY)	100.0	97.6	104.4	81.5
Specialist horticulture (2)				
% of cases of preserving inequality	28.2	26.8	25.4	27.7
% of cases of no inequality	71.8	73.2	74.6	72.3
Dynamics of preserving inequality (YOY)	100.0	95.1	94.8	109.3
Permanent crops (4)				
% of cases of preserving inequality	27.5	35.7	31.9	28.7
% of cases of no inequality	72.5	64.3	68.1	71.3
Dynamics of preserving inequality (YOY)	100.0	130.1	89.3	89.8
Herbivores (5; 6)				
% of cases of preserving inequality	38.0	40.7	35.1	38.2
% of cases of no inequality	62.0	59.3	64.9	61.8
Dynamics of preserving inequality (YOY)	100.0	106.9	86.3	108.8
Granivores (7)				
% of cases of preserving inequality	50.8	54.3	54.3	48.0
% of cases of no inequality	49.2	45.7	45.7	52.0
Dynamics of preserving inequality (YOY)	100.0	107.0	99.9	88,4
Mixed (8)				
% of cases of preserving inequality	24.6	25.3	23,9	22.0
% of cases of no inequality	75.4	74.7	76.1	78.0
Dynamics of preserving inequality (YOY)	100.0	102.7	94.5	91.9
Total				
% of cases of preserving inequality	33.6	34.9	33.6	31.2
% of cases of no inequality	66.4	65.1	66.4	68.8
Dynamics of preserving inequality (YOY)	100.0	103.7	0.962	0.931

Source: own calculations on the basis of the FADN data.

The largest difficulties were encountered by operators of farms of mixed type (as much as 78% of cases of failure to observe this inequality in 2013), on the other hand, maintaining inequality was the easiest task for operators of farms of "granivores" (indicated inequality was not maintained approximately on half of these farms). Except for 2012 and 2013 none of farms determined as "very small" used positive effects of financial leverage. It is also worth noting that in the period of 2010-2013 only for ca. 1/4 of farms determined as "large" fundamental ROE > ROA inequality was not maintained. The presented results concerning satisfying inequality related to rate of return should be confronted with descriptive ROE and ROA statistics, which enables identification of potential "warning signals" for the analysed sample of agricultural farms[47].

[47] ROE and ROA descriptive statistics are presented in Table 1B (Annex to the Chapter).

Table 8. Satisfying of model inequalities by the farms of the FADN panel – according to economic size

Inequality ROE > ROA	2010	2011	2012	2013
Very small (A)				
% of cases of preserving inequality	0.0	0.0	1.9	1.5
% of cases of no inequality	100.0	100.0	98.1	98.5
Dynamics of preserving inequality (YOY)	-	-	-	79.1
Small (B)				
% of cases of preserving inequality	6.7	6,1	6.9	4.6
% of cases of no inequality	93.3	93.9	93.1	95.4
Dynamics of preserving inequality (YOY)	100.0	90.7	112.3	66.3
Medium-small (C)				
% of cases of preserving inequality	26.9	29.4	26.5	26.2
% of cases of no inequality	73.1	70.6	73.5	73.8
Dynamics of preserving inequality (YOY)	100.0	109.6	090.0	98.7
Medium-large (D)				
% of cases of preserving inequality	56.7	59.0	56.6	51.6
% of cases of no inequality	43.3	41.0	43.4	48.4
Dynamics of preserving inequality (YOY)	100.0	104.0	96.0	91.1
Large (E; F)				
% of cases of preserving inequality	74.6	76.4	76.1	73.1
% of cases of no inequality	25.4	23.6	23,9	26.9
Dynamics of maintaining inequality (YOY)	100.0	102.4	99.6	96.1
Total				
% of cases of preserving inequality	33.6	34.9	33.6	31.2
% of cases of no inequality	66.4	65.1	66.4	68.8
Dynamics of preserving inequality (YOY)	100.0	103.7	96.2	93.1

Source: own calculations on the basis of the FADN data.

3.3. Summary

In conclusion, one of initiatives aiming at improvement of competitiveness of family agricultural farms using instruments of financial support (under CAP and national agricultural policy) may be development of the value-based management system (*V-BMS*) of these entities. It should be based on solid theoretical and methodical grounds. An obstacle is, as indicated, a limited availability of data and information on financial nature, resulting from the lack of the obligation to keep accounting records and financial reports, which applies to the majority of family farms (except for entities taking part in the FADN system and a small group of entities with a large production). System of measures and ratios of value-based management used in practice, the so-called corporate finances, requires a considerable modification and adaptation to the specific socio--economic character of farms. An accumulated experience concerning economic--financial analysis of the agricultural entities, gained by scientific units and agricultural advisory centres (cooperating with the FADN system) can be used in order to facilitate this purpose. The use of controlling strategic instruments and, above all, some Balanced Scorecard (BSC) may be considered to be a suggestion on how to support development of the aforementioned system. The results of the presented analyses based on data of the Polish FADN indicate that operators

of small farms were not in a condition to generate positive income from family farms, which had an unfavourable effect on the situation concerning profitability. More attention should be paid to exploration of dependencies concerning financial measures and ratios under the pyramid analysis for particular types of production. It is worth noting that improvement of equity profitability often involves the necessity to undertake strategic activities, including activities of restructuring character. It is worth emphasising that farms of the "mixed" type struggled with difficulties in satisfying ROE > ROA inequality. The analysis regarding satisfaction of model inequalities should also constitute an in depth identification and monitoring of "warning signals" for financial condition of family agricultural farms in Poland.

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Annex

Table 1A. Descriptive statistics of the sample in 2013

Specification	Unit	Minimum	Median	Maximum	Arithmetic mean	Standard deviation
Assets (annual average)	PLN thousand	82.3	817.6	11,770.9	1,121.1	997.9
Equity (annual average)	PLN thousand	72.0	769.0	8,500.1	1,021.1	853.0
Share of debt in financing of assets	%	0.0	2.6	32.9	6.1	7.8
Net value added	PLN thousand	-61.4	60.5	960.5	90.5	92.2
Production reduced by intermediate consumption	PLN thousand	-266.0	55.5	1,000.6	86.3	93.8
Profitability of assets	%	-30.4	1.0	24.4	0.7	6.6
Profitability of equity	%	-30.4	0.9	25.3	0.8	7.0
Total asset turnover	times	-0.125	0.068	0.319	0.079	0.051
Equity multiplier	times	1.000	1.027	1.490	1.074	0.103
WACC	%	6.4	9.0	10.2	8.7	0.6

The sample does not contain objects characterised by negative equity (only one farm) and outliers, N = 5352.

Source: own calculations based on the FADN data.

Table 1B. ROE and ROA descriptive statistics for agricultural farms constituting the panel in 2010-2013

Specification	2010	2011	2012	2013
ROE [%]				
Minimum	-58.74	-77.27	-112.07	-302.20
Median	0.88	1.24	1.09	0.56
Maximum	316.16	171.36	287.68	301.27
Arithmetic mean	1.28	1.41	1.28	0.48
Standard deviation	10.54	10.67	11.75	11.50
ROA [%]				
Minimum	-58.74	-77.27	-112.07	-302.20
Median	1.01	1.38	1.25	0.71
Maximum	284.89	171.36	287.68	301.27
Arithmetic mean	1.10	1.19	1.05	0.34
Standard deviation	9.36	9.47	10.31	10.53

N = 6455 farms in each year.

Source: own calculations based on the FADN data.

4. Conditions for non-agricultural activity of individual farmers

4.1. Introduction

An individual agricultural holding is a kind of a "company", wherein the income of the farmers' family members has a very strong influence on the decisions taken, regarding both production and investment. This is a result of a specific nature of individual agricultural holdings, where no clear separation is noticeable between the household and the holding[1]. J.St. Zegar emphasizes that farmer's income is quite specific, as compared to the income in other professional groups. This specific nature is defined by such phenomena as: the link between an agricultural holding and a household (family), the volume of income sources of farming households, the presence of a material (natural) form of income, the level of income indicators, the connection with an area of a holding, income diversity, specific division thereof as well as the calculation method and others[2].

B. Hill very broadly describes the general process of increasing the significance of income from outside an agricultural holding in its total income[3]. A. Stolarska notices that, on the one hand, the number of agricultural holdings is decreasing along with the number of persons employed in agriculture and, on the other, the number of inhabitants in rural areas is increasing. Therefore, the structure of subsistence of the rural population has also changed, which in turn results in changes in the structure and level of income obtained[4]. I. Augustyńska-Grzymek indicates that the economic situation of farming families, mainly determined by the level of obtained income (from agriculture and other sources), dictates the potential capability of accumulating goods for the proper functioning of a family, but also of the utilized agricultural holdings. All the while, accumulated material goods affect the current and future economic situation of individual families and the development of their holdings, which ultimately, though indirectly, affects the development of agriculture as a whole[5].

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[1] Z. Floriańczyk, S. Mańko, K. Kambo, P. Michalak, *Poziom i struktura dochodów rodzin rolników w gospodarstwach prowadzących rachunkowość w 2012 roku*, IERiGŻ-PIB, Warsaw 2014, p. 5.
[2] J.St. Zegar, *Dochody ludności chłopskiej*, IERiGŻ, Warsaw 2000, p. 49.
[3] B. Hill, *Farm Incomes. Wealth and Agricultural Policy*, Third edition, Avebury, Aldershot 2000.
[4] A. Stolarska, *Dywersyfikacja głównych źródeł utrzymania ludności wiejskiej w Polsce w 2011 roku*, Roczniki Naukowe SERIA, vol. 15, issue 4, Wieś Jutra Sp. z o.o., Warsaw – Poznań – Rzeszów 2013, p. 386.
[5] I. Augustyńska-Grzymek, *Regionalne zróżnicowanie sytuacji ekonomicznej rodzin uzyskujących dochody z gospodarstwa rolnego oraz innych źródeł*, Roczniki Naukowe SERIA, vol. XV, issue 3, Wieś Jutra Sp. z o.o., Warsaw – Poznań – Rzeszów 2013, pp. 27-28.

The Common Agricultural Policy sees the need to encourage farmers to seek employment outside agriculture. In Poland, under the Rural Development Programme for 2014-2020[6] (Polish: *Program Rozwoju Obszarów Wiejskich na lata 2014-2020*), measure M06 Development of holdings and economic activities, sub-measure 6.2 was proposed – Aid for commencing non-agricultural economic activities in rural areas. "Bonuses for Commencing Non-Agricultural Activities" fulfil the specific objective 6A – facilitating the differentiation of activities, establishing and development of small businesses as well as creating jobs. Support is granted to non-agricultural activities of farmers, their spouses, other household members and beneficiaries under: "Payments for farmers transferring small holdings", which will enable them earn income outside the agricultural sector. "Bonuses for Commencing Non-Agricultural Activities" are favourable for conducting innovative operations, which allows them to contribute to fulfilling the cross-cutting objective of the rural development policy, i.e. innovation. The support is rendered in the form of a bonus (PLN 100,000) paid in two instalments of 80% and 20%, accordingly.

This chapter attempts to systematize the income definitions functioning in colloquial language, economics, statistics, general accounting, and particularly in agricultural accounting. It is a starting point for a proper and comprehensive defining of non-agricultural income, which has a substantial effect on the functioning of agricultural holdings. Based on a review of the subject literature, the main purpose of the theoretical considerations was achieved – to define significant determinants of undertaking non-agricultural activities. In the following years, empirical studies shall be conducted of non-agricultural income in Poland and factors influencing it.

4.2. Income in individual agricultural holdings

To provide a precise definition of the term "income" is no easy task. Based on the definitions contained in the Dictionary of the Polish Language[7], several categories of income may be distinguished. In the Encyclopaedia[8], the entry for "income" also lacks a single, universal definition.

From the multitude of definitions of income circulating in the colloquial language, a very general definition may be adopted, describing income as a surplus of revenues over costs of their obtaining in a given period. The definition corresponds to the explanation used in economics, where income is the positive

[6] *Program Rozwoju Obszarów Wiejskich na lata 2014-2020* (*PROW 2014-2020*), MRiRW, Warszawa 2014, pp. 130-133.
[7] Słownik Języka Polskiego PWN, http://sjp.pwn.pl/sjp/dochod;2452759.html.
[8] Encyklopedia PWN, http://encyklopedia.pwn.pl/encyklopedia/doch%C3%B3d;1.html.

result of applying in the management process, production factors such as: land, work, physical and financial capital. From an economic standpoint, income means any and all revenue achieved by a managing entity in a given period, after deducting any and all costs of obtaining them. Thus, income reflects the economic surplus obtained by a given entity, as a result of performing specific activities, which serves to fulfil the said entities' consumer needs and investment objectives. Income is thus a material basis of existence of any business and social entity[9].

In the statistics of the survey of household budgets[10], carried out annually by the Central Statistical Office, the term "disposable income" is defined. This is the amount of current household income from all sources, reduced by advance payments for the personal income tax, rendered by the payer on behalf of the taxpayer (from income from hired labour and from some social insurance benefits and other social benefits), income taxes from property, taxes paid by self--employed persons, including representatives of freelance professions and persons utilizing individual holdings in agriculture, and by health and social security premiums. Disposable income covers financial and non-financial income, including natural consumption (consumer goods and services obtained for household use from individual holdings in agriculture, or business operations conducted on own account), as well as goods and services received free of charge.

Disposable income is intended for expenditures and growth of savings. It includes income from hired labour, income from individual agricultural holdings, income from off-farm self-employment, from practising a freelance profession, property income, income from real estate lease, social security benefits (including pensions and annuities), other social benefits, other income (including donations and alimony).

In the Accounting Act[11] the term income is not present. It defines revenue, profits, costs and losses. Whenever the Act mentions:

– revenue and profits, they are understood as a likely formation of economic benefits in the reporting period, of a reliably assessed value, in the form of increased asset value, or decreased liability value, which lead to an increase in equity or a decrease in its deficiency, otherwise than by contribution of funds by shareholders or owners;

[9] J. Pawłowska-Tyszko (red.), M. Soliwoda, *Dochody gospodarstw rolniczych a konkurencyjność systemu podatkowego i ubezpieczeniowego*, Program Wieloletni 2011-2014, no. 121, IERiGŻ--PIB, Warsaw 2014, pp. 13-14.

[10] *Budżety gospodarstw domowych w 2014 r.,* GUS, Departament Badań Społecznych i Warunków Życia, Warsaw 2015, pp. 18-19.

[11] Act of 29 September 1994 on accounting (Journal of Laws 1994 no. 121 item 591; consolidated text), http://isap.sejm.gov.pl/DetailsServlet?id=WDU19941210591.

– costs and losses, they are understood as a likely decrease in economical benefits in the reporting period, of a reliably specified value, in the form of asset value decrease, or liability and reserve value increase, which lead to a decrease in own equity, or increase in its deficiency, otherwise than by the withdrawal of funds by the shareholders or owners.

Therefore, the key category result in financial reporting is net profit/loss.

Prior to defining the category of income in agriculture, the specifics thereof should also be characterised. According to J.St. Zegar, the said specific character may be described through several phenomena. Firstly, the farmer also fulfils the role of the owner of production means as well as the production workforce (employees). From such an arrangement, a complication arises in terms of measuring income, since, theoretically, the farmer should receive a pension and capital interest under the former title, as well as a remuneration for labour rendered under the latter. Oftentimes it turns out that the farmer not only does not obtain remuneration for involved material and financial production capital, but also that the remuneration for labour rendered (of the farmer and their family) is much lower than the average wage for the national economy workforce.

Secondly, the agricultural holding and household are connected in terms of consuming the time and income of household members. Therefore, the income obtained from an agricultural holding is not assigned in adequate proportion to individual production factors, according to incurred outlays. Thirdly, the specific nature of agricultural income is that part of it is obtained in the natural form, i.e. produce intended for consumption in the household (including donations) and for increasing the production potential (investments such as increasing the basic herd, increase of long-term plantings as well as increase of production stocks). The difficulty of a proper income account is further complicated by a shared use of some items for manufacturing and consumption (e.g. automobiles, energy, etc.), which undoubtedly is also a specific feature of family farming, particularly traditional farming. Fourthly, presently, the issue of agricultural income is further complicated due to the intensifying awareness of the non-commercial (non-production) functions of agriculture and an agricultural holding, and attempts to include these functions in economic calculation. Non-agricultural activity, which is an integral part of agricultural holding operations, or ownership of a certain area (agricultural land areas, forests, waters, wastelands), may be a source of additional income[12].

For individual agricultural holdings, agricultural income is recognized as the basic objective of business operations. Agricultural income is in fact, in the economic sense, the most sensitive connection of an agricultural household with an

[12] J.St. Zegar, *Dochody w rolnictwie w okresie transformacji i integracji europejskiej*, IERiGŻ-PIB, Warsaw 2008, pp. 36-39.

agricultural holding. This income, as an agricultural holding's income, requires special treatment and separation from personal income (disposable) of households connected to agriculture. Otherwise misunderstandings may arise and the condition of agricultural holdings may be evaluated through the lens of personal income (income of households connected to agriculture), or the condition of households through the lens of income obtained from agricultural operations, i.e. agricultural income. Currently, an increasingly smaller percentage of households connected to agriculture obtains income solely from an agricultural holding with a growing significance of income from other sources, which enables them to operate even at a negative agricultural income. It is also quite common to cover some expenses of an agricultural holding with income obtained outside the said holding, which enables its existence despite of losses in production operations.

The basic categories of income in agriculture include:

- On the macroeconomic level: the gross value added and gross disposable income. The gross value added is used as a measure for the social work efficiency and cross-sector comparisons in this respect. Available gross income is a reliable aggregate expressing total income for consumption and gross savings in the subsector of households.
- On the microeconomic level: agricultural income, i.e. income from an agricultural holding (per household or a family labour input unit – the so-called employed full-time) and the sum of income from all sources, i.e. households income, related to the user of an agricultural holding (i.e. personal, general, useable or disposable income). Agricultural income is used for the evaluation of fees for agricultural production factors, including work efficiency in the holding and assessment of the capacity of an agricultural holding to provide subsistence to the family operating it[13].

The system for collecting and use of accounting data from agricultural holdings in Polish FADN uses a method of calculating income categories on the basis of individual data for each individual agricultural holding. The first economic surplus, calculated in the Polish FADN system, is the gross value added of an agricultural holding. It is calculated by subtracting indirect consumption from total production and adding the subsidy and tax balance related to the holding's operations. Subsidies increase the gross value added and taxes (not included in indirect consumption) are a cause for its reduction. After subtracting depreciation from the gross value added, the net value added of an agricultural holding is obtained. The next stage involves deducting the cost of external factors from net value added and adding the subsidy and tax balance concerning investment operations.

[13] Ibidem, pp. 42-43.

This way it is possible to calculate the basic economic surplus obtained from the operational activities of a farm, defined as **income from a family farm**. This income is considered to be a fee for own production factors (work, land and capital) involved in the operational activities of a farm and the risks taken by the person running the farm in the financial year[14]. The Agricultural Accountancy Department has also prepared a method of calculating entrepreneur profit[15]. The calculation involves subtracting the estimated unpaid own factors from the income of a family farm, and adding interest paid on liabilities of the farm.

Under the FADN system data concerning operations other than agricultural, directly related to an agricultural holding (the so-called OGA[16]) are also collected. This type of activity means a holding's activity, which makes use of its resources (land, buildings, machines, devices, work) or produced agricultural goods.

Farmer family off-farm income, in the survey carried out annually by the Agricultural Accountancy Department, includes the sum of revenues from: remuneration for hired labour outside the agricultural holding, retirement benefits and pensions of the farmer or their family members, income from other social benefits (e.g. damages under social insurance, unemployment benefits), income from other sources (e.g. inheritance, donations), and income after tax from a registered non-agricultural activity.

The term **farmer's family income**, in accordance with FADN methodology, means the sum of income from a family agricultural holding and income from outside the said holding.

In subsequent years, empirical research will utilize data from agricultural holdings participating in the FADN system in Poland as well as income categories defined therein.

4.3. Determinants for undertaking non-agricultural activity

Non-agricultural business activity plays an important role in the economy of rural areas. It transforms a mono-functional village into a multi-purpose one, contributing to the economic stimulation of rural areas and encouraging the process of their socio-economic development. It may be linked to agriculture, or completely unrelated thereto[17].

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[14] Z. Floriańczyk, S. Mańko, D. Osuch, R. Płonka, *Wyniki Standardowe 2013 uzyskane przez gospodarstwa rolne uczestniczące w Polskim FADN. Część I. Wyniki Standardowe*, IERiGŻ-PIB, Warsaw 2014, p. 37.

[15] L. Goraj, S. Mańko, *Model szacowania pełnych kosztów działalności gospodarstw rolnych*, Zagadnienia Ekonomiki Rolnej, no. 3, IERiGŻ-PIB, Warsaw 2011, pp. 28-58.

[16] Abbreviation in the English language: OGA – Other Gainful Activities.

[17] D. Zając, *Znaczenie pozarolniczej działalności gospodarczej rolników w procesie rozwoju wielofunkcyjności rolnictwa i obszarów wiejskich*, Wydawnictwo Uniwersytetu Rzeszowskiego, Rzeszów 2014, pp. 148-149.

The determinants for undertaking non-agricultural activities include:

- the regional location of an agricultural holding;
- qualifications and education of the farmer and their family members;
- workforce mobility;
- the life cycle phase of the farmer's family;
- planned/conducted investments in the agricultural holding;
- subsidies (the degree of subsidizing of agricultural holdings);
- agricultural policy;
- agricultural type and the economic size class of an agricultural holding;
- insufficient income from agricultural production.

All of the above factors are subject to scientific research worldwide. A very interesting example is the article by two American researchers, J.M. D'Antoni and A.K. Mishra, who modelled the effects of direct subsidies' reduction, both coupled and decoupled, on the readiness of farmers to undertake non-agricultural activities under contemporary conditions in the USA[18]. The authors analysed the effect of fiscal cuts announcements on the behaviour of agricultural families on the labour market, and the decisions concerning the division of their available time between commercial activities (on- and off-farm) and leisure.

The research has been referred to specific conditions in America, as one of the main determinants for undertaking non-agricultural activities there, is the desire to obtain health insurance funded by the employer. The starting point for the construction of the theoretical model was the function maximizing the utilitarian value of an agricultural family, where leisure and total income are a function of time worked on- and off-farm. Other variables included in the model are: the total time resource in hours divisible between leisure, work on- and off-farm; the profit from an agricultural holding; non work-related household income; income from and off-farm work.

The model assumes that the optimum is achieved when limit values of product obtained from work on- and off-farm are equal. Under balanced conditions, these products should equal relevant salary rates. In this context, health insurance offered by the non-agricultural employer for example, actually increases the payment for work. Due to that the attractiveness of permanent in relation to self-employment is also increasing. If, on the other hand, health employment insurance is co-financed from public funds, stimuli for seeking non-agricultural employment by farmers are decreasing. Such a situation is common in the EU Member States.

[18] J.M. D'Antoni, A.K. Mishra, *Welfare implications of reduced government subsidies to farm families: accounting for fringe benefits*, "Agricultural Economics", vol. 44, no. 2, 2013, pp. 191-202.

The empirical analysis of D'Antoni and Mishra, makes use of the achievements of qualitative variable modelling, namely the Tobit model. It assumes that the dependent variable is of a mixed nature, i.e. quantitative, when it can be observed, and qualitative if that is impossible. In the latter case, the variable has to be assigned an arbitrary value, which is usually zero. When constructed in this way, the dependent variable is referred to as limited. This may be a result of operating on a cut-off sample (information on the independent variables may be obtained when the dependent variable is observed, measured) or a censored sample, i.e. when observations are available for the entire community with regard to independent variables[19].

D'Antoni and Mishra designed separate Tobit models for the holding manager and their spouse.

The collection of independent variables included the following categories:

- the age of the manager and spouse;
- the education of the manager and spouse, measured as the number of years of attendance in all types of schools;
- the distance, in miles, from the workplace outside the holding (again, separate for the manager and spouse);
- the probability of obtaining health insurance founded by the employer outside agriculture (artificial variable assuming a value of 1 when the insurance is obtained and 0 if not);
- decoupled payments (in USD thousand);
- coupled payments (in USD thousand);
- annual sales (in USD thousand);
- the number of members of an agricultural family;
- dairy farm (value of 1, if yes, and 0, if not);
- the spatial location of a farm (artificial variable);
- the year of data collection, i.e. 2006, 2007 or 2008 (artificial variable based on 2006).

Source information were obtained from the ARMS database (Agriculture Resource Management Survey). Two models have been estimated: 1st, with health insurance founded by a non-agricultural employer, and 2nd, without the said insurance, separately for the manager of an agricultural holding and their spouse. Next, the most important modelling results will be commented on, but without the impact of independent variables "holding's spatial location in space" and "year of source data collection", as they reference specifically to the American conditions.

[19] Explanation of the essence of the Tobit model was given on the basis of: *Ekonometria i badania operacyjne: Podręcznik dla studiów licencjackich.* Scientific ed. by M. Gruszczyński, T. Kuszewski, M. Podgórska, Wydawnictwo Naukowe PWN, Warsaw 2009.

As a result of estimating Tobit models, the expected probability of receiving health insurance from a non-agricultural employer was found to actually be positively and statistically significantly correlated with the number of hours worked outside an agricultural holding. This applied both to the model for the agricultural holding manager and their spouse. However, decoupled payments exhibited a negative, statistically significant correlation with the off-farm work time. At the same time, in the instance of coupled payments that was only the case in the model for the agricultural holding manager. The fact of expected probability of receiving health insurance had a significant impact on marginal effects. On the whole, they were significantly higher than in the modelling variant without that additional benefit. In the model for the agricultural holding manager, in the case of separated payments, these effects were reduced from -0.1189 to -0.1854, and for coupled support, the decrease was from -0.0095 to -0.0239. These were very sound statistical estimates, as the α for them was 0.01. Generally, the signs and differences of marginal effects for both model variants for the spouse, were concurrent in the case of two payment options, to those present in the model for the manager. They were less important from the perspective of statistical criteria.

Concurrence between other independent variables and off-farm work time in the model for the manager were compliant only incidentally, in terms of direction in the case of the two options considered. This occurred for variables: "dairy farm" and "sales" (negative correlation) as well as the "distance to a non--agricultural workplace" (positive correlation). Within the option, where the probability of obtaining health insurance, off-farm work time was negatively correlated with: "age" and "education of the manager", positively, on the other hand, with: "size of the agricultural family" variable.

On the whole, the model for the spouse demonstrated a weaker reaction of off-farm work time to budget payments and other independent variables. The correlation nature, marginal effects and the statistical importance of estimates were often significantly different across variants in this instance as well. It is best illustrated by the "education of the spouse" variable. Within the option with health insurance, the better educated spouse has been less involved in the agricultural holding operations. But the situation in the variant without this insurance was completely different.

The negative correlation between budget payments and farmer off-farm work time was also found out by other researchers. For example, C.M. Ahearn et al. (2006) and H. El Osta et al. (2008) proved that the increase in the amount of those payments also increased the number of hours engaged in the agricultural holding operations by its manager, but it reduced the time and frequency of undertaking work outside the holding. The type of payment did not have any

differentiating impact on the obtained results. K.H. Mishra and K.B. Goodwin (1997) concluded that budget payments were negatively correlated with the share in the non-agricultural job market. However, H. Jensen and P. Salant and A.K. Mishra et al. (2012) proved that the desire to obtain non-financial additional benefits may indeed be an important motive to undertake work outside agriculture. This premise plays a certain marginal role in the EU, as social and health insurance in agriculture are widely subsidized. This circumstance and payments from the 1st CAP pillar demotivate non-agricultural activities but, at the same time, the 2nd pillar offered incentives to undertake them. This evident conflict within the subsidizing system has existed for many years and will be maintained in the new EU budget perspective. This is a simple aftermath of the CAP political economy, without connection with economic effectiveness or social justice.

In 2013, A.K. Mishra together with M. Pandit and K.P. Pandel published subsequent studies devoted to the impact of subsidies on the allocation of the time resource of agricultural families[20]. The starting point for the conceptual model of the three researchers was the assumption that the optimal division of the aforementioned resource between the holding, off-farm commercial activities and leisure, takes place when the marginal net value of benefits from such an allocation is even in each of these three applications.

The entire set of independent variables included the following items:

- the age of the holding manager and their spouse;
- the number of years of formal schooling of the manager and their spouse;
- use (1) or not (0) of health insurance offered to the manager and spouse by a non-agricultural employer; artificial variable;
- the number of members of an agricultural family below six years of age;
- the number of members of an agricultural family between six and seventeen years of age;
- net worth of the household in USD million;
- direct payments in USD thousand;
- indirect governmental subsidies in USD thousand;
- full ownership title to an agricultural holding (1) and 0 if not;
- partial ownership of an agricultural holding (1) and 0 if not;
- agri-environmental payment in USD thousand;
- agricultural production value in USD thousand;
- possession of an insurance policy for crops (1) and 0 if not;

[20] M. Pandit, K.P. Pandel, A.K. Mishra, *Do Agricultural Subsidies Affect the Labor Allocation Decision? Comparing Parametric and Semiparametric Methods,* "Journal of Agricultural and Resource Economics", vol. 38, no. 1, 2013.

– the diversification of an agricultural holding, measured with the use of entropy according to the Theila index;
– artificial variable assuming a value of 1 when the holding is located within a metropolitan area, and 0 if not.

It is necessary to explain that A.K. Mishra, M. Pandit and K.P. Pandel, as well as most previous researchers, carried out an appropriate test to determine whether decisions on employment outside agriculture of a farming couple are taken separately or in conjunction. They have determined that the process takes place separately, therefore confirming results obtained in the previous years. That was the reason for separate regression estimations for the manager of an agricultural holding and their spouse. The research sample was comprised of 5,121 observations in 2006, from the *Agricultural Resource Management Survey* network.

Among the set of independent variables in the semi-parametric model for the agricultural holding manager, only two were considered in a nonparametric manner: "age" and the "value of agricultural production". In the case of the spouse, there were six such variables present: "age in years", "age square", "net worth", "direct payments", "indirect payments", and the "agricultural holding diversification".

The entirety of the results of the empirical analysis can be summed up as follows:

1. The age of the holding manager and of their spouse is correlated in the parametric model with the probability of undertaking off-farm work outside in a manner resembling a reversed letter "u". However, in the semi-parametric model, the marginal effect of this dependent variable for the manager turned out to be positive, i.e. the probability (by 0.02) of them engaging in off-farm commercial activity was increasing. At the same time, it was a statistically important relation. In the case of the manager, the probability of undertaking non-agricultural activity decreased rapidly after they past the 43-45 year threshold. For the spouse, this boundary was significantly lower (34 years). The above results, match well with the hypothesis of the lifecycle of a farming family.
2. The probability of undertaking off-farm work was growing for all regression variants along with the extension of the period of formal schooling. It is worth mentioning, however, that for the spouse it was approximately two times greater than for the farm manager. A positive impact on the above-mentioned decision has also been reached by obtaining health insurance from a non-agricultural employer. The marginal effects here were the largest among all the independent variables, again larger, although not as much as in the case of education, for the spouse. This type of insurance, however, is of specific importance for agriculture in America. In the EU, on the other hand, this factor would not constitute even an independent variable, due to the commonness of farmer health insurance.

3. The number of children in the family has, in a noticeable, uniform and statistically significant manner, reduced the probability of undertaking work outside the holding only in the case of the spouse. It was particularly visible for the "children of six or less years of age" variable, which is completely understandable.
4. The probability of undertaking commercial activities beyond a holding has decreased when the family's net worth was increasing. This is manifested through the income effect. On the other hand, ownership of a holding has increased that likelihood in a more pronounced manner than with lessees, but only in the case of the manager. Estimations of both models for the spouse, however, showed a negative correlation. The same type of correlations was also obtained for the independent variable "agricultural production value", which reflects the holding size. At closer inspection it turned out, though, that the relations between this value and the dependent variable are far more complex, i.e. intervals and boundaries appear, where the probability of undertaking work outside agriculture may increase, but also decrease.
5. The impact of subsidies on the dependent variable is very diverse. Obtaining agri-environmental subsidies was positively correlated across the board with the probability of undertaking off-farm commercial activities. It is certainly a result of a certain extensification of agricultural activity after the acceptance of agri-environmental obligations. The marginal effects here, however, were low, only slightly higher for the spouse, but only once of statistical significance. Obtaining direct subsidies reduced the probability of undertaking off-farm work by both spouses. The marginal effects were, however, very low, particularly in the case of direct subsidies, and the statistical significance test was generally passed only by the parametric model. Scientists have formulated a clear political recommendation: agricultural subsidies focused on reducing unemployment in agriculture should not be increased. Limiting them could even be possible without significant detriment to small farmers. It is necessary, however, to wait for additional research to estimate how possible cuts in agricultural subsidies would affect this welfare. Also necessary are in-depth tests for the effectiveness of subsidizing the creation of non-agricultural jobs in rural areas by non-farmers.

Perhaps this area also contains counterintuitive interdependencies, which stand in opposition to previous research results. The situation was different for the independent variable "cultivation insurance". The purchase of this type of insurance has significantly reduced the probability of undertaking work outside the holding mainly in the case of its manager. The reason was mainly the fact that such insurance was purchased by large holdings, specialized in plants covered by government insurance programmes. In this context it cannot come as a surprise that interdependence between the dependent variable and independent

variable "holding diversification" was negative for the manager and positive for the spouse. Also, for the latter, living in metropolitan areas reduced the probability of undertaking off-farm work.
6. Performing Hong and White tests as well as the likelihood ratio (LR) test, clearly showed the superiority of the semi-parametric model in studying the determinants for undertaking off-farm work by either of the spouses managing it. This applies to the statistical significance of parameter estimates and the functional specification of models used. The differences in values of estimated parameters between them indicate the existence of non-linear interdependencies between the dependent variable and independent variables, which, in principle, can only be described by semi-parametric statistics.

A.K. Mishra together with K.A. Mottaleb and S. Mohanty tested the impact of income from outside an agricultural holding on the level of expenses for food in agricultural areas of Bangladesh[21]. The analysed data were obtained from the Bangladeshi *Household Income and Expenditure Survey* conducted in 2000, 2005 and 2010. In 2000, the survey included 7,440 randomly selected households (from 7 regions, 64 districts and 303 sub-districts). In 2005, the number of surveyed facilities increased to 10,080 (7 regions, 64 districts and 355 sub-districts), so as to reach 12,240 randomly selected households (from 7 regions, 64 districts and 384 sub-districts). However, for the purpose of the impact analysis of income from outside agriculture on alimentary expenses, the scientists selected holdings from typically agricultural areas, for which the main source of income is agriculture.

In connection, subsequent years' surveys included the following number of agricultural farms: in 2000 – 2,526, 2005 – 2,640 and 2010 – 3,434. The group has been divided into quintiles. Variables describing the demographic characteristics of the surveyed group included: annual total alimentary expenses, age of the holding manager, percentage of women managing a holding, age of the manager's spouse, years of education of the spouse, years of education of the manager, number of family members, and utilised agricultural area. Results indicate that, on average, the manager was 47 or fewer years of age, the time of their formal education was 3 years, the household includes more than 5 family members, and the holding area is nearly 3 acres. With regard to the manager's spouse (in most cases they were female), they averaged 37 years of age and 2.24 years of school education.

[21] A.K. Mishra, K.A. Mottaleb, S. Mohanty, *Impact of off-farm income on food expenditures in rural Bangladesh: an unconditional quantile regression approach*, "Agricultural Economics", vol. 46, no. 2, March 2015.

The results suggest that revenue from non-agricultural activity had a uniformly positive impact across all quintiles on increasing consumer expenses. Furthermore it turned out that education, experience and household location may affect an increase in alimentary expenses of agricultural holdings. Most importantly, this article proved that within holdings managed by females, who at the same off-farm time work, alimentary expenses are usually significantly lower.

Another very interesting analysis of factors motivating undertaking off-farm work was carried out by Norwegian scientists E. Biorn and H.M. Bjornsen[22]. Their research analysed data from a panel of holdings across 20 years (1989-2008). The panel consisted of holdings providing data from three to twenty years (on average ca. 10 years in a panel). These holdings participated in a Norwegian agricultural accounting system consistent with FADN methodology. Every year the survey covers from 800 to 1,000 holdings. These report that the time worked annually in a holding is between 1,800 and 3,100 hours. The average and median time worked in a holding is 2,500 hours, with the user/manager working 2,000 hours annually, and their spouse only 550. That was the starting point for conducting the behavioural analysis of farmers and their spouses. A criterion for including a holding in the panel has been assumed, of the manager having worked at least one full week off-farm in a year (37.5 hours annually). Subsequently, four groups of holdings were characterized:

- the farmer and their spouse did not undertake off-farm work (00);
- only the spouse is working off-farm (01);
- only the farmer is working off-farm (10);
- both spouses are working off-farm (11).

In order to characterize the researched panel of holdings, calculations were conducted of the average, standard deviation and the minimum and maximum values specified for the following variables:

- holding area,
- number of animals (in livestock units calculated according to FADN methodology),
- investment rate,
- farmer age,
- number of children aged 0-5,
- employment rate in the region (variable characterizing the possibility of undertaking work outside agriculture in a given region).

[22] E. Biorn, H.M. Bjornsen, *What motivates farm couples to seek off-farm labour? A logit analysis of job transitions*, "European Review of Agricultural Economics", vol. 42, no. 2, Oxford University Press, Oxford 2015.

Justifying their selection of these particular variables, the authors of the study put forth several hypotheses: younger farmers are much more willing to look for off-farm employment than older ones (despite the fact that older farmers may have sought such employment in the past); younger farmers are more mobile; the number of children of pre-school age limits the possibility of undertaking off-farm work by at least one parent.

In order to describe the behaviour of farmers and their spouses across twenty years, scientists developed five statistical models. They tested the impact of holding area, number of animals, farmer age, investment rate, regional conditions and family life cycle on undertaking off-farm work. The objects of their analysis were also holding transitions across the studied period between specified groups (00), (01), (10) and (11).

Results indicate that the traditional holding wherein the farmer and their spouse did not undertake non-agricultural work (00), is, on average, smaller and keeps more animals, as compared with the other three groups of holdings. On average, in such holdings (00) farmers are older, and the investment rate is lower. More modern holdings, where both spouses also work outside the holding (11), are characterized by a greater acreage, fewer animals, and significantly lower manager age as well as a high investment rate as compared to the other three groups of holdings.

4.4. Summary

The scale and direction of additional forms of multifunctional activity undertaken by farmers largely depend on endogenous conditions, such as: the age and education of the farmer, the area of arable land in the holding, the dominant type of generated agricultural production and the main intended use thereof, as well as the form and profile of conducted non-agricultural operations and significance of the holding and non-agricultural activity for the family's livelihood. In addition, significance in this respect is borne by such factors, as: the spatial location and characteristics of the local environment (in the commune), wherein the examined holdings are operating, thereby constituting important exogenous conditions for multifunctional operations undertaken by farmers, but of a local importance. It should be added that as a result of undertaking additional forms of multifunctional activity, farmers obtain a number of various benefits both of economic and non--economic (social, environmental, cultural) nature. These benefits apply not only to farmers, their families, agricultural holdings, and non-agricultural activity, but also concern and are important for rural areas and the society as a whole.

Farmers from rural areas neighbouring large and small cities, more often than others, conduct registered non-agricultural activities and such which constitute the main source of income for their families. However, farmers from rural,

naturally valuable areas distant from cities, more often conduct unregistered non-agricultural and agriculture-related activities, which is a sign of the multifunctionality of agricultural holdings as well as such, which constitute an additional source of income for their families[23].

The above theoretical deliberations are a starting point for empirical research aiming at identifying the type and importance of determinants for undertaking non-agricultural operations under Polish conditions as well as determining the impact of non-agricultural income on the economic and financial situation of natural persons' holdings.

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5. Subsidies versus finances and economics of farms belonging to natural persons

In 2011-2014, the Institute of Agricultural and Food Economics – National Research Institute (IERiGŻ-PIB) carried out research focused on identification of the key interrelations between economic and financial effectiveness and the financial condition of farms belonging to natural persons comprising the population covered by the Polish FADN[1] and their subsidising. The operated at that time panel consisted of 5,068 entities, constantly monitored over the period of 2005-2012. In connection with changes in the methodology of the Polish FADN, the present research adopted 2010 as the baseline year. Still, the analysis will be conducted in the form of panel research. Unlike in the previous years, it was decided not to use simple and multiple regression, as it will be used in a different part of this report.

5.1. Methodological assumptions

Since the Polish FADN gathers data regularly, on the basis of a theoretically well-established methodology, and applies highly advanced verification tools, it is guaranteed that the economic and financial effectiveness estimates as well as estimates of the relationships between liquidity, solvency and investment activity are highly credible. As in the previous years, the analysis presented in this chapter was drawn up in the form of a traditional comparison of the key economic and financial ratios and measures. A list of all ratios and measures used in this chapter can be found in Factsheet 1.

[1] *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (scientific ed. J. Kulawik), Program Wieloletni 2011-2014, no. 20, IERiGŻ-PIB, Warsaw 2011; *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (scientific ed. J. Kulawik), Program Wieloletni 2011-2014, no. 46, IERiGŻ-PIB, Warsaw 2012; *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (scientific ed. J. Kulawik), Program Wieloletni 2011-2014, no. 82, IERiGŻ-PIB, Warsaw 2013; *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (scientific ed. J. Kulawik), Program Wieloletni 2011-2014, no. 120, IERiGŻ-PIB, Warsaw 2014.

Factsheet 1. Used indicators and measures related to farm finances

Item	Ratio/measure	Calculation formula
1	Profitability [%]: - equity (1)	$\frac{\text{family farm income – own labour costs}^{1)}}{\text{average annual value of equity}^{2)}} \times 100$
	- equity (2)	$\frac{\text{entrepreneurs' profit}^{1)}}{\text{average annual value of equity}^{2)}} \times 100$
	- total assets (1)	$\frac{\text{(family farm income + interest) – own labour costs}}{\text{average annual total value of assets}^{3)}} \times 100$
	- total assets (2)	$\frac{\text{entrepreneurs' profit}^{1)}}{\text{average annual total value of assets}^{3)}} \times 100$
1'	Alternatively [1)]: - cash return on equity	$\frac{\text{cash flows (1)}}{\text{average annual value of equity}} \times 100$
	- cash return on total assets	$\frac{\text{cash flows (1)}}{\text{average annual total value of assets}} \times 100$
2	Share of gross margin in agricultural production	$\frac{\text{gross margin}^{4)}}{\text{agricultural production}^{5)}} \times 100$
3	Liquidity (times):	
	- current	$\frac{\text{current assets (EY)}^{6)}}{\text{short-term liabilities (EY)}}$
	- fast	$\frac{\text{current assets (EY) – reserves (EY) – current stock (EY)}}{\text{short-term liabilities (EY)}}$

Factsheet 1 cont.

Item	Ratio/measure	Calculation formula
4	Solvency (times):	
	- coverage of total loans with cash flows (1)	$\frac{\text{cash flows (1)}}{\text{total loans (EY)}}$
5	Investment coverage (times)	$\frac{\text{cash flows (1)}}{\text{gross investments}}$
6	Cash generating ratio (1)	$\frac{\text{cash flows (1)}}{\text{family farm income}} \times 100$
7	Cash generating ratio (2)	$\frac{\text{cash flows (2)}}{\text{family farm income}} \times 100$
8	Investment rate	$\frac{\text{gross investments}}{\text{depreciation}} \times 100$
9	Equity growth	$\frac{\text{equity (EY)} - \text{equity (BY)}}{\text{equity (BY)}} \times 100$
10	Working capital growth	$\frac{\text{working capital (EY)} - \text{working capital (BY)}}{\text{working capital (BY)}} \times 100$
11	Measures:	
	- change in the values of equity (PLN)	value of equity (EY) - value of equity (BY)[8)]
	- gross investments (PLN)	investment payments
	- net investments	gross investments – depreciation
	- cash flows (1)	balance of cash flows from operating activities – received subsidies to investments
	- cash flows (2)	balance of cash flows from investment activities + balance of net flows from financial activities + received subsidies to investments
	- family farm income	according to the Individual Farm Report[9)]
	- working capital (EY)	equity (EY) + long-term liabilities (EY) – fixed assets (EY)

Item	Ratio/measure	Calculation formula
12	Dependencies on subsidies:	
	- subsidy rate I:	$\frac{\text{subsidies to operational activities + subsidies to investments + compensation for milk}}{\text{vegetable production + animal production}} \times 100$
	- subsidy rate II (1):	$\frac{\text{subsidies to operational activities + subsidies to investments + compensation for milk}}{\text{family farm income}} \times 100$
	- subsidy rate II (2):	$\frac{\text{subsidies to operational activities + subsidies to investments + compensation for milk}}{\text{family farm income – own labour costs}^{1)}} \times 100$
	- subsidy rate II (3):	$\frac{\text{subsidies to operational activities + subsidies to investments + compensation for milk}}{\text{Entrepreneurs' profit}^{1)}} \times 100$
	- decoupling rate I of subsidies to operational activities	$\frac{\text{"decoupled" payments + LFAs + agri-environmental programmes}}{\text{subsidies to operational activities}} \times 100$
	- decoupling rate II of grants and subsidies	$\frac{\text{"decoupled" payments + LFAs + agri-environmental programmes + investment subsidies}}{\text{subsidies to operational activities + subsidies to investments + compensation for milk}} \times 100$
	- share of subsidies to operational activities in all subsidies	$\frac{\text{subsidies to operational activities}}{\text{subsidies to operational activities + subsidies to investments + compensation for milk}} \times 100$

1) Costs of own labour and the entrepreneurs' profit were calculated on the basis of a method developed by: L. Goraj, S. Mańko: *Model szacowania pełnych kosztów działalności gospodarstw rolnych*, "Zagadnienia Ekonomiki Rolnej", no. 3, IERIGŻ-PIB, Warsaw 2011.
2) Average annual value of equity = (equity at the beginning of the year + equity at the end of the year)/2.
3) Average annual value of total assets = (total assets at the beginning of the year + total assets at the end of the year)/2.
4) Gross margin = agricultural production less the amount of direct costs and the amount of direct costs of forest production.
5) Agricultural production = vegetable production + animal production.
6) (EY) = refers to the state as at the end of year.
7) Gross investments = payments incurred on investment activities. Investment expenses are payments that the farm incurred in a given year on investment activities, amounting to more than PLN 3,500.
8) (BY) = refers to the state as at the beginning of the year.
9) See: http://fadn.pl/metodyka/raporty/raport-indywidualny-1/ and Smolik A., *Jak rozumieć zawartość raportu indywidualnego gospodarstwa rolnego (wersja z 2013)*, IERIGŻ-PIB, Warsaw.

Source: prepared by the author.

5.2. Data sources

The subject of the research consists of individual farms conducting continuous agricultural accounting under the Polish FADN[2] in 2010-2013. The analysis covers only the farms that kept records in Books of Agricultural Accounts (BAA)[3], but omits farms of legal entities, from whom data were collected by means of a special survey. Farms selected for analysis in this manner do not meet the representativeness criterion, which means that the presented results refer to a certain sample of farms and are published in the form of average arithmetic means. The database of the Polish FADN includes many detailed records of data, verified in terms of their correctness and uniformly processed, which may be used in various types of economic analyses. Thus, it is a uniquely valuable resource.

Calculations of particular ratios mainly made use of results from tables of "Individual Report" and "Output Tables – OT". It is pre-aggregated information from the BAA. Their scope is more detailed than the scope of data contained in "Standard Outputs"[4].

Investment expenses are payments that the farm incurred in a given year on investment activities, the value of which exceeds PLN 3,500.

Cash generating ratios (1) and (2) were introduced to the set of ratios. These ratios were not calculated in the case, when the nominator and the denominator were negative. It would lead to wrong conclusions.

Granted subsidies were used for the purpose of the research, which means that grants are recorded, if a farmer received a decision on granting the subsidy and the subsidy amount is consistent with the records in the "Book of Receipts and Expenditures in the BAA".

In order to calculate equity profitability and profitability of total assets, it was necessary to estimate own labour costs. For this purpose, the method[5] was used, prepared in the Agricultural Accountancy Department. The estimation was based on the average remuneration for work per 1 AWU of hired workforce in different regions of FADN and economic size classes (ES6). Furthermore, two

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[2] Legal basis: Act of 29 November 2000 on collection and use of accounting data of agricultural holdings (Journal of Laws no. 3, item 20 of 2001, as amended). More information on the Polish FADN can be found at: www.fadn.pl, and on FADN: http://ec.europa.eu/agriculture/rica/.

[3] Forms of the Books on Agricultural Accounts are available at www.fadn.pl in section "Metodyka/Zbieranie danych/Gospodarstwa osób fizycznych" (not available in English).

[4] Documents: RI/CC RI/CC 882 Rev.9.2 Definitions of Variables used in FADN standard results. European Commission, Brussels December 2014.
Publications with "Standard Results" are available at: www.fadn.pl in section "Publications/Standard Results".

[5] L. Goraj, S. Mańko, *Model szacowania pełnych kosztów działalności gospodarstw rolnych*, "Zagadnienia Ekonomiki Rolnej", no. 3, 2011.

ratios were introduced – return on equity and on total assets, where the entrepreneurs' profit was used in the calculation formula. This profit was also calculated on the basis of the method prepared in the Agricultural Accountancy Department, where the family farm income was reduced by the estimated costs of unpaid own factors and increased by paid interest on farm liabilities.

In order to ensure comparability of the results obtained in the analysed years[6], land valuation according to the farmer was applied, which has been in force since 2009. It is determined on the basis of the amount declared by the farmer, for which he/she would be willing to buy his/her own land.

Farms stored in the database of the Polish FADN vary, e.g., in terms of production, area and economic size. Every farm surveyed by FADN is assigned to a certain type of farming and economic size class. In order to determine the economic situation of the examined farms as well as the impact of subsidies on their financial effectiveness, the analysed group was divided according to types of farming (classification according to TF8 typology) and according to the economic size classes (classification according to ES6). These divisions were used in the "Standard Outputs" published by IERIGŻ-PIB[7].

Until 2009, the main parameter used for classification of agricultural holdings in the European Union was the Standard Gross Margin (SGM)[8]. However, since 2010, the Community Typology for Agricultural Holdings (CTAH) has changed[9]. Parameters of standard output SO "2010" were used for classification of farms[10].

This typology is used, e.g., to describe the sector of agricultural holdings, select a sample for representative surveys as well as for weighting, so that the results obtained by farms could be compared to the whole sector[11]. These are the

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[6] More information necessary to interpret the results of the Polish FADN can be found in the publication: R. Płonka, A. Smolik, I. Cholewa, M. Bocian, E. Juchnowska, D. Osuch, *Najważniejsze informacje niezbędne do interpretacji wyników Polskiego FADN*, IERIGŻ-PIB, Warsaw 2015. (http://fadn.pl/wp-content/uploads/metodyka/Najwazniejsze-informacje.pdf).

[7] See: www.fadn.pl section "Publications/Standard Results".

[8] Decision of the European Commission No. 85/377/EEC establishing a Community typology for agricultural holdings, along with its amendment No. 2003/369/EC of 16 May 2003.

[9] Currently binding: Regulation of the European Commission No. 1242/2008 of 8 December 2008 establishing a Community typology for agricultural holdings, as amended by Commission Regulation (EC) No. 867/2009 of 21 December 2009.

[10] Regulation (EC) No. 1166/2008 concerning community farm structure surveys in 2010, 2013 and 2016, as well as Regulation (EC) No. 781/2009 on farm returns to be used under FADN.

[11] More information on the selection plan and its implementation can be found in the following publications: L. Goraj, D. Osuch, M. Bocian, I. Cholewa, B. Malanowska, *Plan wyboru próby gospodarstw rolnych Polskiego FADN od roku obrachunkowego 2013*, IERIGŻ-PIB, Warsaw 2012, as well as: L. Goraj, D. Osuch, B. Malanowska, M. Bocian, *Opis realizacji planu wyboru próby gospodarstw rolnych dla Polskiego FADN w 2013 r.*, IERIGŻ-PIB, Warsaw 2013.

latest parameters of standard output which will constitute the basis for determination of the farm selection plan that will be in force from 2016. Differences between classification of agricultural holdings determined using SGM coefficients and the classification using SO coefficients have been detailed in a publication of the Agricultural Accountancy Department[12].

In order to ensure comparability of the results, in the studied research period, the classification of farms applied was using standard output coefficients SO "2010". As it has already been mentioned, typology according to TF8 was used for grouping farms (see: Table 1).

Table 1. List of types of farming according to TF8 typology

Symbol	Typology according to TF8 grouping
1	Field crops
2	Horticulture
3	Wine
4	Other permanent crops
5	Milk
6	Other grazing livestock
7	Granivores
8	Mixed

Source: http://fadn.pl/wp-content/uploads/2012/12/TF8_eng.pdf and L. Goraj, M. Bocian, I. Cholewa, G. Nachtman, R. Tarasiuk, Współczynniki Standardowej Produkcji "2007" dla celów Wspólnotowej Typologii Gospodarstw Rolnych, IERIGŻ-PIB, Warsaw 2012.

In the analysis, the economic size of farms was characterised using ES6 classification (Table 2). The table, apart from digital symbols, provides in parentheses the letter symbols used in the analysis.

The set of farms continuously keeping accounting records in 2010-2013 was limited, owing to the presence of:

– non-standard farms,
– farms not classified with the use of the Standard Output coefficient,
– farms below the threshold, according to the applied classification, i.e. farms whose economic size was smaller than EUR 4,000.
– farms differing from the studied set.

Non-standard farms are farms, where the value of:

– equity was negative,
– current assets was equal to 0.

[12] L. Goraj, I. Cholewa, D. Osuch, R. Płonka, *Analiza skutków zmian we Wspólnotowej Typologii Gospodarstw Rolnych*, IERIGŻ-PIB, Warsaw 2010.

Table 2. List of sizes and ranges according to ES6 and ES

Symbol ES6	Name	Symbol ES	limits in EUR
-	-	**1**	EUR < 2 000
1 (A)	Very small	**2**	2,000 ≤ EUR < 4,000
		3	4,000 ≤ EUR < 8,000
2 (B)	Small	**4**	8,000 ≤ EUR <15,000
		5	15,000 ≤ EUR < 25,000
3 (C)	Medium-small	**6**	25,000 ≤ EUR < 50,000
4 (D)	Medium-large	**7**	50,000 ≤ EUR <100,000
5 (E)	Large	**8**	100 000 ≤ EUR < 250,000
		9	250,000 ≤ EUR < 500,000
6 (F)	Very large	**10**	500,000 ≤ EUR < 750,000
		11	750,000 ≤ EUR <1,000,000
		12	1,000,000 ≤ EUR <1,500,000
		13	1,500,000 ≤ EUR < 3,000,000
		14	EUR ≥ 3,000,000

Source: prepared on the basis of: L. Goraj, I. Cholewa, D. Osuch, R. Płonka, Analiza skutków zmian we Wspólnotowej Typologii Gospodarstw Rolnych, IERIGŻ-PIB, Warsaw 2010.

In the case, when the value of short-term liabilities was close or equal to zero, no liquidity ratios were calculated. Since dividing any number by a very small value gives values close to infinity, it was assumed that these farms do not have any short-term liabilities. The values of other ratios, where the denominator was equal to zero, also were not calculated.

As it has already been mentioned, investment expenses are payments within investment activities, the value of which exceeded PLN 3,500. In the case, when this value was smaller, it was established that the farm did not invest in a given year. Other farm selection criteria were additionally adopted.

They are as follows:

a) In the case of analysis of farms in terms of differing facilities, the analysis covered all variables selected for comparisons and calculations.
b) Their ranges were examined for all coefficients. If any value differed significantly from the studied set, then such a farm was excluded from further processing.
c) The next stage consisted in an analysis conducted by means of dispersion charts for points XY.

d) If a farm was excluded from research in a given year, then it was also omitted in the next years. The number of farms in the examined period is thus the same.

5.3. Analysis of the obtained results

As it has already been mentioned, the examined group is highly diverse (Table 3). Such a situation is normal in agriculture, which simultaneously includes small and large functioning facilities, located in favourable and unfavourable natural, climatic and economic conditions, using technologies with various proportions between land, capital and labour, focused on the market or own needs, or functioning and organised intensively or extensively. In addition, farms have different risk profiles, strive to optimise the obtained economic and financial outputs or are content to reach a satisfactory level, are managed by young and older managers, highly or poorly educated, using subsidies to a lesser or greater degree[13].

[13] V. Dolenc, *Der Einfluss der Betriebsgröße, der Ausbildung und des Wirtschaftsjahres auf den Erfolg der Haupterwerbrsbetriebe*, "Berichte über Landwirtschaft", band 89, no. 1, Mai 2011; P.J. Barry, C.L. Escalante, S.K. Bard, *Economic risk and the structural characteristic of farm business*, "Agricultural Finance Review", vol. 61, 2001; D. Freshwater, S. Jetté-Nantel, A. Katchova, M. Beaulieu, *Farm income variability and off-farm diversification among Canadian farm operators*, "Agricultural Finance Review", vol. 71, no. 3, 2011; K. Poon, A. Weersink, *Factors affecting variability in farm and off-farm income*, "Agricultural Finance Review", vol. 71, no. 3, 2011.

Table 3. Descriptive statistics of the panel of farms owned by natural persons for 2013

Item	Specification	Unit	Number of farms	Average	Median	Min.	Max.	Standard deviation	Variability coefficient
1	Return on equity (1)	%	8,472	3.7	3.0	-111.8	302.0	9	253
2	Return on equity (2)	%	8,472	1.8	1.2	-113.0	299.0	9	514
3	Total return on assets (1)	%	8,472	3.5	3.0	-111.8	302.0	8	242
4	Total return on assets (2)	%	8,472	1.5	1.1	-113.0	299.0	8	555
5	Cash return on equity	%	8,472	11.6	9.8	-29.6	381.7	11	93
6	Cash return on total assets	%	8,472	10.8	9.3	-23.2	381.7	10	89
7	Share of gross margin in agricultural production	%	8,472	55.8	56.9	-325.5	99.5	17	31
8	Current liquidity	times	4,477	10.7	5.5	0.0	417.8	18	170
9	Fast liquidity	times	4,477	2.9	1.0	0.0	111.0	6	212
10	Coverage of overall loans with cash flows	times	4,510	4.1	1.3	-9.2	252.7	12	286
11	Investment coverage	times	4,216	5.8	2.7	-9.2	276.9	10	170
12	Cash generating ratio (1)	%	8,021	0.024	0.013	0.000	7.968	0.128	528
13	Cash generating ratio (2)	%	397	0.014	0.003	0.000	0.483	0.044	321
14	Equity growth	%	4,961	7.1	4.6	0.0	145.9	9	128
15	Change in the values of equity	PLN thousand	8,472	37.6	7.2	-1,743.1	4,356.8	153	406
16	Working capital growth	%	4,184	70.8	23.3	0.0	17,267.7	475	671
17	Working capital (EY)	PLN thousand	8,472	116.0	70.7	-1,076.8	3393.6	177	153
18	Economic size	PLN thousand	8,472	240.8	161.1	17.3	6860.1	290	120
19	Investment rate	%	8,470	116.7	0.0	0.0	11,970.9	368	315
20	Gross investments	PLN thousand	8,472	68.2	0.0	0.0	7,369.0	218	320
21	Net investments	PLN thousand	8,472	31.9	-9.8	-500.7	7,150.8	204	642
22	Assets to equity ratio	%	8,472	94.4	99.2	12.3	100.0	9	10

Table 3 cont.

23	Asset freezing ratio	times	8,445	14.1	9.2	0.2	2,451.0	44	315
24	Cash flows (1)	PLN thousand	8,472	134.6	80.4	-287.6	4,795.0	193	143
25	Cash flows (2)	PLN thousand	8,472	-49.5	-13.0	-2,743.6	1,979.0	117	-236
26	Family farm income	PLN thousand	8,472	97.5	56.2	-242.8	3,516.1	152	156
27	Subsidy rate I	%	8,472	28.9	20.5	0.0	940.3	39	135
28	Subsidy rate II (1)	%	8,468	79.0	53.3	-17,051.6	23,004.8	645	817
29	Subsidy rate II (2)	%	8,438	41.1	44.8	-20,518.2	13,401.9	787	1914
30	Subsidy rate II (3)	%	8,440	12.8	28.1	-31,191.4	18,209.0	1002	7835
31	Decoupling rate I of subsidies to operational activities from production	%	8,241	74.4	78.7	0.0	100.0	18	25
32	Decoupling rate II of subsidies from production	%	8,285	76.7	80.2	0.0	100.0	17	22
33	Share of subsidies to operational activities in all subsidies	%	8,285	92.1	100.0	0.0	100.0	16	18

Source: own calculations on the basis of data of the Polish FADN.

More and more often, it is concluded that financial effectiveness, financial condition, existence and development of family farms strongly depend on obtaining a sufficiently high financial output from purely market transactions, namely prior to receiving any subsidies[14]. Following J. Beckman and D. Schimmelpfenning, it can be assumed that this result depends mainly on:

- prices obtained for the sold agricultural products and services,
- prices paid for the purchased production measures and services;
- GDP change rate,
- exchange rate,
- interest rate,
- total-factor productivity (TFP).

In the four years of 2010-2013, the price scissors index was subject to strong fluctuations in Polish agriculture. And so, in 2010, this index was lower than 100 since May until June, and then exceeded this threshold value until the end of the year. The year 2011 was definitely the most favourable period in the examined four years, as the index reached more than 100 throughout all months, without exception. On the other hand, 2012 very much resembled 2010, but the favourable economic situation for agriculture lasted only until April. Such a situation lasted for nearly the entire first half of the last analysed year – 2013.

As regards the interest rates, the most convenient solution is focusing on the reference rate of the National Bank of Poland, which is the point of reference for market rates. In 2010, this rate was on average at the level of 3.50%. However, a year later it increased to 4.50%, then slightly decreased (to 4.25%), but decreased rapidly in 2013, when it averaged at 2.50%.

The average annual exchange rate of PLN:EUR in the analysed four years demonstrated a slight depreciating tendency towards Polish currency, from 3.9948 in 2010 to 4.1975 in 2013. The GDP growth rate was also decreasing. In 2010, it amounted to 3.9%, and then it increased to 4.5%, but in 2012 it went down to 2%, and then to 1.6% in the last analysed year. In our research, the financial and economic output obtained by farms in purely market transactions is the ratio of the share of gross margin in the value of agricultural production. As suggested by Table 4, this relation on average changed to quite a narrow extent, between 53% (2013) and 57.7% (2010). However, in the last year, it reached clearly lower values than in 2012. The recourse was even more visible in comparison to the average of the three-year period of 2010-2012. Even so, the rela-

[14] J. Beckman, D. Schimmelpfening, *Determinants of farm income*, "Agricultural Finance Review", vol. 75, no. 3, 2015; *The Oxford Handbook of Land Economics* (ed.) J.M. Duke, J. Wu, Oxford University Press, New York 2014.

tionship between the abovementioned ratio and the price scissors index does not seem too strict. The same applies to the exchange rate of PLN in relation to EUR and a clear easing of the monetary policy by the National Bank of Poland in 2013. It may be even stated that the decrease in the share of gross margin in the value of agricultural production derives from the slowing down rate of economic growth in Poland in 2012-2013.

For our panel of farms, the year 2013 means a recourse in terms of profitability of assets and equity. All four ratios from this area decreased by ca. 13-14% as compared to 2012. Some of them were also lower in comparison to the average result from the three-year period of 2010-2012. Similar conclusion is drawn after comparing the ROE and ROA ratios of 2013 to the average values from 2005-2010 in the examined farm sample. At this point, it is necessary to add that, in the analysed four years, cash returns on assets and equity were very stable. Even so, their level in 2013 was 20-30% lower as compared to 2005-2010. It probably results from the change in land valuation and increase in the number of research samples.

Throughout the examined four years, static financial liquidity was quite stable and secure from the point of view of how it is traditionally presented in literature within the scope of finances. The clear improvement in cash generating and cash flow balance ratios in 2013 deserves a positive mark. However, a certain deterioration of the situation within multiplication of equity proved to be a negative phenomenon, as equity multiplication is, after all, an important determinant of long-term liquidity, solvency and risk absorption. Tendencies concerning investment activity of farms were not conclusive. Finally, the financial structure, measured with assets to equity ratio, and ownership structure (relation between fixed and circulating assets) underwent small changes. A certain decrease in family farm income in 2013 may also be a bit worrisome, but it was still ca. 3% higher as compared to the average from the whole three-year period.

All four analysed subsidy rates in 2013 demonstrated a very clear increase as compared to 2012. They were also higher than the average from the three-year period of 2010-2012. The same phenomenon, except for the subsidy rate II (2), was observed, when the rates from 2013 were compared to their level recorded in the previous decade for the farm set of the Polish FADN. These tendencies have to cause distress, in the context of the planned mid-term CAP inspection and the highly likely deterioration in the fiscal position of Poland after the parliamentary elections of October 2015. This growing dependence of the national agriculture on budget support may also prove to be a serious development hazard, when the subsequent financial perspective of the EU may not be as favourable for agriculture.

In the current decade, the growth tendency of the degree of decoupling of budget subsidies from agri-production continued. It means that Polish farmers had to consider signals from the markets in their decisions to a greater extent. This is also a proof of the effectiveness of this part of the CAP. In 2005-2013, the share of subsidies to operational activities in all obtained budget support was very stable, ranging between 90.4-99.9%.

Table 5 presents the impact of economic size of the examined farms on the shaping of our economic and financial measures and ratios, which can be summed up as follows:

1. The subsidy rates I (quotient of budget support and agricultural production) and II.1 (share of support in farm income) were continuously decreasing along with the increase in economic size. Their values in 2013, except for very large facilities, were at the same time, higher than the average for 2010-2012. The differences of the aforementioned rates between the largest and the smallest farms are tremendous. In 2013, for rate I, the relation was 1:10.7, and in the case of rate II.1 – 1:6.2. It should be noted that in very small facilities, budget support even exceeded the family farm income. On the other hand, rates II.2 (income reduced by the costs of own labour) and II.3 (entrepreneur's profit in denominator) began to systematically decrease only in the case of farms equal to or smaller than medium-small farms. Also in this case, their values in 2013 exceeded the average from the aforementioned three-year period, with the exception again being the largest farms. The above-mentioned information clearly indicate that, in the budget policy in Polish agriculture, redistribution and stabilisation objectives prevail over allocation objectives, namely, in short, efficiency objectives.

2. Profitability of assets and equity in 2010-2013 was negative virtually everywhere in very small and small farms. In 2013, we can observe their continuous improvement, starting from medium-small entities. For this year, the abovementioned coefficients were higher than the average for 2010-2012, however, only in the largest farms. But in the recent years, a certain recourse in financial effectiveness took place, as compared to the previous decade. Both cash returns demonstrated a clear positive correlation with the economic size of farms. However, in the case of the share of gross margin in the value of agricultural production, the situation was reversed. The latter indicator should be interpreted very carefully, since in the process of calculating this surplus only direct costs should be deducted, as they play a greater role in facilities more closely linked to the market. Then such entities achieve greater production per 1 ha of UAA. In consequence, they usually also obtain higher profitability ratios, expressed as a relation between the value of agricultural production or sale of agricultural products and the overall costs. In other words, they are more operationally efficient prior to receiving any subsidies.

3. Current and fast liquidity, namely expressed statically, was unsatisfactory in 2013 only in the case of very small farms, if we consider the recommendation formulated in the literature on the subject. In other economic size classes of farms, the liquidity ratios in the concerned four years were extremely stable, safe, and maybe even slightly too high, which may, to some extent, reduce profitability. The relatively favourable position of the examined farms, including the smallest ones, is shown through their stable, sometimes even increasing cash generating capacity.

Typically, the coverage of loans with cash flows also improved, leading to an increase in solvency. This is particularly important for larger facilities, as they use foreign capital more, but they still were not exposed to excessive financial risk. The operational risk also slightly decreased, since in the case of most size classes, the value of fixed assets to circulating assets ratio decreased. This means an increase in their flexibility in adjusting to changes in the environment.

4. Except for the largest facilities, in other size classes the year 2013 brought an insignificant deterioration in the equity multiplication capacity. At the same time, that year, a prevailing stability in the scope of shaping family farm income was observed. Altogether, these two phenomena did not significantly impact investment activity of farms, which is understandable, as this activity depends on many other processes, tendencies and factors that affect the farmers' outlook on the future as less or more favourable for investments and estimation of the related risk.

Total return on assets and equity in 2013 slightly improved in all production types listed in Table 6, except for horticultural farms, in comparison to the average from 2010-2012. The situation was similar in the case of both cash returns. It is necessary to mention that horticulture, field crops and production of granivores are the most effective in terms of obtained profitability and cash returns. Their advantage is often even twice as high as in the types "other grazing livestock" and "mixed". The inter-type diversity of the budget support scale looks a bit different. Gardeners for years have been the most poorly subsidised type, just like holdings dealing with production of granivores and permanent crops. Holdings dealing with grazing livestock and field crops are on the opposite side of the spectrum, as the subsidy rates in 2013 were from 3.4 to 12.7 times ("field crops") and from 2.1 to 20.7 times ("other grazing livestock") higher than in the case of gardeners.

Although static liquidity in horticultural holdings in 2013 could even indicate some difficulties with settlement of current liabilities, they had simultaneously the highest cash generating capacity. However, the situation is slightly complicated, as the debt sustainability in the case of gardeners was the lowest. Thus, it should be presumed that the subsidy rates must be automatically reflected in

better liquidity, solvency and financial stability as well as higher level of financial and operational risk. The former, measured by the degree of financing total assets with equity, was the highest in the case of gardeners who additionally scored the second place with regard to the relation between fixed and circulating assets (measure of operational risk).

Usually, not including horticultural holdings, the year 2013 was more favourable than the 2010-2012 period, when analysing the family farm income. The highest level of family farm income in the indicated year was recorded by farms dealing with production of granivores and field crops. Their advantage as compared to the least profitable facilities, i.e. producing other grazing livestock, amounted to, accordingly: 209% and 181%. At the same time, it is curious that farms dealing with field crops and monogastric animals multiplied their equity relatively quickly, even though they still clearly did worse than the gardeners. In turn, the latter multiplied their fixed assets at the rate comparable to the type "granivores", but slower than the types "field crops" and "milk".

Table 4. Shaping of the values of measures and ratios in the panel of farms in 2010-2013

Item	Specification	Unit	Years 2010-2012	2010	2011	2012	2013	2013/2012 x 100
1	Return on equity (1)	%	6.0	5.3	6.1	6.5	5.5	86.0
2	Return on equity (2)	%	3.7	2.9	3.8	4.3	3.7	86.6
3	Total return on assets (1)	%	5.8	5.1	5.9	6.2	5.4	86.2
4	Total return on assets (2)	%	3.7	2.9	3.8	4.3	3.7	86.6
5	Cash return on equity	%	10.7	10.0	10.5	11.4	11.5	101.1
6	Cash return on total assets	%	9.8	9.2	9.7	10.5	10.5	100.4
7	Share of gross margin in agricultural production	%	56.4	57.7	56.2	55.7	53.6	96.1
8	Current liquidity	times	4.0	3.7	4.1	4.2	4.0	94.5
9	Fast liquidity	times	1.1	1.0	1.1	1.1	1.1	97.2
10	Coverage of overall loans with cash flows	times	0.9	0.9	0.9	0.9	0.8	92.7
11	Investment coverage	times	1.3	1.3	1.4	1.3	1.4	107.2
12	Cash generating ratio (1)	%	0.012	0.012	0.012	0.012	0.013	111.5
13	Cash generating ratio (2)	%	0.004	0.004	0.004	0.004	0.006	143.5
14	Equity growth	%	8.0	7.8	8.1	8.2	7.2	88.3
15	Change in the values of equity	PLN thousand	43.8	29.8	56.4	45.1	37.6	83.4
16	Working capital growth	%	42.6	44.3	45.4	38.7	30.7	79.4
17	Working capital (EY)	PLN thousand	103.3	88.5	105.3	116.1	116.0	99.9
18	Economic size	PLN thousand	236.6	235.0	236.3	238.6	240.8	100.9

Table 4 cont.

19	Investment rate	%	150.7	149.1	141.2	161.2	133.3	82.7
20	Gross investments	PLN thousand	59.0	52.4	55.2	69.5	68.2	98.2
21	Net investments	PLN thousand	27.6	23.3	23.3	36.3	31.9	87.7
22	Assets to equity ratio	%	91.9	92.1	92.1	91.6	91.0	99.4
23	Asset freezing ratio	times	8.5	9.3	8.3	7.9	8.2	103.7
24	Cash flows (1)	PLN thousand	115.0	103.5	113.0	128.5	134.6	104.8
25	Cash flows (2)	PLN thousand	-43.5	-40.4	-41.1	-48.9	-49.5	101.3
26	Family farm income	PLN thousand	94.9	84.1	96.1	104.4	97.5	93.4
27	Subsidy rate I	%	17.0	18.5	17.9	15.1	17.7	116.9
28	Subsidy rate II (1)	%	43.9	46.4	45.7	40.3	49.6	123.2
29	Subsidy rate II (2)	%	64.4	71.0	66.5	57.7	74.5	129.2
30	Subsidy rate II (3)	%	105.6	131.1	108.7	87.2	111.8	128.2
31	Decoupling rate I of subsidies to operational activities from production	%	65.1	60.5	65.0	69.6	75.6	108.6
32	Decoupling rate II of subsidies from production	%	67.6	62.9	67.4	72.2	77.8	107.7
33	Share of subsidies to operational activities in all subsidies	%	92.4	93.6	92.5	91.1	91.0	99.9

Source: own calculations on the basis of data of the Polish FADN.

Table 5. Shaping of the values of measures and ratios in the panel of farms depending on their economic size in 2013

Item	Specification	Unit	Very small (A)		Small (B)		Medium-small (C)		Medium-large (D)		Large (E)		Very-large (F)	
			2010-2012	2013	2010-2012	2013	2010-2012	2013	2010-2012	2013	2010-2012	2013	2010-2012	2013
1	Return on equity (1)	%	-4.7	-5.3	-0.04	-0.6	3.9	3.5	6.3	5.7	9.2	8.5	10.3	13.0
2	Return on equity (2)	%	-7.1	-7.1	-2.3	-2.4	1.6	1.6	4.0	3.9	6.8	6.6	7.9	11.0
3	Total return on assets (1)	%	-4.6	-5.2	0.1	-0.5	3.9	3.5	6.1	5.6	8.5	7.8	9.5	11.9
4	Total return on assets (2)	%	-7.1	-7.1	-2.3	-2.4	1.6	1.6	4.0	3.9	6.8	6.6	7.9	11.0
5	Cash return on equity	%	5.5	6.2	7.4	7.9	9.3	9.9	10.7	11.3	12.7	13.6	13.2	19.7
6	Cash return on total assets	%	5.4	6.1	7.3	7.8	8.9	9.4	9.9	10.3	11.1	11.9	11.5	17.3
7	Share of gross margin in agricultural production	%	61.9	58.4	62.6	60.2	61.4	57.8	58.2	55.6	53.3	50.9	41.9	39.6
8	Current liquidity	times	3.6	1.8	4.1	4.1	4.2	4.4	4.0	3.9	3.8	3.8	4.9	5.3
9	Fast liquidity	times	1.0	0.8	1.2	1.3	1.2	1.2	1.1	1.0	1.1	1.1	1.2	1.1
10	Coverage of total loans with cash flows	times	0.8	1.3	1.1	1.1	1.1	1.0	0.9	0.9	0.8	0.7	0.8	1.1
11	Investment coverage	times	1.0	1.3	1.2	1.6	1.3	1.5	1.3	1.4	1.3	1.3	1.8	2.2
12	Cash generation ratio (1)	%	0.013	0.015	0.012	0.014	0.012	0.013	0.012	0.014	0.012	0.013	0.011	0.014
13	Cash generation ratio (2)	%	0.006	0.013	0.007	0.008	0.004	0.006	0.003	0.004	0.003	0.008	0.016	-*
14	Equity growth	%	5.8	4.9	6.5	5.4	7.1	6.1	7.8	6.8	9.2	8.4	7.9	8.2
15	Change in the values of equity	PLN thousand	1.3	-5.5	5.4	0.4	22.7	14.6	57.0	52.3	147.0	135.5	267.5	230.9
16	Working capital growth	%	36.7	35.2	38.0	28.6	40.9	28.8	42.2	29.8	45.6	32.3	41.1	51.4
17	Working capital (EY)	PLN thousand	18.4	18.1	38.6	41.8	72.6	82.1	121.3	136.3	263.5	292.7	1,018.7	1,088.6
18	Economic size	PLN thousand	29.1	28.1	66.4	65.5	146.6	146.8	282.1	282.9	670.5	681.2	3,200.2	3,324.9
19	Investment rate	%	17.9	21.7	59.3	47.9	112.3	94.3	173.0	137.3	188.8	176.6	136.4	175.7
20	Gross investments	PLN thousand	2.5	1.7	8.9	7.5	29.5	31.2	79.6	83.4	193.0	241.0	325.3	418.2
21	Net investments	PLN thousand	-4.2	-5.6	-3.5	-5.8	7.2	6.1	40.8	38.4	117.1	150.6	101.5	192.1
22	Assets to equity ratio	%	99.1	99.4	97.7	97.9	95.1	94.9	92.1	91.4	87.9	86.5	87.5	88.5
23	Assets freezing ratio	times	12.0	12.5	9.8	9.5	9.0	8.5	9.0	8.6	7.6	7.7	5.0	4.4
24	Cash flows (1)	PLN thousand	13.5	16.1	32.6	36.4	73.7	83.5	144.4	162.6	320.7	382.9	865.1	1,172.6
25	Cash flows (2)	PLN thousand	-1.4	1.1	-6.1	-6.2	-22.0	-23.8	-57.1	-60.7	-143.6	-169.0	-324.0	-426.5
26	Family farm income	PLN thousand	10.5	9.2	24.9	24.6	60.1	60.4	118.0	118.2	272.3	280.8	715.4	819.3
27	Subsidy rate I	%	27.9	40.7	25.9	28.7	20.9	23.0	18.6	19.5	13.8	14.0	5.7	3.8
28	Subsidy rate II (1)	%	73.8	112.6	63.7	73.9	48.8	57.6	44.8	51.4	37.8	42.0	25.7	18.1
29	Subsidy rate II (2)	%	-67.6	-74.6	-8,655.1	-697.5	95.4	119.2	62.2	73.1	44.1	49.5	27.2	19.1
30	Subsidy rate II (3)	%	-44.6	-55.3	-155.2	-166.9	234.1	251.9	98.1	107.2	59.5	63.8	35.4	22.6
31	Decoupling rate I of subsidies to operational activities	%	66.0	74.2	65.7	74.5	66.5	75.6	65.1	75.3	63.8	76.1	69.1	85.4
32	Decoupling rate II of subsidies	%	66.5	74.7	67.1	75.6	68.6	77.3	67.9	78.0	66.7	78.4	70.8	86.9
33	Share of subsidies to operational activities	%	98.7	98.3	95.7	95.3	93.4	92.9	91.7	89.1	91.2	90.3	94.3	89.8

* The ratio value was not calculated, if cash flows value or family farm income value were negative.

Source: own calculations on the basis of data of the Polish FADN.

Table 6. Shaping of the values of measures and ratios in the panel of farms depending on their production type in 2013

Item	Specification	Unit	Field crops (1)		Horticultural crops (2)		Permanent crops (4)		Dairy cows (5)		Herbivores (6)		Granivores (7)		Mixed (8)	
			2010-2012	2013	2010-2012	2013	2010-2012	2013	2010-2012	2013	2010-2012	2013	2010-2012	2013	2010-2012	2013
1	Return on equity (1)	%	7.7	8.8	9.6	8.6	4.9	5.4	5.7	5.4	2.9	3.1	8.4	9.0	3.9	4.2
2	Return on equity (2)	%	5.8	7.0	6.1	5.5	2.3	3.0	3.0	2.9	0.3	0.6	5.6	6.5	1.6	2.0
3	Total return on assets (1)	%	7.4	8.3	8.4	7.6	4.8	5.3	5.5	5.2	3.0	3.1	7.8	8.5	3.8	4.1
4	Total return on assets (2)	%	5.8	7.0	6.1	5.5	2.3	3.0	3.0	2.9	0.3	0.6	5.6	6.5	1.6	2.0
5	Cash return on equity	%	11.5	12.7	21.1	20.2	11.5	11.9	11.0	11.1	8.2	8.4	12.3	13.5	8.6	9.2
6	Cash return on total assets	%	10.4	11.5	16.9	16.3	10.8	11.2	10.1	10.2	7.6	7.8	11.1	12.2	8.1	8.7
7	Share of gross margin in agricultural production	%	64.5	65.2	73.2	71.7	83.2	82.7	61.8	59.5	60.5	59.8	36.3	35.3	52.5	51.6
8	Current liquidity	times	4.2	4.5	1.5	1.5	4.1	4.9	2.7	2.9	4.0	4.2	4.9	5.0	4.8	5.0
9	Fast liquidity	times	1.3	1.4	0.8	0.7	1.4	1.7	0.8	0.7	0.6	0.7	1.1	1.1	1.1	1.1
10	Coverage of total loans with cash flows	times	0.9	0.9	0.7	0.6	1.2	1.2	0.9	1.0	0.7	0.7	0.8	0.9	0.9	0.9
11	Investment coverage	times	1.2	1.2	1.6	1.2	1.6	1.4	1.4	1.3	1.1	1.1	1.4	1.6	1.2	1.3
12	Cash generation ratio (1)	%	0.012	0.012	0.014	0.014	0.012	0.014	0.012	0.013	0.012	0.012	0.011	0.012	0.012	0.012
13	Cash generation ratio (2)	%	0.004	0.004	0.006	0.008	0.006	0.005	0.003	0.004	0.006	0.017	0.005	0.003	0.004	0.005
14	Equity growth	%	9.2	9.8	11.5	12.9	8.5	9.4	7.5	7.5	8.8	8.8	8.2	7.6	6.9	6.6
15	Change in the values of equity	PLN thousand	68.0	75.6	12.8	21.6	25.4	32.0	51.7	51.5	31.1	29.2	58.2	52.9	27.1	24.3
16	Working capital growth	%	50.1	46.0	42.5	51.4	65.7	71.7	44.8	37.3	36.1	38.8	36.3	33.8	36.3	30.9
17	Working capital (EY)	PLN thousand	143.8	160.2	38.4	39.2	98.4	116.3	61.2	68.1	73.3	82.5	199.5	227.3	90.3	101.5
18	Economic size	PLN thousand	246.4	244.1	354.9	376.0	149.3	150.7	229.8	234.4	146.8	149.6	542.9	554.6	180.8	180.8
19	Investment rate	%	170.6	183.3	118.0	165.8	92.4	104.9	175.7	183.6	112.0	121.8	160.4	165.9	126.9	131.1
20	Gross investments	PLN thousand	90.9	109.2	52.4	74.8	48.0	56.4	65.6	75.3	29.9	36.3	75.8	83.0	36.2	40.6
21	Net investments	PLN thousand	53.1	69.9	9.9	30.9	1.9	9.1	33.3	40.8	8.9	14.1	34.0	38.3	12.7	16.0
22	Assets to equity ratio	%	90.9	90.1	80.7	80.8	93.9	94.1	91.9	92.0	92.8	92.3	89.9	90.0	94.1	93.9
23	Assets freezing ratio	times	7.9	7.4	9.5	9.7	8.0	7.2	13.5	12.9	8.6	8.0	5.6	5.2	8.1	7.5
24	Cash flows (1)	PLN thousand	158.4	181.4	142.0	140.6	113.7	120.6	120.1	126.9	62.5	67.6	172.9	201.1	76.2	84.9
25	Cash flows (2)	PLN thousand	-61.6	-70.3	-52.0	-64.7	-42.5	-41.5	-50.3	-56.3	-23.0	-23.4	-60.5	-68.7	-26.2	-28.2
26	Family farm income	PLN thousand	134.6	155.1	96.5	93.5	75.9	82.4	95.8	97.0	51.4	55.1	151.0	170.2	63.8	69.1
27	Subsidy rate I	%	25.9	22.8	2.5	1.8	8.5	8.3	15.7	14.1	43.6	37.3	6.6	5.6	19.1	16.7
28	Subsidy rate II (1)	%	51.6	45.4	10.2	8.0	21.4	21.1	37.4	36.6	83.1	76.0	26.4	23.4	51.6	47.3
29	Subsidy rate II (2)	%	64.8	55.7	15.3	12.6	33.3	31.8	57.8	57.5	189.4	166.4	33.9	29.6	96.2	85.2
30	Subsidy rate II (3)	%	85.9	70.1	24.0	19.4	71.0	57.1	109.3	106.5	1,879.9	900.4	50.9	41.4	234.3	175.2
31	Decoupling rate I of subsidies to operational activities	%	63.2	67.6	46.8	75.5	83.5	83.1	67.8	72.5	74.1	77.4	66.0	70.0	64.9	69.4
32	Decoupling rate II of subsidies	%	65.0	69.5	53.9	81.4	85.8	85.6	71.6	76.2	75.5	79.0	70.1	74.3	67.2	71.8
33	Share of subsidies to operational activities	%	94.6	93.8	85.0	75.9	85.9	85.4	88.1	86.2	94.7	92.9	87.5	85.3	93.4	92.1

Source: own calculations on the basis of data of the Polish FADN.

5.4. Summary

The research covered farms that kept continuous agricultural accounting records under the Polish FADN over 2010-2013 period. It caused an increase in the number of examined farms as compared to similar research conducted in 2005-2012. Land valuation according to the farmer also was used, which affected the value of fixed assets and equity in the examined farms. Migration of farms between production types as well as between economic size classes was influenced by the used classification coefficients SO2010, as compared to the previous research period, when SO2004 coefficients had been used. In connection with the above, the results obtained in the previous research period should be regarded with caution, as they may even lead to drawing the wrong conclusions.

In the perspective of values of the average profitability ratios of assets and equity as well as the cash returns of these balance sheet items for the whole panel of farms within the Polish FADN, a certain recourse can be observed in the current decade, as compared to 2005-2010. At the same time, in the three-year period of 2010-2012 and in 2013, all analysed subsidy rates increased, as compared to the period of 2005-2010. It means that the allocative efficiency of the budget support deteriorated in the examined panel. However, this support positively affected the static and dynamic liquidity, solvency and financial stability as well as the farmers' income. This means that the financial policy in Polish agriculture was focused on redistribution and stabilisation objectives more than on the efficiency.

The current decade has been still dominated by interdependence, with subsidy rates nearly continuously decreasing along with the increase of economic size of the examined farms, while, at the same time, improvement in financial effectiveness has been observed in the case of facilities equal or bigger than medium-small. Even so, financial effectiveness in very small and small farms usually had negative value. It was tantamount to a situation, in which the subsidies granted thereto were even higher than the total costs.

The diverse effectiveness and financial situation as well as the subsidy level of different production types of farms, also observed in the previous years, was still present. The domestic and the EU budgets still most strongly supported farms focused on field crops and production of grazing livestock, while the least supported were horticulture and farms dealing with granivores and permanent crops. Although the most heavily subsidised types had the highest financial effectiveness overall, their advantage in this respect over the most poorly subsidised types was expressly smaller than it was the case, when the differences in subsidy rates were analysed.

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6. Impact of direct payments on economic performance farms

6.1. Introduction

One of the most common forms of aid for agriculture is the direct payment system. Polish farmers have benefited from these payments as part of the SAPS system[1] since 2004. These payments constitute an element in the income statement of a farm and thus deserve particular recognition when surveying the financial situation of agricultural holdings or their development possibilities[2].

In the EU Member States, direct payments became an important instrument supporting farmers' incomes within the framework of the MacSharry reform of 1992, and then remained in the subsequent reforms of the Common Agricultural Policy (CAP) – the Agenda 2000 and the Luxembourg Compromise. Since the beginning of the 1990s, the significance of tariff instruments and institutional prices have decreased to be replaced with instruments of direct support, especially direct payments, which are consistently less related to the current production level (decoupling)[3]. These payments constitute the basic instrument of the Common Agricultural Policy and form a foundation for the safety net in the agricultural sector[4]. They significantly stabilise incomes of the EU farmers. They are a tool meant to reward farmers for producing and providing public goods and positive external effects, or to compensate them for the higher costs associated with the use of friendly manufacturing technologies and the continuously more strict food quality and safety standards. They reduce aversion to risk and stimulate investment activities[5].

The multiplicity of objectives, which farmers want to achieve using the direct payments, make them a universal tool. It is difficult to fully specify all impacts of this form of aid. Analyses of these impacts should be conducted both in the micro- and macroeconomic perspective. In addition, apart from the income

[1] SAPS – Single Area Payment Scheme. It is a simplified direct payment system used by all states that joined the European Union in 2004 or later, except for Croatia, Malta and Slovenia. The single area payment rate is calculated by dividing the national annual financial envelope, determined for each state, by the area of the eligible land.

[2] B. Wawrzyniak, K. Zajdel, *Analiza płatności obszarowych w rolnictwie polskim w latach 2004-2006*, "Zagadnienia Doradztwa Rolniczego", no. 1, 2007, p. 45.

[3] R. Marks-Bielska, K. Babuchowska, *Wsparcie dochodów rolników w formie dopłat bezpośrednich*, "Ekonomika i Organizacja Gospodarki Żywnościowej", no. 75, 2009, p. 135.

[4] From 2004 to 2013, the direct payments rate increased, which resulted from the negotiated principles of the phasing-in mechanism.

[5] J. Góral, J. Kulawik, B. Wieliczko, *Uzasadnienie dla stosowania dopłat bezpośrednich*, expert's report prepared at the request of the Ministry of Agriculture and Rural Development on 31.10.2012.

stabiliser function[6,7], we can also evaluate the level of execution of the environmental and social functions of these payments[8,9]. The author of this chapter has identified, on the basis of her analyses of literature, a number of possible channels of subsidy impacts in the previous publication within this field entitled *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych (3)* published in 2013[10], as well as during a seminar entitled *Oddziaływanie dopłat bezpośrednich na wyniki ekonomiczne gospodarstw rolniczych (Impact of direct payments on economic performance of agricultural holdings)* held on 4 December 2015[11]. The subsidies affect:

1. Agricultural land market (demand, prices and lease rate)[12];
2. Cost of capital in agriculture (its reduction);
3. Improvement in creditworthiness of farmers (better credit scoring);
4. Smaller aversion of farmers towards risk and greater motivation for undertaking long-term investments;
5. Mechanisation (equity replacement rate, modernity, efficiency, etc.);
6. Financial situation of farmers (income level, financial liquidity);
7. Agricultural markets, marketing and processing (integration, producer groups);
8. Trade (export of agri-food products);
9. Scientific and technical progress (new technologies, innovations);
10. Labour market in rural areas (forming new workplaces);
11. Generation change in agriculture (slowing down)[13].

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[6] W. Rembisz, *Kwestia interwencji i stabilizacji dochodów producentów rolnych*, [in:] Kwestie ryzyka, rynku, interwencji i stabilności dochodów w rolnictwie, Vizja Press&IT, Warsaw, 2013, pp. 75-120.

[7] W. Rembisz, *Rynkowe i wspomagane przez rządy instrumenty zarządzania ryzykiem cenowym i dochodowym w rolnictwie*, [in:] Zarządzanie ryzykiem cenowym a możliwości stabilizowania dochodów producentów rolnych (scientific ed. S. Stańko, M. Hamulczuk), Program Wieloletni 2005-2009, no. 113, Warsaw 2008, pp. 28-59.

[8] J.St. Zegar, *Rozwój rolnictwa: dylematy-ekonomia-polityka,* Seminar of IERiGŻ-PIB, Warsaw, 23.10.2015.

[9] J.St. Zegar (scientific ed.), *Wpływ WPR 2014-2020 na zrównoważenie polskiego rolnictwa*, [in:] Z badań nad rolnictwem społecznie zrównoważonym (31), Program Wieloletni 2015-2019, no. 6, 2015, p. 89.

[10] J. Góral, *Kapitalizacja wsparcia finansowego rolnictwa*, [in:] Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych (3) (scientific ed. J. Kulawik), Program Wieloletni 2011-2014, no. 82, 2013, p. 107.

[11] J. Góral, *Oddziaływanie dopłat bezpośrednich na wyniki ekonomiczne gospodarstw rolniczych*, IERiGŻ-PIB Seminar, Warsaw, 4.12.2015.

[12] At this point, the phenomenon of capitalisation of financial support for agriculture should be mentioned.

[13] However, it should be emphasised that early retirement were supposed to accelerate this process. Early retirement under the Rural Development Plan for 2004-2006 were granted for

Without this support, many farmers would probably not conduct their operations, which would in turn negatively affect the environment, the rural community and the labour market. However, it should be also noted that it slows down the generation change and structural transformations in agriculture.

Undoubtedly, it is best to evaluate the aforementioned impacts using data in the form of time series; static analyses cannot be completely ignored, though. Static and dynamic perspective of the described phenomena constitutes an element of sensitivity and risk analysis, which, in turn, is intended to confirm (or deny) durability and invariability of the direction of impacts or the nature of relations of a given phenomenon. In the case of a study of the relationships between social, environmental or economic impacts and the size of financial support for agriculture, such sensitivity analysis and meta-analysis are indispensable.

Direct payments as a CAP instrument turned out to be more effective than the previous instruments of price support. The transfer efficiency ratio when using instruments of price support was lower than when using direct payments. In the first case, farmers managing their lands ultimately received 23% of measures, and in the second – 47%[14]. This means that these funds are intercepted by other agribusiness sectors to a smaller extent (this phenomenon is defined as support outflow, mostly for the benefit of suppliers of production measures and recipients). Using the direct payment system leads, thus, to a more rational use of financial measures from the CAP, consistent with the primary intention. The basic feature of the direct payments is their commonness, equal access, independent from the soil quality. This payment system does not usually depend on the efficiency level of the farm, and therefore fosters sustainable development of rural areas.

The purpose of this chapter is to demonstrate the significance of direct payments (area payments) in the functioning of farms on the example of the selected ratios. The research was conducted on the basis of panel data of the FADN. The analysis covered the period from 2010 to 2013. The results used to calculate the ratios mainly originated from the tables of the "Individual Report". The calculations take account of the item "granted subsidies", which means that the payments were recorded after the farmer received the decision on granting the subsidy.

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a period of 10 years, while under the Rural Development Programme for 2007-2013 – until the beneficiary reaches 65 years of age. The new regulations of March 2015 obligate the beneficiaries of early retirement to take-up statutory pension after reaching the retirement age. It is planned for payment of early retirement to end in 2020.

[14] M. Adamowicz, *Mierzenie wartości efektów polityki rozwoju wsi i rolnictwa*, "Problemy Rolnictwa Światowego", vol. 4 (19), 2008, pp. 17-30.

6.2. Impact of subsidies on economic performance in the light of literature

Direct payments are transfers of public funds aiming at increasing the income of farmers. In order for these payments to gain socio-political legitimation, they need to be highly effective[15]. The most effective in this aspect are direct payments, partially decoupled. However, also in this case, as much as 46% of transfers are capitalised in the price of soil owned by the farmer, and another 45% are the income of the owners of the leased land. Regardless of the height of these payments and the form of their calculation, the primary purpose of the direct payment system is ensuring an appropriate level of agricultural income. Therefore, this form of transfers to agriculture is not subject to settlements or verification of their intended use on a farm, and the agricultural producers can freely dispose thereof[16].

P. Ciaian et al. (2015)[17], in the article entitled *Income distributional effects of CAP subsidies. Micro evidence from the EU*, confirmed the important role of subsidies in creating agricultural profit. His team examined the distributional effect of the three main instruments of the Common Agricultural Policy (CAP): Coupled Direct Payments (CDP), the Rural Development Programme (RDP) and direct payments (the Single Payment Scheme – SPS). Based upon the panel data from 1999-2007 and using the generalised method of moments approach (GMM), they proved the significant impact of these aid programmes on the income level in agriculture. The RDP appeared to be the most effective, then – SPS payments, and the least effective were coupled direct payments (CDP). These studies provide a significant argument for decoupling of payments from production, as well as for further focus of support on development of rural areas. They also confirmed the effectiveness of the SPS in attaining the environmental goals.

M. Tóth (2011)[18] analysed profitability of soil in two variants: (1) taking account of subsidies in the income and (2) without the subsidies. These results clearly showed that profitability of soil drastically decreased in the second case (excluding the subsidies from the income calculation). The author emphasised the growing role of state aid in creating income of the EU farmers. M. Tóth con-

[15] A. Zawojska, *Społeczno-ekonomiczne aspekty dopłat bezpośrednich w UE*, "Roczniki Naukowe" SERiA, vol. VIII, issue 4, 2006, pp. 402-403.
[16] W. Czubak, *Rozdysponowanie dopłat bezpośrednich w gospodarstwach rolnych korzystających z funduszy UE w Wielkopolsce*, "Problemy Rolnictwa Światowego", no. 4(317), 2008, p. 118.
[17] P. Ciaian, D. Kancs, S. Gomez y Paloma, *Income distributional effects of CAP subsidies. Micro evidence from the EU*, Outlook on Agriculture, vol. 44, no. 1, 2015, pp. 19-28.
[18] M. Tóth, *Impact of CAP subsidies on profit in agricultural enterprises in Slovakia*, Polityki Europejskie, Finanse i Marketing, Wydawnictwo SGGW, no. 5(54), 2011, ppp. 208-215.

firmed the opinion of G. Blaas (2006)[19], who said that European farmers would not survive in the global environment without financial support. Globalisation makes it necessary to provide continuous support to this sector. Climatic conditions and a number of other factors (including: geographical, soil or social conditions) on other continents make it possible to conduct agricultural production at much lower costs. There are countries that still have substantial production resources, in particular a larger utilised agricultural area.

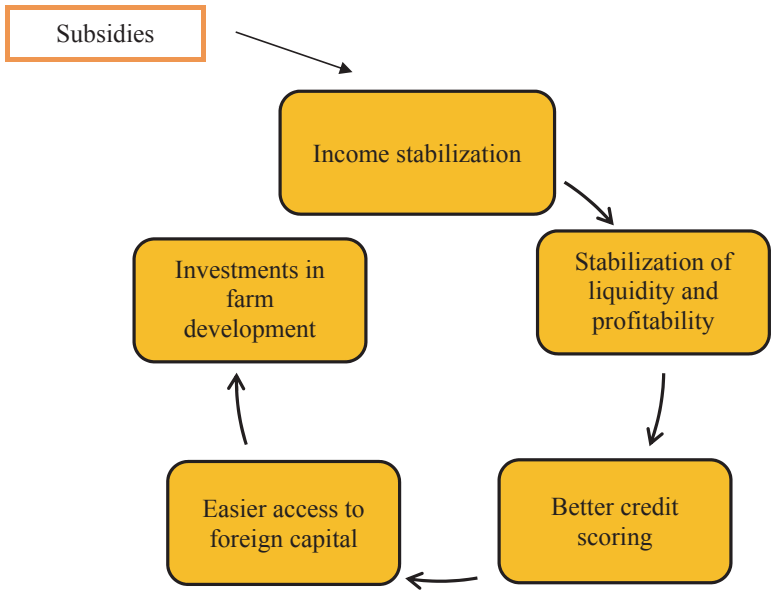
The research results of W. Czubak (2008)[20] proved that direct payments were not assessed by the Polish farmers as substantial financial support for their farms. The money transferred to the accounts of farmers were used mainly for purchase of means of production (68.30% in 2005). Young farmers, with larger farms in terms of the area, are the most active in introducing changes to their farms. The share and value of subsidies allocated for: fertilisers, feeds, fuel and plant protection products prove that, in the examined agricultural holdings, direct payments were not a significant source of financing investment projects.

The purpose of the research of D. Zawadzka, A. Strzelecka, E. Szafraniec-Siluta (2013)[21] was to evaluate the impact of subsidies to current operations in generating income by family farms in Poland in 2004-2011. In the course of the conducted research, it was demonstrated that the significance of subsidies to current operations in creating income has been increasing. As part of the research, a thesis was formulated stating that, due to the characteristics of direct support systems for farmers in Poland as well as the size of financial surpluses typical of specific kinds of agricultural production, the greatest share of subsidies to current operations in generating income of family farms can be attributed to entities specialising in production of grazing animals and to farms, in which operating activities are focused on field crops. Furthermore, changes in the amounts of subsidies to current operations were examined, consisting of: subsidies to plant and animal production, subsidies to intermediate consumption, subsidies to costs of external factors, decoupled payments and other subsidies. The significance of the direction of production was emphasised as a factor determining the amount of farm income.

[19] G. Blass, *Poľnohospodárske politiky v krajinách OECD. Monitoring a hodnotenie 2006,* Správa za SR, VÚEPP, Bratislava, 2006, p. 17.
[20] W. Czubak, *Rozdysponowanie dopłat bezpośrednich w gospodarstwach rolnych korzystających z funduszy UE w Wielkopolsce*, "Problemy Rolnictwa Światowego", no. 4(317), p. 118.
[21] D. Zawadzka, A. Strzelecka, E. Szafraniec-Siluta, *Znaczenie dopłat do działalności operacyjnej w tworzeniu dochodu z rodzinnego gospodarstwa rolnego w Polsce*, Roczniki Naukowe SERiA, vol. XV, issue 3, 2013, pp. 396-402.

Then, J.D. Kropp and A.L. Katchova (2011)[22] analysed the impact of decoupled payments on the farmers' access to offers of the financial sector. They emphasised the significant, positive impact of state aid on perceiving the farm owners as safe and solvent bank clients. Direct payments improve liquidity and creditworthiness. As a result, they facilitate access to credits, which, in turn, determine plans and actions for the development of the potential of agricultural holdings. A positive relation was observed between solvency (repayment) ratios of credits and subsidies granted to American farmers. This impact is presented in Figure 1.

Figure 1. Impact of subsidies on finances of agricultural holdings



Source: prepared by the author.

M. Soliwoda (2014)[23] devoted his article to a similar issue. He assessed the impact of CAP instruments on financial security of agricultural holdings in Poland. In the opinion of the author, CAP should shape the income policy instruments to a greater extent, so as to emphasise the role of agricultural holding managers in making financial decisions, especially related to shaping financial liquidity and solvency.

[22] J.D. Kropp, A.L. Katchova, *The effects of direct payments on liquidity and repayment capacity of beginning farmers*, "Agricultural Finance Review", vol. 71, issue 3, 2011, pp. 347-365.
[23] M. Soliwoda, *Bezpieczeństwo finansowe gospodarstw rolniczych w Polsce z perspektywy wspólnej polityki rolnej,* "Wieś i Rolnictwo", no. 3, 2014, pp. 45-55.

The research of J. Kulawik proves that, in the period when the economic situation was favourable to agriculture (2010), higher subsidies for farms in the network of the Polish FADN resulted in improvement in equity and asset profitability. The increasing amounts of the granted subsidies positively affected the farms' liquidity, solvency and investments as well as cash resources. This means, e.g., that the financial potential of the examined farms slightly improved and thus they were able to consider more ambitious restructuring, adaptation and development strategies. They were also able to deal with various types of risk more effectively[24].

The above-mentioned examples illustrate the extensive range of impacts of state aid, especially its most common form – direct payments. It should be emphasised that its functioning was tightened up under the new direct payments system. The aid will be granted to professionally active farmers. The new system also introduced the so-called degressivity. It consists in reduction in the payment by 100% of the surplus amount of the uniform area payment totalling to more than EUR 150,000. The payment reduction may apply to approximately 150 Polish farms (with total area of 1.4 thousand ha or larger).

6.3. Empirical data and own research

In order to assess the impact of the analysed subsidies on the functioning of farms, it is necessary to first refer to the period from before Poland's accession to the EU. Table 1 presents simplified income statement of a sample Polish agricultural holding in 2002-2003. The agricultural income remained at the level of over PLN 30,000 in 2002, reaching the value of PLN 42,800 in 2003. The growth in this value was, first of all, the result of the growth in the value of total production, with the relatively smaller growth in intermediate consumption on farms.

Table 1. Simplified individual income statement of an average farm in Poland in 2002-2003 (in PLN)

Symbol	Income statement category	2002	2003
SE131	Total production value	123,841	142,170
SE275	Intermediate consumption	73,758	79,707
SE600	Balance of current subsidies and taxes	3,221	5,080
SE420	Family farm income	30,490	42,878

Source: prepared by A. Sobczak on the basis of results obtained by individual agricultural holdings keeping accounting records in 2002 and 2003.

[24] J. Kulawik, R. Płonka, *Subsydia a finanse gospodarstw osób fizycznych*, [in:] Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych (4), (scientific ed. J. Kulawik), Program Wieloletni 2011-2014, no. 120, Warsaw 2014, pp. 122-165.

Table 2 presents the basic income statement categories of a standard Polish agricultural holding in 2010-2013. The largest increases of values related to intermediate consumption[25], slightly smaller ones – to total production. The values of the balance of subsidies and taxes, as well as the balance of income grew at a significantly slower pace, but their increase was very stable.

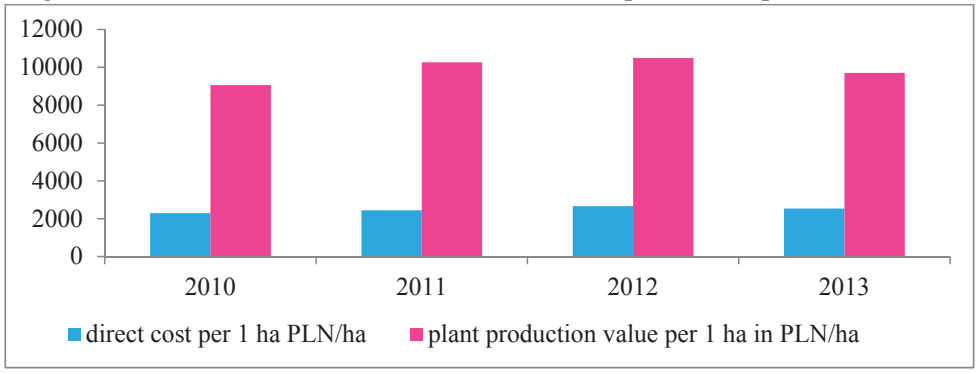
Table 2. Simplified individual income statement of an average farm in Poland in 2010-2013 (in PLN)

Symbol	Income statement category	2010	2011	2012	2013
SE131	Total production value	100,969	115,723	126,580	141,919
SE275	Intermediate consumption	62,200	72,916	79,994	93,967
SE600	Balance of current subsidies and taxes[26]	22,457	23,827	22,855	24,753
SE420	Family farm income	38,289	42,114	43,539	40,588

Source: own study on the basis of Standard Results of the FADN.

Figures 2-3 briefly present the most important data on the studied set of agricultural holdings included in the Polish FADN. The information originated from Individual Reports of the FADN. A small collapse can be clearly seen in the growing trend of plant production value per 1 ha of UAA. In the case of animal production, this decrease was avoided in 2013. The values of direct costs per 1 ha and per 1 LU were similar.

Figure 2. The level of direct costs and the value of production per 1 ha of UAA

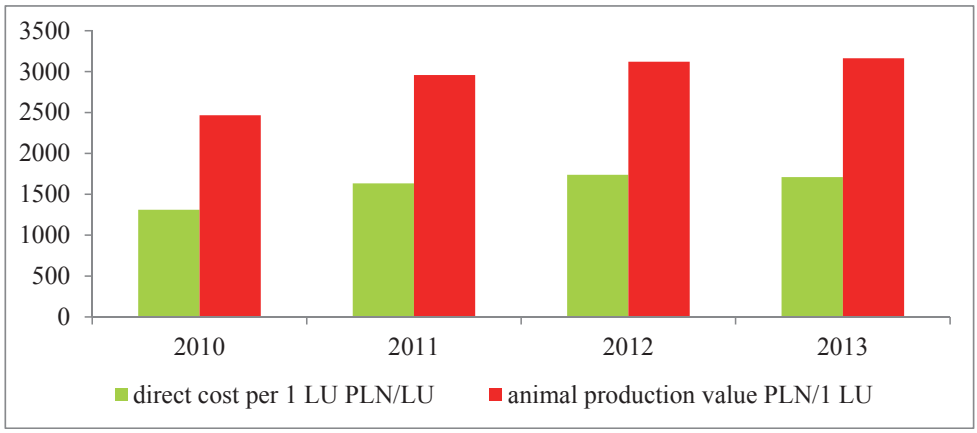


Source: prepared by the author on the base of data of the FADN.

[25] Intermediate consumption (according to the definition of L. Goraj and E. Olewnik, 2014) includes the value of agricultural products originating from internal production used for production purposes as well as purchased materials (along with fuels), energy, external services (external processing, agrotechnical, veterinary services, commissions paid for bank services), costs of business travels and other costs (e.g. insurance).

[26] In the studied period, the amount of direct payments received by Polish farmers systematically increased. It was related to the growing subsidy rate granted to area of up to 1 ha of UAA. However, we should also keep in mind the variable exchange rate used to convert the subsidy values granted in a given year.

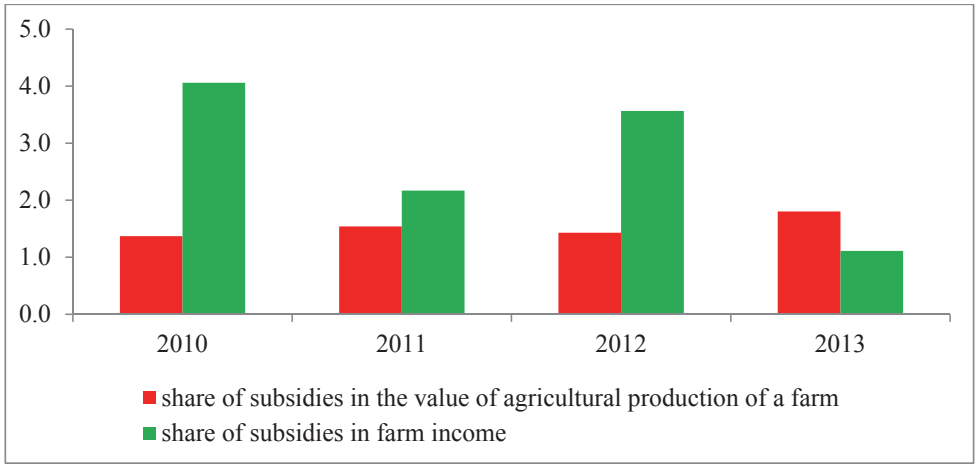
Figure 3. The level of direct costs and the value of production per 1 LU[27]



Source: prepared by the author on the basis of data of the FADN.

Figure 3 illustrates high variability over time with regard to the share of subsidies in the income and the values of agricultural production.

Figure 4. The share of subsidies in the value of agricultural production and income

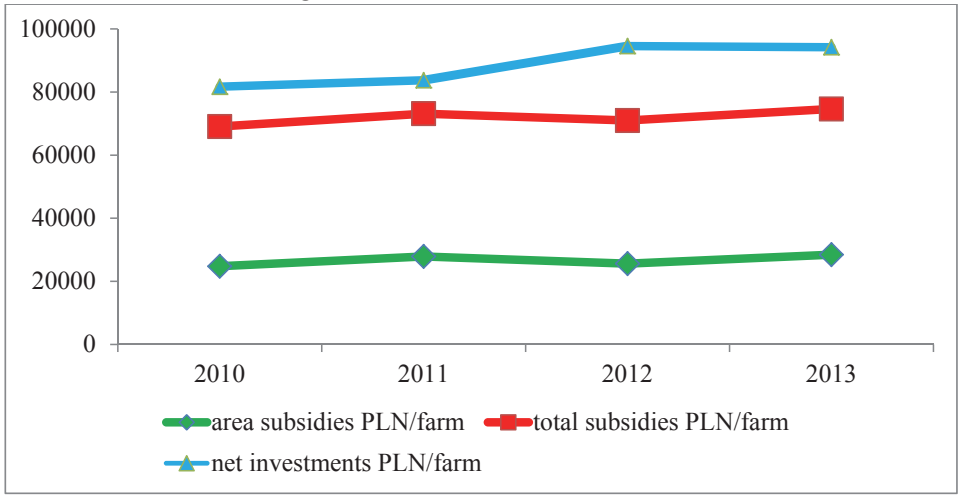


Source: prepared by the author on the basis of data of the FADN.

Figure 4 shows trends in the relationship between investments and the subsidy level. In 2010-2011, the direction of this relationship was the same. The year 2010, favourable for agriculture, probably caused the increase in the number of investments in subsequent years.

[27] LU – Livestock Unit.

Figure 5. Subsidies and investments



Source: prepared by the author on the basis of data of the FADN.

Table 3 contains information about the correlation between particular ratios and the subsidy rate I. In the course of own research, this rate played the biggest role in determining other ratios in agricultural holdings. However, its impact was negative.

Table 3. Correlation between the analysed indicators and the subsidy rate I

Years	WOO[28]	ROE[29]	AP[30]	PP[31]	ROA[32]
Subsidy rate I[33,34,35]	-0.932	-0.763	-0.191	-0.579	-0.936

Source: prepared by the author on the basis of data of the FADN.

Next, Table 4 presents examples of relations between the ROA ratio and the subsidy rate I. The ROA ratio makes it possible to assess the effectiveness of all assets involved in functioning of a farm. It is always lower than the ROE ratio. Return on assets depends strongly on the value of the earned profit. It is best for the entity, when this profit is earned through market transactions, namely sale of products. The scale of production of goods, as well as the bargaining power at the stage of price negotiations, affect the value of ROA. The

[28] WOO – agricultural production to total costs ratio.
[29] ROE – return on equity (farm profit adjusted by costs of own labour to equity value).
[30] AP – assets profitability.
[31] PP – total production profitability.
[32] ROA – return on assets (farm profit adjusted by own labour costs to total assets).
[33] Subsidy rate I – direct payment to total production value ratio.
[34] Subsidy rate II – direct payments to farm profit ratio.
[35] SAPS – Single Area Payment Scheme in PLN (SE632).

study searched for relationships between other factors, less obvious from the economic point of view. Therefore, the set of independent (control) variables, discussed below, was used, and the results are presented in Table 5.

Table 4. Simple regression for assets profitability ratio (**y = ROA**)[36]

Specification	Coefficients	Standard error	Value-p
Constant	1.096	0.050	0.000
Subsidy rate I	**-1.378**	**0.125**	**0.000**
R square	0.003		
Observations	44,920		

Source: prepared by the author on the basis of data of the FADN.

Like in previous years, the set of control explanatory variables consisted of the following measures and ratios:

a) economic size,
b) equity in PLN,
c) cash flows,
d) SAPS amount in PLN,
e) entire sum of budget support in PLN,
f) soil quality ratio,
g) investment rate,
h) share of leased soil in all used acreage,
i) fixed assets to circulating assets ratio,
j) assets to equity ratio,
k) farm manager age,
l) education (binary variable),
m) FADN region[37],
n) type of farming (TF8),
o) other gainful activities (binary variable).

Return on assets was stimulated to the greatest extent by the soil quality ratio as well as the location of farms in Pomerania and Masuria. Investment rate also had a favourable impact on ROA.

Other gainful activities, as well as state aid (subsidies in the form of subsidy rate) had the most unfavourable effect on the level of return on assets. Excessively high value of fixed assets and equity adversely affected ROA as well.

[36] Regression analysis using the classic least squares method for the whole studied set of all types of farms included in the FADN database.
[37] A –Pomorze i Mazury; B – Wielkopolska i Śląsk; C – Mazowsze i Podlasie; D – Małopolska i Pogórze.

Table 5. Multiple regression for assets profitability ratio (**y = ROA**)

ROA	*Coefficients*	*Standard error*	*Value-p*
Constant	-1.809	0.199	0.000
Subsidy rate I	**-1.492**	**0.123**	**0.000**
Investment rate	0.001	0.000	0.000
Fixed assets to circulating assets ratio	-0.006	0.001	0.000
Equity to total assets ratio	-0.547	0.283	0.053
other gainful activities (0-no; 1-yes)	-1.708	0.090	0.000
REG_A (A=1, other=0)	1.689	0.125	0.000
Soil quality ratio	2.528	0.122	0.000
R square	0.067		
Observations	44,920		

Source: prepared by the author on the basis of data of the FADN.

6.4. Summary

Direct payments have a complex, multifaceted, immediate and delayed, positive and certainly sometimes negative effect on the agricultural sector. This effect is multilateral/multi-channel. In general, these channels include impacts of the wealth and protective effects on uncertainty and risk, the desire to remain in agriculture as well as the degree of improvement of access to credits.

The direct payments system is considered by many farmers to be their only opportunity to increase profitability of the conducted agricultural activities. However, the increasing share of direct payments in agricultural income may indicate a deteriorating situation of farmers, decrease in efficiency of their farms, or unfavourable changes in prices of agricultural goods – in the global perspective for the whole economy.

In the financial perspective of 2014-2020, direct payments are supposed to be an important tool for achieving the EU goals relating to sustainable natural resource management as well as for ensuring food security. It should be noted that effective management of limited resources is a requirement not only for entrepreneurs – in this case farmers – but also administrators of public funds.

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