INSTITUTE OF AGRICULTURAL
AND FOOD ECONOMICS
NATIONAL RESEARCH INSTITUTE

MULTI-ANNUAL PROGRAMME
2015 - 2019

Subsidies versus economics, finances and income of farms (3)

59.1 MONOGRAPHS OF MULTI-ANNUAL PROGRAMME

WARSAW 2017

Subsidies versus economics, finances and income of farms (3)

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AND FOOD ECONOMICS
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Subsidies versus economics, finances and income of farms (3)

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MULTI-ANNUAL PROGRAMME 2015 - 2019

THE POLISH AND THE EU AGRICULTURES 2020+
CHALLENGES, CHANCES, THREATS, PROPOSALS

Warsaw 2017

All authors are the researchers from the Institute of Agricultural and Food Economics – National Research Institute

This monograph was prepared under the task **Financial and fiscal factors in the improvement of efficiency, sustainability and competitiveness of the Polish agriculture**, in the topic *Subsidies versus economics, finances and incomes of farms*.

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ISBN 978-83-7658-700-4

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Michał Soliwoda, PhD

Introduction

Investments in agriculture are a medium of innovative progress. They may determine, although indirectly, shifting labour force from rural areas to other sections of the national economy. The farmer's decision on taking an investment project determines the investment activity at the level of the sector, and consequently, the competitive capacity of Polish agriculture – in international terms.

The investment processes in agriculture undoubtedly require access to capital. Still open and inconclusive remains the issue of whether and how to subsidise investments made by farms. Subsidies for the agricultural development, involving an extensive group of non-repayable instruments within the framework of the Rural Development Programme (RDP), including measures typically supporting the investment, modernisation or restructuring activity, were, by assumption, to be used as a tool to stimulate the transformations of the agrarian structure. The issue of assessing the impact of these support instruments on the farms' economic and financial situation is associated with the exploration of investment behaviour of farmers.

The essential objective of this monograph was to identify the mechanisms and to assess the use and impact of subsidies for the agricultural development on the family farms' economics and finance. The implementation of the objective formulated in this way entailed conducting comprehensive literature studies (including the elements of meta-analysis), as well as empirical studies using the modern quantitative methods.

The monograph consists of five chapters. The first chapter reviewed the theories on the role of subsidies in the economy and in the agricultural sector. Account has also been taken of the practice of interventionism in the sphere of financing the agricultural and rural development on an example of the measures implemented under the Common Agricultural Policy (CAP) programmes. The second chapter is a methodological and methodical study, illustrated with many examples of national and international empirical studies on real investments of the family farms. This chapter identified the determinants of investment behaviour of those entities. It also described the methods for assessing the impact of subsidies for the agricultural development on the economic and financial situation of the farms of natural persons.

The last three chapters of the monograph are typically empirical. The third chapter identified the determinants of obtaining subsidies for the agricultural development by the farms of natural persons. In addition, it assessed the impact of the analysed subsidy instruments on the family farms' economy. The fourth chapter explored the relationships between the processes of growth in the farms' activity, and the level of risk in operational and strategic terms. The last (fifth) chapter contains the results of the empirical analysis of the impact of EU subsidies on the family farms' economy and finance, which are a continuation of studies from previous years (conducted since 2011).

Aleksander Gorzelak, MA

1. Subsidies for the agricultural development – theoretical approach and practice of the EU Common Agricultural Policy

1.1. Introduction

The investment processes in agriculture require access to capital, which is of interest to, *inter alia*, economists, representatives of financial institutions and policy makers[1]. Still open and inconclusive remains the issue of whether and how to subsidise investments made by farms. Providing financial services for rural areas and agriculture in the developing countries proved difficult despite recent reforms and billions of dollars allocated for subsidising programmes for the development of financial institutions.

This chapter contains two parts. The objective of the first one is to review theories on the role of subsidies for the agricultural development in the economy and in the agricultural sector. The method of literature studies has been used (including both foreign and national publications). The purpose of the other section is to attempt to describe how the rationales, objectives and instruments of interventionism in the sphere of financing the agricultural and rural development, as presented in the theoretical part, are implemented in practice in the CAP programmes. Here, the documentation method has been primarily used.

1.2. Theoretical analysis of the issue of interventionism in the sphere of financing the agricultural development

Credit markets differ from an idealised market as the information is imperfect, and loan contracts are difficult to enforce. Stiglitz analysed the impact of the information asymmetry in credit markets on the economy, by introducing the concept of credit rationing[2]. On the other hand, the phenomenon of *market failure* occurs when the market inefficiently allocates its resources[3]. Complex environmental, material and production factors in agriculture inhibit the supply and demand of credits loans and insurance, which makes it particularly difficult to create sustainable financial institutions supporting this sector. So, no wonder that efforts to increase the formal credit supply had

[1] B. Bashaasha, E. Odeke, *Developments in WFP's Purchase for Progress (P4P) Programme*, [in:] Agricultural Finance Yearbook 2009 (eds. R. Roberts and R. Ocaya), pp. 140–143.
[2] J. Stiglitz, A. Weiss, *Asymmetric Information in Credit Markets and its Implications for Macroeconomics*, "Oxford Economic Papers", Vol. 44, Iss. 4, 1 January 1992, pp. 694–724.
[3] T. Besley, *How Do Market Failures Justify Interventions in Rural Credit Markets?* "World Bank Research Observer", 9 (1), pp. 27–47, Washington 1994.

an unfavourable history and quick improvements did not work. Most successes resulted from the careful, long-term institutional development. In the years 1960-80 subsidised, targeted programmes of agricultural loans were frequent in the top-down government programmes (the aging paradigm of financial interventionism in agriculture). Unfortunately, the attempts to resolve the market failure often led to governmental failures. In the 80s of the 20th century, a new paradigm for financial markets appeared, which shifted the emphasis from dispersing cheap credit to creating sustainable institutions, treating borrowers and savers as customers and not as beneficiaries, creating products tailored to the customer, as well as determining properly the prices of products and services so as to cover the costs and risk.

Agencies of lenders reduced the use of lines of credit for subsidies, loans and technological assistance in order to develop appropriate products, institutions and policies. Microfinance has also been developed thanks to the market-oriented approach[4]. Microfinance institutions[5] entered into agriculture (agricultural finance) and rural areas (rural finance)[6], but in order to develop the products and methodology, further efforts[7] are needed to tailor them to the seasonal cash flows of households (cf. Fig. 1). Management of costs and risks of agricultural loans was difficult. There is a need for a better understanding of the demand for and use of agricultural credit so as to develop effective products, institutions, projects and policies[8]. The rapid growth of microfinance suggests that there is a high unmet demand for agricultural credits, but we need to

[4] A. Demirgüç-Kunt, Th. Beck, P. Honohan, *Finance for All? Policies and Pitfalls in Expanding Access,* "A World Bank Policy Research Report", 2008, Washington, USA, p. 119.

[5] D. Adams, J. Pischke, *Microenterprise Credit Programs: Déja vu,* "World Development", 2012, 20(10), s. 1463-1470.; Compare in: V.M. Hartarska, M. Holtman, *An Overview of Recent Developments in the Microfinance Literature*, "Agricultural Finance Review", 2006, 66 (2s), pp. 147–65.

[6] A. Banerjee, E. Duflo, *Giving Credit Where It Is Due*, "Journal of Economic Perspectives", 2010, 24(3), pp. 61–80.

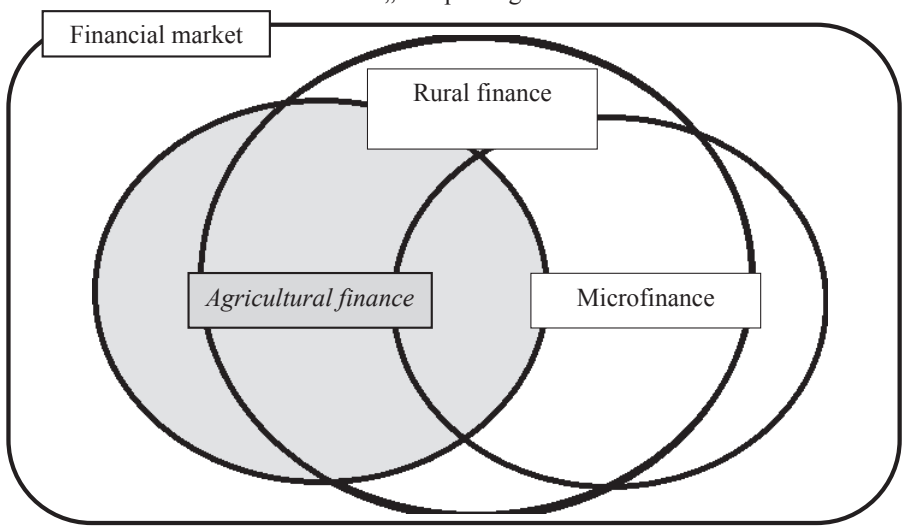
[7] In 1992's Bolivia an unprecedented-scale solution was devised by establishment of the foundation (Agrocapital Foundation) which became the first NGO in the region allowing rise in microfinancing, see: J. Alvardo, F. Galarza, *The Agrocapital Foundation of Bolivia: Pioneering Individual Loans in Rural Areas*, "Promising Practices in Rural Finance: Experiences from Latin America and the Caribbean" (ed. M.D. Wenner), pp. 213-242, IADB, Washington 2003.

[8] The reader may find more information in a joint agricultural finance primer by FAO and GTZ (*Deutsche Gesellschaft für Technische Zusammenarbeit*), see: FAO/GTZ, *Agricultural Finance Revisited: Why?*, "Agricultural Finance Revisited Monograph 1", FAO, Rome 1998.

consider two issues. Firstly, there may be a tendency to overvalue the demand[9], a phenomenon observed in the case of microfinance. Secondly, the empirical question relates to the borrower's sensitivity to interest rates (sensitivity analysis) in relation to other factors affecting the demand. The demand for agricultural credit may be limited, if the interest rate in the broad market is the same as the interest rate required by microfinance institutions (MFI) necessary to retain the profitability[10].

Figure 1

Location of agricultural finance in the theory of finance according to the so-called „new paradigm"



Explanations: microfinance – financial services for the poorest[11], often based on the cooperative model; rural finance – financial services for rural areas, regardless of the level of wealth and purpose; agricultural finance – financing the agricultural activity.
Source: Own studies based on World Bank subject literature: World Development Report 2008: Agriculture for Development. The World Bank, Washington, DC.

An analysis of using subsidies in aid programmes led to the guidelines for "smart" or "market-friendly" subsidies. These guidelines include: subsidising institutions rather than borrowers so as to reduce market failure; avoiding

[9] M. Anand, R. Rosenberg, *Are We Overestimating Demand for Microloans?,* "Consultative Group to Assist the Poor", Washington 2008.
[10] B. Armendariz, J. Morduch, *The Economics of Microfinance*, [in:] Arnold R.A., "Microeconomics", 7th ed., Mason, USA 2015.
[11] A. Besigye, *Financial Institutions Client Perspectives from Kapchorwa*, [in:] Agriculture Finance Year Book 2008 (red. R. Roberts and R. Ocaya), pp. 59–62. Compare: A. Banerjee, E. Duflo., R. Glennerster, C. Kinnan, *The Miracle of Microfinance? Evidence from a Randomized Evaluation*, MIT, Cambridge 2009.

subsidies for institutions undermining the competition; subsidising the creation of public goods which benefit the entire financial sector; subsidising individual financial institutions in the case of occurrence of spillover effects; determining quantitative indicators of efficiency, so that subsidies for financial institutions did not discourage from improving financial results; carrying out a cost-benefit analysis in order to determine subsidies generating the greatest benefits; requiring subsidy beneficiaries to demonstrate their commitment through their individual matching; designing subsidies for financial institutions in such a way so that final beneficiaries clearly understand the difference between subsidies and loans.

The major types of intervention in the agricultural sector are enumerated in Table 1. They are described as below[12].

Table 1

Types of intervention in the agricultural sector by Mahul and Stutley

No.	Name of an intervention
1.	*Micro- and index-insurance*
2.	*Credit-guarantee funds*
3.	*Warehouse receipts*
4.	*Specialised Agriculture Development Banks, ADBs*
5.	*Farm investment funds*

Source: O. Mahul, C. Stutley, Government Support to Agricultural Insurance: Challenges and Options for Developing Countries, World Bank 2010.

Ad.1. Many experiments with index-based insurance products have been carried out so as to mitigate the risk both for households and lenders providing financial services to farmers. Index insurance provides decreasing administrative costs, reducing phenomena of adverse selection and moral hazard. Combining insurance products with deposit and credit products becomes a logical step towards reducing costs and accelerating adaptation process, but additional experiments in different environments are needed in order to develop the best practices. Solid studies are necessary to prove that insurance subsidies actually bring the desired effects and to assess the role of public subsidies in private insurance and catastrophic insurance markets. The logical function of governments and donors is to focus on long-term investments in public goods, for example, in meteorological stations and basic collection of data needed to create the conditions and infrastructure for strong insurance markets. Additional

[12] Compare: O. Mahul, C. Stutley, *Government Support to Agricultural Insurance: Challenges and Options for Developing Countries*, 2010, Washington, USA; In: World Bank, *World Development Report 2008: Agriculture for Development*, Washington 2008.

investments in basic risk mitigation methods are required: cheap irrigation, drought-resistant seeds, improving sanitary conditions and preventive health care.

Ad. 2. Donors and governments expect that credit guarantee funds will reduce the risk of insolvency and encourage lenders to support specific target groups or institutions. It is believed that guarantee subsidies accelerate market research, thanks to which lenders improve the credit analysis and lend their liquid funds rather than invest in government securities or lend only to borrowers with high collaterals. However, the methodology used in assessing guarantees was poor, therefore, questions on value added and sustainability still tend to appear. Guarantees may provide additional comfort to financial institutions interested in testing possibilities of granting credit to a new customer, but the guarantee itself does not result in granting additional credit, if lenders are not interested. International agencies may offer an important service to carry out an evaluation so as to determine whether and on what conditions guarantees bring expected results, and whether their design affects their performance. It is also important to assess whether they cause market disruption and discourage the development of the private credit market. It may turn out that training and technical support in guarantee programmes are more important than guarantees themselves so as to be able to stimulate granting loans to new customers. This situation suggests that programmes such as "Guarantee+" can only be an incentive, not a ready-to-use solution.

Ad. 3. The basic advantage of warehouse receipts is that they reduce the risk of lenders, serving as a collateral, which can be realised in the case of the borrower's insolvency. Goods are stored in certified warehouses which issue notes confirming the quantity and quality of the goods. The owners of the goods (such as farmers or traders) provide warehouse receipts in exchange for loans. Except for the cases of the double or triple harvest, credit obtained after the harvest does not resolve the seasonal demand for working capital. It is difficult to determine when and where the deposit systems contribute to improving access to agricultural credits, especially for small farmers. They can improve the functions of storage and marketing of goods in the value chains. Expenses related to the creation, operation and monitoring of these systems mean that the appropriate scale is a serious challenge, and thus for semi-subsistence farms the most effective may be small systems at the level of the village. In addition, small farmers prefer production loans so as to meet seasonal cash outflows at the beginning of planting, and not marketing loans after the harvest. The more

detailed analyses of the prices of agricultural raw materials are necessary to determine which plants demonstrate the sufficiently high seasonal price fluctuations, so as to compensate for the storage costs. The fact that the storage is common in the case of export crops suggests that economic barriers may limit the expansion of the production of cereals and other goods on local outlet markets. Several long-term investments in public goods have been identified, which enabled financing of the warehouse receipt system.

Ad. 4. The paradigm of subsidised special purpose credits led to the creation of many state-owned agricultural development banks (AgDBs)[13]. These banks have generally poor results, which led to a debate on them. Successful reforms are only possible when governments introduce fundamental changes in the field of ownership, supervision, products, and maybe even customers. Some reformed banks have successfully implemented microfinance procedure for agriculture. However, what is needed are sophisticated risk management techniques for financial institutions, which grant high loans for farmers and non-commercial enterprises. One of the tools can be small loans with the use of microfinance technologies and slow increase of credits with the growing institutional capacity and access to commercial sources of financing. This type of banks must be protected from political interference and be able to cover the market interest rates, including own costs, using the margin.

Ad. 5. Agricultural investment funds are a form of a mutual fund used to merge investment capital and disperse the risk[14]. They offer the possibilities of diversification and employ professional managers to carry out a risk assessment and manage the investment portfolio. Estimates on enormous capital requirements for agricultural investments in the developing countries are a logical argument in favour of the greater involvement of professional external investors. An analysis is needed to determine whether these funds also contribute to intensifying debt financing by local loan institutions. It is probable that funds will be more beneficial for wealthy and enterprising farmers, so there can be significant problems in terms of the wealth and income distribution. Benefits in a form of improved access to inputs (*CAPEX*), markets and jobs can

[13] Check the Guatemalan example of Banrural S.A., i.e. conference address L.N. Alfaro-Gramajo *Reverting the Tendency in Developing Finance: The Case of Banrural S.A. in Guatemala*, "Paving the Way Forward for Rural Finance: An International Conference on Best Practices", USAID, Washington, 02-04 June 2003.

[14] C. Miller, S. Richter, P. McNellis, M. Mhlanga, *Agricultural investment funds for developing countries*, FAO, Rome 2010.

go to small farmers and the poor, but the high informational, transactional, and contract enforcement costs mean special measures are needed in order to include poor farmers in the value chain. In addition, if these funds do not invest in financial institutions for agriculture, they will not contribute to broadening the offer of financial services important for farmers and rural residents. Intensive monitoring and analysing of the funds' activity is a proper and efficient role of international agencies. Subsidies for technological assistance components can help increase the local potential and investments, reduce risk and cover some costs of aid to small farmers in the value chains under which investments are made. These measures can help broaden the offer of financial services for rural areas.

***

In general, there are no easy solutions in order to create sustainable systems of agricultural credits. With some exceptions, the "old paradigm" approach did not usually lead to the creation of sustainable agricultural credit institutions. It has been only recently that there has been the careful development of products, policies, institutions and infrastructure. Renewed interest in the development economics has stimulated the fundamental studies on financial services. New, more rigorous study methods bring the promise to deepen the understanding of the impact of human behaviour on the operations in the credit market. These studies must be widely disseminated so as to benefit the entire financial industry. Support for innovation will provide international agencies with opportunities to help in disseminating agricultural credit in the developing countries and will let them use selective subsidies and investments to the greatest extent possible.

***

This part of the paper identifies the potential role of agriculture in contributing to the economic growth[15]. Moreover, this indicates the key areas where there may be positive links and empirical difficulties in determining their size and direction of the impact of those links. The evidence of the impact of investments in rural areas on the economic growth has been discussed. The discussion on the agricultural policy focuses in particular on the importance of this sector for reducing poverty and stimulating the growth.

[15] The issue under discussion is holistically reviewed in the paper A. Banerjee, E. Duflo, *Growth Theory through the Lens of Development Economics*, MIT, Cambridge 2004; whereas insurance topic is wholly undertaken by Valdes et al. Crop Insurance for Agricultural Development: Issues and Experience, Johns Hopkins University Press, Baltimore 1986.

How does agriculture contribute to the economic development and how does the economic development affect agriculture? This is the question which has already been asked by at least the physiocrats in the mid-18th century and was crucial for the early development of analytical economics by Adam Smith, David Ricardo and Thomas Malthus[16]. Even the first modern, comprehensive effort to answer this question – the article "The role of agriculture in the economic development", written by Johnston and Mellor – appeared long time ago, in 1961. But the issue is still discussed, as stated by the lecture by D. Gale Johnson addressed to the American Economic Association – "Agriculture and the Wealth of Nations"[17].

The most satisfying approach to the measurement of the uneven impact of agriculture on the economic growth is that of the theories of growth by Barro and Sala-i-Martin (1995). The modern empirical growth models introduce the control variables for the initial conditions, accumulation of production factors, improvement in the labour and capital factor, and then they search for the control variables affecting the overall efficiency of resource allocation. The openness of the economy, the size of the public sector, price distortions and macroeconomic instabilities affect the efficiency of allocation, but the potential contribution of the agricultural growth to the economic efficiency has not been directly tested in the new models.

At the most basic level, historical readings of GDP show positive relationships between the speed of the economic growth and the rural economics. In a sample of 65 developing countries, there was a very significant positive correlation between 1960 and 1985. About 20% of the growth rate in agriculture were added to the exogenous growth rate in non-agricultural sectors[18]. It is disputable whether this direct and positive link between the growth in both sectors indicates a cause and effect relationship. For example, the well-thought macroeconomic policy could make both sectors develop independently, or each sector could, at the same time, contribute to the growth of other sectors[19].

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[16] J.M. Keynes, *The Collected Writings of John Maynard Keynes*, Vol. 10, Palgrave Macmillan, London 1972.

[17] D.G. Johnson, *Agriculture and the Wealth of Nations. Richard T. Ely Lecture*, "American Economic Review", 1997, 87(2), pp. 1–12.

[18] World Bank, *World Development Report 2011*, Washington 2011.

[19] C.P. Timmer, *Agriculture and pro-poor growth: What the literature says*, USAID, Washington 2003.

An important reason for investing in the domestic agricultural sector is the potential of stabilisation of the national food economy, and thus increasing food security. This potential is greater in the more densely populated countries which affect the global rice prices, as the global market of this cereal is very shallow and unstable, and cultivation systems are irrigation-dependent – the local production is less variable than the global price. The import of food can provide a stronger basis for food security than the domestic food production in small countries, in food systems based on wheat and maize and in agriculture based on rainfall. There are, however, many conditions in which the import of food may not provide the stability[20].

The modern economic policy has been developed, *inter alia*, in order to address the issue of state intervention in agriculture. The debate over the corn laws at the beginning of 1816 in Great Britain contrasted the increasingly sharp microeconomic models by Ricardo with the vague but realistic concerns expressed by Malthus, affecting the dynamic macroeconomic effects and overall equilibrium. The general model of equilibrium shows that Malthus was right, at least for England at the early stages of the industrial revolution[21].

At the end of the 20th century, the behavioural approach was identified as an alternative to traditional study methods[22]. However, the father of classical trend, Adam Smith, in the "Theory of Moral Sentiments" of 1759, linked the psychological factors with economic decisions. In turn, according to J.M. Keynes[23], the predictions as to the interest rate in the future are determined by the psychology of crowds. As the precursors of the modern behavioural economics we consider Herbert Simon and Harvey Leibenstein. From the point of view of investments in agriculture, particularly important are joint papers by Amos Tversky and Daniel Kahneman on the prospect theory, including the issue of so-called framing[24] (i.e. the negative or positive semantic aspect of the same

[20] H. P. Binswanger, R. S. Khandker, M. R. Rosenzweig, *How Infrastructure and Financial Institutions Affect Agricultural Output and Investment in India*, "Journal of Development Economics", 1993, vol. 41, issue 2, pp. 337-366.
[21] O. A. Williamson, *Comparison of Alternative Approaches to Economic Organization*, "Journal of Institutional and Theoretical Economics (JITE)"/ Zeitschrift Für Die Gesamte Staatswissenschaft, 1990, 146(1), pp. 61-71.
[22] The breakthrough moment and an inflection point was awarding Daniel Kahneman, the author of the *prospect theory*, with the Swedish National Bank's Prize in Economic Sciences in Memory of Alfred Nobel in 2002 .
[23] *Ibidem.*
[24] I.P. Levin, S.L. Schneider, G.J. Gaeth, *All frames are not created equal: A typology and critical analysis of framing effects*, Organizational Behavior and Human Decision Processes 76, 1998, pp. 149-188.

phenomenon) in the attractiveness of decisions made. The behavioural approach allows to identify the emotional factors associated with a decision on starting investing by the farmer. S. Gomez Y Paloma, E. Majewski et al.[25] examined the investment intentions of farmers using a model solution with the multi-criteria dynamic programming. This approach made it possible to gather empirical evidence of the impact of the Common Agricultural Policy (CAP) on the farmers' expectations and strategies. The investment intentions of the farmers were dependent on their individual characteristics and farm resources, rather than from the management system and production type.

O. Musshoff deals with the issue of economic experiment in agriculture, by examining the behavioural aspects of investment decisions of the farmers in a sample of German farms[26], using the benchmarks of the classical finance theory and real options. The approach known from the new discipline of neurofinance measuring the impact of the processes in the brain on investment decisions is also slowly transferred to agriculture[27].

1.3. Overview and assessment of the legislation concerning the interventionism instruments in agriculture and rural development in the EU and in Poland

The EU Common Agricultural Policy (CAP) – particularly within the framework of the second pillar – plays an important role in creating the profitability of farms and the rural development trajectory. The literature highlights the complexity of this issue in the context of structural adjustments, labour markets and capital markets, conditions of uncertainty and the life cycle of households.

The instruments of the second pillar of the CAP 2007-2013 include support for various types of investments, and are addressed to a wide group of recipients. In the programming period 2007-2013 (just like in the years 2000-

[25] S. Gomez Y Paloma, E. Majewski, M. Raggi, D. Viaggi, *Wpływ wspólnej polityki rolnej na zachowania inwestycyjne rolniczych gospodarstw domowych w Polsce, „*Roczniki Nauk Rolniczych", 2008, 94 (2), pp. 95-105.

[26] S.C. Maart-Noelck, O. Musshoff, *Investing Today or Tomorrow? An Experimental Approach to Farmers' Decision Behaviour*, "Journal of Agricultural Economics", 2013, vol. 64, pp. 295–318.

[27] Confrontation of the classical MPT (*Modern Portfolio Theory*) by Harry Markowitz with the achievements of Amos Tversky and Daniel Kahneman, utilising outputs from, among others electrocardiograms, magnetic resonances and computer tomography, was undertaken by Persian scientists from the University of Shiraz, see S. Khajavi, H.F. Nafchi, *Neuro finance, Perspective of Behavioral Finance*. "Journal of Investment Knowledge", 2013, pp. 21-34.

-2006 and in the current seven-year period of the CAP 2014-2020), the EU countries had a considerable freedom and flexibility in shaping the instruments to support investments in agriculture, rural areas and in their environment (cf. Table 2 and 3). It should be stressed that the assessment of the impact of investment support on the agricultural sector is complex. Although the European Commission sets the principles for assessing the RDPs and indicates the key study areas and the methodological procedure, comparative assessments among the Member States are simply unfeasible. So far, there have been no effective methods by which it is possible to assess the impact of a single support instrument[28].

Table 2

Instruments to support investments under the CAP 2007-2013

Type of investment instruments	Number of the measure	Name of the measure
Support for productive investment aimed at improving economic results/increasing the competitiveness of the economic activity pursued by individuals	121	Modernisation of agricultural holdings
	122	Improving the economic value of forests
	123	Adding value to agricultural and forestry products
	311	Diversification to non-agricultural activities
	312	Support for the creation and development of microenterprises
	313	Encouragement of tourism activities
Support for investments in public infrastructure	125	Improving and developing infrastructure related to the development and adaptation of agriculture and forestry
Support for non-productive invetsments regarding environmental or non-market issued implemented by individuals	216	Non-productive investments in agriculture
	227	Non-productive investments in forestry
	313	Encouragement of tourism activities
Support for investments implemented by individuals and concerning adaptation of the standards co-financed under the measures 121 and 123	121	Modernisation of agricultural holdings
	123	Adding value to agricultural and forestry products

Source: European Commission, DG-AGRI, Unit E.4, Investment Support under Rural Development Policy. "Publications Office of the European Union", Brussels 2014.

[28] B. Wieliczko, *Wpływ wsparcia inwestycyjnego w ramach WPR na rolnictwo*, „Europa Regionum", 2015, Vol. 25, pp. 471.

Table 3

Impact of support for investments under the CAP 2007-2013 for agriculture

Specification	Austria	Czech Rep.	Germany	Poland	Slovakia
1 EUR of support resulted in the increase in GVA* in the supported farm (in EUR)	0.37	0.10	negative	0.20	0.03
1 EUR of support resulted in the increase in FFI* in the supported farm (in EUR)	0.16	0.16	-	0.14	-
1 EUR of support resulted in the increase in the labour productivity in the supported farm (in EUR)	0.09	0.01	negative	0.03	negative
Number of annually created/maintained jobs (per FTE) thanks to EUR 1 million of support	23.24	negative	3.60	-	100.63

GVA (*gross value added*) – gross value added or gross farm income,
FFI (*family farm income*) – income from the family farm.
Source: B. Wieliczko, op. cit., 2015.

As noted by B. Wieliczko, "among the farmers planning to invest under the current CAP perspective, the estimated scale of investments throughout the period of 2014-2020 is significant when compared to the total average value of assets per one farm in the EU, as it is almost 59% of the value of assets in 2012. Depending on the type of planned investments, their scale is also changing. The farmers plan to spend least on training and most on land"[29].

Within the framework of the "Measure M04: investments in fixed assets", the following submeasures have been identified:

1. Aid for investments in farms:
   a) Investments in farms situated in the Natura 2000 sites
   b) Investments in farms situated in the NVZ areas
   c) Modernisation of farms
2. Aid for investments in processing/marketing and development of agricultural products
3. Land consolidation.

Support for investments under the so-called second pillar of the CAP accounts for the largest part of the total budget of all rural development programmes implemented in the current programming period (RDP 2014--2020)[30].

[29] *Ibidem*, p. 471.
[30] A. Gorzelak, J. Herda-Kopańska, J. Kulawik, M. Soliwoda, B. Wieliczko, *Controversies over the European Value Added created by CAP,* „Problems of Agricultural Economics", 1(350), 2017, pp. 3-28.

Today, it is already known that the new CAP perspective will be an important element of the long-term Community budget for the years 2021-2027, which is to be ready by the end of 2018. The basis for the legislative proposals is the so-called Monti Report[31]. The withdrawal of Great Britain from the EU entails the liquidation of the British correction mechanism and related "rebate on rebate" – a reduction which benefits Germany, Austria, the Netherlands and Sweden thanks to British financing. In general, all correction mechanism on the income side should be abolished.

Although the European Commission has not adopted any position on the future CAP post-2020 yet, it has committed to the rural development in the Declaration of Cork 2.0, the objective of which is to check how rural areas fit in with the most important contemporary issues, e.g. the economic development, the digitisation process, the demographic growth, the natural environment, the ecological transformation. On 27 October 2016, the European Parliament adopted a resolution on the way in which the CAP is to improve job creation in rural areas, by determining its goals for the CAP post-2020. The EU Committee on Agriculture and Rural Development regularly discusses the challenges for agriculture post-2020 and the preparations for the CAP reform. Finally, in 2016, the European Agriculture Council started discussing the future of the CAP[32].

According to the Ministry of Agriculture, which prepared the draft position of the Polish Government on the CAP post-2020, it is necessary to strengthen financing for the second pillar of the CAP regarding the rural development. In addition, the MARD demands so as to keep the cohesion--oriented criteria of the budget allocation for this pillar to the greatest possible extent. Also, according to the Ministry, it is necessary to ensure the appropriate involvement of other EU policies for rural development[33].

By the end of 2017, the European Commission will draw up a communication on the future of the CAP. The new shape of the common agricultural policy will be ultimately determined by the governments of the Member States and the European Parliament.

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[31] J. Comte, *EU should raise own taxes, says report*, „EU Observer", 16.01.2017. Access from: https://euobserver.com/institutional/136553 (01.08.2017).

[32] European Committee of the Regions, *The CAP post-2020*, Discussion paper COR-2017-01102-00-00-TCD-TRA (FR), 2017.

[33] PAP Municipal Service, *Future of the CAP*. The *Common EU agricultural policy after 2020 from the perspective of the Ministry of Agriculture*, Warsaw 2017.

1.4. Summary

As a result of investment subsidies, the cost of capital is reduced, making it easier to make investments, as subsidies are cost-free and non-repayable. When capital gets cheaper, investment projects are implemented, which would not be taken in commercial conditions, also, the risk of overinvestment is growing. Subsidies for agriculture should modernise the productivity. Purely economic effects should also be analysed. Capital is a substitute for labour, therefore the modernisation and growth of the manufacturing potential should lead to a decrease in employment. The potential in agriculture increases by leaps and bounds, while 75%[34] of all subsidies are absorbed by direct payments, that is, the element of the first pillar of the CAP. The system of interventionism must be then complementary and must co-exist with the political courage leading to changes. In the case of the insufficient labour supply, transformations in agriculture are inhibited, and defence against economic migrants is inadequate in a situation where the labour force is needed. Macroeconomic effects of interventionism in agriculture using current mechanisms implemented in the CAP are insufficient. In the discussion of the European Commission on the shape of the programmes of agricultural support from the second pillar of the CAP, non-refundable financial instruments e.g. in a form of microcredits, guarantees and equity-linked instruments, implemented, *inter alia,* directly by the European Investment Bank (EIB) are becoming more and more popular. From the point of view of the history of economic thought, similar "market" solutions would be best for the free credit market as they do not distort the curves of the supply and demand for credits in the models of the variable interest rate and do not result in crowding-out of market investments by subsidised investments. Such solutions have similar assumptions as the programmes of agricultural support in Canada and the US, whose positive impact on the financial and economic situation of agricultural enterprises is noticeable and has been measured[35].

[34] Measured on the basis of European Commission budgetary data obtained from: http://ec.europa.eu/budget/figures/2007-2013/index_en.cfm (access from: 28.11.2017).

[35] A. Gorzelak, *Assessment of the Implications of Changes in Income Support Policies on Financial Health of Farms in Canada and the USA (at the Industry Aggregate Level)*, "Problems of Agricultural Economics", 2017, Vol. 2(351), pp. 51-76.

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2. Review of the methodological approaches and empirical studies on investment behaviour of farmers and assessment of subsidies for agricultural development at the micro level[1]

2.1. Introduction

Investment processes[2] in agriculture can be considered from several perspectives: sector as a subsegment of the national economy, single farm or its production branch. In addition, at the lowest level of analysis there is a single investment project. The issue of assessing the impact of investment, modernisation and restructuring subsidies (hereinafter referred to as "subsidies for agricultural development") on economic and financial condition of the farms is associated with the exploration of investment behaviour of farmers[3]. The agricultural producer's decision on taking an investment project determines the investment activity at the level of the sector, and consequently also the

[1] Of the greatest importance among the extensive set of "subsidies for development" are investment subsidies.

[2] Analysis of investment processes is underpinned by the fundamental issue of defining investments, whose set will be narrowed down to "material investments". The essence of this type of investment consists in "engaging financial resources in enhancing physical resources of elements of elements of the entity's fixed assets". According to A. Michalak, they are made in order to, inter alia: "increase the value of assets"; A. Michalak, *Finansowanie inwestycji w teorii i praktyce*, Wydawnictwo Naukowe PWN, Warszawa 2007, p. 21. Of similar opinion is R. Ziarkowski, who, however, draws attention to the definition scope of "material investments" in the strict sense: "material investments consist in investing capital in non-financial elements of the entity's assets", stressing at the same time that "some authors consider as material investments only investments in tangible fixed assets", R. Ziarkowski, *Opcje rzeczowe oraz ich zastosowanie w formułowaniu i ocenie projektów inwestycyjnych*, Wydawnictwo Akademii Ekonomicznej, Katowice 2004, p. 15. It should be stressed that from the point of view of the farm manager, it is important to assess the profitability of investments along with the selection of sources of their funding, which is handled by capital budgeting – the area common for both financial management and managerial accounting; cf. E. Nowak, *Rachunek opłacalności inwestowania*, PWE, Warszawa 1999; W. Rogowski, *Rachunek efektywności inwestycji. Wyzwania teorii i potrzeby praktyki*, Wolters Kluwer Polska, Kraków, 2013. In detail, the issue of assessing the profitability of investments in relation to entities of the agricultural sector has been presented in the paper by J. Ziółkowska; cf. J. Ziółkowska, *Metody oceny efektywności projektów inwestycyjnych w agrobiznesie*, Studia i Monografie, nr 136. IERiGŻ-PIB, Warszawa

[3] V. Gallerani et al. include in the extensive set of investment behaviour types also decisions made by the farmer on, *inter alia*, taking an investment project, determining the time of its starting, intensity, location and source of financing. Cf. V. Gallerani, S. Gomez Y Paloma, M. Raggi, D. Viaggi, *Investment behavior in conventional and emerging farming systems under different policy scenarios*, JRC Scientific and Technical Reports, European Commission Joint Research Centre, Institute for Prospective Technological Studies, Seville, Spain 2008.

competitiveness of agriculture at the international level. Investments in agriculture are often a medium of innovative progress, therefore, they determine, although in an indirect way, shifting of labour force from rural areas to other sections of the national economy. Modernisation of agriculture (*inter alia*, through automation, ICT, biological progress) promotes a deeper connection of this sector with other components of the national economy which justifies the adoption of a very broad analytical perspective. Making material investments is important from the point of view of farms, as it may, *inter alia*, increase the productivity of production factors, improve welfare of livestock, as well as stabilise the economic viability of agricultural entities[4].

The objectives of this chapter include to identify, firstly, the determinants of investment behaviour of the farms and, secondly, a review of the methods to assess the impact of subsidies for agricultural development on the economic and financial situation of the farms of individuals. What was primarily used, was the method of critical literature studies and bibliometric analysis.

2.2. Investment behaviour of the farms – micro-perspective

Making material investments leads to increasing property resources of an economic entity. The investment processes in agriculture, assisted by support from instruments of the Common Agricultural Policy[5], are analysed both from the strictly economic and financial perspective, and definitely rarely analysis of investment projects refers to management issues.

It should be stressed that the number of empirical studies on investments made by the farms is significant (Table 1). This is evidenced at least by the results of the queries on investment behaviour of the farmers in the abstract search engine Scopus Search (according to the so-called ABS String, i.e. *Article title, Abstract, Keywords*) "investment behavior" AND farm – 35 articles (as of 1.08.2017).

[4] Cf. N. Olli, A.-M. Heikkilä, S. Myyrä, *Accounting risk in farm investment calculations: application to dairy farm investment*, Paper prepared for presentation at the EAAE 2016 Seminar 156, Prospects for agricultural insurance in Europe, October 3-4, 2016, Wageningen Campus, Netherlands.

[5] Cf. European Commission, *Investment Support under Rural Development Policy*, 2014.

Table 1

Results of bibliometric analysis – studies on investment behaviour of the farmers

Specification	Number of articles
Keywords	Investment (9), Investment Behaviour (6), Eurasia (5), Agriculture (4), Europe (4), Agricultural Policy (3), Common Agricultural Policy (3), Decision Making (3),Experimental Economics (3), Farmers Attitude (3)
Country of affiliation of authors	Germany (8); USA (6); the Netherlands (5); Italy (4); Spain (4)
Authors	M. Raggi (4); D. Viaggi (4); K. Agethen (2); R. Bokusheva (2)

Note: research in Scopus Search (1.08.2017).
Source: own studies.

As observed by Atwood et al., on the one hand, the investment processes in agriculture affect structural changes in the agricultural sector, while on the other hand, the determinants related to the agricultural structure affect the investment activity of the individual entities[6]. According to Gallerani et al., "land and capital are to some extent complementary, agricultural land as a single investment factor is also treated as an alternative when making material investments"[7]. In the case of a flexible approach to shaping the capital structure of the farm, investment decisions allow to decide on entering/leaving the agricultural sector, changing the size of the farm or introducing innovation in the farm. It must also be added that the area of studies on identifying the determinants of the investment activity, generally using multiple regression models or, increasingly, binary (usually logit or tobit) models is very extensive. Of great importance are also studies using primary data obtained during diagnostic surveys (e.g. as in the paper by Gomez y Paloma et al.[8]). The determinants of investment behaviour of the farmers, as mentioned in the literature of the subject, include:

[6] J.A. Atwood, G.A Helmers, S. Shaik, *Farm and non-farm factors influencing farm size*. Selected paper presented at AAEA-WAEA Annual Meetings, Long Beach, California, 2002; F.C.A. Andersson, *Decoupling: the concept and past experience*, SLI Working paper, 1, 2004.
[7] V. Gallerani, S. Gomez Y Paloma, M. Raggi, D. Viaggi, *Investment behaviour...,* op.cit., p. 34.
[8] S. Gomez Y Paloma, E. Majewski, M. Raggi, D. Viaggi, *Facing the future: strategies and investment behaviour of polish farmers*, Paper prepared for presentation at the 104th (joint) EAAE-IAAE Seminar Agricultural Economics and Transition: What was expected, what we observed, the lessons learned. Corvinus University of Budapest (CUB) Budapest, Hungary. September 6-8, 2007.

- phase of the business cycle (*boom/bust* in agriculture)[9];
- factors related to the macroeconomic, political environment[10];
- characteristics associated with investment projects (*inter alia*, start time, duration, source of financing);
- characteristics relating to commodity markets, as well as production factor markets (e.g. credit market);
- characteristics of the family farm[11];
- attitude of the agricultural producer.

Particular importance is assigned to the agricultural policy instruments (both at the national and transnational level, for example, EU). It is about, *inter alia*, decoupled payments or the agriculture taxation system[12]. In general,

[9] Although W. Czubak examined subsidy instruments under the RDP 2007-2013 (based on the ARMA data), he stated that investment behaviour of the Polish farmers was fairly conservative and stable over time, as "the way of using support remained unchanged (...) dominant were investments associated with projects related to equipping the farms with machinery, equipment and tools for the agricultural production". What is more, resources to support the investment activity were allocated primarily for the farms in Central Poland. This resulted in strengthening "the competitiveness of regions with the relatively good agrarian structure, in which agriculture is considered well developed" (p. 57); W. Czubak, *Wykorzystanie funduszy Unii Europejskiej wspierających inwestycje w gospodarstwach rolnych*, „Journal of Agribusiness and Rural Development", 2012, 3(25), pp . 57-67. D. Kusz, St. Gędek and R. Kata studied the macroeconomic determinants of investments in Polish agriculture. Generally, their conclusions do not differ substantially from those which apply to the determinants of the investment activity of enterprises. Those economists stated that the decrease in interest rates and the increasing GDP growth rate should stimulate the investment activity of the Polish farms; D. Kusz, S. Gędek, R. Kata, *Egzogeniczne uwarunkowania inwestycji w rolnictwie polskim*, (in:) *Problemy rozwoju rolnictwa i gospodarki żywnościowej w pierwszej dekadzie członkostwa Polski w UE* (eds. A. Czyżewski, B. Klepacki), pp. 54-68, Wyd. PTE, Warszawa 2015..

[10] D.A. Hay, D.L. Morris, *Industrial economics and organisation. Theory and evidence*, Oxford University Press, Oxford 1991.

[11] Cf. E.L. LaDue, L.H. Miller, J.H. Kwiatkowski, *Factors Influencing Farm Investment Behavior*, Proceedings of Regional Research Committee NC-161, Financing Agriculture In a Changing Environment: Macro, Market, Policy And Management Issues, Mclean, Virginia, October 4-5, 1988; J.V. Olsen, M. Lund, *The impact of socio-economic factors and incentives on farmers' investment behavior*, "Acta Agriculturae Scandinavica, Section C — Food Economics", 2011, vol. 8, iss.- 3, pp. 173-185.

[12] The more in-depth discussion on the relationship between the structure of the taxation system and the competitiveness of the agricultural sector is contained in the paper by: M. Soliwoda, J. Pawłowska-Tyszko, *Income taxation in agriculture vs. competitiveness. International perspective and evidence from Poland*, „Jahrbuch der Österreichischen Gesellschaft für Agrarökonomie", 2016, Band 25, pp. 211-220. An important role is played by the presence of elements (e.g. rate, subject- and object-based exemptions) indicating preferential treatment of the agricultural sector in fiscal terms. A clear example is the Polish

subsidy instruments within the framework of the agricultural policies, in combination with the tax preferences, can reduce the farmers' propensity to make investment decisions, however, not related to the farm's production activity. In addition, as shown by the studies by Lagerkvist[13], investment decisions related to increasing the area of the farm (i.e. through the purchase of agricultural land) were made in conditions of uncertainty associated with various options of the agricultural policy. In this case, Lagerkvist considered the introduction of the single farm payment (SFP). Much attention has been given in empirical studies to the effects of decoupling on investments of the farms[14]. The conclusions of those studies were as follows[15]:

- decoupled payments stimulated investment processes, in particular investments in machinery and equipment, buildings and structures;
- risk aversion hypothesis (RAH) has been confirmed;
- diversity of the obtained results of empirical studies could result from various methodological approaches;
- significant part of decoupled payments has been allocated for the household consumption[16].

The agricultural policy may contribute to increasing the farmers' propensity to invest, provided that they financial constraints are "loosened"[17]. In the case of imperfect capital markets, agricultural income support policies were conducive to increasing the propensity to invest[18].

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tax system in which the family farms (except for the farms from so-called special sections) are basically charged with agricultural tax only.

[13] C.J. Lagerkvist, *Agricultural policy uncertainty and farm level adjustments – the case of direct payments and incentives for farmland investment*, "European Review of Agricultural Economics", 2005, 32(1), pp. 1-23.

[14] Here, it is worth quoting at least numerous papers by the OECD or numerous articles by the Italian agro-economists. Cf. OECD, Policy Framework for Investment in Agriculture, OECD Publishing, Paris 2014; P. Sckokai, M. Moro, M., *Modelling the impact of the CAP Single Farm Payment on farm investment and output*, "European Review of Agricultural Economics", Vol 36 (3) (2009), pp. 395–423.

[15] European Commission, *Evaluation of The Structural Effects Of Direct Support*, July 2013. http://publications.jrc.ec.europa.eu/repository/bitstream/JRC97340/jrc%20report%20final.pdf

[16] Cf. B.K. Goodwin, A.K. Mishra A.K., *Another look at decoupling: Additional evidence on the production effects of direct payments,* "American Journal of Agricultural Economics", 2005, 87(5), pp. 1200-1210.

[17] F.C.A. Andersson, *Decoupling: the concept and past experience*. SLI Working paper, 1, 2004.

[18] It should be stressed that the expected effect of public (here: agricultural) policy instruments may be quite surprising for decision-makers. For example, B.K. Goodwin and A.K. Mishra demonstrated that the definitely higher part of decoupled payments was to be used on the farm, cf. B.K. Goodwin, A.K. Mishra, *Another look at decouplings…*, *op.cit*.

The theory of agricultural investments identifies so-called sluggishness in the farm transformation processes. Firstly, it may result from adjustment costs, and secondly, from the so-called *asset fixity,* i.e. asset immobility (resulting from the difference between the cost of acquisition and its residual value, so-called *salvage value*). The theory of adjustment costs is only a partial attempt to explain why the economic entity adjusts capital resources to the optimum level only to a small extent. The problem of the so-called *asset fixity* results from the specificity of the investment as a process associated with waiting for the economic and financial effects deferred in time. From the point of view of analysing investment processes at the micro level (single farm), significantly important is the issue of uncertainty inhibiting the farm's investment activity. Uncertainty refers indirectly to the irreversibility of investments[19].

E. Vollmer et al.[20] used the method of economic experiment in their empirical studies. The main objective of their study was to determine the impact of non-monetary determinants on the German farmers' decisions on investing in the construction of a piggery (organic production). The respondents had an opportunity to choose subsequent investments related to the conventional and then organic production. Other economic conditions were identical. The results of the studies by Vollmer et al. confirmed that the framing effect had been associated with the farmers' response to opportunities of investing in piggeries for both the conventional and organic production. The farmers invested later on, if they had to change the type of production[21].

The surveys by J. Fritsch et al.[22] on semi-subsistence farms in three Central and Eastern European countries (Poland – 175, Romania – 185, Bulgaria – 184 farms) made it possible to divide those entities into: (1) rural "diversifiers", (2) rural pensioners; (3) producers-farmers, (4) rural newcomers.

The American agricultural policy as early as in 2014 withdrew government payments as an instrument to redistribute agricultural income, by putting an emphasis on subsidising risk management tools.

[19] Cf. V. Gallerani, S. Gomez Y Paloma, M. Raggi, D. Viaggi, *Investment behavior* …, op. cit.; A.K. Dixit, R.S. Pindyck, *Investment under Uncertainty*, Princeton, NJ: Princeton, University Press, 1994.

[20] E. Vollmer, D. Hermann, O. Musshoff, *An Experimental Approach to the Investment Timing of Conventional and Organic Hog Farmers,* "Canadian Journal of Agricultural Economics", 65 (2017), pp. 293-315.

[21] Ibidem.

[22] J.Fritzsch, S. Wegener, G. Buchenrieder, J. Curtiss, S. Gomez y Paloma, *Semi-subsistence Farm Households in Central and South-eastern Europe: Current State and Future Perspectives*. Contributed Paper prepared for presentation at the International Association of Agricultural Economists Conference, Beijing, China, August 16-22, 2009.

Only the entities representing the third group were characterised by the development potential, including the use of instruments supporting the investment and modernisation activity[23].

As it results from the studies by I. Fertő et al.[24] on assessing investment behaviour of farms, both in the EU countries in Western Europe as well as in Central and Eastern Europe (Hungary, Slovenia), in all analysed countries investment behaviour did not differ significantly, although there were differences regarding the structural characteristics of the agricultural sector. Credit market imperfections were noticeable mostly in Hungary and Slovenia. The panel data from the FADN system for the research period 2003-2008 has been used. Gross investments of the farm were correlated positively with a change in sales revenues (at current prices) and investment subsidies. It should be noted that the aforementioned instruments can reduce the negative impact of capital market imperfections, but only in the short term. In the long term, of great importance is to maintain the competitive capacity of the farms in commodity markets, as well as to ensure sufficient cash flows[25].

The objective of the studies by S. Gomez y Paloma et al. (including E. Majewski) of 2007 was to identify the farmers' strategies, and consequently also their expectations and response to a potential reduction in the role of agricultural policy instruments[26]. The study sample, although chosen in a very arbitrary manner, included agricultural producers with a "dynamic" approach to management, as well as with the higher than average propensity to take new initiatives. The farmers showed different expectations regarding the future, first of all, that:

– the difference between gross sales revenues and costs will decline and, as a consequence, a decrease in the gross margin for dominant crops will be noticeable;

[23] Ibidem.

[24] I. Fertő, Z. Bakucs, Š. Bojnec, L. Latruffe, *East-west European farm investment behaviour - The role of financial constraints and public support*, "Spanish Journal of Agricultural Research", 2017, vol. 15, iss. 1.

[25] The issues of financing agricultural investments in Slovenia during economic transformation are also referred to in the paper by Š. Bojnec, L. Latruffe, *Financing availability and investment decisions of Slovenian farms during the transition to a market economy*, "Journal of Applied Economics", 2011, vol. 14, iss. 2, November 2011, pp. 293-317.

[26] S. Gomez Y Paloma, E. Majewski, M. Raggi, D. Viaggi, *Facing the future: strategies and investment behaviour of polish farmers*, Paper prepared for presentation at the 104th (joint) EAAE-IAAE Seminar Agricultural Economics and Transition: What was expected, what we observed, the lessons learned, Corvinus University of Budapest (CUB) Budapest, Hungary. September 6-8, 2007.

– role of the common agricultural policy (including the CAP) will be greatly reduced.

In the majority of the farms, EU subsidies have been used to cover current costs and investment expenses. To explain the differences between the expectations of the individual farms, more useful were the variables on production organisation, human capital, use of production factors than those on the production system[27].

Table 2 summarises the results of the studies on identifying the determinants of investment behaviour. It should be noted that the more experienced and educated was the farmer, the more frequently he made material investments. The typical variables describing the farm should include: size of the farm (*inter alia*, expressed by means of the area), production profile. Debt (expressed using the debt-to-assets ratio) in the Danish economists' studies stimulated the investment activity (studies by Olsen and Lund of 2009), although we should bear in mind also the sensitivity of investment processes in the farms to cash flows, which is associated with the structure of the capital market.

Table 2

Determinants of investment behaviour of the farmers – overview of studies

Authors of the studies	**Variables describing investment behaviour of the farmers***	**Research methods applied**
La Due et al., 1988	Socio-demographic characteristics: age (+), experience of the manager (+), level of education (+) Farm characteristics (+): size of the farm, production profile, soil quality, location of the farm (region).	Logistic regression
Benjamin, Phimister, 2002	Structure of the capital market -> sensitivity of investments to cash flows	Three model approaches based on regression analysis (including the basic model q)
Olsen, Lund, 2009	Standard gross margin (+) Economic size (as power) (-) Debt (+) Period of occupation of the farm by the farmer (+)	Logistic regression

Explanation: *the type and significance of the correlation were provided
Source: own study.

Summing up, we may identify several groups of the determinants of investment behaviour in the farms. An important role is played by the category associated with the socio-demographic characteristics of the farm managers.

[27] Ibidem.

2.3. Assessment of the impact of subsidies for agricultural development on the farms' economic and financial situation – review of study approaches

Investment, modernisation and restructuring subsidies have multiple effects on the farm's financial and economic situation. What is more, this issue seems extremely complex, given that the effect of these support instruments is usually distributed over several years[28]. Taking into account the methodological approaches, we may identify several groups, namely those related to the sector (ignored in this subchapter), single entity or investment project.

The methods most commonly used to assess the impact of investment subsidies (the most relevant from the point of view of the above group of support instruments) on the enterprises' economic and financial condition include:

- multiple regression discontinuity designs[29],
- models using estimators, such as Matching Estimators[30];
- models based on the estimator Difference-in-Difference (DiD)[31].

A team of the Austrian economists of agriculture made an attempt to organise the existing methodological approaches used to assess the impact of investment, modernisation and restructuring subsidies on farms. From the rural development programmes of many Member States it resulted that the objective

[28] Of particular importance can be the issue of optimisation, with consideration given to so--called *optimal intertemporal investment, modeling*. F.W. Agbola and S.R. Harrison explored investment behaviour of the farms specialised in extensive rearing of ruminants in the Australia's pastoral region. Cf. F.W. Agbola, S.R. Harrison, *Empirical investigation of investment behaviour in Australia's pastoral region*, "The Australian Journal of Agricultural and Resource Economics", 2005, 49, pp. 47-62.

[29] A. Cerqua, G. Pellegrini, *Do subsidies to private capital boost firms' growth? A multiple regression discontinuity design approach*, "Journal of Public Economics", Vol. 109, January 2014, pp. 114-126.

[30] „Matching estimation allows to achieve unbiased estimators of the difference in the expected values of the examined variable in two different situations: occurrence of the above--mentioned impact and its absence (p. 309); A. Szulc, *Assessment of the effect*…. An example of using this method is contained in the empirical article by G.E. Atzeni and O.A. Carboni, cf. G.E. Atzeni, O.A. Carboni, *The effects of grant policy on technology investment in Italy*, "Journal of Policy Modeling", Vol. 30, Iss. 3, May–June 2008, pp. 381-399.

[31] S. Kirchweger, J. Kantelhardt, F. Leisch, *Impacts of the government-supported investments on the economic farm performance in Austria*, "Agric. Econ – Czech", 2015, 61, (8), pp. 343--355; H. Zhou, Ch. Taber, St. Arcona, Y. Li, *Difference-in-Differences Method in Comparative Effectiveness Research: Utility with Unbalanced Groups*, Applied Health Economics and Health Policy. 2016; 14, pp. 419-429; J. Michalek, P. Ciaian, D. Kancs, *Investment Crowding Out: Firm-Level Evidence from Northern Germany*, "Regional Studies", 2016, Vol. 50, Iss. 9, pp. 1579-1594.

of actions supporting the investment activity is to improve the economic efficiency of the farms by making better use of production factors[32]. In addition, the general lines of the CAP by 2020 took account of investments, which "should improve both the economic and environmental efficiency"[33]. The issue of assessing the impact of investment subsidies is associated with many methodological difficulties:

- self-selection,
- large diversification of socio-demographic and economic characteristics of the farms,
- granting investment subsidies is usually associated with the exact assessment of the investment project.

It should be stressed that the aforementioned methods are particularly useful for counterfactual analysis of the impact of support instruments (though not only) on economic entities, hence their increasing popularity as tools in evaluation studies of the effects of public policies.

We can talk about some, although limited, possibilities of adapting the methods to assess the impact of investment subsidies from the SME sector[34].

[32] Cf. European Commission, Directorate-General for Agriculture and Rural Development, *Rural Development in the European Union….*

[33] Communication from The Commission to The European Parliament, The Council, The European Economic and Social Committee and The Committee of The Regions, *The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future /** COM/2010/0672 final */, 52010DC0672, Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52010DC0672&from=EN

[34] For example B.Ch. Chin et al. made an attempt to assess the impact of subsidy instruments supporting innovation on the productivity measured by value added of Korean SME companies. They used a unique large panel containing variables on public R&D subsidy. The econometric procedure included counterfactual analysis and was two-stage (Tobit/Logit – DPD). The results clearly showed the positive impact of these support instruments on the improvement in the productivity. Cf. B. Cin B.,Y.J. Kim, N.S. Vonortas, *The Impact of Government R&D Subsidy on Firm Performance: Evidence from Korean SMEs*, The Asian Research Policy Symposium, "Asian Model of Innovation: Innovation and Creative Economy," Seoul, Korea 2013. It is worth stressing that highly useful were the methods applied in relation to the food industry entities. For example, J. Spicka, Z. Naglova and M. Gurtler applied a typical panel approach to assess the impact of investment subsidies on the financial situation of enterprises of the meat industry (endogenous variables were the rate of return, labour productivity, credit debt ratio. Cf. J. Spicka, Z. Naglova, M. Gurtler, *Effects of the investment support in the Czech meat processing industry*, "Agric. Econ. – Czech", 63, 2017.

More attention, due to increasing interest of the researchers, should be given to economic experiment[35].

Colen et al.[36] are considering a possibility of using an experimental approach to assess the changes in the effects of the agricultural policy (including the Common Agricultural Policy, CAP). Those researchers specially highlight the following areas of using economic experiments[37], namely:

- assessment of the potential effects of the policies (or changes) before implementation;
- identification of the role of behavioural factors in making economic or financial decisions;
- measurement of the environmental effect of the given instrument (in cause and effect terms).

Specific characteristics distinguishing economic experiment from the extensive range of many study methods are: (1) demonstrating causality and (2) usefulness, to a certain limited extent, in eliminating potential selection biases[38].

The most frequently invoked is the case of identifying the impact of support instruments, as the difference between the result of the given policy (observed data), and the resultant of factors in the absence of the impact of the given instrument (counterfactual state)[39]. Sometimes e.g. the increase in yields on farms receiving investment subsidies can be explained by a parallel fall in prices of fertilisers.

Another area of application is associated with the elimination of a potential distortion regarding self-selection. Observable or non-observable

[35] Methodological issues have been quoted in the article by the co-author of the monograph: M. Soliwoda, *Podejście behawioralne i eksperyment ekonomiczny w finansach rolnictwa*, „Zagadnienia Ekonomiki Rolnej", 2014, No. 1, pp. 57-77.

[36] L. Colen, S. Gomez y Paloma, U. Latacz-Lohmann, M. Lefebvre, R. Préget, S. Thoyer, *Economic Experiments as a Tool for Agricultural Policy Evaluation: Insights from the European CAP*, "Canadian Journal of Agricultural Economics", 2016, vol. 64., iss. 4, p. 667–694.

[37] S. Flejterski and M. Urchs are of opinion that the study procedure applied in the economics is somehow similar to the general procedure of empirical sciences and its specific features are determined by the distinctness of the examined entity, S. Flejterski, M. Urchs, *Elementy filozofii i metodologii nauk ekonomicznych. Perspektywa kryzysowa*, Wyd. edu-Libri, Kraków-Legionowo 2015.

[38] D. Hermann, K. Agethen, O. Mußhoff, *Ein experimenteller Vergleich des Investitionsverhaltens ökologisch und konventionell wirtschaftender Schweinehalter in Deutschland*, "German Journal of Agricultural Economics", 2015, 64 (2015), No. 1, pp. 1-15.

[39] S.C. Maart-Noelck, O. Musshoff, M. Maack, *The Impact of Price Floors on Farmland Investments: A Real Options Based Experimental Analysis*, "Applied Economics", 2013, 45(35), pp. 4872-4881.

characteristics simultaneously determined the membership in the sample and the size of the analysed phenomenon[40]. Therefore, a challenge is to distinguish between the impact of the policy from other previously existing differences between those receiving investment subsidies and the farmers not using this support. For example, the farms of the farmers using investment subsidies are characterised by significantly higher surpluses. However, this is related not to the direct impact of investment subsidies. This can be explained by the fact that among applicants for investment subsidies the farms with higher income and with the far better economic efficiency are dominant.

Given that the method of economic experiment involves a fairly expensive study process, which due to various limitations (difficulties in obtaining so-called randomised experiment[41]) cannot be taken, the achievements of the modern microeconometrics also contains methodological approaches, which can be described as "quasi-experimental". An example is the regression method with the estimator Difference-in-Difference[42].

In practice, most empirical studies (especially in Poland) on the impact of agricultural investments on the farms' economic and financial situation include a statistical description (especially highlighting changes in the value of indicators over a longer period of time). Some papers use traditional econometric approaches, associated with building, *inter alia*, panel regression models (cf. Table 3).

[40] Cf. P. Strawiński, *Przyczynowość, selekcja i endogeniczne oddziaływanie*, WNE UW, Warszawa 2007, p. 7, http://coin.wne.uw.edu.pl/pstrawinski/publ/selekcja.pdf.

[41] In this type of experiment, entities in the tested group as well as those in the control group are characterised by the identical distribution of both observable and non-observable characteristics; *Propensity Score Matching*, http://coin.wne.uw.edu.pl/pstrawinski/psm/psm06.2015.pdf (7.08.2017).

[42] In the simplest terms, this estimator (difference-in-difference) estimates the impact of the programme as the difference between the change in the value of the target variable for the experimental and control groups; *Ibidem*.

Table 3

Impact of investments on the farms' economic and financial situation – overview of studies

Authors of the studies	Economic and financial variables which are stimulated/destimulated by investments*	Study method applied
Józwiak, Kagan, 2008	Farm productivity (+)	Statistical description
Sandibichler and others, 2011	Economic size, non-agricultural income, debt-to-assets ratio, farm income, economic efficiency, years of establishment (statistical significance of variables)	Statistical analysis of the data obtained during diagnostic surveys
Zając, 2012	Labour productivity (through replacement of labour force with capital) – this applied only to the smallest farms and those representing the type of "horticultural crops".	Statistical description
Filipiak, 2014	Productivity and profitability of vegetable-growing farms (+)	Indicator analysis and statistical description methods (using the FADN empirical sample)
Kirchweger and Kantelhard, 2015	Number of livestock units/farm (+) Area of the farm (+/-)	Regression method with the DiD estimator
Kusz, Sobolewski, 2016	Farm productivity (+), while this increase was mainly determined by changes in the technical efficiency	As above, in addition: economic efficiency assessment (Malmquist indexes), correlation analysis
Špička, Naglova, Gurtler, 2017 *	Rate of return (+/-) Labour productivity (+/significantly) Debt-to-assets ratio (+/-)	Panel regression

Note: *the direction of the impact of investment was basically provided; (+/-) no statistically significant relationship; ** paper by Špička, Naglova and Gurtler related to the food processing sector, however, their study approach may also be used for farms.
Source: own study.

Summing up, the assessment of the impact of subsidies for agricultural development on the farms' economic and financial situation is a complex study issue. This results from the multiple impact of this kind of support instruments on the farms' economy and financial situation. As indicated, evaluation studies usually use two or more study approaches, including usually fairly traditional methods (e.g. panel regression).

2.4. Summary

The investment processes in the agricultural sector can be considered from several perspectives. The identification of the mechanisms of the impact of subsidies for agricultural development on the farms' economic and financial condition is inherently associated with the exploration of investment behaviour of the farmers.

The assessment of the impact of subsidies, in particular investment subsidies, is a complex methodological issue, which results from, *inter alia*, the problem of self-selection and a need to include many socio-demographic characteristics, including those related to the farm manager. The key methods to assess the impact of subsidies for agricultural development on the economy and financial situation of farms include typical econometric methods (primarily models of limited dependent variable, such as logit, probit, panel regression models). In addition, increasing popularity is enjoyed by methods moved from the evaluation programmes for investment subsidies in the SME sector, including multiple regression discontinuity designs, models using estimators such as Matching Estimators, models based on the estimator Difference-in--Difference (DiD). Existing attempts to adapt the selected approaches to the assessment of the impact of investment subsidies on the economic and financial situation of enterprises to the specificities of farms should be considered promising. Very interesting is the use of economic experiment, though it is associated with numerous limitations and organisational difficulties[43].

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3. Use of subsidies for agricultural development and their impact on the economic and financial situation of farms

3.1. Introduction

Obtaining financial support in a form of EU subsidies greatly determines the competitive potential of the Polish farms. Subsidies for agricultural development, involving an extensive group of non-refundable instruments under the RDP, including the measures typically supporting investment, modernisation or restructuring activity, were, in principle, to be used as a tool stimulating transformation of the agrarian structure[2]. Assessing the impact of these instruments on the farms' economy and finance is relatively complex, however, it should be preceded by the identification of factors determining obtaining those resources by these entities.

The objectives of the chapter were as follows: (1) to present the family farms' economic and financial situation in a breakdown into those obtaining subsidies for agricultural development and those not receiving these support instruments; (2) to identify the determinants of obtaining subsidies for agricultural development by these entities; (3) to assess the impact of analysed subsidy instruments on the economy of the family farms.

This chapter presents the results of empirical studies based on accounting data of the farms participating in the FADN system. The typical statistical and econometric methods: statistical description, probit regression method and PSM (*Propensity Score Matching*) method have been used.

3.2. Characteristics of the research sample and statistical description

The study sample covered the farms of natural persons[3] included in the Polish network FADN. The years 2009-2015 were adopted as the study period. The Polish FADN database includes accounting data (as well as organisational and production or socio-demographic data) in a systematic manner, and control

[1] M. Soliwoda is the co-author of subchapters 3.1-3.3 and the part of 3.5; A. Gorzelak wrote the subchapter 3.4 and the part 3.5.

[2] Cf. D. Kusz, *Zróżnicowanie regionalne nakładów inwestycyjnych w rolnictwie polskim*, „Zeszyty Naukowe SGGW - Ekonomika i Organizacja Gospodarki Żywnościowej", 2009, 75, pp. 79-89; D. Kusz, *Inwestycje produkcyjne w gospodarstwach rolniczych korzystających ze wsparcia finansowego Unii Europejskiej*, „Zeszyty Naukowe SGGW w Warszawie. Ekonomika i Organizacja Gospodarki Żywnościowej", 2013, nr 103, pp. 67-77.

[3] In the paper will be also used the interchangeable term „family farms".

of its quality at different levels which guarantees its reliability and consistency[4]. This database was a source of data used in various statistical and econometric analyses, aimed at monitoring the impact of EU and national subsidies on the family farms' economic and financial situation[5]. Adopting the Polish FADN database as a source of empirical data was fully justified, as this system collects data in a very systematic manner and, what is more, data verification tools guarantee the high reliability of analysis of the family farms' income and financial situation. Just like in statistical analyses presented in publications on the impact of EU subsidies on the family farms' economic and financial situation, the empirical sample included entities keeping accounting records in the Agricultural Accounting Books (AAB). The indices presented in the further part have been calculated based on the tables of the "Individual Report" and the "Result Tables". The land valuation by farmer (valid since 2009) has been applied. To classify the farms, the standard output SO "2010" parameters have been used. The sample did not exclude outliers and also those objects where the equity value was negative[6].

It should be stressed that the qualitative binary variable used to classify the farms (i.e. those with subsidies for agricultural development vs. those not using this support instrument[7]), refers to the group of subsidies within the RDP, namely:

- „subsidies for investments and equipping the farm",
- „investments in fixed assets",
- support for „investments reproducing the potential of agricultural production",
- subsidies for „farm and business development".

Table 1 shows the general characteristics of the study sample of the farms of natural persons participating in the FADN system. It should be stressed that its size was variable, which resulted from the fact that some entities quit

[4] Cf. Z. Floriańczyk, D. Osuch, R. Płonka, *Wyniki standardowe 2015 uzyskane przez gospodarstwa rolne uczestniczące w Polskim FADN. Część I. Wyniki standardowe*, IERiGŻ, Warszawa 2016.

[5] From 2011, the IAFE-NRI (within the framework of the Multi-Annual Programme 2011-2014 and 2015-2019) has issued monographs presenting the above results of empirical studies on the impact of EU subsidies on the economic and financial situation of farms.

[6] Elimination of outliers was necessary in the process of building probit models (discussed in the further part of this subchapter).

[7] In general, granting subsidies was equal to their receipt, therefore, in the further part of the study the author will use both terms interchangeably.

participating in the FADN system. The share of the farms using subsidies for agricultural development (D_INW) did not exceed 7.5% in the analysed period. In 2015, this form of support was used by 6% of the farmers belonging to the FADN system. This indicates that subsidy instruments, focused on the development of the farms, were not popular among the commercial farms. Generally, the FADN sample in Poland covers the entities focused on the commercial production, whose size exceeds the economic size (ES) equal to EUR 2,000. The highest (i.e. PLN 106.9 thousand) average family farm income was generated in 2012, while the lowest income of this type (i.e. PLN 78.0 thousand) in the analysed period was achieved in 2009. High variability of agricultural income results from substantial price fluctuations (including changes in prices of the purchase basket of agricultural products and cumulative index of price scissors) and yields in Poland.

Table 1

General characteristic of the sample of farms participating in the FADN system

Specification	2010	2011	2012	2013	2014	2015
The sample size	11 004	10 890	10 909	12 117	12 123	12 105
The number of farms not receiving subsidies for agriculture development	10 209	10 244	10 088	11 605	11 660	11 383
The number of farms receiving subsidies for agricultural development	795	646	821	512	463	722
The share of farms receiving subsidies for agricultural development in the total sample [%]	7,2%	5,9%	7,5%	4,2%	3,8%	6,0%
The average utilised arable area [ha]	35,3	35,6	36,3	35,6	36,2	35,8
The average net farm income [PLN thous.]	90,3	101,8	106,9	94,0	88,3	78,0

Source: own calculations based on FADN data.

Tables 2-7 represent the area (utilised agricultural area), as well as the evolution of the income and financial situation (illustrated with several key financial rate of return and debt indices) for the sample divided according to the criterion of obtaining investment subsidies. In addition, by using the non--parametric Mann-Whitney U test for two independent samples, the significance of distribution differences has been assessed. The basic descriptive statistics have been presented (mean, median, standard deviation, minimum and maximum).

The data presented in Table 2 shows that the farms receiving instruments supporting the investment, modernisation or restructuring activity, were

characterised by the much larger area. This is evidenced by the higher values of means in all years of the analysed period (e.g., in 2015, the average area of UAA – 43.2 ha in the case of farms using support, 35.4 ha – in the subsample of entities not using this form of support).

Table 2

UAA (ha) of the farms depending on the criterion of obtaining subsidies for farm development

Specification	Median	Average	SD	Min.	Max.
2010					
N_INW	**21,9**	33,8	43,2	0,0	772,8
INW	**39,0**	54,4	50,6	0,0	596,8
2011					
N_INW	**22,6**	35,7	44,4	0,0	740,0
INW	**35,7**	44,3	41,9	0,2	432,9
2012					
N_INW	**23,0**	35,7	44,4	0,0	740,0
INW	**33,2**	44,3	41,9	0,2	432,9
2013					
N_INW	**23,1**	34,9	40,7	0,0	703,4
INW	**38,6**	52,0	53,0	0,3	603,0
2014					
N_INW	**23,7**	35,8	42,7	0,0	806,0
INW	**37,3**	46,6	39,2	0,9	359,6
2015					
N_INW	**23,8**	35,4	41,4	0,0	703,4
INW	**32,2**	43,2	36,0	0,3	336,2

Note: INW – farms receiving subsidies for agricultural development, N_INW – farms not receiving subsidies for agricultural development; the values of medians for p-value below the traditionally adopted significance level of 0.05 are in bold; p-value from the Mann-Whitney U test refers to the differences of distributions/medians between the groups (those receiving vs not receiving „investment subsidies").

Source: own calculations based on the FADN data.

A significant dispersion indicates large variability of income generated in the identified subsamples in the individual years (Table 3). The highest range was recorded for the sample of the farms which did not use subsidies for agricultural development (2013). For all years, there were statistically significant ($p<0.05$) distribution differences. This confirms the argument that the farms using this kind of support instruments generated a higher level of farm net income. Taking into account the ratio of the standard deviation to the mean, i.e. the coefficient of variation (CV), the greater diversification of the income level was characteristic of the farms not receiving subsidies for agricultural development.

Table 3

Farm net income (PLN) depending on the criterion of receiving subsidies for agricultural development

Specification	Median	Average	SD	Min.	Max.
2010					
N_INW	**51 182,01**	86 214,38	126 388,06	-541 777,00	2 179 156,00
INW	**106 070,84**	143 196,43	149 837,16	-113 826,28	1 625 059,00
2011					
N_INW	**59 444,00**	97 376,88	142 212,90	-311 551,00	3 959 342,90
INW	**130 599,80**	172 347,60	163 577,92	-100 393,00	1 368 793,46
2012					
N_INW	**59 004,84**	104 780,50	163 834,51	-320 210,00	3 695 993,00
INW	**100 515,52**	132 923,53	137 630,90	-77 948,00	1 317 481,56
2013					
N_INW	**53 433,14**	92 648,59	157 369,56	-251 936,00	7 290 597,58
INW	**89 445,04**	124 636,29	141 695,06	-122 296,00	1 233 936,00
2014					
N_INW	**48 644,39**	87 154,76	143 178,33	-1 806 450,78	4 679 053,00
INW	**84 081,00**	118 207,38	146 628,64	-336 647,19	1 091 511,00
2015					
N_INW	**44 423,99**	76 120,07	129 937,90	-526 930,07	5 609 913,00
INW	**88 733,16**	107 761,62	120 401,04	-279 273,00	1 193 899,00

Explanation and source as in the previous table.

As it results from the data presented in Tables 4 and 5, in the group of the farms using instruments supporting the development, when compared to those not receiving this form of support, the rates of return on equity and on assets[8] were higher (exception: the ROE mean in 2009). This is shown by the values of the means, medians, as well as the results of the Mann-Whitney U test. In the subsample of the farms using subsidies for agricultural development, the ROA and ROE indices were positive in the years 2009-2014, in 2015, only the average return on assets was non-negative. Standard deviations, thus the coefficients of variation, were higher for the rates of return of the farms not using subsidies for agricultural development. The subsample of the entities using these support instruments was characterised, in the entire period, by the lower empirical variability of the rate of return in the individual years. The significantly higher rate of return of the farms using investment, modernisation or restructuring subsidies may be a result of many factors, among which we cannot ignore the socio-demographic characteristics, or the production characteristics.

[8] In the case of farms of individuals, using accounting and recording solutions of the FADN system, return on assets (ROA) and return on equity (ROE) were calculated as a ratio of family farm income (SE420) less costs of unpaid labour to, respectively, assets and equity, which corresponds to the definition adopted in the FADN Individual Report.

Table 4

ROA [%] depending on the criterion of receiving subsidies for agricultural development

Specification	Median	Average	SD	Min.	Max.
2010					
N_INW	**0,8**	0,9	9,7	-121,8	284,9
INW	**3,7**	4,1	6,5	-19,8	36,1
2011					
N_INW	**1,1**	0,9	10,1	-252,5	218,2
INW	**3,6**	3,4	7,0	-26,5	33,3
2012					
N_INW	**0,9**	0,9	10,2	-186,6	287,7
INW	**2,6**	2,6	7,4	-28,0	51,4
2013					
N_INW	**0,4**	0,2	9,6	-302,2	301,3
INW	**2,2**	2,7	6,2	-16,8	50,0
2014					
N_INW	**-0,8**	-0,9	10,0	-227,9	406,6
INW	**1,0**	1,2	6,5	-45,2	30,8
2015					
N_INW	**-1,1**	-1,3	9,0	-114,2	328,3
INW	**-0,1**	-0,1	7,1	-26,2	88,1

Note and source as in Table 1.

Table 5

ROE [%] depending on the criterion of receiving subsidies for agricultural development

Specification	Median	Average	SD	Min.	Max.
2010					
N_INW	**0,7**	5,4	436,9	-121,8	44128,6
INW	**3,7**	4,7	8,9	-26,2	101,5
2011					
N_INW	**1,0**	0,1	103,2	-10380,6	218,2
INW	**3,7**	3,8	8,6	-32,3	54,8
2012					
N_INW	**0,8**	1,1	11,7	-186,6	287,7
INW	**2,5**	2,6	9,2	-35,9	64,1
2013					
N_INW	**0,2**	0,3	10,5	-302,2	301,3
INW	**2,1**	2,7	8,1	-31,4	57,3
2014					
N_INW	**-0,8**	-0,7	11,8	-350,8	406,6
INW	**1,3**	1,4	7,6	-45,2	49,3
2015					
N_INW	**-1,2**	-1,1	13,4	-114,2	1025,4
INW	**-0,1**	0,1	8,3	-26,2	88,1

Note and source as in Table 1.

Tables 6 and 7 present the statistical description of debt of the family farms. Attention was drawn to the evolution of the debt-to-equity and debt-to--assets ratios. It should be noted that both groups of the farms were characterised by the relatively moderate debt level (debt-to-assets ratio for the farms not using subsidies for agricultural development amounted to 10.4%, in the case of those using these investment activity instruments, this ratio was more than twice

lower). Although the Polish or foreign (especially Anglo-American) literature[9] points to the numerous advantages of using a leverage, it is necessary to take into account the financial risk in the financial planning process. It is worth noting that the analysis of the median value for the group of the farms not using development subsidies indicates that half of entities belonging to this subsample did not have any liabilities. In addition, the relatively low values of the debt-to-equity and debt-to-assets ratios (means and medians <50%) even in the group of the entities using instruments supporting the investment activity highlight the conservative strategy of shaping the capital structure in our family farms[10].

Table 6

Total debt-to-assets ratio [%] depending on the criterion of receiving subsidies for agricultural development

Specification	Median	Average	SD	Min.	Max.
2010					
N_INW	**0,9**	5,1	8,6	0,0	99,8
INW	**8,3**	10,2	10,0	0,0	94,9
2011					
N_INW	**0,7**	4,9	8,4	0,0	99,8
INW	**6,8**	9,5	10,0	0,0	54,5
2012					
N_INW	**0,4**	5,1	8,8	0,0	103,3
INW	**6,8**	9,6	10,0	0,0	63,7
2013					
N_INW	**0,1**	5,1	9,1	0,0	111,8
INW	**9,7**	11,7	11,1	0,0	68,9
2014					
N_INW	**0,0**	5,1	9,2	0,0	99,1
INW	**9,3**	12,0	11,7	0,0	61,1
2015					
N_INW	**0,0**	4,9	9,2	0,0	151,0
INW	**7,8**	10,4	11,3	0,0	85,1

Note and source as in Table 1.

[9] D. Zawadzka (p. 621), based on comprehensive empirical studies carried out on a sample of farms of central Pomorze, formulated a conclusion that „long-term investments are financed mostly from fixed capital where a dominant foreign source are bank credits" (p. 621). D. Zawadzka, *Kredyt w decyzjach finansowych przedsiębiorstw rolniczych w Polsce (ze szczególnym uwzględnieniem podmiotów z regionu Pomorza Środkowego)*, „Zarządzanie i Finanse", 2013, vol. 11, iss. 2, part. 2, pp. 619-630

[10] M. Soliwoda attempted to classify the family farms making material investments. He identified the following clusters: (1) self-financing entities (2) subsidising, (3) slightly indebted, (4) strongly indebted. His results of empirical studies, regarding admittedly a sample of farms of 2014, were convergent with the results of work on the CEEC countries (e.g. Fertő et al. positively verified a hypothesis that gross investments of the farm were positively correlated with the level of investment subsidies. Empirically verified must be an argument that investment behaviour of farmers, regarding the use of these support instrument, is more balanced in a long-term. Cf. M. Soliwoda, *Financing patterns of investing farms. An empirical evidence from Poland, ECEE Conference at TTU*, Tallinn, June 11-13, 2017 (working paper, unpublished).

Table 7

Total debt-to-equity ratio [%] depending on the criterion of receiving subsidies for agricultural development

Specification	Median	Average	SD	Min.	Max.
2010					
N_INW	**0,9**	12,8	603,8	0,0	60988,3
INW	**9,7**	14,7	19,8	0,0	270,4
2011					
N_INW	**0,7**	10,7	411,7	0,0	41635,7
INW	**8,0**	13,9	19,2	0,0	147,3
2012					
N_INW	**0,4**	7,1	27,1	0,0	1856,6
INW	**8,2**	14,3	19,7	0,0	198,6
2013					
N_INW	**0,1**	7,4	27,4	0,0	1828,1
INW	**11,8**	19,0	37,3	0,0	647,0
2014					
N_INW	**0,0**	8,1	102,6	0,0	10565,5
INW	**10,3**	16,4	21,1	0,0	157,1
2015					
N_INW	**0,0**	6,6	20,3	-1020,2	491,9
INW	**8,5**	14,5	28,2	0,0	570,5

Note and source as in Table 1.

3.3. Using subsidies for agricultural development by the farms of natural persons – results of empirical studies[11]

The probit regression model has been used (with QML standard errors) so as to indicate the significance and direction of the impact of the farm characteristics on obtaining subsidies for agricultural development. The analysis applied to 2015 only. It should be stressed that the "raw" sample covered 12,105 farms. In order to make it possible to use certain economic and financial variables, the following entities have been eliminated from the sample:

- not having utilised agricultural area;
- whose manager did not provide his age;
- with the extremely high or low states of current liquidity;
- where it was not possible to calculate the investment rate (gross investments/ depreciation), as the denominator value was 0.

[11] The R^2 indicator, used in the case of the linear regression model, may not be used as an element to build diagnostic tests. Basic indicators of matching in the „qualitative variable models" (mainly in the logit and probit models) are the value of the log-likelihood function for the model with the constant only (*ln L0*) the value of the log-likelihood function for the estimated model (*ln L(full)*). G. Koop, *Wprowadzenie do ekonometrii*, Oficyna Wolters Kluwer, Warszawa 2014, s. 306; P. Strawiński, *Analiza wyborów dyskretnych. Logit i logit wielomianowy,* http://coin.wne.uw.edu.pl/pstrawinski/awd/awd02.pdf.

Such an arbitrary selection of the farms was adequate to the objective of empirical studies adopted this year. However, taking into account the above--mentioned limitations, the study results cannot be generalised to the population of the commercial farms in Poland. In addition, the procedure of removing outliers has been applied[12].

Table 9 shows a set of variables applied to the aforementioned model with the synthetic definitions, as well as their potential impact on obtaining subsidies for agricultural development[13]. Also, the hypothetical, expected sign of the parameter of the variable has been provided. The statistical description of the proposed variables to the probit model has been shown in Table A1 in Annex.

Table 8 summarises the list of independent variables, which may be potential determinants of obtaining subsidies for agricultural development.

Table 8

Variables applied to the probit model

Variable	Definition	Impact of the variable on receiving subsidies for agricultural development	Expected sign of the parameter of the variable
FADN A, B, C, D	Location of the farm in one of macroregions (binary variable): A – Pomorze and Mazury, B – Wielkopolska and Śląsk, C – Mazowsze and Podlasie, D – Małopolska and Pogórze	Location in the given region could have a hypothetical positive and statistically significant impact.	+/-
RENT_AREA_TOTAL_RENT	Share of rented utilised agricultural area in total utilised agricultural area [%]	The impact of this variable can be both positive and negative.	+/-
WBG	Soil valuation index [-]	The higher is the WBG, the higher is the farm productivity, which can translate into the financial efficiency of that entity.	+
CROP	Specialisation in the crop production, if the farm was classified into one of the crop production types (binary variable)	Farms specialised in the crop production are characterised by the highest rate of return, although the risk associated with this production reduces the stability of achieved income.	+
LIVESTOCK	Specialisation in the livestock production, as above.	Farms specialised in the livestock production are characterised by the lowest rate of return.	-
MIXED	Mixed production (type TF8 8 – mixed)	Diversification of production can have a significant impact on the increased needs to replace fixed assets of the farm.	+/-

[12] Outliers are objects whose values of variables exceeded the range (Q_1–3IQR, Q_3+3IQR), where Q_n – n-th quartile, IQR – interquartile range.

[13] Correlation analysis confirmed the significance of dependencies between received subsidies for agricultural development and the postulated set of variables. This justifies a need to include them as exogenous variables in the econometric model.

Table 8 (cont.)

HHI_crop	Herfindahl-Hirschman Index (HHI), Herfindahl index created from different branches of the crop production	Diversification of crop production can be associated with a need to make replacement and modernisation investments.	+
LOG_ES	Decimal logarithm of economic size (SE005)	The greater is the economic scale, the greater are the needs related to financing the farm development	+
CH_EQ	Change in the level of equity (1 – if the increase compared to 2014, 0-i	Increasing the level of equity is beneficial from the point of view of assessing the development potential of the farm.	+
AV_FIN_LIQ	Current liquidity in annual average terms [times]	Liquidity problems are disrupting the development processes of the farm.	+
SKL_UB	Use of crop and/or livestock insurance (1 – paid insurance premium, 0 – the farmer does not use insurance)	The use of insurance coverage may hypothetically affect receiving development subsidies.	+
ROA	Return on assets [%]	The higher is the rate of return of the farm, the greater are the related expectations of the manager	+
ROE	Return on equity [%]	As above	+
DTA	Debt-to-assets [%]	The greater financial risk reduces the probability of receiving development subsidies.	-
DTE	Debt-to-equity [%]	As above.	-
AGR_BACK	Agricultural education of the farm manager (binary variable)	Agricultural education determines the professionalisation of management processes, and also affects the acquisition of financing sources.	+
HIGHER_BACK	Higher education of the manager (binary variable)	The higher education has the farmer, the greater is the level of using subsidy support.	+

Explanation: definitions of ROA, ROE, DtA and DtE – based on the FADN „Individual Report".
Source: own study based on literature studies.

The results of estimating the parameters of the final model describing the impact of the selected determinants on the probability of obtaining development subsidies by the farms, are presented in Table 9. Analysing the results of estimating the parameters of the model of the probability to obtain the above subsidies by these entities points to the statistical significance amounting to 1% for as many as 6 variables (ROA, FADN B, AGE, LOG_ES, CH_EQ and AV_FIN_LIQ). The parameter estimation results, presented in Table 9, allow to state only the direction and significance of the impact of the individual determinants[14]. It should be stressed that two out of four variables regarding the

[14] Determining in the quantified way the impact of these factors would also require providing marginal effects also for independent variables. In addition, it should be noted that in microeconometric models used in empirical finance, usually leaving irrelevant variables in

location of the farms proved to be statistically significant, and the FADN B macro-region (Wielkopolska and Pomorze) proved to be significant at the level of 1%. This is due to the fact that the institutional environment, high level of social capital and historical conditions affect the development potential of the family farms[15]. The results of estimating the model confirmed quite unambiguously the positive impact of the farm manager's age, however, this correlation should be examined also in a more in-depth way[16].

The initial assumption regarding the direction of the impact of the farm specialisation in crop production has not been confirmed, which resulted from the specificity of selecting the sample to build the econometric model. It is worth adding that the total debt-to-assets ratio proved to be a statistically significant determinant of the probability to obtain analysed subsidies[17]. With the increase in the economic size, it was easier for the farms to obtain support instruments under the second pillar of the CAP. It should be noted, however, that the relatively complex eligibility criteria related to preparing a simplified business plan, discouraged farms with the lower economic size. Attention should

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the model (at the expense of the lower accuracy of estimating the model parameters) is more favourable than ignoring statistically significant variables. Cf. M. Gruszczyński, *Mikroekonometria. Modele i metody analizy danych indywidualnych*, Wolters Kluwer Polska, Warszawa 2012.

[15] W. Czubak, A. Sadowski, *Wpływ modernizacji wspieranych funduszami UE na zmiany sytuacji majątkowej w gospodarstwach rolnych w Polsce*, Journal of Agribusiness and Rural Development, 2014, 2(32), pp. 45-57; W. Czubak, *Wykorzystanie funduszy Unii Europejskiej wspierających inwestycje w gospodarstwach rolnych*, „Journal of Agribusiness and Rural Development", 2012, 3(25), pp. 57-67.

[16] Cf. E.L. LaDue, L.H. Miller, J.H. Kwiatkowski, *Factors Influencing Farm Investment Behavior*, Proceedings of Regional Research Committee NC-161, Financing Agriculture in a Changing Environment: Macro, Market, Policy And Management Issues, Mclean, Virginia, October 4-5, 1988.

[17] R. Kata stressed the importance of behavioural factors, which affect credit decisions of farmers. Access to external financing affects the farmers' investment activity. This financier identified a set of behavioural factors, inter alia, „attitude to risk, knowledge and skills (e.g., on risk assessment, investment cost-benefit analysis), trust, experience in using financial instruments, satisfaction with professional status, openness to change, openness to cooperation (with the institutional environment, including banks)". His empirical studies confirmed that those behavioural factors, in addition to demographic characteristics related to the farm manager, were of essential importance in shaping the farmers' decisions in the credit market. R. Kata, *Czynniki behawioralne i demograficzne wpływające na korzystanie przez rolników z kredytów inwestycyjnych*, „Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie – Ekonomika i Organizacja Gospodarki Żywnościowej", 2013, No.103, pp. 53-65.

be paid to the model adjustment indicators[18] (Table 9). Generally, McFadden R^2 was not too high (15.8%), which, however, is typical of models based on economic and financial variables, based only on observations from one reporting period.

Table 9

Results of estimating the parameters of the model of the probability of obtaining subsidies for agricultural development by the family farms

Variable	Parameter estimation	Standard error	z-statistics	Significance level	Graphical determination of significance
CONST	**4.5700**	**0,5290**	**8,6390**	**0,0000**	***
FADN A	0.1412	0,1347	1,0490	0,2944	
FADN B	**0.3383**	**0,1201**	**2,8170**	**0,0048**	***
FADN C	0.3070	0,1218	2,5200	0,0117	**
RENT_AREA_TOTALRENT	0.0143	0,1134	0,1259	0,8998	
ROA	**0.0408**	**0,0061**	**6,6570**	**0,0000**	***
CROP	0.0803	0,0720	1,1150	0,2650	
LIVESTOCK	0.1565	0,0721	2,1690	0,0301	**
AGE	**0.0155**	**0,0029**	**5,3270**	**0,0000**	***
AGR_BACKGR	0.1342	0,0598	2,2430	0,0249	**
HIGHER_BACK	0.0731	0,0825	0,8864	0,3754	
HHICROP	0.0006	0,0002	2,4070	0,0161	**
WBG	0.0136	0,0903	0,1505	0,8803	
LOG_ES	**0.5830**	**0,1072**	**5,4370**	**0,0000**	***
CH_EQ	**1.0940**	**0,0669**	**16,3500**	**0,0000**	***
AV_FIN_LIQ	0.0008	0,0004	2,1450	0,0319	**
DtA	**0.0110**	**0,0022**	**4,9410**	**0,0000**	***
Statistics				**Value**	
McFadden R^2 [%]					15.78
Logarithm of likelihood					-1321.912
Schwarz criterion					2789.981
Corrected R^2 [%]					14.69
Akaike criterion					2677.8240
Hannan-Quinn criterion					2716.9740

Source: own research based on FADN data.

3.4. Estimating the impact of subsidies for agricultural development on the economy of the family farms

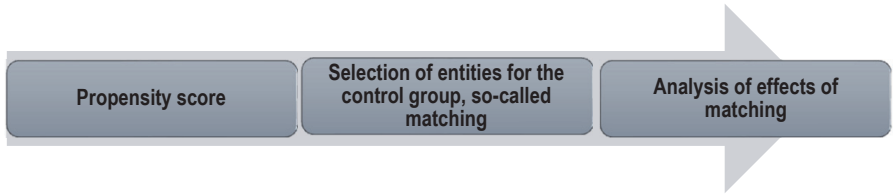
An important area of using quantitative analyses at the micro level is the effectiveness of measures taken by public institutions. This applies in particular to forms of support, including investment support. Usually, such measures are addressed to specific groups of recipients due to the eligibility of instruments and self-selection or selection of the sample.

[18] The final model was the best iteration of several iterations in the adopted estimation procedure, in which it was sought to achieve the maximum of the likelihood logarithm.

The PSM method, built on a basis of logit model[19] or probit model[20], consists of three stages, presented in Fig. 1 and described below.

Figure 1

Stages of the PSM method



Source: J. Kulawik (ed.), Assessment of the functioning of the Act of 7 July 2005 on crop and livestock insurance, Report for the MARD, IAFE-NRI, Warsaw, 2017, p. 112.

Each farm receiving subsidies for agricultural development must be assigned at least one, as similar as possible, entity from the group not participating in it (farms not receiving this kind of support instruments). The similarity is expressed in categories of the probability of participating in the event, estimated based on observable characteristics of individual entities (farms). The selected farms are a part of the control group, whose results can be compared with the results observed in the group of entities participating in the event. The starting point for using the PSM method is to verify the availability of the relevant data. Here, attention should be paid to the following issues:

1. Independence of variable X determining the independence of variable Y (Conditional Independence Assumption).
2. Size of the intervention group and of the control pool.
3. Unity of time.
4. Standardisation of the data collection method.

After the initial determination of the catalogue of variables, we should estimate the *propensity score* value. At this point, we need to decide what model of estimation we should use. There are various methods to estimate *P (Xi)*, but in the literature the logit or probit models are usually indicated – with the

[19] P. Strawiński, *Propensity Score Matching. Własności małopróbkowe*, Wyd. UW, Warszawa 2014.

[20] Logit and probit models differ in terms of the distribution of the random element (logit – normal, probit – logistic), but give similar results. The detailed specification of these models can be found in papers by P. Strawiński, W. Pan and H. Bai, S. Morgan and H. Winship, Cf. W. Pan, H. Bai, *Propensity Score Analysis*, The Guilford Press, New York 2015; S.L. Morgan, C. Winship, *Counterfactuals and Causal Inference*, Cambridge University Press, New York 2015.

advantage of the former. Caliendo and Kopeinig[21] note that in a situation where the dependent variable is dichotomous (participation or no participation), then both models give similar results. Selecting the method to estimate the *propensity score* value may, however, be more difficult when the predicted event is a multiple treatment case, that is, when the entity may select between more than two possibilities (participate or not). In this situation, we should use the so--called polynomial logit model or polynomial probit model. The former needs stronger assumptions, therefore, sometimes it is recommended to use the probit model.

The third, indirect way is **to use the multiple logistic regression models**. In this situation, we create successively regression models taking into account all options faced by the entity (farm). However, this approach has two disadvantages:

1) with the increase in the number of possible options, from among of which the entity can select, the number of models to estimate is growing disproportionately;
2) in each models only two options are being considered at once, so the probability of participation in one of two selected groups is estimated, despite the fact that there are more groups in total – therefore, there is no holistic approach to the assessment of interventions.

After assessing the *propensity score* value, we should choose the appropriate technique to select the entities from the control pool to the control group. To do this, we can apply at least several approaches expressed in practice by different algorithms of matching entities. In practice, prior to the matching procedure we should make the following three decisions:

1) either to carry out matching with or without replacement, i.e., whether the used entity from the control pool should be included in this pool again;
2) how many control entities are to be per one beneficiary, and finally;
3) what matching method to use[22].

It must be verified whether the use of the above procedure allowed to obtain the balanced distributions of variables included in the model in the experimental group and in the control group. In general, we should compare

[21] M. Caliendo, S. Kopeinig, *Some Practical Guidance for the Implementation of Propensity Score Matching*, German Institute for Economic Research IZA, Berlin 2005.
[22] A. Pawłowska, W. Rembisz, *Ewaluacja polityki rolnej za pomocą metody łączenia danych według prawdopodobieństwa*, XLVI KZM, Zakopane 2017. https://www.impan.pl/~zakopane/46/Pawlowska.pdf

the situation from before matching to the situation achieved with the use of the selected algorithm of selecting the control group. Therefore, we firstly compare the experimental group with the entire control pool, i.e. with the entire available group of entities which do not participate in the assessed activity. Then, we should compare the intervention group with the selected control group. The „essence" is the degree of minimising the initial differences between the entities in the control pool and the entities in the experimental group. If the differences between both groups are significant, we should return to the previous stages of using the PSM method. This can be, for example, going to the stage of selecting the matching algorithm or even of estimating the *propensity score*[23].

The pioneers of these studies are the Austrians, who used the PSM non--parametric method to estimate the effects of LFA payments in the years 2000--2005 in a sample of German farms[24].

The studies were carried out in the sample of:

1. Family farms in total: n=4,504;
2. Family farms, type – field crops: n=1,375;
3. Family farms, type – granivores: n=307;
4. Family farms, type – mixed: n = 1,541.

To elaborate the results, the binomial logit model and the PSM method were used. The means and standard deviations for the variables have been shown in Table 10.

Table 10

Mean and standard deviation of the quantitative variables for the empirical sample

Variables	Mean	SD
Total output (PLN)	251 684,41	430 910,34
Area of agricultural land (ha)	38,81	45,52
Total output per 1 ha of agricultural land (PLN per ha)	15 262,24	108 476,98
Crop production per 1 ha (PLN /ha)	12 667,54	166 474,38
Off-farm income (PLN)	2 859,13	11 141,23
Net farm income (PLN)	82 560,04	144 945,56
Average annual value of long-term loans (PLN)	91 849,39	286 341,65
Average annual value of short-term loans (PLN)	4 415,29	31 146,73

Note: above descriptive statistics refer to the total empirical sample used in the PSM method.
Source: own research based on FADN data.

[23] A. Pawłowska, M. Bocian, *Estymacja wpływu polityki rolnej na wydajność pracy z wykorzystaniem propensity score matching*, p. 60; J. Kulawik (ed.) *Assessment of the functioning of the Act of 7 July 2005 on crop and livestock insurance, Report for the MARD, IAFE-NRI, Warsaw, 2017, p. 111.*

[24] Cf. A. Pufahl, C.R. Weiss, *Evaluating the effects of farm programs: results from propensity score matching*, 12 Congress of the European Association of Agricultural Economists – EAAE 2008.

The results of estimating using the PSM method in the sample and subsamples (2015) depending on the type of the farm have been presented in Table 11. Analyses have been presented to the sample in total and for three production groups (field crops, granivores and mixed).

Table 11

Differences in the levels of the variables between the experimental group and the control group for the selected production types

Variables	Total sample	Field crops	Granivores	Mixed
Total output (PLN)	65 174,00	65 010,00	403 711,00	60 006,00
Area of agricultural land (ha)	0,49	7,11	9,92	8,24
Total output per 1 ha of agricultural land (PLN/ha)	14 076,00	775,35	90 123,00	1 337,20
Crop production per 1 ha (PLN/ha)	6 267,60	810,87	-474,04	311,46
Off-farm income (PLN)	-771,74	584,38	5 332,50	-642,18
Net farm income (PLN)	594,37	18 849,00	56734,00	8 646,30
Average annual value of long-term loans (PLN)	18 495,00	43 636,00	-101 069,00	68 875,00
Average annual value of short-term loans (PLN)	820,26	6 128,10	12 698,00	1 075,50

Source: own research.

In the group of the farms which received investment subsidies, i.e., in the experimental group, the average size of the total production was by PLN 65,174 higher than in the control group (Table 11). This result was not statistically significant. In the case of utilised agricultural area, the average size of the area was by 0.49 ha higher in the experimental group than in the control group. However, this result was not statistically significant either. When it comes to the production per 1 ha of utilised agricultural area, its average size in the group of the farms receiving investment subsidies was by PLN 14,076/ha higher than in the control group. On the other hand, the average size of the crop production per 1 ha was by PLN 6,267.60/ha higher than in the experimental group than in the control group. Both results were not statistically significant. In the case of income, the situation was as follows: in the group of the farms which received investment subsidies, the average amount of non-farm income was by PLN 771.74 lower than in the control group, while the average amount of family farm was by PLN 594.37 higher. Both results were not statistically significant. In turn, when it comes to the annual average value of credits, the average value of long-term credits was by PLN 18,495 higher in the experimental group than in the control group, and of short-term credits – by PLN 820.26 higher. The results were statistically insignificant.

In the group of the farms which were dominated by field crops and received investment subsidies, i.e. in the experimental group, the average size of the total production was by PLN 65,010 higher than in the control group (Table 11). This result was statistically significant. In the case of utilised agricultural area, the average size of the area was by 7.11 ha higher in the experimental group than in the control group. However, this result was not statistically significant. When it comes to the production per 1 ha of utilised agricultural area, the average size in the group of the farms receiving investment subsidies was by PLN 775.35/ha higher than in the control group. On the other hand, the average size of the crop production per 1 ha was by PLN 810.87/ha higher in the experimental group than in the control group. The results were not statistically significant. In the case of income, the situation was as follows: in the group of the farms which received investment subsidies, the average amount of non-farm income was by PLN 584.38 higher than in the control group, while the average amount of family farm was by PLN 18,849 higher. The second result was not statistically significant. In turn, when it comes to the annual average value of credits, the average value of long-term credits was by PLN 43,636 higher in the experimental group than in the control group, and of short-term credits – by PLN 6,128.10 higher. The first result was statistically insignificant.

The results presented in Table 11 show that in the group of the farms which were dominated by granivores and received investment subsidies, i.e. in the experimental group, the average size of the total production was by PLN 403,711 higher than in the control group. In the case of utilised agricultural area, the average size of the area was by 9.92 ha higher in the experimental group than in the control group. When it comes to the production per 1 ha of utilised agricultural area, its average size in the group of the farms receiving investment subsidies was by PLN 90,123/ha higher than in the control group. On the other hand, the average size of the crop production per 1 ha was by PLN 474.04/ha lower in the experimental group than in the control group. In the case of income, the situation was as follows: in the group of the farms which received investment subsidies, the average amount of non-farm income was by PLN 5,332.50 higher than in the control group, while the average amount of family farm was by PLN 56,734 higher. In turn, when it comes to the annual average value of credits, the average value of long-term credits was by PLN 101,069 lower in the experimental group than in the control group, and of short-term credits – by PLN 12,698 higher. All results were statistically insignificant.

In the group of the mixed farms which received investment subsidies, i.e. in the experimental group, the average size of the total production was by PLN 60,006 higher than in the control group (Table 11). This result was statistically insignificant. In the case of utilised agricultural area, the average size of the area was by 8.24 ha higher in the experimental group than in the control group. However, this result was not statistically significant either. When it comes to the production per 1 ha of utilised agricultural area, the average size in the group of the farms receiving investment subsidies was by PLN 1,337.20/ha higher than in the control group. On the other hand, the average size of the crop production per 1 ha was by PLN 311.46/ha higher in the experimental group than in the control group. The results were statistically significant. In the case of income, the situation was as follows: in the group of the farms which received investment subsidies, the average amount of non-farm income was by PLN 642.18 lower than in the control group, while the average amount of family farm was by PLN 8,646.30 higher. Both results were statistically significant. In turn, when it comes to the annual average value of credits, the average value of long-term credits was by PLN 68,875 higher in the experimental group than in the control group, and of short-term credits – by PLN 1,075.50 higher. The first result was then statistically insignificant.

3.5. Summary

The farms benefiting from subsidies for agricultural development were described by the definitely larger agricultural area. The significantly higher rate of return of the farms using investment, modernisation or restructuring subsidies may result from a lot of determinants, among which we cannot ignore socio--demographic features or production characteristics.

Empirical studies have proved that with the increasing economic size, the level of current liquidity, equity, age of a farm operator and the probability of receiving subsidies increased. Further studies (including the longer time interval, using the binary panel models) should identify dynamic relationships in the more in-depth way. The results of the aforesaid studies could be a basis for any potential changes in the eligibility criteria, made during the mid-term overviews of the RDP. The results of analysing the impact of subsidies for agricultural development showed that subsidies for agricultural development had a significant positive impact on the total production. They also contribute to the increase in the average debt level, in particular long-term. Therefore, it may be important to build support instruments in such a way so as not to lead to overinvesting and excessive leverage of the farm, as farm income grows more

slowly than the production and debt. The effects of operating leverage were declining. Support for investments turned out to be the most effective for the farms specializing in granivores and the least effective for mixed and field crops.

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APPENDIX

Table A1

Descriptive statistics for a sample used for probit model

Variables	Average	Median	SD	Min.	Max.
Dependent variables					
DOT_INW	0,085	0,000	0,278	0,000	1,000
Binary indepenedent variables					
SKL_UBEZP	0,272	0,000	0,445	0,000	1,000
FADNA	0,171	0,000	0,376	0,000	1,000
FADNB	0,410	0,000	0,492	0,000	1,000
FADNC	0,333	0,000	0,471	0,000	1,000
FADND	0,087	0,000	0,282	0,000	1,000
RENT_AREA_TOTAL_RENT	0,260	0,220	0,243	0,000	1,000
GENDER	0,110	0,000	0,313	0,000	1,000
CROP	0,358	0,000	0,479	0,000	1,000
LIVESTOCK	0,363	0,000	0,481	0,000	1,000
MIXED	0,279	0,000	0,449	0,000	1,000
AGR_BACKGR	0,652	1,000	0,477	0,000	1,000
HIGHER_BACK	0,116	0,000	0,320	0,000	1,000
ORGANIC_FARMING	0,015	0,000	0,123	0,000	1,000
LFA	0,542	1,000	0,498	0,000	1,000
CH_EQ	0,471	0,000	0,499	0,000	1,000
Independent, continous variables					
TOTAL_UAA	50,000	36,300	50,500	0,080	703,000
ROA	0,964	0,720	7,740	-35,500	328,000
ROE	1,410	0,790	16,200	-52,100	1 030,000
DtA	10,900	7,480	11,100	0,000	111,000
DtE	14,800	8,080	28,400	-1 020,000	570,000
AGE	44,800	45,000	9,660	19,000	82,000
HHICROP	75,900	4,000	1 620,000	0,000	110 000,000
WBG	0,858	0,860	0,345	0,050	1,840
SUBS_AGR_OUT	0,306	0,240	0,441	-11,400	11,300
LOG_ES	4,770	4,770	0,322	3,720	6,150
LG_AV_EQ	5,850	5,860	0,335	4,380	7,100
AV_FIN_LIQ	9,820	4,760	43,200	0,000	1 850,000

Source: own research based on FADN data.

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4. Increase of the production in the farms and its impact on the level of the operational and strategic risk

4.1. Introduction

Managing a farm, like any other economic activity, is exposed to many types of risk. Traditionally, as characteristic of the agricultural production we should consider production risk resulting mainly from the biological nature of the production, which depends largely on factors beyond control of the producer[1], *inter alia*, weather factors, crop status and healthy growth of animals.

In the literature, there are many studies describing the individual risk categories occurring generally in the economic activity[2] and in relation to the specificities of the farms[3].

Despite some differences in risk categorisation, we can identify the most common types of risk in relation to the farms. In addition to production risk, often mentioned due to the special nature of the agricultural production, just like in other sectors of the economy there is also price risk, financial, property or personal risk[4]. In addition, frequent CAP reforms and growing uncertainty regarding to its future shape, create the additional institutional risk for future

[1] M. Jerzak, *Podstawowe zagadnienia ryzyka w gospodarce rolnej* [in:] „Ekonomiczne uwarunkowania wykorzystania rynkowych narzędzi stabilizacji cen i zarzadzania ryzykiem w rolnictwie" (ed. Jerzak M.A., Czyżewski A.) Wydawnictwo Akademii Rolniczej im. Augusta Cieszkowskiego w Poznaniu, Poznań 2006.

[2] M. Thlon, *Charakterystyka i klasyfikacja ryzyka w działalności gospodarczej*, „Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie", 2013, nr 902, s. 57-67.

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agricultural income. The studies on this issue have been the subject of attention as part of the work carried out under the Multi-Annual Programme 2011-14[5].

It should be noted, however, that such aspect of the division of risk sources on the farms may not be sufficient in general. An alternative perspective of the risk taxonomy in agriculture is presented by Miller et al.[6] by proposing, in the first place, the division of risk into operational and strategic. Operational risk is defined by Miller and co-authors in a traditional way, whereby as part of operational risk he identifies business risk – in all farms, regardless of the way of financing the activity, as well as financial risk associated with financing the farm. He also indicates the fact of using a leverage results in multiplying the impact of business risk on financial results.

Unlike other authors, Miller et al. point to the importance of strategic risk. By specifying strategic risk, he indicates that it concerns primarily the choice of a management strategy and its translation into the value of the farm in a long term with respect to uncertainty related to the changes in the economic situation. In particular, this applies to political changes, changes in macroeconomic connotations, social and natural factors, but, more importantly, also changes in the markets of raw materials and products, changes in technology translating into changes in the dynamics of the entire sector, and thus into the level of competition among the farms.

When analysing the proposed division, we may notice that some strategic risk factors, although exogenous from the point of view of individual farms, are endogenous from the point of view of the sector. Farmers' decisions on the farms' development i.e. making investments, introducing new technologies, establishing cooperation with processors or commercial networks, increasing the scale of activity lead to changes in the level of competition within the sector, and thus may translate into the higher risk of achieving unsatisfactory financial results or even being thrown out of the market for individual players.

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[5] *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (sc. ed. J. Kulawik), „Program Wieloletni 2011-2014", nr 20, IERiGŻ-PIB, Warszawa 2011; *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (sc. ed. J. Kulawik), „Program Wieloletni 2011-2014", nr 46, IERiGŻ-PIB, Warszawa 2012; „Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych" (sc. ed. J. Kulawik), *Program Wieloletni 2011-2014", nr 82, IERiGŻ-PIB, Warszawa 2013; „Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (sc. ed. J. Kulawik), „Program Wieloletni 2011-2014", nr 120, IERiGŻ-PIB, Warszawa 2014.

[6] A. Miller, C. Dobbins, J. Pritchett, M. Boehlie, C. Ehmke, *Risk Management for Farmers. Department of Agricultural Economics*, Staff Paper 04-11, Purdue University 2004.

The approach to the risk analysis on the farms, presented by Miller *et al.* is not isolated. A similar division, but not taking into account the specificities of agriculture, can be found in the Polish literature[7]. The proper identification of risk sources is a basis for taking remedial measures aimed at reducing the occurrence of a given risk factor or at least at limiting its negative effects. With regard to operational risk, a number of instruments and measures are proposed to mitigate its effects. As methods of limiting production risk, we may mention the production diversification[8], application of production insurance[9] or investments in newer technologies reducing the effects of adverse weather conditions[10]. With respect to price risk, very often the authors of analyses devoted to this issue indicate opportunities arising from the use of financial instruments, *inter alia*, futures contracts, cooperation among the individual farms or strengthening cooperation among producers and customers[11]. The limitation in the use of the majority of the above-mentioned instruments in Poland is a relatively small scale of activity of farms[12],[13]. Also, we may notice that the studies carried out so far[14],[15] indicate risk of losses declining along with the increasing economic size. The faster and faster increase in the scale of the

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[7] J. Radomska, *Inkoherencja relacji pomiędzy ryzykiem strategicznym a operacyjnym w zarządzaniu strategicznym.* „Zarzadzanie strategiczne w teorii i praktyce", Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu 2016, r 444 p. 400-410.

[8] A. Kurdyś-Kujawska, *Significance of production diversification in ensuring financial security of farms in Poland*, "Journal of Agribusiness and Rural Development", 2(40) 2016.

[9] M.A.P.M. Van Asseldonk, E. Majewski, M.P.M., Meuwissen, W. Guba, G. Dalton, J. Landmesser, E. Berg, R.B.M. Huirne, *Economic impact of prospective risk management instruments under alternative policy scenarios*, [in:] "Income Stabilization in a Changing Agricultural Word: Policy and Tools", Wieś Jutra, Warszawa 2008.

[10] J. Kłoczko, A. Wąs, *Sposoby ograniczenia ryzyka dochodowego wynikającego z przymrozków wiosennych w sadach jabłoniowych*. „Roczniki Nauk Rolniczych", 2008, vol. 94, iss. 2 p. 164-171.

[11] M.P.M. Meuwissen, M.A.P.M. Van Asseldonk, R.B.M. Huirne, *Income Stabilisation in European Agriculture: Design and Economic Impact of Risk Management Tools*, Wageningen 2008.

[12] M.P.M. Meuwissen, E. Majewski, E.Berg, K. Poppe, R.B.M. Huirne, *Introduction to income stabilisation issues in a changing agricultural world* [in:] "Income Stabilization in a Changing Agricultural World: Policy and Tools", Wieś Jutra, Warszawa 2008.

[13] M.P.M Meuwissen,. *Income Stabilisation in European Agriculture*…op. cit.

[14] P. Sulewski, A. Wąs, *Gospodarstwa wielkoobszarowe w różnych scenariuszach uwarunkowań ekonomicznych w perspektywie roku 2013 - studium przypadku*, „Roczniki Nauk Rolniczych", Seria G; Ekonomika rolnictwa, 2008 vol. 95, iss. 1, p.76-84.

[15] A. Wąs, A. Malak Rawlikowska, *Policy impact on production structure and income risk on Polish dairy farms.* in: "The Common Agricultural Policy After the Fischler Reform" ed. S. Sevrini Ashgte 2011 p. 183-193.

farms' activity, resulting from, *inter alia*, technical progress, globalisation or rising labour costs can be considered at least as a rationale for limiting business risk[16]. It should be noted, however, that the increased scale of activity, especially when takes place in a short period of time and using external financing sources, increases financial risk. As a result, this may adversely affect the income situation of farms and enhance risk of losses.

In view of the above, an obvious dilemma arises. Increasing the economic size of the managed farm, in the light of existing studies, creates greater opportunities for limiting business and strategic risk. On the other hand, as a result of financing growth processes from external sources, additional financial risk is taken, resulting from the at least temporary use of external capital to finance the farm development, which should be considered as a risk increasing factor. The objective of this study is to identify the relationships between the processes of growth in the farms' activity and the level of risk in operational and strategic terms.

4.2. Methodological assumptions

The primary source of data for analysis is the farm accountancy data network – FADN. On a basis of individual data from the farms, a balanced panel[17] of the farms, present in the sample continuously for a period of 12 years from 2004 to 2015, has been created. To describe the income variation, typical descriptive statistics tools were used while to assess the income variation level the farm simulation model was applied using the Monte Carlo method[18]. As

[16] A. Wąs, S. Małażewska, *Przemiany strukturalne w rolnictwie w wybranych krajach europejskich.* „Roczniki Ekonomii Rolnictwa i Rozwoju Obszarów Wiejskich", 2012, vol. 99, iss. 4. p. 75-88; A. Wąs, *Modelowanie przemian strukturalnych w polskiego rolnictwa*, SGGW, Warszawa 2013; A. Wąs, P. Kobus, *Disparities in Polish Agriculture*, EAAE Congress 2017 Proceedings, Parma, Italy 2017.

[17] Balanced panel – „set of data in which for each of N units we have full data from N years", based on: *Models and methods of analysis of individual data - Modele i metody analizy danych indywidualnych* (aut. M. Bazyl, M. Książek, M. Owczarczuk, A. Szulc, A. Wiśniowski, B. Witkowski), Wolters Kluwer, 2012 p. 270.

[18] The Monte Carlo method is used for mathematical modelling of excessively complex processes (e.g. calculation of integrals, chains of statistical processes). Due to complexity of modelled processes it is not possible to predict their results by means of an analytical approach. The Monte Carlo stochastic simulation allows to include the stochastic nature of examined phenomena in analysis. Its essence is sampling of random variables from the specific distribution(s) which are then used to obtain a large number of solutions for the considered problem. In this way, after aggregating the results of individual samplings we obtain an empirical probability distribution which provides much information about the examined phe-

a result of the operation of the model, the probability distributions for agricultural income in the analysed farm groups have been estimated. The indicators of operational risk are the mean and standard deviation of income, probability of loss (agricultural income <0) or obtaining payment for unpaid labour at the specified level (minimum salary, average non-agricultural salary). Strategic risk has been defined qualitatively as a chance for the farm to survive or achieve satisfactory remuneration of labour in a longer term. It has been determined on a basis of comparing economic results in the groups of farms with the extremely different economic growth rate. Strategic risk may be understood in this aspect as a risk of losing the current competitive position in relation to other farms.

Observation of the processes of the economic size growth in the individual farms required gathering data illustrating changes taking place in them in a long term. For this reason, the studies assumed to identify, within the Polish FADN sample, a balanced panel of the individual farms present in the sample continuously from 2004 to 2015. Although the FADN sample size varies in the analysed period at the level of about 11-12 thousand farms, the adoption of a relatively long period of observation has led to selecting a panel covering 3,915 farms continuously present in the Polish FADN for 12 years.

The nature of changes taking place in the selected sample of the farms has been initially specified by applying the criterion of belonging to the economic size classes of the farms and production types. In order to eliminate economic size fluctuations arising from using in the FADN system different rates in different years to determine the economic size in all the analysed years, the standard output index based on the FADN typology of 2010 has been used.

Although a single sample of the farms continuously present in the FADN sample for 12 years was observed, it may be clearly demonstrated that the structure of the farms in the analysed panel was subject to constant changes (Figure 1).

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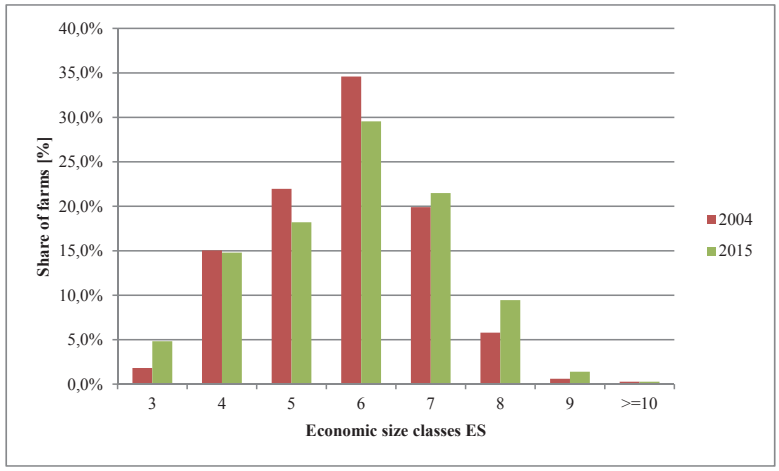
nomenon. It is assumed that this method was described for the first time by Metropolis and Ulam in 1949. N. Metropolis, S. Ulam, *The Monte Carlo Method*, „Journal of the American Statistical Association" 1949, Vol. 44, No. 247.

Figure 1

Structure of the farms in the balanced panel by economic size, in the years 2004 and 2015



Source: own calculations based on the FADN data.

In the chart, we can clearly see a significant (more than double) increase in the share of the smallest farms. This may attest to the progressive phasing out of the agricultural production on the smaller farms, which gradually transform into so-called "hobby farms". The general scale of this phenomenon is still small. In addition to the smallest farms, the share of the large farms is clearly growing. The rate of these changes is not as big as in the case of the smallest farms, however, their "specific gravity" is much larger, since even a small increase in the number of the large farms affects to a significant extent the changes in using production factors and production volume.

Table 1 shows in a more precise way the evolution of the farms in the analysed period by indicating the directions and scale of "migration" of the farms among the economic size classes.

It can be observed that in the analysed period, only slightly more than half of the farms maintained their original economic size. The particularly large scale of migration applies to the farms which in 2004 had a small economic size. A specific phenomenon is a significant scale of reducing the economic size among the largest farms. About 25% of them limited the production volume measured by the standard output.

Table 1

Scale of changes in the farms by economic size classes, in the balanced panel in the years 2004-2015 [number of the farms in the given economic size class in 2004 = 100]

Economic size [ES]		Year 2015								Total
		3	4	5	6	7	8	9	>=10	
Year 2004	3	**57,75**	23,94	12,68	1,41	1,41	2,82			71
	4	18,17	**53,48**	19,19	5,94	2,89	0,34			589
	5	3,60	22,56	**40,81**	29,77	2,91	0,23		0,12	860
	6	0,59	3,55	16,62	**53,18**	23,26	2,58	0,22		1354
	7	0,13	0,64	1,67	18,23	**56,48**	21,95	0,90		779
	8	0,44		0,88	1,32	18,50	**66,96**	11,45	0,44	227
	9					4,17	25,00	**66,67**	4,17	24
	>=10							27,27	**72,73**	11
Total		189	579	713	1157	841	370	55	11	3915

Source: own calculations based on the FADN data.

It can be observed that in the analysed period, only slightly more than half of the farms maintained their original economic size. The particularly large scale of migration applies to the farms which in 2004 had a small economic size. A specific phenomenon is a significant scale of reducing the economic size among the largest farms. About 25% of them limited the production volume measured by the standard output.

In addition, in order to illustrate the transformations taking place in the selected sample of 3,915 farms in terms of the production types, in the same manner changes in the structure of production types in the 2004-2015 have been indicated. For classifying the production types, the GTF classifications have been used.

We may notice that the vast majority of the farms belonging to the TF1--TF4 types in 2015 maintained the production type of 2004. On the other hand, a significant part of the farms belonging to the TF5-TF8 types changed their production structure. Only less than 27% of the farms classified in 2004 as the TF7 type in 2015 were classified as this type again. Other farms either became specialised in the cattle production (more than 39% – TF4) or got diversified towards mixed farms (23% – TF 8). Strong specialisation processes can be seen also in the mixed crop farms (TF6) where only 36% in 2015 had the same type as in 2004, while more than half became specialised in the cultivation of trees and shrubs, field crops or horticultural plants (TF 3 – 30%, TF 1 – 17%, TF 2 – 10%).

Table 2

Scale of changes in the farms by production types, in the balanced panel in the years 2004--2015 [number of the farms in the given economic size class in 2004 = 100]

Production type [TF8]		Year 2015								Total
		TF1	TF2	TF3	TF4	TF5	TF6	TF7	TF8	
Year 2004	TF 1*	88,22	1,41	1,41	0,70	0,70	1,58		5,98	569
	TF 2	1,10	86,81	1,10			9,89		1,10	91
	TF 3			95,56			4,44			90
	TF 4	2,21			91,76			0,88	5,15	680
	TF 5	7,60	0,30			59,27	0,61	7,60	24,62	329
	TF 6	17,72	10,13	30,38			36,71	1,27	3,80	79
	TF 7	4,66			39,23	6,45	0,14	26,47	23,05	729
	TF 8	27,45	0,82	0,89	9,05	5,93	1,48	6,08	48,29	1348
Total		961	107	131	1036	326	74	307	973	3915

Explanation: *TF1 – Field crops, TF2 – Horticulture, TF3 – Permanent crops, TF4 – Cattle farms, TF5 – Granivores, TF6 – Mixed crops, TF7 – Mixed animals, TF8 – Mixed activities.
Source: own calculations based on the FADN data.

Taking into account these changes in the structure of the farms in the panel, it should be pointed out that the results of the studies cannot be easily generalised. Due to changes in the panel structure in relation to the production types and economic size classes, as well as changes in FADN general population structure, it should be stressed that the selected farm panel does not constitute a representative sample of the farms for any specifically defined population of the farms (Table 3).

Table 3

Number of farms represented by the balanced panel selected for studies against a background of the individual farm population represented by the Polish FADN

Year	Number of the represented by the balanced panel 2004-2015*	Number of individual farms represented by the FADN population*	Share of farms represented by the panel in the FADN population
2004	235772	744167	32%
2005	215655	743724	29%
2006	208869	743558	28%
2007	192456	751840	26%
2008	201470	751516	27%
2009	213317	751518	28%
2010	237296	735634	32%
2011	244772	735530	33%
2012	255127	735486	35%
2013	220322	728065	30%
2014	226478	728330	31%
2015	228420	728229	31%

Explanation: * calculation based on the SYS 02 variable.
Source: own calculations based on the FADN data.

In the analysed period, the farms from the balanced panel represented, depending on the adopted year, 26 to 35% of the farms. Therefore, although the sample covers the group of the same farms present in the FADN sample for 12 years, we cannot clearly indicate the size of the population of the farms it represents. This arises from both changes in the farms that result in assigning them, in subsequent years, to various production types and economic size classes of farms, as well as from changes in the way of selecting the FADN sample and, consequently, changes in weights (SYS_02) specifying the number of the farms represented by the individual farms from the sample.

Although the results of analyses point to changes taking place among the analysed farms, they cannot be generalised to the FADN populations, or to the whole farm sector in Poland.

In order to examine the impact of production growth processes on income risk, the farms gathered in the income panel have been divided into 2 groups by applying the economic size criterion and the growth rate of this size.

For the most precise determination of the economic size of the analysed farms, it was decided to resign from the usually applied economic size specified according to the FADN typology by standard output (SO) criterion for the benefit of the actual value of production produced in the individual farms. In order to classify the farms by classes used in the FADN typology, the actual value of agricultural production achieved by individual farms (average for the years 2004-2006) has been converted into EUR according to the SO coefficient exchange rate of 2010[19]. The obtained values of agricultural production were used to divide the farms by adopting the values of intervals analogous as in the FADN typology:

- Small farms (EUR 4,000-15,000),
- Medium farms (EUR 15,000-50,000),
- Large farms (EUR 50,000-100,000),
- Very large farms (more than EUR 100,000).

To identify the groups of the farms characterised by the high growth rate within the individual economic size classes, the relative increase in the production has been determined for all farms in the panel in the analysed period. As the baseline value, the average value of agricultural production for the years 2004-06 has been adopted, while as the final value – the average for the years 2013-15.

[19] M. Bocian, I. Cholewa, R. Tarasiuk, *Współczynniki Standardowej Produkcji „2010" dla celów Wspólnotowej Typologii Gospodarstw Rolnych* IERiGŻ, Warszawa 2014.

As the criterion of identifying the group of the farms characterised by rapid growth processes, which has been given the working name „development", the value of the relative increase in the production value exceeding the 3rd quartile in the given economic size class has been adopted, while the farms whose relative increase in the production was below the 1st quartile in each economic size have been selected as the reference group and given the working name „stagnation".

In total, 8 groups of the farms have been identified. The number of the farms in the individual economic size classes and the threshold values of the relative production increase are presented in Table 4.

Table 4

Size and characteristics of the individual groups of the farms by economic size classes

Economic size 2004-2006 by production value [EUR 2010]	The total number of farms in the panel	Number of farms in the "development" group	Number of farms in the "stagnation" group	Average production increase [%]* (average 2013-15 / average 2004-06)		
				I quartile	III quartile	Average *
Small (under 15 th. EUR)	1029	257	257	107,3	176,4	157,7
Medium (15-50 th. EUR)	2039	510	510	116,6	193,2	164,8
Large (50-100 th. EUR)	616	154	154	128,7	211,9	178,0
Very large (more than 100 th. EUR)	231	58	58	132,1	223,3	183,9
Total	3915	979	979	116,5	194,4	166,1

Explanation: * average value of dynamics indices for farms within a given group.
Source: own calculations based on the FADN data.

For such identified groups of the farms, the basic economic indices have been calculated, respectively, for the beginning and for the end of the analysed period as well as their increase over this period. Just like in the case of the production volume, the baseline values adopted for comparison purposes were the averages of the years 2004-06 and the analysed values – the averages of the years 2013-15.

For the entire panel and for the individual groups of the farms the following have been analysed: changes in the production volume, structure of inputs and level and structure of assets and liabilities as well as family farm income.

In order to determine the full range of the agricultural income variation in the analysed groups of the farms, a simulation model has been built, allowing to determine the expected probability distribution for agricultural income based on

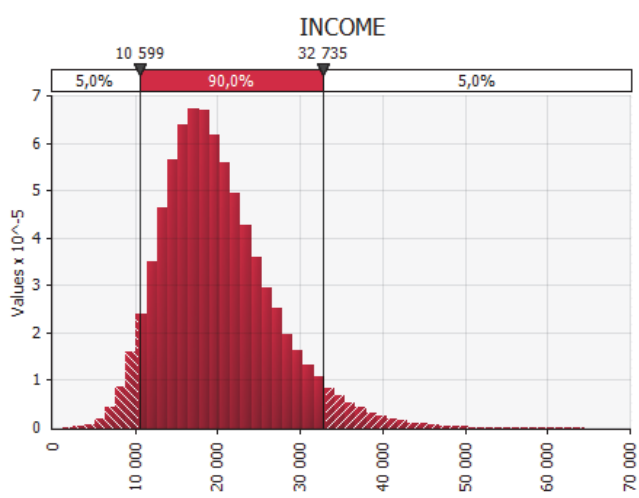
the introduced input parameters. Analysis of the model results (probability distribution for agricultural income) allowed to define operational risk, in the individual groups of the farms, understood as a possibility of obtaining unsatisfactory financial results in a single year and strategic risk, defined as a threat of permanent loss of the competitive position in relation to other farms.

4.3. Simulation model

The built farm simulation model uses the Monte Carlo method[20]. The primary function of the created model was to examine the income variation of the analysed farms. As a result of the operation of the model based on the stochastic probability distributions, defined for the individual variables, and their correlation, the input parameters have been drawn. Then, based on those parameters, the value of the P&L category – agricultural income has been determined (Fig. 2). This process was repeated many times to determine the variability of agricultural income specific to the farm type. In order to ensure the repeatability of obtained solutions, it has been assumed that the solutions will be generated based on 10,000 replications. This assumption guaranteed the repeatability of the generated solutions.

Figure 2

Exemplary result of the operation of the simulation model – probability distribution of obtaining the specific values of agricultural income



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 study.

[20] Cf. Footnote 18 of this chapter.

The model is static and does not make any endogenous changes in the production structure nor does it make any other adjustments, e.g. investments. The operation of the model is limited to determining the variability of the profit category i.e. agricultural income. The variables regarding the production structure are in this case exogenous, have been established based on the data from the individual farms from the FADN sample.

The farm simulation model used for analyses contains three essential elements:

I. Production value and production costs;
II. Variability of the basic parameters of the account;
III. Correlations among the model parameters.

To estimate the model parameters, the following methodological approaches have been used.

I. Production value and costs. As the average values for the individual types the following variables of the base model have been determined: agricultural production value, value of subsidies, individual total specific costs, overheads and costs of external factors, in particular, costs of labour and interest on credits.

II. Standard deviations for the model parameters. The variability of the model parameters has been expressed as the value of the average standard deviation estimated as the average of standard deviations for the individual model parameters. In order to exclude the parameter variability among the individual farms, the standard deviation has been calculated for all observations from each observed farm in the analysed period and then averaged as part of each observed group. This approach made it possible to capture the average parameter variability over time without differentiation among objects classified within each group.

The standard deviation has been used as one of the probability distribution parameters determining a potential range of variability of the model's input parameters. For the base model, the variability level in the analysed types of the farms, as established based on the data from the years 2010-2015, has been adopted. Due to the low number of observations for estimating the type of distribution using econometric methods, it was decided to adopt the assumptions that observed parameters have normal distribution. Also, the restrictions were introduced which prevented, during the simulation, taking negative values with respect to costs and revenues.

III. Correlations among the model parameters ensure a more realistic representation of the relationships among the individual variables and prevent generating the parameters which, in fact, do not take certain values due to the

level of other variables (e.g. obtaining high yields requires incurring appropriate inputs). Unlike the values for the individual model parameters, the correlations have been defined among all the observed parameters in all identified 8 groups of farms.

The result of the simulation model is a number of the agricultural income values achievable with the assumed variability of the input parameters and their correlations. For each analysed farm, as a result of the simulation model, 10,000 achievable agricultural income values have been obtained. Based on those results, basic statistical indicators have been calculated to describe the agricultural income variation: mean, standard deviation, coefficient of variation (quotient of the standard deviation and the mean) and the value of 5th to 95th percentile.

In addition, the probability of obtaining results exceeding the adopted threshold values has been estimated. The usual threshold value in this type of considerations is 0. Achieving lower income means loss, and the share in the simulation results exceeding zero is interpreted as the probability of achieving income higher than 0. As an additional threshold whose exceeding could mean the financial instability of the farm, the value of loss equal to the value of short--term financial assets in the closing balance sheet has been adopted. However, in the case of agricultural income, which does not include costs of unpaid labour and opportunity costs of engaged capital, but includes subsidies received by farmers, adopting the threshold value of 0 or lower would be purely theoretical as the probability of negative farm income is usually close to zero. Therefore, three additional threshold values, established individually for each analysed groups of the farms for individual economic sizes, have been adopted in the studies. The threshold values is the product of declared used unpaid labour resources and its potential salary determined at the level of the subsistence minimum (PLN 1,084.48/month[21] – June 2015), the minimum salary (PLN 1,750/month – for 2015[22]) and the average salary in the national economy (PLN 3,854/month – for the second quarter of 2015[23]).

[21] Instytut Pracy i Spraw Socjalnych, *Informacja o wysokości minimum socjalnego w czerwcu 2015 r.,* Warszawa, 15 września 2015.

[22] *Rozporządzenie Rady Ministrów z dnia 11 września 2014 r. w sprawie wysokości minimalnego wynagrodzenia za pracę w 2015 r*. Dz. U. poz. 1220, KPRM 2014.

[23] *Komunikat Prezesa Głównego Urzędu Statystycznego z dnia 11 sierpnia 2015 r.* w sprawie przeciętnego wynagrodzenia w drugim kwartale 2015 r., GUS 2015.

Growth processes in the analysed groups of the farms

The analysed groups of the farms have been selected based on the criterion of the production value growth rate. In accordance with the assumptions, the farms in both identified groups were in the base period (2004-06) of the similar economic size measured by the actual production level. In the case of the farms from the "development" group, this size was increasing in the subsequent years faster than in 3/4 of remaining farms in each economic size class. The "stagnation" group, used as the reference group, includes the farms with the lowest production growth rate. The relative increase in the production volume in the individual economic classes is shown in Table 5.

In the analysed period, we can observe a significant increase in the production value. It should be stressed, however, that it is partially due to inflation. Owing to this, much more important than the absolute increase in the observed production values are, in this case, the differences in the growth rate of the analysed values, occurring between the analysed groups of the farms. When considering the entire panel together, we can notice that the fastest production growth took place in the largest farms. This relationship is also confirmed in the group of the fastest developing farms. The farms from the "stagnation" group in nominal terms decreased their production volume. To the greatest extent, this applies to the smallest entities. It should be noted that even maintaining the production unchanged in nominal terms, which can be seen in the "stagnation" in the "large" farms means a significant decrease in its real value.

Table 5

Changes in the agricultural production value level in the analysed period, in the analysed groups of the farms, by economic size

Economic size of farms as of 2004-06	Change in the years 2004-2015 [2004=100]			The value of the characteristic in the group of „development" farms [group „stagnation" =100]	
	Total	„Development" group	„Stagnation" group	In years 2004-06	In years 2013-15
Small	157	262	86	100	302
Medium	168	266	90	112	332
Large	179	275	100	101	279
Very large	179	285	98	90	261
All*	173	274	95	101	292

Source: own study.

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the analysed values, occurring between the analysed groups of the farms. When considering the entire panel together, we can notice that the fastest production growth took place in the largest farms. This relationship is also confirmed in the group of the fastest developing farms. The farms from the "stagnation" group in nominal terms decreased their production volume. To the greatest extent, this applies to the smallest entities. It should be noted that even maintaining the production unchanged in nominal terms, which can be seen in the "stagnation" in the "large" farms means a significant decrease in its real value.

When analysing the relationship between the "development" and "stagnation" groups in the base period (2004-06) and the final period (2013-15) we can note that the large farms, which were characterised by the dynamic growth, had initially the slightly smaller production value than those which did not enter the path of the dynamic growth. Despite the fastest production growth rate (285%), in the very large farms this difference is visible also in the final period, in which the farms from the "development" group show the production at the level of 261% of the reference group, which is less than average for the entire "development" group. A similar effect can be seen in the fast-growing medium farms, which at the beginning of the period were slightly larger than the reference group farms.

Despite the similar average production growh rate in all identified economic size classes, in each group we could observe a slightly different distribution of the farms grouped by growth rate (Fig. 3). In the group, which in nominal terms decreased its production value, included the highest percentage (almost 20%) of the small farms. Almost half of the small farms showed the slower than average production growth rate, and were included in the group of the farms whose production growth rate was at the level of 100-150% of the baseline level. Despite the small initial production volume, only a low percentage of the small farms (4.2%) was able to increase the production more than three times. The large farms usually developed at a rate slightly higher than the average (63% of the farms in the group above 150% of the baseline level). The largest percentage of the large farms in the final period had the production nearly two times higher than the baseline level.

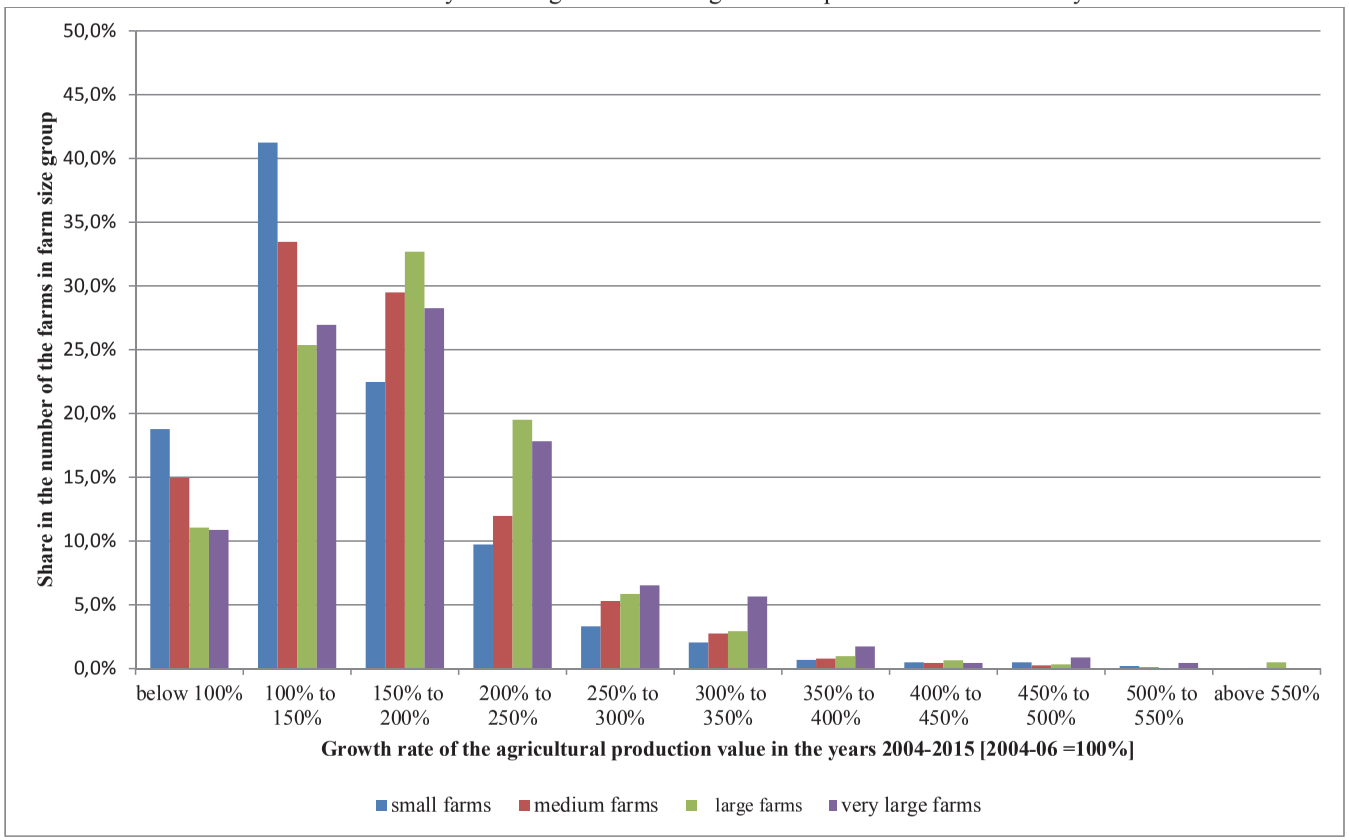
The largest farms are characterised by the most even distribution of the groups identified according to the growth rate. The smallest percentage of the entities from this group, as only 10%, decreased the scale of their production. Also, despite the significant initial size, those farms relatively often were classified into the groups which achieved the production value of even up to 3 times higher than in the base period.

These changes can attest to the progressive process of polarisation among the Polish farms. A significant part of the small farm owners did not decide to enter the path of the dynamic growth. On the other hand, we can indicate the largest farms, which although as early as in 2004 showed the significant production value, were able to increase it by three (7.4% of the farms), four (1.3% of the farms) or even five times (0.9% of the farms).

One of the basic production factors in the farms is land. Throughout the observed period, we can notice that the farms selected to the panel, on average, increased their area by less than 20% (Table 6). The farms from the "development" group increased the area of their land more than the average farms in the respective economic size classes. The slightly lower growth rate of the occupied area was typical of the largest farms.

Figure 3

Structure of the farms by relative growth of the agricultural production value in the years 2004-2015



Source: own study.

Table 6

Changes in the level of the area of occupied land in the analysed period, in the analysed groups of the farms, by economic size

Economic size of farms as of 2004-06	Change in the years 2004-2015 [2004=100]			The value of the characteristic in the group of „development" farms [group „stagnation" =100]	
	Total	„Development" group	„Stagnation" group	in years 2004-06	in years 2013-15
Small	114	147	94	107	167
Medium	118	148	94	126	198
Large	121	145	98	132	196
Very large	114	132	95	109	151
All*	117	144	95	121	184

Source: own study.

Analysing the relationships of land resources between the groups with different growth rates, we can notice that even in the base period the farms from the "development" group showed a certain advantage in this field, with the area larger, on average, by 21%. In the final period, those farms used the area nearly twice larger in relation to the reference group.

The growth of the area of the farms translated into the increased assets value. The dynamic increase in the total assets value (Table 7) was mainly due to the increased value of used land. The rise in prices of land, although resulting from the concentration processes taking place in the farms implementing active development strategies, applied to all the farms to a similar degree. Therefore, the differentiated increase in the assets value in both observed groups is relatively small.

Table 7

Changes in the level of the total assets value in the analysed period, in the analysed groups of the farms, by economic size

Economic size of farms as of 2004-06	Change in the years 2004-2015 [2004=100]			The value of the characteristic in the group of „development" farms [group „stagnation" =100]	
	Total	„Development" group	„Stagnation" group	in years 2004-06	in years 2013-15
Small	221	291	175	96	159
Medium	266	343	213	116	187
Large	299	379	234	112	180
Very large	289	395	203	81	158
All*	274	356	211	105	176

Source: own study.

Much greater differences in the growth rate of the assets value can be seen by analysing their value excluding the land value (Table 8). The average increase in the value of other assets, except for land, is less than 43% in nominal terms over a period of 12 years.

Table 8

Changes in the level of the total assets value less the land value in the analysed period, in the analysed groups of the farms, by economic size

Economic size of farms as of 2004-06	Change in the years 2004-2015 [2004=100]			The value of the characteristic in the group of „development" farms [group „stagnation" =100]	
	Total	„Development" group	„Stagnation" group	in years 2004-06	in years 2013-15
Small	100	143	76	94	177
Medium	134	197	89	118	263
Large	164	230	104	114	251
Very large	163	244	102	78	186
All*	143	207	94	105	232

Source: own study.

Particularly noteworthy are the values observed in the small and medium farms in the "stagnation" group" where the assets value in nominal terms decreased by 24% and 11%, respectively. The increase in the assets value in the smallest farms from the "development" group is equal to the average values for the entire panel (43%). This may indicate a slow-down in investment processes in most small farms. Only the most active farms in this economic size class show the more than average increase in the capital value.

The significantly higher growth rate is shown by the current assets value in the analysed farms (Table 9). The current assets value increased slightly faster than on average in the large farms.

Table 9

Changes in the level of the current assets value in the analysed period, in the analysed groups of the farms, by economic size

Economic size of farms as of 2004-06	Change in the years 2004-2015 [2004=100]			The value of the characteristic in the group of „development" farms [group „stagnation" =100]	
	Total	„Deve-lopment" group	„Stagnation" group	in years 2004-06	in years 2013-15
Small	161	215	118	99	180
Medium	177	238	128	108	201
Large	190	252	134	103	194
Very large	176	234	119	82	161
All*	179	239	126	99	187

Source: own study.

It should be noted that the farms, which were characterised by the rapid production growth in the base period did not show any significant advantage in terms of the current assets value over the farms from the reference group. In particular, the largest farms in the base period had financial assets at the level of 80% of the farms from the reference group.

The increase in the assets value can be financed from various sources. Access to foreign financing, using a leverage can significantly accelerate the production growth rate. In the analysed farms, the average level of the total liabilities increased twice in nominal terms (Table 10).

Table 10

Changes in the level of the total liabilities in the analysed period, in the analysed groups of the farms, by economic size

Economic size of farms as of 2004-06	Change in the years 2004-2015 [2004=100]			The value of the characteristic in the group of „development" farms [group „stagnation" =100]	
	Total	„Development" group	„Stagnation" group	in years 2004-06	in years 2013-15
Small	227	465	45	178	1851
Medium	209	361	87	185	768
Large	199	317	114	147	409
Very large	180	312	87	87	313
All*	197	337	93	130	473

Source: own study.

The fastest was the increase in the value of total liabilities in the smallest farms, however, the growth rate of that phenomenon was strongly differentiated. The smallest farms from the "development" group increased the level of liabilities nearly five times, while the same size farms from the reference group reduced the value of liabilities by more than half. As a result, the average small farm from the "development" group in the final period was indebted more than 18 times than the farm from the reference group. The average value of total liabilities (Table I, Appendix) in the smallest farms from the "development" group" in the final period was more than PLN 56 thousand.

Most liabilities in the case of the farms from the "development" group were long-term credits. The increase in the value of this type of liabilities (Table 11) in the case of the smallest farms was even greater than in the case of total liabilities (Table 10).

Table 11

Changes in the level of the long-term credits value in the analysed period, in the analysed groups of the farms, by economic size

Economic size of farms as of 2004-06	Change in the years 2004-2015 [2004=100]			The value of the characteristic in the group of „development" farms [group „stagnation" =100]	
	Total	„Development" group	„Stagnation" group	in years 2004-06	in years 2013-15
Small	281	542	49	204	2250
Medium	233	400	98	210	860
Large	204	330	108	151	462
Very large	194	343	93	86	319
All*	212	366	97	134	506

Source: own study.

In the subsequent economic size classes, the growth rate of the value of credits was lower and lower. The larger farms as early as in the base year were characterised by the greater value of long-term credits, which accounted for a significant part of their liabilities. Therefore, despite the increasing debt level of all the farms from the "development" group, the growth rate of this phenomenon is lower than in the large farms (the so-called "base effect") in total.

The significant increase in the share of external financing sources poses a risk of an excessive increase in debt service costs. The average increase in the costs of interest is slightly higher than the increase in the amount of liabilities (Table 12). Such a relationship may seem striking in relation to the decreased interest rates from 2004 to 2015.

However, it should be noted that the increased burden with the costs of interest is different in both analysed groups of the farms. While in the case of the farms from the "development" group, the costs of interest increase almost in proportion to the increase in the level of liabilities, in the case of the farms from the "stagnation" group the increase in the amount of interest is clearly higher than the increase in the debt level. This may be due to differences in the structure of liabilities. The farms, which conduct investment processes probably more often use long-term credits, which are generally lower interest-bearing or subsidised, while the non-developing farms more often use short-term instruments with a typically higher interest rate.

Table 12

Changes in the level of the interest value in the analysed period, in the analysed groups of the farms, by economic size

Economic size of farms as of 2004-06	Change in the years 2004-2015 [2004=100]			The value of the characteristic in the group of „development" farms [group „stagnation" =100]	
	Total	„Development" group	„Stagnation" group	in years 2004-06	in years 2013-15
Small	240	482	65	174	1285
Medium	257	402	123	194	631
Large	256	375	165	171	387
Very large	197	344	112	77	238
All*	236	382	126	133	404

Source: own study.

The comparison of the amount of interest in both analysed groups of the farms at the beginning and at the end of the analysed period leads to an observation that in the base period (2004-06) the farms from the "development" group were burdened with more interest than those from the "stagnation" group. This can be explained by the higher levels of liabilities. However, at the end of the analysed period in the farms from the "development" group, the ratio of financing costs to the amount of debt significantly improves. This is most evident on an example of the smallest farms from the "development" group, in which, despite the amount of long-term credits which is 22 times higher, the burden of interest is by only 12 times higher in relation to the small farms from the "stagnation" group.

Despite the significant burden of credits, it should be noted that throughout the analysed period the average debt level of the farms can be considered relatively safe. On average, across the panel, both in the beginning and final period, the fixed assets value is lower than the equity value (Table 13).

Table 13

Ratio of the fixed assets value to the equity value in the analysed groups of the farms

Economic size of farms as of 2004-06	Total		„Development" group		„Stagnation" group	
	years 2004-06	years 2013-15	years 2004-06	years 2013-15	years 2004-06	years 2013-15
Small	90%	94%	92%	101%	90%	92%
Medium	93%	97%	95%	102%	90%	93%
Large	97%	100%	100%	105%	94%	96%
Very large	102%	102%	105%	109%	102%	97%
All*	95%	99%	98%	104%	93%	95%

Source: own study.

With respect to certain groups of the farms, we may notice the existence of fixed assets whose value exceeds the equity value. In the final period, all farms from the „development" group are characterised by a small advantage of the fixed assets value in relation to the equity value. This phenomenon does not occur in the farms from the „stagnation" group. Despite the slightly larger burden undoubtedly related to the faster increase in the production, the farms that develop a little faster achieve better economic results (Table 14). The average amount of income, in nominal terms, in the analysed group of the farms increased by 84% within 12 years in relation to the base year. Without any doubt, we may notice that this means the real growth of average income. However, income growth had not the same rate in all farms.

On average, the income situation improved most in the smallest farms. However, we may notice a significant diversification of the level of changes in this economic size class. A slight increase in income in the „stagnation" group leads to large disparities. As a result, the smallest farms from the „development" group at the end of the analysed period had income which was four times higher than that in the farms from the „stagnation" group. These disparities are decreasing with the increase in the economic size of the farms, but even in the case of the very large farms income achieved by the farms from the „development" group is more than 2.5 times higher than in the similar farms from the „stagnation" group. Also, we cannot forget that in the case of the large farms from the „stagnation" group, nominal income decreased by 9%. In real terms, after adjusting for inflation, this means a significant reduction in achieved income.

Table 14

Changes in the level of the family farm income value in the analysed period, in the analysed groups of the farms, by economic size

Economic size of farms as of 2004-06	Change in the years 2004-2015 [2004=100]			The value of the characteristic in the group of „development" farms [group „ stagnation" =100]	
	Total	„Development" group	„Stagnation" group	in years 2004-06	in years 2013-15
Small	232	386	115	115	387
Medium	190	296	100	125	370
Large	178	278	91	101	310
Very large	170	258	100	99	255
All*	184	288	98	110	324

Source: own study.

A factor justifying, to some extent, achieving lower income is lower engagement of the labour factor (Table 15). The average labour input in the analysed group of the farms decreased by about 3%. This decrease is visible in particular in the farms from the „stagnation" group. In the case of the very large farms from this group, the number of hours worked decreased by as much as 30%. In other farms, the implementation of the stagnation strategy reduces the labour input by about 15%.

Table 15

Changes in the level of the total labour input in the analysed period, in the analysed groups of the farms, by economic size

Economic size of farms as of 2004-06	Change in the years 2004-2015 [2004=100]			The value of the characteristic in the group of „development" farms [group „ stagnation" =100]	
	Total	„Development" group	„Stagnation" group	in years 2004-06	in years 2013-15
Small	94	108	84	97	124
Medium	97	109	86	103	131
Large	99	110	87	100	127
Very large	98	128	70	68	124
All*	97	111	83	96	128

Source: own study.

Achieving income at the unchanged level while reducing the labour input may seem, from the point of view of the farmers, a beneficial strategy, notably if „saved" labour resources are used in the non-agricultural activity.

However, the presence of such a large stratification as regards the growth rate of the production, income, investment opportunities may point to increasing strategic risk in the farms from the „stagnation" group. The seemingly safe strategy of maintaining the current assets, avoiding indebtedness of the farms from the „stagnation" group, leads to a systematic deterioration of their position in relation to the entities implementing the dynamic growth strategy. The persistence of this trend over a longer period of time can lead, despite many existing barriers, to the takeover of resources of non-developing farms by the entities implementing the rapid development strategy.

Results of the simulation model

The increase in average income achieved by the farms from the „development" group can be considered as a rationale confirming the previous observations indicating a reduction in risk of losses along with the increase in the scale of their activity. In order to determine the agricultural income variation in the identified 8 groups of the farms, the farm simulation model using the Monte Carlo method has been applied. Based on observations from the years

2010-2015, the variability of individual model parameters affecting the amount of agricultural income has been determined. On their basis, the parameters of the financial result variation have been estimated. For each farm, the following have been determined: the average value of agricultural income, minimum and maximum values during the simulation, value of the 55th and 95th percentile and standard deviation. In addition, based on the value of the standard deviation and the mean value, the coefficient of variation has been calculated. The results obtained are summarised in a tabular form (Table 16).

Table 16

Basic indicators of the agricultural income variation in the analysed groups of the farms – results of the simulation model

Agricultural income [PLN]	**Farms „Development" group**			
	small	**medium**	**large**	**very large**
Average	48758	116484	236776	527655
Minimum	11077	16055	5993	-130623
Percentile 5%	27411	58456	102955	188831
Percentile 95%	69865	174109	371465	865423
Maksimum	84437	214980	475225	1169985
Standard deviation (SD)	13142	35819	82899	207740
Coefficient of variation (CV)	0.270	0.308	0.350	0.394
Agricultural income [PLN]	**Farms „Stagnation" group"**			
	small	**medium**	**large**	**very large**
Average	16300	39018	92938	232855
Minimum	-425	-1220	-7837	-99249
Percentile 5%	6256	16766	36301	50941
Percentile 95%	26276	61244	149488	415176
Maksimum	34048	76063	198326	565231
Standard deviation (SD)	6154	13777	34925	111483
Coefficient of variation (CV)	0.378	0.353	0.376	0.479

Source: own study.

The average value of income estimated by the model is consistent with the results obtained directly from FADN accounting. The financial result, determined by the model, is slightly lower which can result from the fact that the period taken into account in estimating the model parameters was slightly longer (2010-2015) than in the case of determining the changes in family farm income (2013-2015). With the existence of an upward trend, this resulted in slightly lower average values. The main task implemented using the model was to compare the income variation level among the identified groups of the farms. It can be assumed that a small difference of the value between average income calculated on a basis of three observation from FADN accounting and average

income determined as a result of the simulation is not any obstacle to achieving the main objective.

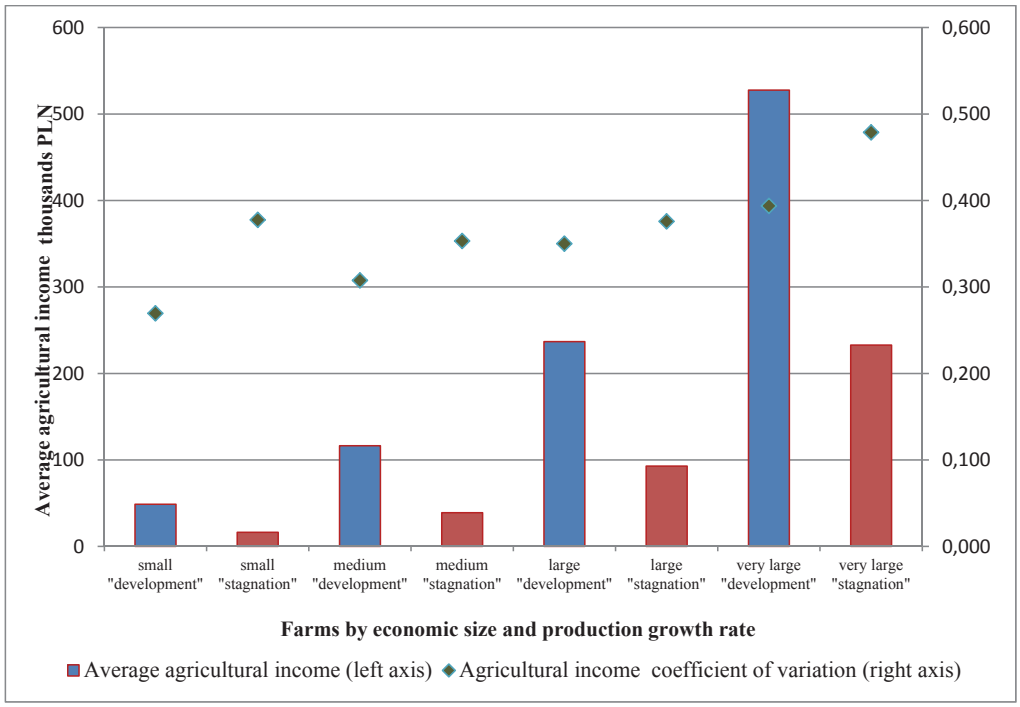
The results of the simulation model for the „stagnation" group show not only significantly lower average values, but also a relatively high value of the standard deviation. As a result, the coefficient of variation for agricultural income in the „stagnation" group in each considered size class is higher than in the similar class from the „development" group. As expected, the probability of suffering loss, due to the existence of support in a form of direct payments, is negligible in all analysed groups of the farms, however, in all economic classes in the „stagnation" group at least one simulation had a negative value. In the „development" group, this result was achieved only for the largest economic class. The higher average values of agricultural income in the „development" group also positively affect the achievable maximum values which are significantly higher in the case of developing farms.

The most important results of the simulation model in the graphic form are shown in Fig. 4. By comparing the results of the model, we may notice that the dynamically developing farm from the „development" group is able to achieve the average financial result at the level of the farm from the larger economic size class from the „stagnation" group. Moreover, we may notice that in the farms from the „stagnation" group in all cases the higher coefficient of variation has been recorded.

These results show that both due to the amount of achieved income and the level of its variation, the fast developing farms have an advantage over the farms from the „stagnation" group. Analysis of distributions of agricultural income obtained by the model in terms of achieving individual predefined threshold values (Table 17) also seems to confirm a conclusion that the faster development path can foster reducing income risk in both operational and strategic terms.

Figure 4

Expected value and level of the agricultural income variation in the analysed groups of the farms – results of the simulation model



Source: own study.

Table 17

Probability of the occurrence of threshold values of agricultural income in the analysed groups of the farms [%] – results of the simulation model

Probability of the occurrence of threshold values (*value at risk*)		**Farms „Development" group"**			
		small	**medium**	**large**	**very large**
Making loss (agricultural income < 0)		0.00	0.00	0.00	0.23
The loss is greater than the value of short-term financial assets		0.00	0.00	0.00	0.07
Obtaining the own work fee at a level higher	social minimum	98.84	99.86	99.86	99.46
	minimum salary	79.53	98.70	99.41	99.22
	average salary	0.10	66.50	93.75	98.06
Probability of the occurrence of threshold values (*value at risk*)		**Farms „Stagnation" group**			
		small	**medium**	**large**	**very large**
Making loss (agricultural income < 0)		0.05	0.02	0.07	1.30
The loss is greater than the value of short-term financial assets		0.00	0.00	0.00	0.00
Obtaining the own work fee at a level higher	social minimum	31.70	85.53	97.71	97.23
	minimum salary	0.19	53.00	91.72	95.82
	average salary	0.00	0.00	46.88	88.66

Source: own study.

As already highlighted, risk of achieving negative agricultural income in conditions of support provided by the CAP in an average farm from the FADN sample should be considered as very low. As even less probable, we should consider suffering loss equal to or greater than the value of short-term financial assets, which can be considered as a situation likely to lead to loss of liquidity and disturbance in the financial situation of the farm.

The noticeable probability (> 1%) of suffering loss was observed only in the very large farms from the „stagnation" group. Such a result does not, however, result directly from the increased variation of income but from relatively large input of labour force which must be paid. The lower level of average income in the farms from the „stagnation" group translates into the higher probability of suffering loss even with the same level of income variation. Also, the relatively high value of short term financial assets reduces risk of more severe effects of such loss in this group of the farms. Unpaid value of labour of the farmer and his family is, in the case of the smaller farms, a guarantee of achieving positive financial results. However, it should be noted that the income value per unit of unpaid labour shows the farm's possibilities to survive in the longer term. In the case of the small farms from the „development" group, it is almost certain that labour resources will be remunerated at the level of the subsistence minimum, which will succeed only in less than 1/3 of the farms from the „stagnation" group. In this group of the farms, chances of obtaining payment of the labour factor at the level of the minimum salary are almost zero (0.19%), while in the group of the smallest farms with the fast growth rate, the chance to receive such payment of the labour factor is nearly 80%.

On this basis, it can be concluded that the small farms that have not made effort to increase the production value despite almost zero risk of bankruptcy in the short term are characterised by almost 100% certainty of leaving the sector of commercial farms in the longer term. Such entities will be able to function as hobby farms if their owners obtain another source of income. In the case of the medium farms, greater resources (at least the greater area, which determines the amount of subsidies received) collected in the base period guarantee obtaining a slightly higher payment for labour involved. However, in the case of the medium farms from the „stagnation" group, the probability of paying the labour factor at the level of the minimum salary only slightly exceeds 50% which does not make such entities the main source of livelihood for their owners. In the case of the medium farms, in which the production increased by more than 60%, the chance of payment of the labour factor at the level of the average non--agricultural salary can be interpreted as a significant indication for the further

functioning of these farms in the longer term. In this respect, they are better than the large farms from the „stagnation" group characterised by the lower probability of achieving this level of income. It should be stressed that in this case, both these groups of the farms (medium in the „development" group and large in the „stagnation" group) in the final period have the area of land (about 46-47 ha). In the case of the largest farms with an area often exceeding 100 ha, guaranteeing payment of unpaid labour at the level of the average non-agricultural salary is not a significant problem. With the current system of support, the very amount of received direct payments is enough to meet the needs of the farmer's family at the sufficient level. It can be assumed that such reasoning for at least some farmers from the „stagnation" group seems attractive due to the low level of income risk. Given that almost half of achieved income comes from subsidies, we may ask a question if such a strategy is not too exposed to institutional risk. In the very large farms from the „development" group, only every fourth PLN comes from subsidies, with the similar coefficient of variation of income and much higher average income. This allows the farmers to analyse the proposed changes in the support system under the CAP with greater peace of mind.

Limitations

A certain limitation resulting from the use of the panel method is the impossibility of generalising the study results. Owing to the limitation of the sample of the observed farms to those which were continuously present in the sample in the years 2004-2015, it must be assumed that this sample is not representative of the FADN population and all observations apply only to the selected sample of the farms.

As the criteria for the selection of the farms were different than those used in the FADN, it cannot be assumed that the farms in the FADN population represented by the individual farms from the sample are fully comparable. i.e. that they developed in the same pace.

4.4. Summary

The risk factors, indicated at the beginning and occurring in the farms apply to all farms, translating into operational risk, which in this study has been measured using the coefficient of variation of income and risk of achieving income of a specific value. Analyses were to indicate whether safer, from the point of view of financial results, is the „stagnation" strategy or making effort to increase the activity scale.

To this end, the farms present in the FADN continuously for a period of 12 years were analysed. Although in each subsequent year, analysis covered the sample of the same 3,915 farms its nature changed over time. Only about 1/3 of the farms have maintained, for the entire analysed period, their original economic size and production profile. In other farms, we could notice numerous changes, including the dynamic growth of their economic size.

In order to compare whether the benefits of the dynamic development compensate risk associated with the investment effort, 2 groups of the farms have been identified, with the working names „development" and „stagnation", which represented the fastest developing farms and the slowest developing ones in the individual economic size classes. For those groups, the relative changes in the major economic indices have been calculated and the simulation model has been constructed so as to estimate the probability distribution parameters for agricultural income.

The increased production in the „development" group was associated with a significant increase in the area of the farms, increased value of land and other assets as well as increased debt, particularly in the smallest farms. In general, however, the dynamic development did not lead to a drastic violation of the so--called „financial golden rule" stating that fixed assets should be financed from equity only. With the increase in the economic size, the coefficient of variation of income showed a slight upward trend. However, the higher average income level, even at a slightly higher level of variation, provided also the greater probability of obtaining payment for unpaid labour at the level of the minimum salary or even the average salary in the non-agricultural sector in the case of the large and very large farms. Therefore, we can generally conclude that the level of operational risk, measured by a possibility of suffering loss, in the farms is relatively low. It must be stressed, however, that there is growing strategic risk resulting from, inter alia, growing pressure on increasing the production scale. The farmers developing their farms increase their opportunities to obtain payment for labour at the level equal to or, in the case of the large and very large farms, even higher than the average level of salary. The implementation of the stagnation strategy seems to lead to the marginalisation of the economic

importance of underinvested entities by making their functioning dependent on transfers in a form of subsidies or on achieving income from other sources.

An additional observation resulting from the studies is to demonstrate that carrying out any studies based on the balanced panel built on a basis of the FADN database requires special attention. Although the sample selected in this way is composed of the same set of the farms present in all the analysed years, it must be strongly emphasised that the characteristics of these farms, including their belonging to the production types and economic size classes is subject to dynamic changes. It should be definitely stressed, that observed changes should not be easily generalised, without testing first whether the changes in the structure of the farms in the panel correspond to the changes in the structure of the farms in the FADN sample and the general population represented by these farms.

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APPENDIX

Table I

Characteristics of farms in „development" and „stagnation" groups according to the economic size in the analysed period

Economic size of farms *	Total		„Development" group		„Stagnation" group	
	years 2004-06	years 2013-15	years 2004-06	years 2013-15	years 2004-06	years 2013-15
Agricultural land [ha]						
Small	15	17	15	22	14	13
Medium	28	33	32	47	25	24
Large	53	64	62	89	47	46
Very large	102	116	113	149	104	99
All**	33	39	37	53	30	29
Agricultural production value [PLN]						
Small	40271	63175	40469	105964	40632	35139
Medium	114805	192676	120920	321672	107953	96949
Large	277896	496680	278620	766731	274940	274869
Very large	742581	1329646	767921	2191642	855395	838677
All**	157918	273557	162938	445840	160830	152654
Family farm income [PLN]						
Small	12290	28475	13464	51945	11681	13432
Medium	38730	73616	42485	125732	34121	33972
Large	91138	162324	89163	248089	88138	80002
Very large	206060	349374	212193	548363	214992	214639
All**	49900	91980	52264	150647	47443	46524
Assets value [PLN]						
Small	199070	439901	199650	580911	208127	365139
Medium	396619	1053673	424582	1458277	366405	781111
Large	766366	2293121	790454	2993521	708058	1660053
Very large	1532032	4434907	1463615	5784445	1799235	3650173
All**	469867	1286877	484644	1725756	463485	980148
Fixed assets value [PLN]						
Small	172126	396453	172427	522265	180530	332602
Medium	333990	942765	359176	1302603	306040	703638
Large	628217	2030119	650179	2640692	572488	1478181
Very large	1214455	3875634	1152183	5056882	1417543	3196958
All**	389692	1143314	402909	1530659	380855	875789
Current assets value [PLN]						
Small	26944	43448	27223	58646	27597	32536
Medium	62629	110907	65405	155674	60365	77472
Large	138149	263002	140275	352829	135569	181872
Very large	317577	559273	311431	727564	381692	453215
All**	80175	143563	81735	195097	82630	104359

Table I cont.

Economic size of farms *	Total		„Development" group		„Stagnation" group	
	years 2004-06	years 2013-15	years 2004-06	years 2013-15	years 2004-06	years 2013-15
Short-term current assets [PLN]						
Small	6554	11339	7362	15823	6588	9180
Medium	13775	24083	15343	33430	12909	18092
Large	30410	52860	29830	66912	29460	36520
Very large	70519	101515	68961	89051	83015	131968
All**	17843	29830	18703	37370	18006	25398
Total liabilities [PLN]						
Small	7980	18090	12054	56020	6789	3027
Medium	35350	73967	46442	167702	25063	21846
Large	116771	232306	140218	443942	95252	108475
Very large	338979	610444	354932	1108645	408387	354077
All**	58882	115848	70442	237583	54016	50216
Long-term loans [PLN]						
Small	4874	13714	8156	44194	4002	1964
Medium	24137	56208	32708	130978	15583	15224
Large	86442	176390	105723	348383	70049	75354
Very large	248028	481144	267293	916530	309801	287271
All**	42087	89022	51646	188934	38541	37319
Interest paid [PLN/year]						
Small	264	632	378	1821	217	142
Medium	1038	2669	1416	5692	731	902
Large	3118	7973	3848	14442	2256	3729
Very large	9690	19128	9149	31514	11867	13246
All**	1672	3939	1984	7582	1496	1878
Equity capital [PLN]						
Small	191011	419546	187457	519354	201338	361485
Medium	360728	971012	377320	1271974	341069	755752
Large	646154	2037704	647137	2509900	611765	1543760
Very large	1189513	3795063	1102089	4639459	1389875	3284443
All**	409932	1160534	412860	1468635	409105	926018
Yearly depreciation [PLN/year]						
Small	8828	10373	8731	14797	9299	8487
Medium	17365	26894	18049	41087	16728	17639
Large	32963	64240	33467	88424	31716	41642
Very large	60658	121684	53124	157760	68621	94368
All**	20130	34021	20106	48544	20210	23558
Labour input [hours/year]						
Small	3747	3537	3640	3925	3771	3163
Medium	4700	4567	4725	5129	4586	3921
Large	5973	5923	5969	6587	5956	5167
Very large	10117	9951	8895	11348	13155	9171
All**	4969	4827	4883	5411	5095	4229

Explanation: *regarding value of agricultural production value in years 2004-2006; ** Average value for all analysed farms,

Source: own study.

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5. Subsidies and finance and economics of farms managed by natural persons

5.1. Introduction

The considerations presented below are a continuation of the studies carried out in the previous years at the IAFE-NRI and devoted to identifying the key relationships among various types of subsidies and the economic and financial results of farms of natural persons forming the Polish FADN network[1]. We will continue to base on the panel of farms but the analysis period will include 2015. Before we go to a detailed comment on the results obtained for the years 2010-2015, we will make a synthetic overview of the most important issues related to subsidising family farms.

Agricultural subsidies must be treated as a component of the wider budgetary concept, i.e. fiscal incidence or budget incidence. In general, it is about integrating the economic impacts of taxes and budgetary expenses into one methodological and application approach[2]. In brief, this incidence tries to answer the question who ultimately bears the tax burden or uses the budgetary expenses[3]. Otherwise, fiscal incidence is trying to identify entities which benefit and/or incur the costs from the application of specific regulations and budgetary instruments[4]. Owing to this, we can analyse, *inter alia*, the changes in income

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[1] *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (sc. ed. J. Kulawik), Program Wieloletni 2011-2014, nr 20, IERiGŻ-PIB, Warszawa 2011; *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (sc. ed. J. Kulawik), Program Wieloletni 2011-2014, nr 46, IERiGŻ-PIB, Warszawa 2012; *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (sc. ed. J. Kulawik), Program Wieloletni 2011-2014, nr 82, IERiGŻ-PIB, Warszawa 2013; *Dopłaty bezpośrednie i dotacje budżetowe a finanse oraz funkcjonowanie gospodarstw i przedsiębiorstw rolniczych* (sc. ed. J. Kulawik), Program Wieloletni 2011-2014, nr 120, IERiGŻ-PIB, Warszawa 2014; *Subsydia a ekonomika, finanse i dochody gospodarstw rolniczych* (1), (sc. ed. J. Góral), Monografia Programu Wieloletniego 2015-2019, nr 4, IERiGŻ-PIB, Warszawa 2015, *Subsydia a ekonomika, finanse i dochody gospodarstw rolniczych* (2), (sc. ed. J. Góral), Monografia Programu Wieloletniego 2015-2019, nr 37, IERiGŻ-PIB, Warszawa 2016.

[2] J. Cullis, P. Jones, *Public Finance and Public Choice. Analytical Perspectives*, Third Edition, Oxford University Press, Oxford, New York 2009.

[3] T. Döring, *Öffentliche Finanzen und Verhaltensökonomik: Zur Psychologie der budgetwirksamen Staatstätigkeit*, Springer Gabler, Wiesbaden 2015.

[4] H. Zimmermann, D.K., Henke, M. Broer, *Finanzwissenschaft: Eine Einführung in die Lehre von der öffentlichen Finanzwirtschaft*, 11. Auflage, Verlag Franz Vahlen, München 2012; W. Scherf, *Öffentliche Finanzen. Einführung in die Finanzwissenschaft*, 2. Auflage, UVK Lucius UTB, München 2011.

and its distribution by people, sectors, regions and even in the intergenerational dimension. This further means a need for the simultaneous examination of redistribution, allocation and stabilisation issues.

We may identify several types of fiscal incidence. The most important are:

- Formal incidence. This is the major approach determined based on a specific theory.
- Effective incidence, also referred to as the economic or factual incidence. This is the end point of the fiscal impact analysis, and thus the state following the occurrence of all adjustments generated by a specified fiscal stimulus or regulation. In this way, we can determine the above--mentioned final beneficiaries of the budget and net taxpayers.
- Absolute, or specific incidence. In this case, we are interested in the effects of only a single fiscal instrument.
- Net or holistic incidence. It should be understood as a net position towards the budget resulting from a comparison of the costs incurred for its benefit with all benefits and services it provides[5]. Only then are we able to move closer to determining whether the given fiscal system is *per saldo* progressive, i.e. supporting people with lower income or regressive i.e. benefitting higher income groups.

From the above, it clearly follows that the analyses in the style of the fiscal incidence require taking into account budget flows in the entire sector of public finance, i.e. government, local government and social security. On the other hand, the Great Britain and Australia are examples of the countries, where the statistical offices officially for many years have been publishing the impact of taxes and budget expenses on income of the population, in the style of the "benefit incidence analysis", and thus also including the redistributive implications in education, health care and social assistance. Also, the World Bank conducts methodological and analytical work in the above areas. In this context, it is worth mentioning the paper by A. Harding et al. of 2007[6]. Those three Canadian economists consider the fiscal incidence in the seven following aspects:

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[5] B.Ch. Blankart, *Öffentliche Finanzen in der Demokratic. Eine Einführung in die Finanzwissenschaft*, 8 Auflage, Verlag Franz Vahlen, München 2017; D. Brümmerhoff, *Finanzwissenschaft*, 11. Auflage, De Gruyter Oldenburg, München 2014.

[6] A. Harding, N. Warren, R. Lloyd, *Beyond Conventional Measures of Income: Including Indirect Benefits and Taxes*, [in:] Jenkins P.S., Micklewright J. (eds.) *Inequality and Poverty Re-examined*, Oxford University Press, Oxford 2007.

- coverage, and thus inclusion of budgetary expenses for the provision of public goods,
- range, i.e. inclusion the indirect consumption of public services in addition to direct transfers,
- methodology to estimate the value of all received budgetary benefits,
- period of time for which the net balance-sheet shall be drawn up,
- units of analysis, i.e. a natural or legal person, family or household,
- applied comparative scales,
- measure of the budgetary redistribution.

Specification of the fiscal incidence in the case of agricultural subsidies is the problem of their distribution among owners of land and other material assets and persons leasing these assets. It leads us directly to the issue of capitalisation of budget support in lease rent rates. In the case of coupled subsidies, a prerequisite for their capitalisation in rents is a perfect inflexibility of supply of the land factor and the stability of prices of other inputs[7]. In case of decoupled support, the issue is much more clear, i.e. due to the fact that their impact on the production and inputs is at most minimal. If, however, they are linked with the land factor, they should be adequately reflected in rents for its lease and be vested in its owner as a whole. In practice, it is difficult, however, to assume the complete decoupling of government payments. Hence, there are estimates that each additional monetary unit in a form of these payments led to an increase in the lease rent rates from 6 to 38%. In other words, 62-94% of subsidies went, however, to lessees.

These, actually, low values of capitalisation of decoupled subsidies in lease rent rates according to B.E. Kirwan and M.J. Roberts are, in fact, a proof of their incomplete decoupling and multi-channel nature of their impact on farmers' decisions and imperfection of the competition in the market of production factors, but they also must result from certain simplifications adopted in empirical models. The latter come down to the fact that researchers are looking for a relationship between payments received by the whole farm and lease rents. According to Kirwan and Roberts, the impact of parameters of changes in the land productivity and of permanent factors describing the farm environment on the obtained estimates is not reflected at all in this way. Following it, the measurement errors are somehow added to the abandoned variables, which results in incomplete addressing of the issue of endogeneity in econometric models. The appropriate solution, according to Kirwan and

[7] E.B., Kirwan, J.M. Roberts, *Who Really Benefits From Agricultural Subsidies*? *Evidence from Field – Level Data*, „American Journal of Agricultural Economics", vol. 98, no. 4, 2016.

Roberts, is where subsidies are closely associated with land parcels and rents paid for these parcels. After making adequate calculations, both American economists obtained the fiscal incidence for decoupled payments equal to 42-49% for the whole farm, but only 20-28% when the analysis was carried out at the level of land parcels. This incidence also decreased by 5-15 percentage points, if the leased area has doubled. Interesting was also the impact of the duration of a lease contract, i.e. every extension of this contract by one year resulted in a decrease in rent by 0.1-0.8 percentage points. It may be concluded that decoupled payments do not need to inhibit the growth of scale in agriculture, if the self-reinforcing mechanism works well: larger farms have a stronger position in the market of lease and this improves the bargaining position of lessees and increases the part of budgetary support vested in them.

The group of relationships describing the dependence of the FADN farms on subsidies also includes those on their decoupling from future production decisions of farmers. The question of the level of decoupling still raises controversy among not only economists but also politicians, as it also affects the distortion of level-playing field in the international agri-food markets. Recently, interest in this issue has even increased, as under the CAP it was directly made possible to have a part of budgetary support coupled.

The study on the level of decoupled agricultural subsidies generally focuses on those which are direct income support. In this context, a major challenge is to carry out relevant analyses taking into account the uncertainty and risk. Commonly used here is the formula of the state-contingent approach (SC). This means that the effects of the risk are examined depending on possible uncertain states of environment and the nature in particular. The origins of the SC should be associated with the papers by G. Debreu (1952) and K. Arrow and G. Debreu (1954)[8]. Those two Nobel Prize winners proved that the uncertainty and risk may be, without major problems, integrated into the conventional theory of production. In agricultural economics, the SC approach appeared only in 2000, when G.R. Chambers and J. Quiggin published a book entitled "Uncertainty, Production, Choice and Agency: the State-Contingent Approach". However, the book was totally theoretical. Fortunately, in 2006 Chambers and Quiggin published a much more intelligible article which gave the SC a strong stimulus to penetrate into decision-making by farmers themselves. The same trend, more outreach, also included the books by S. Rasmussen (2011) and J.B. Hardeker et al. (2015).

[8] B.J. Hardaker, L. Godbrand, R.J. Anderson, M.B.R. Huirne, *Coping with Risk in Agriculture*, 3rd Edition, Applied Decision Analysis, CABI, Wallingford, Boston 2015.

Among the works embedded in the SC philosophy and focused on decoupling subsidies directly supporting agricultural income, of unquestionably breakthrough nature was an article by D.A. Hennessy of 1998[9]. He proved that with the wealth and insurance effect, such subsidies may be coupled again, which he defined as "recoupling". This is to result from changes in marginal income utility, mitigation of financial and credit constraints, new possibilities to distribute the labour resource owned by the farmer among the farm and non--farm activities. However, Hennessy carried out his considerations for one period only. Later on, other researchers did the same, including also other channels and mechanisms of the impact of direct farm income support on production decisions, stressing mainly that recoupling, if occurs, usually is small.

In 2017, R.G. Chambers and D.C. Voica published an important article in which they presented the theory of decoupling payments directly supporting agricultural income[10]. In fact, this is an extension of the analysis published in 2009 by Chambers and J. Quiggin, dedicated to a possibility of decoupling the decision on the stochastic production from risk preferences in terms of participation in financial markets. The current model by Chambers and Voica is two-period, and farm families may obtain income from working on and out of the farm, as a result of financial operations and in a form of budgetary support. With regard to the distribution of the farmer's working time the free time was also included explicitly. The analysis is carried out using the theory of portfolio and SC approach, while the previous studies assumed that adjustments take place in the sphere of production only. Consequently, the farmer's risk preferences, risk and uncertainty in the prices of agricultural products and disciplining and disruptive effects of financial markets on it have been modelled. In accordance with the above, between the periods t and $t+1$ the agricultural producer may transfer his assets and thus finance his consumption by generating stochastic agricultural revenues, stochastic financial investments and stochastic non-farm income, and, to a large extent, determined government subsidies. It is opening of the farmer to the commodity and financial markets which finally result in decoupling subsidies directly supporting agricultural income. When, however, there are no sufficient disciplining impacts of these markets, they may become coupled. In this context, it is necessary to nuance the results obtained by Hennessy. Indeed, income subsidies change the marginal choices on the consumption and free time, but not directly the on-farm production programme.

[9] D. Hennessy, *The Production Effects of Agricultural Income Support Policies Under Uncertainty*, „American Journal of Agricultural Economics", vol. 80, no. 1, 1998.
[10] G.R. Chambers, C.D. Voica, *Decoupled Farm Program Payments are Really Decoupled: The Theory*, „American Journal of Agricultural Economics", vol. 99, no. 3, 2017.

Of course, here we may have some direct impact of the wealth and insurance effect on other decisions relating to the entire portfolio of possible commitments of the farmer, but they are minor and secondary. This makes it very difficult to estimate them precisely in econometric terms.

Unquestionably, the theoretical and empirical studies on the effects of applying agricultural subsidies are dominated by the trend linking them with the technical efficiency and productivity of farms or the entire agricultural sector. In fact, however, taking into account the known multi-channel nature of the impact of these subsidies, theoretical work does not bring final decisions, mainly from the reason that agriculture is very diversified internally and individual farms operate in the very diverse environment, which cannot be included by researchers in the conceptual models. Therefore, the subsidies-efficiency ratio becomes a completely empirical issue. Unfortunately, the results of existing estimates are very diverse here. From the meta-analysis carried out by J.J. Minviella and L. Latruffe it results, for example, that in 1/4 studies the positive impact of subsidies on the technical efficiency was obtained, in more than half this relationship was negative, and in the other there were no statistically significant relationships at all[11].

In 2017, an interesting article by L. Latruffe et al. was published, devoted to assessing the impact of subsidies on the technical efficiency of farms specialised in the milk production in nine EU countries: Belgium, Denmark, France, Spain, Ireland, Germany, Portugal, Great Britain and Italy. The analysis period covered the years 1990-2007, and thus the considerations included both coupled and decoupled support. The source material came from the FADN database[12].

Latruffe et al. applied the Stochastic Production Frontier (SPF), by estimating the model using the method of moments with the four-step approach. In fact, however, they estimated the commonly known Cobb-Douglas function. The milk production has been expressed in constant prices in EUR. As inputs, they included: utilised agricultural area (ha), labour (working hours), purchased current assets (constant prices in EUR) and other assets (also in constant prices in EUR). In turn, the inefficiency segment included: total subsidies in EUR per 1 ha, the interactive segment: total subsidies × artificial variable, i.e. their coupling or decoupling, share of leased land in the UAA, share of paid

[11] J.J. Minviell, L. Latruffe, *Effects of Public Subsidies in Farm Technical Efficiency: A Meta--Analysis of Empirical Results*, „Applied Economics", July, 2016.

[12] L. Latruffe, E.B. Bravo-Ureta, A. Carpentier, Y. Desjeux, H.V. Moreira, *Subsidies and Technical Efficiency in Agriculture: Evidence from European Dairy Farms*, „American Journal of Agricultural Economics", vol. 99, no. 3, 2017.

employment in total inputs of this production factor and debt ratio. The time variable and its square were used to reflect the impact of technological progress. In addition, the model included the artificial variable "situation of the farm in the LFA". In turn, the instrumental variables were: milk price index, its square and index of current inputs purchased in the market.

In all econometric analyses of the relationships among various variables, a serious challenge is the issue of endogeneity. In the paper by Latruffe et al., its essence has been reduced to the adjustments made by farmers in terms of inputs, following the stochastic events and/or to adequately reflect their specific situation. If it is not taken into account, there may be a correlation between the random segment of the model and the input vector and the constant term. This is not all yet, as inputs may be additionally correlated with the inefficiency segment of the model. In other words, inputs, rather than being exogenous variables, thus the data from outside the model and being beyond control of the farmer, become endogenous variables. This feature is most rapidly assumed by current assets purchased in the market, as they may be relatively flexibly dosed. Latruffe et al. assumed so and obtained the mitigation of endogeneity through the use of the above instrumental variables and fourth-stage model estimation procedure using the method of moments.

Here, being limited at this point only to the issue of the impact of subsidies on the technical efficiency, the following three findings by Latruffe et al. are important:

1. Relationships are clearly diversified, when coupled support is considered. In Belgium, Great Britain and Italy, they were negative at the acceptable level of the stochastic significance. In the second group of countries (Denmark, France, Ireland, Germany), the analysed variables did not show, in principle, any clear relationships. Only in Spain, the correlation was positive and statistically significant.
2. Going to decoupled payments, and therefore taking into account the effects of the so-called Luxembourg reform of 2003, results in the decisive weakening of their relationship with the technical efficiency. In Belgium and Italy, they had even a positive and statistically significant impact on the latter. The very small positive correlation also appeared in Germany and Great Britain, but only in the latter was $\alpha = 0.05$. In five other countries, above payments deteriorated the technical efficiency, but only in Spain and Portugal it was more clear.
3. In parallel to analysing the overall impact of subsidies on the technical efficiency, it is necessary to examine the impact of their individual types. In the case of decoupled support, which is focused on achieving several

objectives, it is required to intensify searching so that it was properly reflected in the product vector in the methodology and empirical models for estimating the technical efficiency and productivity and their determinants.

5.2. Methodological assumptions

As the Polish FADN collects data in a systematic way, based on the well-established, in theoretical terms, methodology and applies very advanced verification tools, this gives solid guarantees that the estimates of the economic and financial efficiency and relationships describing the liquidity and solvency, and investment activity are highly reliable. As in previous years, the analysis presented in this chapter has been carried out as a traditional comparison of key indices and economic and financial indicators. An overview of all indices and indicators used in the chapter is contained in Box 1. Undoubtedly, it is very extensive and may even look redundant. However, this solution has been chosen as in the traditional analysis, there is no uniform, commonly accepted standard. Researchers have simply very different preferences. Besides, the point was also to comprehensively present various aspects of the economic and financial situation of analysed farms and its change over time.

Box 1

Used indicators and measures related to finance of farm households

No.	Ratio/measure	Calculation formula
1	Return on [%]: - equity, ROE (1)	$\frac{\text{family farm income} - \text{own labour costs}^{1)}}{\text{average annual value of equity}^{2)}} \times 100$
	- equity, ROE (2)	$\frac{\text{Entrepreneurs' profit}^{1)}}{\text{average annual value of equity}^{2)}} \times 100$
	- assets, ROA (1)	$\frac{(\text{family farm income} + \text{interest}) - \text{own labour costs}}{\text{average annual total value of assets}^{3)}} \times 100$
	- assets, ROA (2)	$\frac{\text{Entrepreneurs' profit}^{1)}}{\text{average annual total value of assets}^{3)}} \times 100$
1'	Alternatively [1)]: - cash return on equity	$\frac{\text{cash flow (1)}}{\text{equity (averaged)}} \times 100$
	- cash return on total assets	$\frac{\text{cash flow (1)}}{\text{total assets (averaged)}} \times 100$
2	Total profitability index	$\frac{\text{total output}}{\text{total costs}} \times 100$
3	Sales profitability index	$\frac{\text{total sales}}{\text{total costs} - \text{costs of own seeds and own feed}} \times 100$

Continuation of Box 1

Lp.	Ratio/measure	Calculation formula
4	Liquidity (multiplicity):	
	- current ratio	$\frac{\text{current assets (EY)}^{6)}}{\text{short-term liabilities (EY)}}$
	- quick ratio	$\frac{\text{current assets (EY)} - \text{reserves (EY)} - \text{current stock (EY)}}{\text{short-term liabilities (EY)}}$
5	Solvency (multiplicity):	
	- coverage of overall loans with cash flows (1)	$\frac{\text{cash flows (1)}}{\text{overall loans (EY)}}$
6	Investment coverage (multiplicity)	$\frac{\text{cash flows (1)}}{\text{gross investment}}$
7	Cash generating ratio (1)	$\frac{\text{cash flows (1)}}{\text{family farm income}} \times 100$
8	Cash generating ratio (2)	$\frac{\text{cash flows (2)}}{\text{family farm income}} \times 100$
9	Investment rate	$\frac{\text{gross investments}}{\text{depreciation}} \times 100$
10	Equity growth	$\frac{\text{equity (EY)} - \text{equity (BY)}}{\text{equity (BY)}} \times 100$
11	Working capital growth	$\frac{\text{working capital (EY)} - \text{working capital (BY)}}{\text{working capital (BY)}} \times 100$
12	The coverage ratio of assets with equity	$\frac{\text{equity (EY)}}{\text{total assets (EY)}} \times 100$
13	Immobilization ratio (multiple)	$\frac{\text{fixed assets (EY)}}{\text{current assets (EY)}}$
14	Measures (PLN)	
	- economic size	calculated on the basis of the standard production coefficients SO'2010
	- change in the value of equity	equity (EY) - equity (BY)
	- gross invesment	investment payments
	- net investment	gross investments - depreciation

	- cash flow (1)	balance of cash flows from operating activities
	- cash flow (2)	balance of cash flows from investing activities + balance of cash flows from financing activities
	- total subsidies	subsidies for operating activities + investment subsidies + milk compensation
	- family farm income	according to the individual farm's report scheme[8]) (Individual Report)[8)]
	- working capital (EY)	equity (EY) + long-term liabilities (EY0 - fixed assets (EY)
15	Dependencies on subsidies: - subsidy rate I:	$\frac{\text{subsidies to operational activities + subsidies to investments + compensation for milk}}{\text{crop production + livestock production}} \times 100$
	- 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):	$\frac{\text{subsidies to operational activities + subsidies to investments + compensation for milk}}{\text{family farm income - own labour costs}^{3}} \times 100$
	- decoupling rate I of subsidies to operational activities from production	$\frac{\textit{decoupled} \text{ payments + LFAs + agri-environmental programmes}}{\text{subsidies to operational activities}} \times 100$
	- decoupling rate II of grants and subsidies from production	$\frac{\textit{decoupled} \text{ payments + LFAs + agri-environmental programmes + investment subsidies}}{\text{subsidies to operational activities + subsidies to investments + compensation for milk}} \times 100$
	- share of subsidies to operational activities in all subsidies	$\frac{\text{subsidies to operational activities}}{\text{subsidies to operational activities + subsidies to investments + compensation for milk}} \times 100$

Note:

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 (The estimation model of full operating costs of agricultural holdings), "Zagadnienia Ekonomiki Rolnej" ("Issues of Agricultural Economics"), No. 3, IAFE-NRI, 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) Agricultural output = crop input + livestock input.
5) (EY) = refers to the state as at the end of year.
6) 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 3500.
7) (BY) = refers to the state as at the beginning of the year.
1) Cf. See: http://fadn.pl/metodyka/raporty/raport-indywidualny-1/ and Smolik A. (2014): Jak rozumieć zawartość raportu indywidualnego gospodarstwa rolnego (Understanding the content of the individual farm report) (version from 2013). IAFE-NRI, Warsaw.

Source: prepared by the author.

5.3. Data sources

The subject of the research consists of individual farms conducting continuous agricultural accounting under the Polish FADN[13] in the years 2010--2015. The analysis covers only the farms that kept records in Books of Agricultural Accounts (BAA)[14], but omits farms of legal entities, from which 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 "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".[15]

Investment expenses are payments that the farm incurred in a given year on investment activities, the value of which exceeds PLN 3500.

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[16] was used, prepared in the Agricultural Accountancy Department. The estimation was

[13] Legal basis: Act of 29 November 2000 on collection and use of accounting data of agricultural holdings (Journal of Laws Dz. U. 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/.

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

[15] 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.

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

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 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[17], 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, among others, in terms of production, area, as well as 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 IAFE-NRI[18].

Until 2009, the main parameter used for classification of agricultural holdings in the European Union was the Standard Gross Margin (SGM)[19]. However, since 2010, the Community Typology for Agricultural Holdings (CTAH) has changed[20]. Parameters of standard output SO "2010" were used for classification of farms[21].

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[17] 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 (Most important information necessary for interpretation of the results of the Polish FADN),* IAFE-NRI, Warsaw 2015. (http://fadn.pl/wp-content/uploads/metodyka/Najwazniejsze-informacje.pdf).

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

[19] 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.

[20] 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.

[21] 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.

This typology is used, among others, 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[22]. These are the 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[23].

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	Fieldcrops
2	Horticultural crops
3	Wine
4	Other permanent crops
5	Dairy cows
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 (Standard Output Coefficients „2007" for the purposes of Community Typology for Agricultural Holdings), IAFE-NRI, 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.

[22] 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,* IAFE-NRI, 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.,* IAFE-NRI, Warsaw 2013.

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

Table 2

List of sizes and ranges according to ES6 and ES

Symbol ES6	Name	Symbol ES	Limits in euro
-	-	1	EUR < 2 000
1 (A)	Very small	**2**	2000 ≤ EUR < 4000
		3	4000 ≤ EUR < 8000
2 (B)	Small	**4**	8000 ≤ 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 (Analysis of the effects of changes in the Community Typology for Agricultural Holdings), IAFE-NRI, Warsaw 2010.

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

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 3500. 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 had been 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.

5.4. Analysis of results

The analysis presented below ends in 2015. Therefore, it is worth highlighting the general production and economic conditions in this year, as this will make it easier to comment on the evolution of the constructed indices and indicators.

The global agricultural production in the year concerned decreased by 4.2% when compared to 2014, which directly resulted from deep regression in the crop production (decrease by 11.2%), with the increase in the livestock production by 3.1%. As a result of deflation trends in the Polish economy from December 2015–December 2014, there was a cumulative decrease in the prices of agricultural products by 5.2%. In the same period, the prices of means of production for agriculture decreased by only 0.5%. As a consequence, the cumulative price scissors index in 2015 was 95.3, while the year before it was, however, 89.7. In 2015 itself, this index was above 100 only in the first quarter.

2015 was the third successive year, in which the prices of means of production for agriculture decreased, mainly due to the lower prices of direct energy media and building materials. On the other hand, the prices of mineral fertilisers in the period of 2014-2015 increased slightly, only by 0.7%. The higher increase was observed in the case of plant protection products (+1.6%). However, the greatest increase was observed in the prices of agricultural machinery (+3.5%), which may be partially due to the greater availability of funds from the new RDP.

In 2015, the prices of wheat increased by 0.9%, of barley and rye – by 4.3 and 5.3%, but of maize by as much as 27.2%. In total, those increases were very moderate, if we consider the declines in the harvest. This is due to globalisation, which is to

largely outdate the so-called natural protection against the price risk. The above term defines a situation where despite the decline in the harvest of some crop, its prices do not rise, as in other regions of the world its harvest increased, therefore, the overall supply did not decrease. Here, we need to add that the price and quality competitiveness of Polish wheat deteriorated, and the domestic demand for cereals was relatively stable. It is interesting in this context that the above-mentioned natural hedging, to some extent, worked for potatoes, where the prices rose by 31%. The problem here, however, is complicated as the cultivation area of that crop kept on decreasing. The prices of poultry and cattle were in 2015 very beneficial. On the other hand, there was a definite decrease in the prices of milk (by 8.6%) and pork (by 7.8%).

Table 3 presented the basic descriptive statistics of the analysed indices and indicators. As in previous years, in 2015 we had to do with a very diverse community of farms. This may not be surprising, as their economic and financial achievements are shaped by a large number of exo- and endogenous factors. In the case of financial efficiency indices, i.e. cost-effectiveness, profitability and cash returns, much greater variability was shown by those in which family farm income was decreased by the remuneration for farm family's labour and contractual interest rate of equity. When it comes to the indices of liquidity, solvency and financial stability, they are clearly more diverse when their structure includes cash flows, i.e. the category showing large fluctuations. In other indices, the situation is approximately similar. In other words, if the formula of calculating the index contains the positive and relatively homogeneous categories (for example, in a form of totals), the variability, to some extent by definition, should be smaller. This correlation can be seen well also in the group of relationships describing budgetary support of the analysed farms. The rate of subsidisation I, thus being a quotient of the amount of support and agricultural production, showed a coefficient of variability equal to 128. The rate II (1), where the denominator contains family farm income, increases this coefficient to 536, the rate II (2), where we divide support by above income reduced by the own labour costs, results in its increase to 3,105. Against this background, in turn, both indicators of decoupling budgetary support and the share of payment to operating activities in this support were very stable.

The evolution of average values of the analysed indices and indicators in the years 2010-2015 and in two subperiods, 2010-2012 and 2013-2015, are shown in Table 4. In the case of the financial efficiency, the negative trends, basically observed already in 2013, were, unfortunately, continued. In 2015, all indices from the above area deteriorated in relation to 2014 and both indicated subperiods. Against that background, particularly negative was the cost--effectiveness and cash returns on total assets and equity. In turn, the

profitability decreased only slightly when compared to previous years. In these conditions, we should not be surprised by the decisive decline in family farm income, both formulas of profit, cash flows (I), gross and net investments and equity in the period of 2014-2015, and most often also in relation to the averages of two subperiods. Alarming should also be the regression in the current and rapid liquidity and in the cash flow/credit ratio. Positive is, however, in this case, a small improvement in the cash generation ratio and cash flow/investment ratio (1). Finally, we have to note that average budgetary support per one farm in the analysed two-year period also slightly decreased (by 2.1%), while being only slightly higher than, on average, in the years 2010-2012 (by PLN 1.4 thousand) and 2013-2015 (by only PLN 800). On the other hand, all three rates of subsidisation increased, mostly the rate II (2), with the exception of the rate I, and reached the historically highest level. In turn, very stable were both levels of decoupling of payments and the share of the part supporting operating activities in these payments.

Table 3

Descriptive statistics of the panel of farms owned by natural persons for 2015

Item	Specification	M.u.	Number of farms	Mean	Median	Min.	Max.	Standard deviation (SD)	Coefficient of variation (CV) [%]
1	Return on equity (1)	%	7 086	2,3	1,7	-70,6	133,8	8	360
2	Return on equity (2)	%	7 086	0,5	0,0	-71,9	133,0	8	1 714
3	Total return on assets (1)	%	7 086	2,2	1,8	-70,6	130,0	8	348
4	Total return on assets (2)	%	7 086	0,3	0,0	-71,9	129,3	8	2 673
5	Cash return on equity	%	7 086	9,9	8,2	-24,6	179,4	9	90
6	Cash return on total assets	%	7 086	9,2	7,8	-24,2	179,4	8	87
7	Total profitability index	%	7 086	118,8	113,7	16,6	488,3	37	31
8	Sales profitability index	%	7 086	123,0	118,5	7,3	469,1	43	35
9	Current ratio	multiplicity	3 498	8,9	4,8	0,0	183,5	14	154
10	Quick ratio	multiplicity	3 498	2,5	0,9	0,0	96,2	5	212
11	Cash flow/total credit and loans	multiplicity	3 516	3,2	1,1	-16,1	326,5	11	331
12	Investment coverage	multiplicity	3 083	5,7	2,4	-50,1	119,4	9	164
13	Cash generating ratio (1)	%	6 510	0,0257	0,0135	0,0002	9,3815	0,1473	573
14	Cash generating ratio (2)	%	344	0,0206	0,0042	0,0000	1,1527	0,0785	381
15	Equity growth	%	2 971	6,5	3,4	0,0	228,4	11	161
16	Change in the values of equity	PLN thous.	7 086	4,5	-5,5	-2 752,3	2 630,7	139,6	3 098
17	Working capital growth	%	3 479	70,6	24,9	0,0	13 684,8	378	535
18	Working capital (EY)	PLN thousands	7 086	110,0	68,1	-945,3	5 245,9	169,4	154
19	Economic size	PLN thousands	7 086	249,0	165,1	17,3	5 658,1	304,1	122
20	Investment rate	%	7 085	101,9	0,0	0,0	7 165,7	315	309

Table 3 cont.

21	Gross investment	PLN thousands	7 086	54,7	0,0	0,0	4 168,7	168,5	308
22	Net investment	PLN thousands	7 086	19,5	-10,0	-658,4	3 978,7	158,3	814
23	Assets to equity ratio	%	7 086	94,6	100,0	16,9	100,0	9	10
24	Asset freezing ratio	multiplicity	7 076	13,0	9,7	0,2	579,2	15	119
25	Total subsidies	PLN thousands	7 086	47,6	27,2	0,0	696,5	64,0	134
26	Cash flows (1)	PLN thousands	7 086	118,4	70,4	-457,4	6 830,3	179,8	152
27	Cash flows (2)	PLN thousands	7 086	-42,9	-10,0	-1 634,3	1 013,9	104,5	*
28	Family farm income	PLN thousands	7 086	82,9	47,7	-394,1	5 321,2	140,3	169
29	Farm profit	PLN thousands	7 086	48,1	14,3	-427,9	5 267,9	137,5	286
30	Entrepreneurial profit	PLN thousands	7 086	26,2	-0,2	-419,2	5 046,0	126,5	482
31	Subsidy rate I	%	7 086	28,9	22,1	0,0	1 124,5	37	128
32	Subsidy rate II (1)	%	7 079	78,2	57,3	-8 288,7	9 684,9	420	536
33	Subsidy rate II (2)	PLN thousands	7 061	34,8	38,9	-38 619,8	36 282,1	1 081	3 105
34	Decoupling rate I of subsidies to operational activities from production	PLN thousands	6 694	74,1	83,1	0,0	100,0	26	35
35	Decoupling rate II of subsidies from production	PLN thousands	6 785	77,0	85,2	0,0	100,0	24	31
36	Share of subsidies to operational activities in all subsidies	%	6 785	90,8	100,0	0,0	100,0	19	21

* Due to the fact that the average value of cash flows (2) is a negative value, the coefficient of variation was not calculated.

Source: own calculations based on data from the Polish FADN.

Table 4

The values of measures and indicators in the farm panel in years 2010-2015

No.	Specification	M.u.	Years 2010-2012	Years 2013-2015	2010	2011	2012	2013	2014	2015	$\frac{2015}{2014}$ x 100
1	Return on equity (1)	%	5,8	4,6	5,1	6,0	6,3	5,5	4,5	3,9	71,3
2	Return on equity (2)	%	3,5	2,8	2,7	3,6	4,1	3,6	2,8	2,1	59,1
3	Total return on assets (1)	%	5,6	4,5	5,0	5,8	6,1	5,3	4,4	3,8	72,7
4	Total return on assets (2)	%	3,5	2,8	2,7	3,6	4,1	3,6	2,8	2,1	59,1
5	Cash return on equity	%	10,5	10,5	9,9	10,4	11,3	11,4	10,5	9,6	84,1
6	Cash return on total assets	%	9,7	9,5	9,1	9,6	10,4	10,4	9,5	8,7	83,7
7	Total profitability index	%	129,0	120,4	128,2	128,3	130,3	122,7	120,6	117,9	96,1
8	Sales profitability index	%	129,5	127,3	127,6	128,7	131,7	130,1	127,7	124,0	95,3
9	Current ratio	multiplicity	3,98	3,55	3,70	4,04	4,19	3,90	3,46	3,33	85,6
10	Quick ratio	multiplicity	1,08	0,94	1,04	1,09	1,10	1,06	0,90	0,87	82,2
11	Cash flow/total credit and loans	multiplicity	0,88	0,74	0,86	0,88	0,90	0,82	0,73	0,66	80,3
12	Investment coverage	multiplicity	1,29	1,36	1,26	1,34	1,28	1,31	1,40	1,36	103,3
13	Cash generating ratio (1)	%	0,012	0,014	0,012	0,012	0,012	0,013	0,014	0,014	102,2
14	Cash generating ratio (2)	%	0,004	0,006	0,004	0,004	0,004	0,006	0,004	0,008	128,1
15	Equity growth	%	8,0	7,2	7,7	8,1	8,2	7,3	8,2	5,8	79,3
16	Change in the values of equity	PLN thous.	44,6	25,9	29,8	57,4	46,5	39,6	33,5	4,5	11,4
17	Working capital growth	%	42,9	31,0	44,9	45,8	38,6	31,6	29,7	31,4	99,5
18	Working capital (EY)	PLN thousands	102,9	111,6	88,1	104,9	115,8	115,7	109,0	110,0	95,1
19	Economic size	PLN thousands	233,7	246,0	231,7	233,5	236,0	238,7	250,2	249,0	104,3
20	Investment rate	%	154,4	126,1	153,1	145,6	164,0	138,5	129,4	111,0	80,1
21	Gross investment	PLN thous.	59,9	63,1	53,3	56,6	69,8	71,7	62,8	54,7	76,2
22	Net investment	PLN thous.	28,8	28,0	24,5	24,9	36,9	35,6	28,9	19,5	54,6

Table 4 cont.

23	Assets to equity ratio	%	92,0	90,8	92,2	92,1	91,6	90,9	90,8	90,7	99,8
24	Asset freezing ratio	multiplicity	8,5	8,7	9,4	8,4	8,0	8,3	8,9	8,8	106,8
25	Total subsidies	PLN thousands	46,2	46,8	45,4	47,2	46,0	48,7	44,2	47,6	97,9
26	Cash flows (1)	PLN thousands	113,8	126,6	102,1	111,9	127,4	133,9	127,5	118,4	88,4
27	Cash flows (2)	PLN thousands	-43,7	-47,9	-40,5	-41,4	-49,3	-50,6	-50,0	-42,9	*
28	Family farm income	PLN thousands	94,2	89,5	53,1	64,7	71,4	64,2	55,0	48,1	75,0
29	Farm profit	PLN thousands	63,1	55,8	83,1	95,5	104,0	97,2	88,3	82,9	85,3
30	Entrepreneurial profit	PLN thousands	37,7	34,0	27,8	38,8	46,5	42,2	33,7	26,2	62,1
31	Subsidy rate I	%	17,2	17,6	18,7	18,3	15,2	18,0	16,8	18,1	100,8
32	Subsidy rate II (1)	%	44,3	52,2	46,8	46,4	40,3	50,3	50,8	55,8	111,0
33	Subsidy rate II (2)	PLN thousands	66,0	83,6	73,2	68,4	58,5	76,1	81,5	96,0	126,2
34	Decoupling rate I of subsidies to operational activities from production	PLN thousands	64,9	76,6	60,4	64,6	69,4	75,6	79,4	74,9	99,1
35	Decoupling rate II of subsidies from production	PLN thousands	67,5	79,0	62,8	67,2	72,2	77,8	81,7	77,6	99,7
36	Share of subsidies to operational activities in all subsidies	%	92,1	89,8	93,4	92,3	90,7	90,8	89,1	89,5	98,5

* Due to the fact that the average value of cash flows (2) is negative in the analysed years, the change of this measure in 2015 as compared to 2014 is not presented.

Source: own calculations based on data from the Polish FADN.

The impact of the economic size of the analysed farms on the constructed indices and indicators is shown in Table 5. As in previous years, the considerations are conducted in five size groups. It should be added that in the case of very small units, most indices of liquidity and debt servicing capacity and the cash flow/investment ratio were not provided, as the latter were often negative. Table 5 may be summarised as follows:

1. Without any exception, all indices of cost-effectiveness, cash returns and profitability increased along with the size of the farms. The smallest differences applied here to the indices of profitability. Only in the small farms, the values of all eight efficiency relationships increased in the two--year period 2014-2015. If we ignore very small and small units, it appears that the financial efficiency in three other groups also decreased in relation to two identified subperiods. Certainly, to some extent this was due to the economic slump, which explains the evolution of the sales profitability index, and thus the indicator not containing any subsidies. The problem, however, becomes more complicated as the profitability in very small and small units in 2015 was higher than in the subperiod 2013-2015.
2. In terms of the static and dynamic liquidity and the cash flow/credit and investment ratio, the situation looks interesting. On one extreme, there are small units which, on average, apply financial conservatism and are not much risky, which means great attention to financial security. On the other hand, other farms pursued the more aggressive financial policy. This is expressed primarily by the lower indices of the current and rapid liquidity and the wider use of credits. The latter results from the evolution of the equity/assets ratio. To this, we should add the greater flexibility in larger farms, as evidenced by the central immobilisation index. If we compare, however, these more risky strategies with the higher financial efficiency, we can see that *per saldo* they are rather more effective than conservative.
3. With the exception of small farms, average family farm income in 2015 was everywhere lower than in 2014 and in two identified subperiods. Starting with medium and small units, we had to do with the same phenomenon also in the case of profits. Total subsidies per farm showed various trends against this background. In the two-year period 2014-2015, they decreased only in very small units, while in large units, their value in 2015 was lower when compared to two subperiods. Small and medium--small farms are two groups, in which the average value of budgetary support increased in the years 2010-2015. Concern must also be raised by the fact that 2015 saw the almost general deterioration of the financial potential of the farms and possibility of self-financing their development,

thus, the adverse situation in the field of generating equity, investment rate, net investments and cash flows (2). If these trends persisted in the following years, the existence of many farms would be seriously at risk.

4. All three rates of subsidisation in 2015, as in previous years, decreased as the size of the farms increased. This may not be surprising as the Polish budget policy supports smaller unit. These rates, however, starting with medium-small units, increased in the two-year period of 2014-2015. There were also, on average, higher than those observed in two subperiods. In contrast, the intergroup diversification of the level of decoupling budgetary support was low, although it was higher everywhere than in the years 2010-2012. It would result from this that – theoretically speaking – the analysed farmers should include the market signals more extensively in their decisions. Moreover, noticeable is the fact that medium-large units received relatively more subsidies from the second pillar than units from three smaller groups. On the other hand, however, the interpillar proportions show the high stability over time in the individual economic size classes.

Table 5

Values and indicators in the panel of farms depending on their economic size in 2015

No.	Specification	M.u.	Very small (A)				Small (B)				Medium-small (C)				Medium-large (D)				Large and very large (E;F)			
			Years 2010-2012	Years 2013-2015	2014	2015	Years 2010-2012	Years 2013-2015	2014	2015	Years 2010-2012	Years 2013-2015	2014	2015	Years 2010-2012	Years 2013-2015	2014	2015	Years 2010-2012	Years 2013-2015	2014	2015
1	Return on equity (1)	%	-4,8	-5,2	-5,4	-5,1	-0,02	-1,1	-1,6	-1,1	3,9	2,7	2,3	2,1	6,2	4,9	4,9	4,2	9,0	7,3	7,4	6,1
2	Return on equity (2)	%	-7,2	-6,9	-7,0	-6,7	-2,3	-2,8	-3,3	-2,8	1,5	0,9	0,6	0,4	3,9	3,1	3,1	2,4	6,6	5,4	5,6	4,3
3	Total return on assets (1)	%	-4,8	-5,1	-5,3	-5,0	0,1	-1,0	-1,5	-1,1	3,8	2,7	2,4	2,2	6,0	4,8	4,8	4,1	8,3	6,7	6,7	5,7
4	Total return on assets (2)	%	-7,2	-6,9	-7,0	-6,7	-2,3	-2,8	-3,3	-2,8	1,5	0,9	0,6	0,4	3,9	3,1	3,1	2,4	6,6	5,4	5,6	4,3
5	Cash return on equity	%	5,4	5,4	5,5	4,7	7,4	7,2	6,8	6,9	9,3	9,2	9,2	8,3	10,7	10,4	10,5	9,5	12,4	12,3	12,3	11,2
6	Cash return on total assets	%	5,4	5,4	5,5	4,6	7,2	7,1	6,7	6,8	8,9	8,8	8,8	8,0	9,8	9,5	9,6	8,7	10,9	10,6	10,6	9,6
7	Total profitability index	%	112,9	98,3	95,2	99,5	119,6	110,8	107,4	112,2	130,1	119,2	118,2	117,6	131,3	121,7	122,6	118,4	128,7	121,5	122,3	118,5
8	Sales profitability index	%	98,6	95,3	89,5	96,3	114,1	112,5	108,9	113,5	127,3	124,0	123,6	121,1	130,4	126,8	128,1	122,1	132,4	130,7	131,4	127,3
9	Current ratio	multiplicity	-*	-*	-*	-*	4,07	3,90	3,98	3,63	4,30	4,18	4,08	3,97	4,02	3,65	3,53	3,55	3,85	3,35	3,26	3,08
10	Quick ratio	multiplicity	-*	-*	-*	-*	1,17	1,23	1,23	1,24	1,19	1,16	1,12	1,10	1,07	0,97	0,92	0,95	1,04	0,85	0,82	0,76
11	Cash flow/total credit and loans	multiplicity	-*	-*	-*	-*	1,07	1,03	0,99	0,98	1,08	0,98	1,02	0,88	0,96	0,82	0,81	0,75	0,77	0,65	0,65	0,58
12	Investment coverage	multiplicity	-*	-*	-*	-*	1,16	1,42	1,40	1,19	1,33	1,48	1,68	1,31	1,27	1,39	1,41	1,37	1,31	1,30	1,33	1,38
13	Cash generating ratio (1)	%	0,012	0,014	0,015	0,014	0,012	0,014	0,014	0,013	0,012	0,014	0,014	0,013	0,012	0,014	0,014	0,014	0,012	0,014	0,013	0,014
14	Cash generating ratio (2)	%	-*	-*	-*	-*	0,007	0,008	0,006	0,010	0,004	0,006	0,004	0,008	0,003	0,005	0,003	0,007	0,004	0,007	0,004	0,008
15	Equity growth	%	5,7	5,8	8,6	3,4	6,4	6,2	7,6	5,9	7,1	6,4	7,5	5,4	7,8	7,2	8,6	5,7	9,2	7,7	8,4	6,0
16	Change in the values of equity	PLN thous.	1,9	-5,1	-5,5	-6,6	5,9	-0,3	0,1	-3,0	23,3	8,0	10,6	-3,6	58,5	35,7	48,1	5,0	154,3	97,3	118,7	34,1
17	Working capital growth	%	36,5	24,0	22,6	25,1	37,7	29,8	27,2	32,6	41,0	28,5	25,9	30,2	42,3	29,9	28,5	31,2	46,2	33,6	33,3	32,1
18	Working capital (EY)	PLN thous.	19,4	19,1	20,0	18,5	39,1	41,4	39,9	41,9	72,5	79,3	76,9	78,5	122,8	130,9	126,6	128,4	279,9	284,0	276,2	272,1
19	Economic size	PLN thous.	29,1	28,1	28,2	27,9	66,6	65,4	65,3	65,0	146,6	146,6	146,8	146,2	281,6	283,1	283,2	283,6	722,2	741,5	754,4	743,5
20	Investment rate	%	20,4	17,1	13,7	12,2	63,2	49,3	47,5	54,7	114,8	91,7	90,7	85,0	175,3	128,0	131,0	112,0	192,6	162,1	168,1	135,6
21	Gross investment	PLN thous.	3,1	2,4	3,6	1,8	9,5	7,5	7,1	8,4	29,8	28,1	26,1	25,6	81,1	77,3	77,3	67,2	203,0	218,9	217,1	178,6
22	Net investment	PLN thous.	-3,5	-4,3	-3,4	-4,3	-2,9	-4,7	-4,6	-3,3	7,7	5,0	3,9	3,3	42,0	34,1	35,9	24,3	123,9	128,0	129,9	86,0
23	Assets to equity ratio	%	99,1	99,5	99,3	99,6	97,8	98,2	98,3	98,2	95,2	95,3	95,5	95,5	92,2	91,5	91,6	91,6	87,8	86,0	86,0	85,9
24	Asset freezing ratio	krotność	11,6	12,9	12,8	13,2	9,7	9,7	10,2	9,6	9,1	8,9	9,2	8,9	9,0	9,0	9,3	9,2	7,5	8,1	8,3	8,4
25	Total subsdies	PLN thous.	7,9	9,9	10,6	8,3	16,7	17,5	16,3	17,9	32,1	33,6	31,4	33,8	61,5	58,5	53,5	60,5	116,3	112,1	107,5	110,5
26	Cash flows (1)	PLN thous.	13,3	14,8	15,5	12,9	32,6	33,5	31,7	32,5	73,8	77,9	78,7	70,8	145,1	153,3	154,3	141,8	330,1	363,8	362,5	336,3
27	Cash flows (2)	PLN thous.	-1,8	0,4	3,0	-0,4	-6,5	-5,6	-5,6	-4,9	-22,1	-21,4	-22,0	-17,6	-57,8	-58,7	-61,1	-52,7	-150,8	-166,5	-172,3	-148,3
28	Family farm income	PLN thous.	10,7	8,6	8,7	7,5	25,1	22,4	19,8	22,7	60,3	54,7	51,9	50,9	119,1	108,8	107,4	99,9	280,8	259,7	259,9	232,6
29	Farm profit	PLN thous.	-11,9	-14,2	-15,0	-14,0	-0,1	-5,1	-7,6	-5,4	30,5	22,6	19,6	18,0	84,7	72,6	71,5	62,9	239,7	214,4	216,7	184,3
30	Entrepreneurial profit	PLN thous.	-17,9	-18,8	-19,6	-18,5	-10,2	-13,2	-15,6	-13,3	12,2	7,6	4,8	3,2	52,9	46,1	45,8	36,0	175,7	160,2	164,3	130,2
31	Subsidy rate I	%	28,9	38,8	42,6	35,2	25,6	28,9	28,9	29,1	20,9	22,9	21,7	23,6	18,6	19,4	18,2	20,7	13,3	13,3	12,8	13,4
32	Subsidy rate II (1)	%	74,4	114,4	124,4	111,2	63,0	77,5	84,6	75,5	48,5	59,9	59,8	62,7	44,8	53,2	50,8	58,3	37,9	43,8	42,4	47,4
33	Subsidy rate II (2)	%	-67,0	-69,3	-72,2	-59,7	-23 068,5	-338,6	-218,9	-317,7	95,6	144,8	157,3	177,1	63,0	79,7	76,2	92,6	44,5	53,1	50,8	59,8
34	Decoupling rate I of subsidies to operational activities from production	%	65,7	76,0	76,2	78,7	65,7	76,6	79,4	76,1	66,3	76,5	78,8	75,5	65,0	76,4	78,9	75,3	63,5	76,8	80,3	74,0
35	Decoupling rate II of subsidies from production	%	66,2	76,5	76,7	79,1	67,0	77,8	80,5	77,3	68,4	78,3	80,4	77,3	67,9	79,4	81,8	78,5	66,7	79,4	82,6	77,0
36	Share of subsidies to operational activities in all subsidies	%	98,5	98,1	97,9	98,4	95,7	95,1	94,8	95,1	93,4	92,5	91,9	92,4	91,4	87,3	86,1	86,9	90,8	88,9	88,3	88,5

* Due to the fact that the average value of cash flows (2) in the analyzed years takes negative values, the change in the value of this measure in 2015 as compared to 2014 is not presented.

Source: own calculations based on data from the Polish FADN.

Table 6 shows the analysed indices and indicators according to seven types of production. It is worth noting that virtually all relationships in the field of the financial efficiency in 2015 were better than in 2014 for all three types belonging to the crop production, although the embargo on the export of fruit and vegetables to Russia was nominally still in effect. For the type "horticultural crops", the results of 2015 were even better than in 2014 in all three types belonging to the crop production. For the type "horticultural crops" the results of 2015 were even better than in two subperiods. This correlation was to a large extent observed also in "permanent crops". We should add here that the sales profitability, thus the result not containing any subsidies, in the analysed two--year period 2014-2015 deteriorated only in case of field units. These facts are clearly in contradiction with the general regression in the crop production in entire agriculture. This requires to nuance also the previous conclusion on disappearing of the so-called effect of natural hedging in the conditions of globalisation. In three types of the livestock production in the years 2014-2015 all indicators of efficiency deteriorated, but to the smallest extent in the case of granivores. As we remember from the previous considerations, the livestock production of agriculture increased in that period. The efficiency indices for livestock types of 2015 were usually worse than the averages of two subperiods, but at this moment positive were the farms keeping granivores, where cash returns were even higher than in the years 2010-2012. In all analysed types, the highest financial efficiency in 2015 was shown by horticultural farms. Their advantage over the type "herbivores", which was the least effective, in the case of the cost-effectiveness (2) of assets and equity was even 40-fold.

In the two-year period 2014-2015, there were no important changes with regard to the static liquidity, i.e. more or less the equal number of the types experienced some improvement, and a slight deterioration, while the working capital resource improved more often and the fluctuations in terms of cash generating were also small. Compared to the averages of two subperiods, the liquidity situation, especially in static terms, in 2015 was mostly slightly deteriorated. In turn, rather stable was the situation when it comes to cash flow/credit ratio (1). On the other hand, in the crop production types in the years 2010-2015 the cash flow/investment ratio definitely improved. In the analysed types self-financing of activity dominated, as evidenced by the equity/assets ratio, typically exceeding the level of 90%. Here, the horticultural farms stand out again, where the above ratio in 2015 was close to 76%. This may mean that those farms, using debt more extensively, achieved a positive leverage, which then was translated to their highest financial efficiency. On the other hand, those units in 2015 had the second highest central immobilisation index, and thus did not show

the high flexibility. At the same time, the horticultural farms had one of the lowest current liquidity and rapid indices. This may indicate both the financial tension and the deliberate strategy to maintain low resources of liquid assets, so as to increase the cost-effectiveness.

Family farm income and both profits in the two-year period of 2014-2015 improved only in the horticultural farms and in the type "permanent crops", reaching in 2015 the maximum level of the entire period 2010-2015. In the other types, the moderate decreases in these three categories were most often dominant, although the regression in the units involved in the milk production was clear. The situation was slightly better in the mixed farms, which suggests that the diversification of the agricultural activity did not amortise sufficiently the unfavourable economic situation in 2015. Cash flows (1), as the indicator of the financial potential, improved only in the horticultural farms and units with permanent crops. In turn, those marked as (2) decreased only in the type "granivores". In all types, we could observe the decrease in the equity creation rate in 2015. This is equal to the shrinking of the self-financing base and risk buffering capacity. It had immediately a negative impact on the investment rate which in the two-year period 2014-2015 improved only in the type "granivores".

Total subsidies in thousand PLN per farm in 2015 were higher when compared to 2014, in four types: "field crops", "dairy cows", "granivores" and "mixed". However, only in the latter they were higher than the average for two subperiods. For many years, the situation in this regard has been virtually stable i.e. the maximum amount of subsidies occurs in the field units, and the minimal – in the horticultural farms. In 2015, the difference between them amounted to 7.6:1. However, it deepens when we compare three rates of subsidisation. After taking a closer look, it turns out that this is not the field units which have the highest rates of subsidisation, as these rates are clearly higher in the type "granivores". In turn, in the type "granivores", these rates were, in the last year of analysis, lower than in the case of farms focused on keeping ruminants, from 2.5 (rate II (1) to 5.6 times (two other rates). Throughout the six-year period, relative budgetary support declined only in the horticultural farms. A moderate increase in both rates of subsidisation II was, in turn, observed in the most liberalised type, i.e. the farms keeping granivores.

Table 6

Values and indicators in the panel of farms depending on their economic size in 2015

No.	Specification	M.u.	Fieldcrops (1)				Horticulture (2)				Uprawy trwałe (4)				Milk (5)				Other grazing livestock (6)				Granivores (7)				Mixed (8)			
			Years 2010-2012	Years 2013-2015	2014	2015	Years 2010-2012	Years 2013-2015	2014	2015	Years 2010-2012	Years 2013-2015	2014	2015	Years 2010-2012	Years 2013-2015	2014	2015	Years 2010-2012	Years 2013-2015	2014	2015	Years 2010-2012	Years 2013-2015	2014	2015	Years 2010-2012	Years 2013-2015	2014	2015
1	Return on equity (1)	%	7,6	5,1	4,9	4,5	9,3	12,1	11,6	13,9	5,2	3,4	0,1	5,4	5,5	5,4	6,1	4,1	3,0	2,0	2,1	1,7	8,0	6,6	6,0	5,4	3,8	2,7	2,6	1,9
2	Return on equity (2)	%	5,6	3,5	3,3	2,9	5,9	10,0	9,8	11,8	2,6	1,6	-1,6	3,6	2,8	3,4	4,2	2,1	0,3	0,0	0,1	-0,3	5,2	4,6	4,0	3,5	1,5	0,9	0,8	0,1
3	Total return on assets (1)	%	7,2	4,9	4,7	4,3	8,2	10,1	9,7	11,2	5,1	3,4	0,4	5,3	5,3	5,2	5,9	4,0	3,0	2,1	2,2	1,8	7,5	6,3	5,7	5,2	3,8	2,8	2,7	2,0
4	Total return on assets (2)	%	5,6	3,5	3,3	2,9	5,9	10,0	9,8	11,8	2,6	1,6	-1,6	3,6	2,8	3,4	4,2	2,1	0,3	0,0	0,1	-0,3	5,2	4,6	4,0	3,5	1,5	0,9	0,8	0,1
5	Cash return on equity	%	11,4	10,2	9,9	9,3	20,5	25,2	24,1	27,5	11,6	11,2	9,9	11,1	10,9	11,2	12,0	9,8	8,4	7,6	8,0	7,2	11,9	12,9	12,7	12,0	8,6	8,8	8,8	8,0
6	Cash return on total assets	%	10,4	9,1	8,8	8,3	16,7	19,3	18,2	20,8	10,9	10,5	9,3	10,5	10,0	10,3	11,0	9,0	7,8	7,1	7,4	6,6	10,7	11,7	11,6	10,8	8,1	8,2	8,2	7,5
7	Total profitability index	%	134,2	117,9	118,0	115,7	129,8	133,6	131,9	135,9	150,8	130,2	106,2	143,3	137,3	132,5	136,5	125,9	112,5	106,0	107,6	109,5	121,3	116,8	116,0	114,7	123,2	114,2	114,3	110,9
8	Sales profitability index	%	126,9	116,9	116,4	113,2	128,9	133,2	131,3	136,6	140,5	131,0	119,8	131,9	136,4	135,0	139,5	127,7	104,8	106,1	106,6	109,1	135,8	141,8	143,5	139,9	123,4	123,1	122,3	121,0
9	Current ratio	multiplicity	4,16	3,49	3,37	3,26	1,76	1,16	1,03	1,17	4,35	3,04	2,51	2,88	2,74	2,90	2,93	2,88	3,47	3,23	3,17	3,67	4,66	4,31	4,26	3,87	4,80	4,47	4,37	4,11
10	Quick ratio	multiplicity	1,32	1,08	1,05	0,93	0,86	0,63	0,49	0,74	1,30	0,98	0,87	0,93	0,77	0,74	0,75	0,74	0,56	0,46	0,45	0,60	0,99	0,90	0,87	0,85	1,08	0,97	0,90	0,90
11	Cash flow/total credit and loans	multiplicity	0,85	0,62	0,59	0,56	0,70	0,58	0,52	0,65	1,11	0,92	0,80	0,94	0,95	0,90	0,96	0,78	0,74	0,57	0,65	0,54	0,82	0,89	0,92	0,77	0,92	0,80	0,79	0,71
12	Investment coverage	multiplicity	1,19	1,15	1,16	1,21	1,66	1,22	1,33	2,24	1,53	1,73	1,36	2,10	1,43	1,65	1,71	1,67	1,22	1,16	1,23	1,06	1,36	1,69	1,87	1,32	1,23	1,33	1,38	1,21
13	Cash generating ratio (1)	%	0,012	0,014	0,014	0,014	0,014	0,014	0,014	0,014	0,013	0,015	0,019	0,012	0,012	0,013	0,013	0,013	0,012	0,013	0,013	0,012	0,011	0,013	0,014	0,015	0,012	0,014	0,014	0,014
14	Cash generating ratio (2)	%	0,004	0,007	0,005	0,010	0,007	0,009	0,012	0,009	0,006	0,007	0,004	0,011	0,003	0,004	0,002	0,006	0,005	0,004	0,002	0,003	0,004	0,004	0,001	0,007	0,004	0,007	0,005	0,007
15	Equity growth	%	9,2	8,4	10,5	6,0	11,2	12,1	12,5	11,9	9,3	7,2	7,6	6,9	7,5	6,2	6,3	4,6	8,1	7,2	9,3	5,4	8,4	7,1	7,1	6,6	6,9	6,2	6,9	5,5
16	Change in the values of equity	PLN thous.	69,1	52,0	71,4	28,8	9,7	9,1	9,7	-6,1	28,7	3,8	-13,0	15,7	51,7	25,1	38,6	-19,0	30,4	14,8	27,5	-1,0	58,7	16,1	0,7	-1,0	27,8	12,4	14,3	0,1
17	Working capital growth	%	50,1	34,5	33,5	32,6	41,2	35,3	32,4	37,3	69,0	38,1	38,7	43,8	46,1	33,4	33,3	32,5	35,8	28,4	26,7	32,5	36,8	30,2	24,3	36,5	36,3	25,9	25,5	25,8
18	Working capital (EY)	PLN thous.	142,7	141,8	137,2	139,3	45,4	38,2	33,3	39,4	101,6	93,9	77,4	98,0	60,8	74,6	74,0	76,6	70,3	79,1	74,4	88,9	191,2	206,5	199,7	194,0	90,4	101,2	100,7	98,0
19	Economic size	PLN thous.	245,4	239,7	239,3	241,2	330,4	389,0	392,6	403,5	133,7	138,2	138,9	140,4	227,2	247,6	249,9	253,8	149,5	181,0	241,2	157,5	533,3	570,7	572,0	585,2	181,0	189,6	192,8	191,8
20	Investment rate	%	175,2	139,1	136,4	127,6	117,0	174,8	168,9	85,7	106,7	91,3	105,6	69,3	174,2	128,7	145,4	96,4	106,9	95,6	127,6	76,8	167,0	124,8	117,3	133,5	129,8	108,8	108,9	108,2
21	Gross investment	PLN thous.	92,5	93,3	87,0	79,8	51,9	94,7	92,3	48,5	51,7	46,1	51,0	35,6	65,3	65,1	70,7	52,8	29,9	30,6	33,2	26,2	76,5	67,8	62,4	71,6	37,0	39,3	40,0	36,7
22	Net investment	PLN thous.	54,6	51,3	46,6	37,7	9,9	50,2	51,5	2,2	8,4	2,6	9,3	-7,6	32,9	26,9	33,6	14,1	8,4	8,1	11,5	3,5	35,9	23,8	20,8	27,3	13,6	13,7	15,2	11,6
23	Assets to equity ratio	%	90,8	89,0	89,0	89,0	81,5	75,7	75,1	75,8	93,6	93,7	93,4	94,2	92,1	91,8	91,7	91,7	93,4	92,7	92,8	92,9	90,0	90,6	90,9	90,2	94,1	93,2	93,2	93,2
24	Asset freezing ratio	krotność	7,9	8,7	8,9	8,9	9,3	10,0	10,5	9,2	7,7	8,2	9,6	7,8	13,6	12,9	13,3	12,7	9,0	8,8	9,2	8,2	5,7	5,6	5,7	6,0	8,2	7,9	8,0	8,1
25	Total subsdies	PLN thous.	73,7	72,0	66,9	72,5	13,4	12,0	15,7	9,6	20,5	25,1	30,4	24,5	41,9	38,0	36,2	37,8	46,2	45,1	44,7	41,3	44,7	42,1	39,4	42,7	36,3	38,5	35,6	40,0
26	Cash flows (1)	PLN thous.	158,1	156,0	150,1	145,8	140,5	186,2	179,0	208,1	111,7	111,0	97,9	109,8	118,9	139,4	151,3	124,3	65,2	66,9	69,2	64,5	162,9	189,6	186,1	179,6	76,1	85,3	86,6	78,4
27	Cash flows (2)	PLN thous.	-62,4	-66,7	-67,5	-61,2	-49,9	-66,1	-69,1	-55,1	-42,5	-40,9	-43,5	-36,9	-49,9	-54,0	-60,5	-45,2	-23,9	-25,3	-28,3	-22,5	-61,1	-57,9	-53,4	-56,1	-26,7	-28,7	-30,0	-25,3
28	Family farm income	PLN thous.	134,1	108,8	104,7	102,3	96,0	125,4	121,6	142,1	78,1	63,9	31,7	84,5	94,5	104,9	114,3	90,5	53,5	50,4	50,8	49,7	143,5	134,0	123,6	120,0	64,0	59,4	58,5	52,9
29	Farm profit	PLN thous.	105,2	77,9	74,3	70,6	63,4	89,5	86,6	104,7	50,3	33,6	1,5	53,3	59,7	67,2	76,9	51,8	23,4	17,2	17,8	15,0	109,6	97,1	87,5	81,7	33,8	26,2	25,5	18,6
30	Entrepreneurial profit	PLN thous.	78,1	53,6	50,5	45,8	40,4	74,0	72,9	89,3	25,3	15,9	-15,7	36,0	30,2	42,3	52,5	26,7	2,7	-0,4	0,9	-3,1	71,2	67,1	58,3	52,2	13,4	8,9	8,3	1,3
31	Subsidy rate I	%	25,5	26,9	25,2	27,8	3,0	2,3	2,8	1,9	8,3	12,7	18,3	11,6	15,7	14,5	13,4	14,8	43,8	42,6	40,7	37,2	6,8	6,4	6,5	6,6	19,0	20,3	19,1	21,2
32	Subsidy rate II (1)	%	51,0	65,6	64,1	69,1	11,7	8,7	10,6	6,8	19,7	35,7	81,4	27,8	37,7	38,0	34,1	42,9	82,7	91,6	88,6	85,2	27,8	31,2	32,7	33,9	51,5	63,5	61,9	70,4
33	Subsidy rate II (2)	%	65,0	91,4	90,2	100,1	17,7	12,2	14,9	9,2	30,6	67,6	1 772,8	43,8	59,6	59,3	50,5	74,9	187,6	268,8	253,0	282,5	36,5	43,0	46,1	49,7	97,3	143,7	141,4	200,6
34	Decoupling rate I of subsidies to operational activities from production	%	62,9	74,9	77,5	72,9	45,0	71,8	64,5	75,7	81,7	72,3	63,6	74,3	67,8	79,9	84,4	77,7	73,8	84,8	87,2	84,8	65,5	77,5	80,0	77,1	64,8	76,5	80,0	75,0
35	Decoupling rate II of subsidies from production	%	64,9	76,7	79,2	75,0	52,1	77,8	70,7	82,0	84,6	77,0	68,7	79,3	71,7	83,1	87,1	81,2	75,2	85,8	87,9	85,9	69,9	81,1	83,3	81,0	67,1	78,7	81,9	77,4
36	Share of subsidies to operational activities in all subsidies	%	94,2	92,6	92,1	92,2	86,7	78,7	82,7	74,1	84,4	82,9	85,4	80,8	87,7	84,0	82,8	84,3	94,8	93,5	94,2	92,8	87,1	84,1	83,2	83,1	93,2	90,8	89,9	90,3

Source: own calculations based on data from the Polish FADN.

5.5. Summary

Generally, 2015 was not beneficial for Polish agriculture. Undoubtedly, this has a clear impact on the regression in the economic and financial situation of the analysed panel of the farms. Certainly, disturbing must be a continuation of the trend of deterioration in the cost-effectiveness and cash returns on total assets and equity as well as the decrease in income and profits, cash flows and investment inputs. This disturbance is growing, as, in parallel, the current and rapid liquidity and debt servicing capacity looked worse. All this happened in the conditions where only the rates of subsidisation were growing. Naturally, the evolution of the latter is, formally speaking, a derivative of the stronger decline in the categories included in the numerators of the individual formulas for their calculation than of only a small decrease in the amounts of budgetary support in their numerators. This means that budgetary support, on the one hand, tried to mitigate the negative trends in the economic situation, but on the other hand it might deepen them. If those trends continued to persist, this would be certainly disturbing.

Achieving the economies of scale, using the more aggressive financial and investment strategies, greater flexibility as well as lower dependence on subsidies, are the main rationales for the growth of the financial efficiency, income and profits as we go to the larger farms. On the other hand, starting from medium-small units, we may observe a continuous growth of all rates of subsidisation in the years 2010-2015. This circumstance, in any case, does not change the overall conclusion that the higher economic size means the improved allocation efficiency, more stable growth and development of the farms as well as higher income, which implies the less involvement of the state budget in the sphere of distribution and redistribution.

For several years, we have been dealing with a situation where the horticultural farms are relatively least subsidised, but at the same time, they achieve the high, often the highest, financial efficiency. Their market success also results from the most extensive use of debt and maintaining the low level of liquid current assets. To a lesser extent, the ratio of the relatively low rates of subsidisation to the high financial efficiency is also encountered in the swine and poultry farms. At the other extreme, we have the type „granivores", where with the highest rates of subsidisation the cost-effectiveness, cash returns and profitability are usually lowest. In this context, an open question is whether the low efficiency is a consequence of extensive financial support, or whether it results also from other factors.

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Print run: 250 copies, 7,66 publisher`s sheets
Printing and binding: ZAPOL Sobczyk Spółka Jawna