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LITHUANIAN FAMILY FARM PROFITABILITY: THE ECONOMIC DIMENSION OF SUSTAINABILITY

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SANTRAUKA

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LIETUVOS ŪKININKŲ ŪKIŲ PELNINGUMAS: EKONOMINĖ TVARUMO DIMENSIJA

Ši studija nagrinėja pelningumą kaip svarbų ekonominio tvarumo elementą. Svarbiausias metodinis studijos indėlis yra integruotas DuPont analizės ir Shapley vertės modelis, skirtas pelningumo pokyčių analizei. Empiriniame tyrime nagrinėjama Lietuvos ūkininkų ūkių veikla 2005–2015 m. Tyrimui naudojami apibendrinti Ūkių apskaitos duomenų tinklo (ŪADT) duomenys. Studijoje aptariama ekonominė tvarumo koncepcijos dimensija, analizuojama pelningumo rodiklių svarba tvarumo kontekste. Indeksinio išskaidymo analizė pritaikoma išskaidant pelningumo pokyčius Lietuvos ūkininkų ūkiuose, atsižvelgiant į paaiškinamuosius veiksnius. Siekiant įgyvendinti minėtą modelį, sudaryta ŪADT rodiklių sistema. Gauti tyrimo rezultatai yra svarbūs žemės ūkio politikos formuotojams siekiant priimti pagrįstus sprendimus atskirų ūkininkavimo tipų plėtros ir paramos klausimais. Teoriniu požiūriu pasiūlytieji metodai gali būti pritaikyti ne tik žemės ūkio, bet ir kituose sektoriuose.

Raktiniai žodžiai: pelningumas; indeksinio išskaidymo analizė; *DuPont* tapatybė; tvarus augimas; Lietuvos ūkininkų ūkiai.

SUMMARY

This study focuses on the profitability as an important element of the economic sustainability. The major methodological contribution of this study is that we integrate the DuPont identity and Shapley value in the index decomposition analysis model. The latter model can be applied for decomposition of the change in profitability. The empirical application focuses on performance of Lithuanian family farms during 2005-2015. The aggregate data from the Farm Accountancy Data Network (FADN) are applied for the analysis. We begin our exposition by discussing the economic dimension of sustainability. The importance of the indicators of profitability is discussed in the context of sustainability. The index decomposition analysis is applied to decompose the changes in profitability of Lithuanian family farms with respect to explanatory factors. To this end, we also establish indicator system based on the FADN. The results obtained are important in guiding policy makers with regards to decisions on development and support of different farming types. As regards the theoretical contribution, the models proposed in this study can also be applied in other sectors.

Keywords: profitability; index decomposition analysis; DuPont identity; sustainable growth; Lithuanian family farms.

CONTENTS

ABBREVIATIONS

AAGR – Annualised Average Growth Rate

AWU – Annual Working Unit

CAP – Common Agricultural Policy

EU – European Union

IDA – Index Decomposition Analysis

ROA –Returns on Assets

ROCE – Returns on Capital Employed

ROE – Returns on Equity

SGC – Sustainable Growth Challenge

SGR – Sustainable Growth Rate

UAA – Utilised Agricultural Area

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The concept of sustainability has become an important facet of the contemporary business. The sustainability of agribusiness is even more important as agricultural activities have diverse effects on economic, social, and environmental state of the rural areas. The economic dimension of the agribusiness is important in terms of ensuring its viability and welfare of the population involved in this economic activity. The social dimension is also related to the welfare of the rural population, yet it comprises wider range of impacts compared to the economic dimension. The environmental dimension is important for the agricultural sector in the short run as natural hazards might affect the level of productivity, whereas long-run effects are associated to ability to recreate environmental resources. As regards the rural areas, the environmental impacts of agriculture are also topical in regards to the welfare of the local population. Therefore, analysis of agricultural sustainability poses a multi-faceted problem with different impacts of each dimension on the different stakeholders.

The complexity of the agricultural sustainability calls for the development of appraisal tools allowing one to monitor the progress of implementing the goals sustainability. These tools have to account for multidimensionality of the concept of sustainability by proposing as integrated measures as possible and yet be detailed enough to capture different facets of the sustainability by means of respective indicators. Therefore, there is a need for establishment of frameworks, tools, and indicators allowing for an integrated approach towards measurement of the agricultural sustainability.

There have been certain frameworks introduced to quantify the sustainability in the agricultural systems. As it is the case with any other sector, there can be two broad groups of models for sustainability assessment defined: the measures relying on the direct approach and those relying on the indirect approach (Zhou et al., 2008). The direct approach involves calculation of the composite indicators based on the set of sustainability indicators. The indirect approach returns efficiency scores which are related to productive technology (i.e. transformation of inputs to outputs). Whereas the indirect approach requires economic and environmental variables in most cases, the direct approach relies on much broader data set, yet does not satisfy the economic axioms. Therefore, construction of the composite indicators based on the direct approach requires development of the basis of sustainability indicators.

The example of indirect approach can be found in study by Picazo-Tadeo et al. (2012) who applied frontier framework to derive the efficiency scores adjusted for the environmental impacts. Reig-Martínez et al. (2011) and Kamali et al. (2017) proposed frameworks based on the direct approach. These studies combine different indicators representing various facets of agricultural sustainability by means of multi-criteria decision making techniques. The indirect approach was combined with the direct one by Areal et al. (2018). Huang et al. (2018) proposed a methodology for decomposing the measures of sustainability with regards to the different dimensions of the concept in the framework based on the indirect approach. In any case, there is a need to impute the indicators reflecting farm performance in social, economic or environmental dimension.

In this study, we focus on the economic dimension of sustainability. More specifically, we aim to propose indicators describing dynamics in farm profitability. These indicators allow one to consider the economic viability of the farms in the long run. Methodologically, we explore the construction of the financial indicators related to profitability and devise some indicators defining changes in the farm profitability. The index decomposition analysis (IDA) is applied to decompose the profitability change into different factors associated with extensive and intensive growth. The Shapley value is exploited to facilitate the decomposition. Such an approach warranties that there are no residuals remaining following the decomposition, the model is not sensitive to time reversal and path independency is maintained. Indeed, these properties might not be satisfied if other indices are applied.

The empirical research focuses on Lithuanian family farms. We adapt the theoretical financial analysis models the empirical data from the FADN. The measures of investments, profitability and growth are obtained in order to explore the patterns of the development of Lithuanian family farms from the perspective of economic sustainability. The research covers the period of 2005-2015. The resulting indicators can also be applied in further studies in order to represent the economic dimension of the family farm sustainability and, particularly, to monitor the sustainable growth. A part of the research has been presented by Baležentis and Novickytė (2018).

The study is organised as follows: Section 1 presents the theoretical preliminaries of the concept of sustainability and its economic dimension. The measures of profitability are also discussed in this context. Section 2 describes the tools for analysis of changes in farm profitability and sustainable growth. The IDA model for DuPont analysis based on the Shapley value is introduced for the profitability change analysis. Section 3 presents results of the empirical analysis which focuses on performance of Lithuanian family farms.

1. THE PARADIGM OF SUSTAINABILITY AND ITS MANIFESTATIONS

Agricultural sector is important in several regards. From the perspective of the food security, agricultural activities can be perceived as the source of food. Taking the environmental perspective, the production of agricultural goods induces certain effects which can be both desirable and undesirable. Also, the social effects arise in terms of the rural societies.

The agriculture has seen serious transformations during the last 50 years (Tilman et al., 2002). For instance, the production of the cereals has increased two-fold globally during that time. Term the "Green Revolution" has been applied to describe these developments. However, this has been achieved by applying more intensive agricultural practices, which meant an increase in the use of agricultural chemicals. The increasing specialization also induced the loss of biodiversity. On the other hand, intensive agriculture allowed keeping certain amounts of the land area for non-agricultural use. Anyway, the increased food supply led to increased intakes which contribute to increase in human productivity.

The aforementioned trends in productivity are also related with increased input intensity, both currently consumed and capital ones. The public support has also been an important factor influencing the agribusiness. These issues are related to farm profitability and prices of agricultural products. Therefore, the society is also affected by the performance of the agricultural sector. In order to analyze the farm performance with regards to different perspectives of the sustainable development, one needs to identify the underlying indicator set and measure the performance. In this section, we overview the theory of sustainable development, its relevance to agricultural sector and the economic dimension of sustainability.

1.1. Development of the concept of sustainability

The importance of the concept of sustainable development has become evident across many regions. Indeed, sustainability is the broad definition which embodies multiple concepts associated with the proper use of scarce resources. The concept of sustainability or sustainable development can be considered as one of the most challenging and most controversial concepts in scientific literature. The definition of sustainability or sustainable development varies due to different goals and factors associated with this concept. The concept of sustainable development came into consideration in 1972, when members of the Rome Club presented the worrisome scenarios for unbalanced development (population growth, pollution, and depletion of natural resources) which suggested that physical growth of population on Earth could have negative effects on environment. Consequently, the world leaders established the Brundtland Commission to evaluate the possible negative consequences of an unbalanced development and to focus on a balanced existence on Earth for the economy, the environment and society. In 1987, Commission presented the most commonly used definition of sustainable development or sustainability[1]: "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: (a) the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and (b) the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs" (Our Common Future… 1987). Obviously, the key idea stemming from the definition presented above is the intergenerational equality. By further assuming that there exists a certain utility function describing the satisfaction of the needs by a society at a certain time point, one can conclude that sustainability seeks to keep the level of welfare, or utility level available for society, at a non-decreasing level throughout the time. The utility function may include different factors. Hence, the interaction among society, economy, and environment can be modelled from this viewpoint. Such an approach implies that stakeholder at different levels (from micro to macro level) model their future actions in the domain confined by the principles of sustainability and the corresponding utility function.

Elkington (1994) put forward the concept of the "Triple Bottom Line". In this concept, sustainability is considered as a benchmark of business activities. Indeed, three pillars of sustainability (environmental, economic, and social) are considered as important ones besides the traditional profit-based approach. Indeed, the measures of profit and profitability can be observed by the business, yet such processes as market expansion should also be considered as objectives important for the society. Therefore, the triple bottom line approach suggests that the long-term growth can only be maintained in case the concept of sustainability is respected in the business activities. Both private impacts (profit) and public ones (ecosystem services, social effects) need to be considered in order to ensure sustainable development.

Further distinction can be made between the strong and weak sustainability by assuming no substitution and perfect substitution of the elements of the utility function, respectively. Hart (1998-2010) proposed more holistic view towards sustainability and argued that strong sustainability corresponds to the setting where each dimension of sustainability is seen as one of the concentric circles which cannot be removed or replaced by the other dimension (see the right-hand side of Fig. 1). This setting suggests that the economy exists only within society and human interaction is treated as a prerequisite for human economy in this case. However, society is much more than the economic agents. Society coexists within the environment, as much of the inputs for the human economy, and human life in general, are delivered from the environment. Accordingly, the third dimension – environment – surrounds society.

[1] The definition was presented in report "Our Common Future" published by the United Nations World Commission for Environment and Development (WCED chaired by Gro H. Brundtland and known as the Brundtland Report (Our Common Future…, 1987).

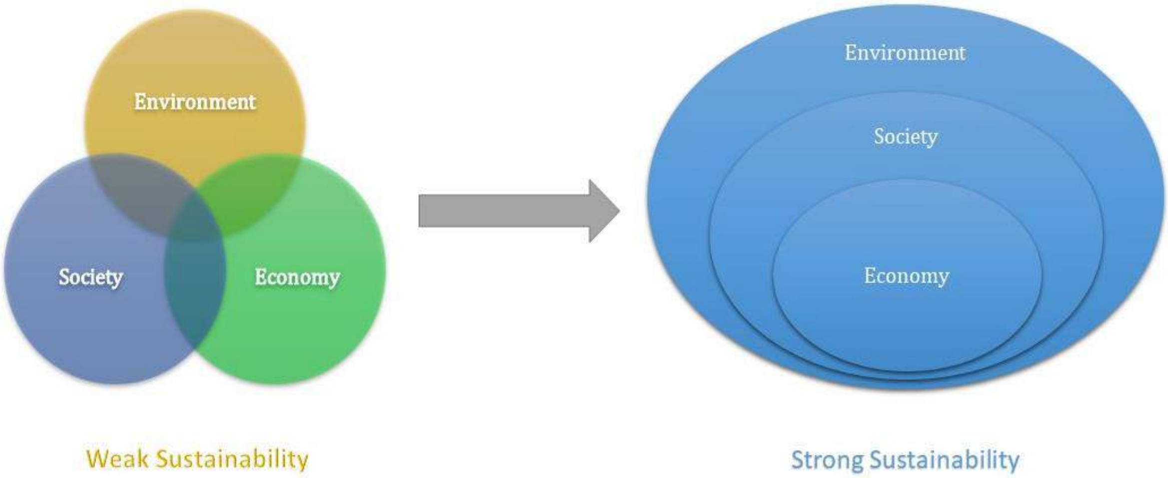


Fig. 1. Triple Bottom Line: interconnected and interdependent benefits

Source: Hart (1998-2010)

By comparing the two settings depicted in Fig. 1, we can further compare the concepts of the strong and weak disposability. In both cases, society seeks to maintain the constant level of utility (or even improve it), yet the possibilities for this are different.

Both paradigms refer to constant consumption or utility, and the main difference is between assumptions about substitution possibilities of natural capital. Neumayer (2003) and Perman et al. (2003) noted that the weak sustainability corresponds to assumption of full substitutability of the natural capital and manufactured goods in the sense of the utility. The latter approach can be linked to the neo-classical economic theory. Indeed, there have been extensions of the neo-classical economic theory to accommodate for the undesirable outputs (such as the greenhouse gas emission) when modelling the productive technology, see Huang et al. (2018) for application of such environmentally-adjusted measures. At the other end of spectrum, the concept of strong sustainability marks a fundamentally different shift in the economic thinking where the resource-based neo-classical technology is replaced with the notion of the "green economy". As it was already mentioned, the strong sustainability does not allow for sacrificing the natural capital in order to augment the output of the economy. In this case, the focus is placed on the elements of sustainability assuming that each of them must be non-declining as opposed to the case of the strong sustainability where only the aggregate level of utility is considered. Mathematical representations of the underlying technology correspond to the two concepts as follows: the Cobb-Douglas production function represents the weak sustainability, whereas the Leontief production function can be used to model a productive technology under the strong sustainability paradigm (Neumayer, 2003; Perman et al., 2003).

The two basic notions of sustainability raised further discussion on the possible intermediate cases. Costanza and Daly (1992) noted that besides the weak and strong sustainability paradigms can be distinguished the absurdly strong sustainability. The latter paradigm refers to the case where any kind of resource is not to be depleted. This implies that non-renewable resources of any kind could not be used. Otherwise, the use of any non-renewable resources would imply a decreasing capital stock associated with the decreasing level of unsustainability. Dewan (2006) applied composite sustainability indicators within the framework of strong and weak sustainability conditions. In this case, the five degrees of sustainability were considered: perfectly sustainable, strongly sustainable, and weakly sustainable, unsustainable, and non-development. These different degrees of sustainability were defined based on different levels of indicator which was applied to measure the level of sustainability.

Stiglitz, Sen, and Fitoussi (2009) presented the report on behalf of the Commission on the Measurement of Economic Performance and Social Progress. The report contributed to discussion on the definition and measurement of sustainability. The progress in moving towards sustainability was discussed in the Rio + 20 Conference in 2012. Such directions as the green economy and inclusion of the principles of sustainability into managerial decisions taken by the public bodies at different levels were foreseen as necessary to ensure sustainable development.

The general concept of sustainability is important for evaluating development of society. Turning to the corporate issues poses certain additional issues. Recently, the discussion regarding the concept of the corporate sustainability has emerged. The definition and measurement of the corporate social responsibility has appeared as one of the main topics in this regard. Therefore, the corporate sustainability can be considered as an important paradigm within the wide framework of the sustainability. the term "paradigm" is used consciously, because the sustainability of an enterprise induces different behavioural assumptions underlying the firm model. Specifically, the conventional objective function related to profit maximization (or cost minimization/output maximization) is replaced with the objective function satisfying the principles of the (corporate) sustainability. Therefore, such objectives as profit maximization and growth are supplemented with societal contribution so that economic development, social justice and environment pressures are mitigated and streamlined.

Wilson (2003) noted that corporate sustainability should be treated as a part of the corporate management paradigm. He argued that the four well-defined approaches underlie the notion of the corporate sustainability: sustainable development, corporate social responsibility, stakeholder theory, and corporate accountability theory (see Fig. 2). It was also stressed that there exists the two important links between corporate social responsibility and sustainable development. First, it sets the mutual goals to be achieved by the society and companies. Second, the economic, environmental, and societal goals can be identified as those needed to be respected when seeking for corporate sustainability. Thereafter, these can be translated into targets for companies. In this context, the practice of the performance management can be implemented and guided by the goals posited by the concept of the corporate sustainability.

The role of the corporate social responsibility can be highlighted by the fact that corporate social responsibility acts as the basis of the ethical dimension of the corporate management. Indeed, the corporate performance in the ethical dimension highly depends on the proper inclusion of the principles of the corporate social responsibility in the decision making and goal-setting. The involvement of the stakeholders into promotion of sustainable development of an organization can be explained and implemented by means of the stakeholder theory. This indicates that close cooperation between all stakeholders makes it possible to achieve business objectives along with the goals of sustainability. The communication and relationships with the external actors (i.e. society) can be explained in terms of the corporate accountability theory. In this case, the role of the corporate executives is important.

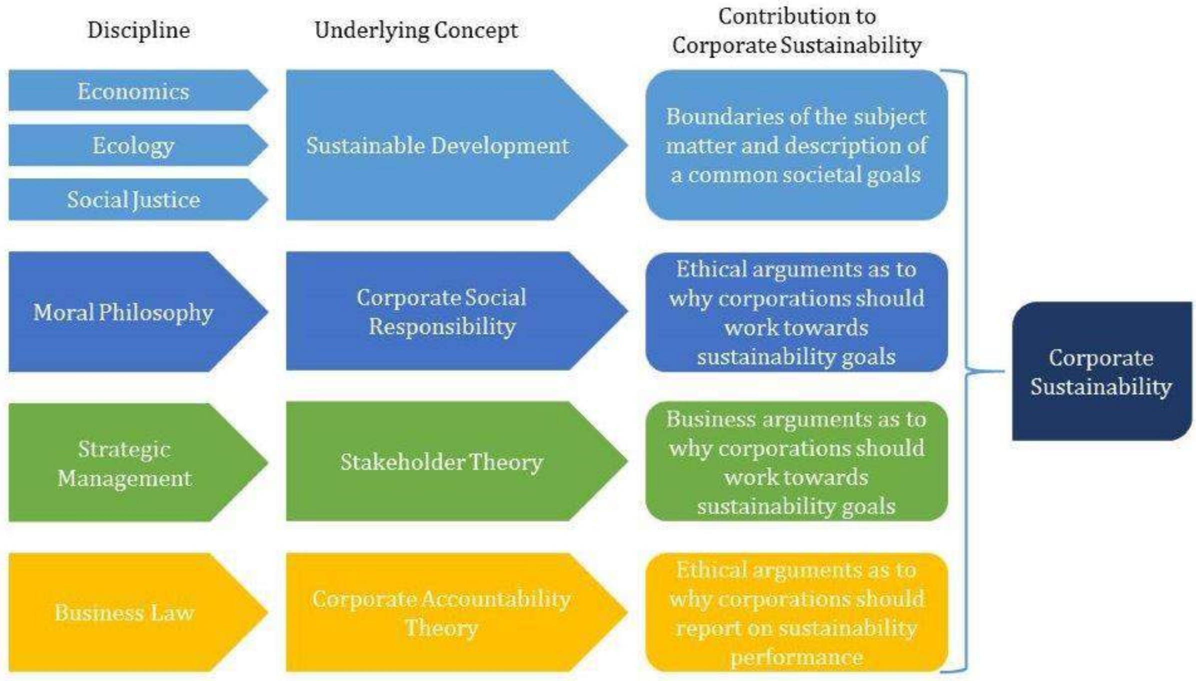


Fig. 2. The evolution of corporate sustainability

Source: Wilson (2003)

Delai and Takahashi (2011) proposed a model for gauging the corporate sustainability. The model allows a more detailed and comprehensive analysis thereby increasing the scope of the measurement of sustainability in a number of aspects. For example, the proposed model takes into account all three sustainability dimensions, considers the interaction among a company and the relevant stakeholders, and models the entire value chain associated with business continuity. Noteworthy, assessing corporate sustainability requires taking a holistic approach is necessary. Application of the holistic approach is necessary in day-to-day operations carried out within a company to achieve the corporate sustainability.

To summarize, the proper analysis of the sustainability requires considering the two key issues: first, the notion of sustainability and, second, the means for measurement the progress towards sustainability. Tackling these questions is not a trivial task as there has been no universal notion of sustainability and a wide array of techniques and approaches have been available for measurement of sustainability in regard to different approaches. In this sub-section, we have discussed the theoretical preliminaries surrounding the notion of sustainability and its linkages to the corporate sustainability. In the following sub-section, we focus on the approaches towards the measurement of sustainability.

1.2. State-of-the-art in sustainability assessment

There have been several approaches towards the assessment of sustainability (sustainable development). Based on the conventional used definition of sustainability presented by the Brundtland Commission (Our Common Future… 1987), Hardi and Zdan (1997) presented "The Bellagio Principles". These principles can serve as the general framework for the assessment of processes in the light of the concept of sustainability. The process is related to the design of the whole assessment system covering the identification, interpretation and publication the results. Therefore, Bellagio's principles emphasize openness, communication, broad participation, multidisciplinary processes, appropriate institutional capacity and the need for a coherent system. All ten principles are presented in Fig. 3. The four main groups of the principles envisaged in the Bellagio system can be outlined (Jensighaus, 2014): definition of the starting point of the analysis (Principle 1), definition of the contents and focus of the analysis (Principles 2-5), properties of the analytical process (Principles 6-8), continuity of the assessment (Principles 9-10).

Given the ambiguities surrounding the very concept of sustainability, the assessment of sustainability also appears as an intertwisted and arbitrary process. In this context, one needs to describe the objectives and ultimate goals of the analysis of sustainability. Formulating the basic notions and final outcomes of the analysis comprise the first principle of sustainability assessment. This principle alone constitutes a separate focal point in the system of principles.

The second group of principles focuses on the definition of the contents and highlights of the analysis. The second principle suggests applying a holistic approach when conducting the analysis of sustainability which implies that both the system under analysis and its constituent parts need to be taken into consideration. This enables one to identify the underlying linkages within the system. Also, the three elements (dimensions) of sustainability should be represented when identifying the parts of system and describing the system itself. The third principle is also tightly related to the three dimensions of sustainability. Basically, it implies that the three types of equity should be considered in the analysis, each per dimension of sustainability. The fourth principle is related to the scope of the analysis in the sense of the time horizon. Indeed, the concept of sustainability is related to inter-generational equity. Therefore, the scope of the analysis must be adjusted so that the period covered by the analysis of sustainability is long enough to capture the inter-generational dynamics. Also, the possible and desirable states of the system should be identified. The fifth principle implies that the measurement of sustainability should be feasible, i.e. the number of indicators involved in the analysis should be finite and the measurements of these indicators should be clear and uniform (standardized).

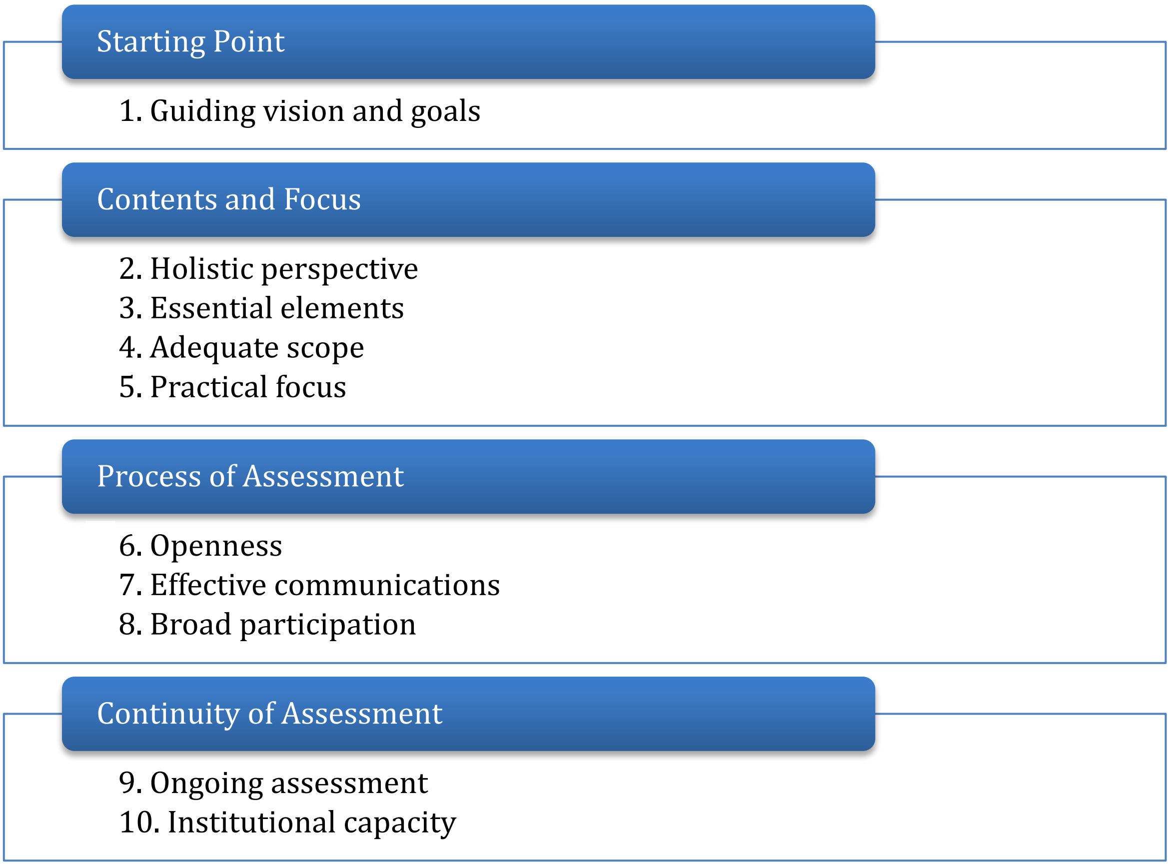


Fig. 3. Sustainability assessment according to the Bellagio principles

Source: Hardi and Zdan (1997).

The third group of principles focuses on the properties of the process of the sustainability analysis and the communication with the parties involved. The sixth principle suggests that the methods and data that are used to assess sustainability must be clearly described and available to all the stakeholders. The same applies to the techniques used in the analysis. In addition, the possible uncertainties should be outlined. The seventh principle turns to the importance of communication with the stakeholders. Following this principle, all the participants of the assessment processes should be effectively communicated with. This corresponds to the concept of sustainability in that all the parties involved into a certain process should be treated as equally important ones. The eighth principle is linked to the previous principle. Broad participation ensures that decision-makers are involved in the whole assessment process, which allows they actively pursue the adopted policies.

Finally, the fourth group of principles focuses on the continuous assessment. The basic idea is that the assessment of sustainability should be related to a long-term vision and monitoring. The ninth principle implies that iterative measurements should take place in order to identify the prevailing trends and account for the new experience. The tenth principle focuses on the institutional capacity. Institutional capacity is needed to monitor the progress towards the sustainable development. Therefore, the proper resources must be guaranteed to ensure the continuity of the analysis of sustainability.

The Bellagio principles had been in practice for couple decades. However, the dynamics in the socio-economic environment induced the need for revision of these principles. The new framework was based on the Bellagio principles and termed "Sustainability Assessment and Measurement Principles (Bellagio STAMP)" (IISD, 2009). The number of the principles to be followed was reduced; some were re-defined in order to avoid the possible vagueness. Fig. 4 presents the new setting. Bakkes (2011) also noted that new assessment methods and challenges to sustainable development had impacted the revision of the Bellagio principles. He emphasized that Bellagio STAMP framework is more conceptually condensed and more easily implemented.

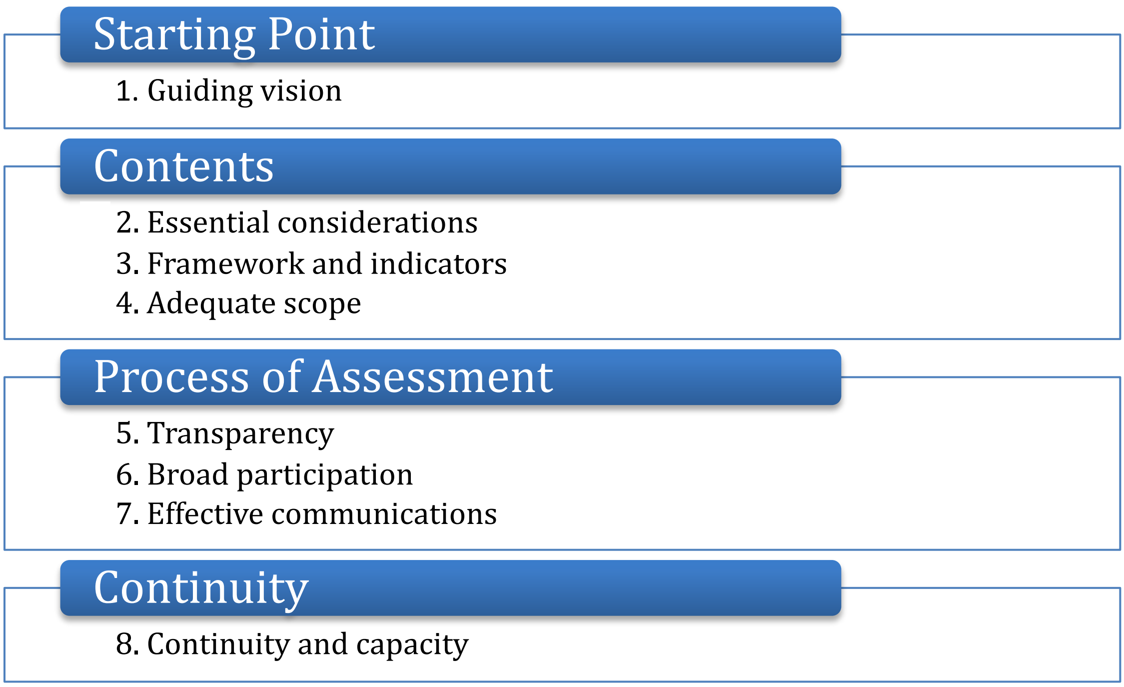


Fig. 4. Bellagio Sustainability Assessment and Measurement Principles (Bellagio STAMP)

Source: Pintér et al. (2012) and Bakkes (2011)

Pintér et al. (2012) identified four groups of principles (the latter pastern follows that used in the case of the Bellagio principles). Therefore, the first principle of Bellagio STAMP is considered as the one belonging to the starting point of the sustainability assessment. The second group of principles (comprising Principles 2-4) focuses on the content of the sustainability assessment. The third group is mainly dedicated to the process of the sustainability assessment (Principles 5-7). Finally, the last principle is associated with the continuity of the analysis and considered as a separate group.

Pintér et al. (2012) noted that most of the applications of the Bellagio principles and Bellagio STAMP were not related to business sector (e.g. companies). This finding can be explained by the market-oriented approach which dominated in business decisions. In this regard, the analysis of problems related to the economic performance dominated over the holistic approach involving all the dimensions of sustainability. However, social and environmental dimensions cannot be neglected when pursuing for a long-term growth. Therefore, the frameworks involving more diverse measures of performance are still needed to be applied.

There have been different frameworks and indicators proposed to measure the progress in achieving sustainability at different levels. The theoretical principles (e.g. the Bellagio principles or Bellagio STAMP) need to be operationalized by means of particular indicators. Therefore, it is important to discuss the choice of indicators with respect to the underlying theoretical principles when assessing the sustainability.

Sala, Ciuffo, Nijkamp (2015) argued that the fusion of the principles of sustainability need to take place when identifying the tasks and procedures underlying the analysis of sustainability. Indeed, the fusion of the principles means that different theories and approaches need to be integrated (inter-disciplinary approach) rather than simply considered simultaneously (multidisciplinary approach). They proposed that a methodological framework for the sustainability assessment should consist of two main components. First, the theoretical principles allowing for sustainability-oriented reasoning should be identified and adapted to the case under analysis. Second, a procedure for carrying the assessment of sustainability in the light of certain theoretical foundations is needed. The Bellagio STAMP was suggested as a set of principles for the analysis of sustainability, whereas the procedure for the analysis should be chosen so that it reflects the underlying approach to sustainability, the sustainability targets which basically correspond to the theoretical approach taken, the decision context (i.e. level of analysis, possible directions of changes, time horizon, among other factors) and the methodological framework for the assessment (research instruments used in the analysis).

Waas et al. (2014) developed yet another framework for sustainability analysis. The proposed framework is somewhat similar to the Bellagio STAMP in that the process of the analysis is covered. However, in the framework by Waas et al. (2014), more attention is paid for the implementation of the analysis rather than the underlying principles. The three basic requirements (and challenges) for the analysis of sustainability are (i) understanding the principles of sustainability in a given context, (ii) adapting the procedures and techniques used for the decision making with regards to the principles of sustainability and develop measures for the progress, and (iii) seeking for impact of the developed procedures so that the objectives of sustainability are implemented. These three challenges can also be termed interpretation, information and influence challenges, respectively.

Waas et al. (2014) discussed the notion of sustainability indicators. Indeed, these can be considered as the aggregates of information describing the achievements in the sense of sustainability for a particular system. Such a representation allows delivering the information in quantitative or qualitative manner. The indicators can be normalized so that their values are relative to some reference values. Depending on the objectives of optimization, some criteria can be minimized, whereas others – maximized. Also, the optimum level of criteria can be desired. However, the use of the indicators is related to certain caveats. The data available might impose certain shortcoming of the models used. If the data is not detailed enough, some trends might be masked. The lack of some information might lead to measurement of some other processes which might not be that relevant in context of sustainability. Also, some earlier models followed in the analysis might actually be invalid. The interests of the decision makers might also affect the results of the model (e.g. through manipulation of coefficients of importance). Waas et al. (2014) presented a generalized framework for the use of the sustainability indicators in the context of sustainability assessment. The logics behind construction of the sustainability indicators should adhere to the context of the analysis and be in lines with the principles of the sustainability. In this case, the process of assessment of sustainability is more related to the underlying logics, whereas the construction of indicators depends on this logic also relies on the technical issues regarding the data used and techniques applied.

The different types of application of the sustainability indicators were defined by Morse (2015). Specifically, instrumental, tactical and political uses of indicators were defined as those contributing to certain decisions in general (whether these are actions or inactivity). Instrumental use of indicators is direct involvement of the sustainability indicators into decision making process. In this case, indicators act as guidelines thereof. Tactical use of the indicators is used for obtaining grounds for putting certain actions into delay. Political use of indicators is similar to tactical one, yet the difference is that in the former case indicators contribute to support of certain policies, yet they are mostly linked to activities rather than delaying. They are both related to theoretical insights rather than real action. Conceptual use is of interest for science and education. Symbolic use justifies the approaches taken by the decision makers. Obviously, some of these groups overlap and require further consideration in order to arrive at a more clear taxonomy.

There exists certain confusion in regard to the notions of indicators and indices. For instance, Waas et al. (2014) refer to indices when speaking of composite indicators representing multiple dimensions of sustainability. However, statistics use term indices when speaking of the comparisons of certain values over time or across any other dimension (following a multiplicative relationship). The basic example of this concept is price indices which measure the differences in prices across time periods, countries etc. Therefore, the use of this term should be restricted in the context of the composite indicators. Basically, composite indicators which are not measured against any reference value in a multiplicative relationship should not be referred to as the sustainability indices.

The need for the integration of the principles of sustainability and the corresponding measures was also discussed by Böhringer and Jochem (2006). They argued that there are certain requirements and criteria for selecting appropriate sustainable development indicators. More specifically, there should be a strong connection among the indicators and the definitions of sustainability. This is based on the selection of relevant indicators that should not be highly interrelated. Furthermore, the data for quantitative analysis should cover as long time spans as possible (this was already stressed in the context of intergenerational approach underlying the notion of sustainability). The reliability and availability (measurability) of data need to be assessed in order to ensure the appropriate analysis of the sustainability. In general, the choice of indicators should be focused on the process towards the improvement of the sustainability. The application of the selected indicators should allow one to deliver political (secondary) implications.

An integrated approach towards measurement of the sustainability was proposed by Carraro et al. (2013). The proposed approach allowed for comparisons of sustainability across time and space. The composite indicator comprised the three main dimensions of sustainability represented by different indicators. The computable general equilibrium model was applied to generate development paths of the economy.

Singh et al. (2009) presented a broad review of the methodologies for sustainability assessment. They also proposed the composite indicators that can be applied to measure the progress towards the sustainable development. They argued that the major advantage of the composite indicators is their multidimensionality. However, they also pointed out that construction of indicators or other assessment tools may involve certain pitfalls. The use of statistical rules and techniques can be useful in alleviating those shortcomings.

The composite indicators are the major concept surrounding the construction of sustainability indicators. They can be applied in order to aggregate information representing different dimensions of sustainability. What is more, they provide with quantitative information in regard to the progress towards the goals of sustainability. Construction of the composite indicators has been discussed by Saisana and Tarantola (2002). They outlined techniques for construction of the composite indicators. These techniques include regression analysis, dimension reduction methods (e.g. principal component analysis), normalization (multi-criteria decision making), and data envelopment analysis, among others. Deng (2015) further focused on the applications of the multi-criteria decision making techniques in the area of sustainability measurement.

Construction of the composite indicators can be carried out mathematically without considering the principles of economics. In this regard, the approaches towards construction of the composite indicators representing the sustainability paradigm can be grouped into direct and indirect ones (Zhou et al., 2008). The quantitative techniques allowing for aggregation of multiple indicators without considering economic axioms represent the direct approach, i.e. the data are directly used to construct the composite indicators. The indirect approach applies frontier methods (e.g. data envelopment analysis). In this case, the data are used to construct the production frontier and then used to measure the efficiency scores which, in this context, represent the composite indicators. Noteworthy, the conventional production technology (including inputs and outputs) may be replaced with the environmental technology (including inputs, desirable outputs, and undesirable outputs). The way undesirable outputs are included into the analytical framework can vary depending on the axioms imposed on the environmental technology. The three main approaches are available: assuming strong disposability of the undesirable outputs (this can be feasible whenever the complete abatement of the pollutants is possible without posing restrictions on the production activities); assuming weak disposability of the desirable and undesirable outputs (the desirable and undesirable outputs are adjusted by the same factor on the efficient frontier), and by-production approach (the undesirable outputs are related to pollution-generating inputs in a separate sub-technology).

In summary, consider sustainability indicators as an important component of the sustainability assessment. Appropriate choice of the data sources and construction principles of the sustainability indicators allow one to measure the process of sustainable development and deliver meaningful policy implications. Anyway, sustainability remains a multi-faceted notion with ambiguities surrounding these issues. Therefore, the methodologies for the measurement of the sustainability need to account for possible uncertainties.

1.3. Economic sustainability approach in agriculture

The concept of sustainability comprises the three main dimensions (economic, social, and environmental), yet performance in each dimensions needs to be measured by means of specific indicators. In order to construct meaningful indicator, one needs to review the underlying theoretical concepts and relate them to the indicators available. This sub-section seeks to look into the economic dimension of sustainability. Therefore, we discuss the literature on the economic dimension of sustainability at the farm level. In general, the economic sustainability can be understood as “a capability of an organization to secure its long-term economic performance through maximizing shareholder’s returns” (Dyllick, Hockerts, 2002).

In order to be sustainable, farms must be managed simultaneously be economically viable, environmentally sound and socially acceptable (van der Meulen et al., 2014; Latruffe et al., 2016b). Economic sustainability of farms has attracted much academic interest in recent literature (Buckwell et al., 2014; Micha et al., 2017). Many scholars see the concept of economic sustainability as (long-term) economic viability of farms, i.e. their capability to generate income which is appropriate to provide farmers with reasonable living conditions and, what is more, to maintain the level of capital employed for agricultural activities so as to remain active in business considering the long run time horizon .

For instance, according to Józwiak et al. (2014), economic sustainability of farms means their ability not only to continue current activity but also to develop. This is possible only when farms generate income covering costs of use own factor inputs (land, labour, and capital) and are capable of investing into new assets. Diazabakana et al. (2014) argued that economic viability of farms can be defined as their capability to survive in the long term in changing economic conditions (e. g., output and input prices, yields, and public support). Bachev (2017) defined farm viability as acceptable economic return on used resources and financial stability. Roesch et al. (2017) pointed out that economically sustainable farms are able to achieve income comparable to those generated by the rest of the working population. Other definitions of economic viability are presented in Table 1.

Table 1. Selected definitions of farm economic viability

Location	Reference	Definition of viability
USA	Smale et al. (1986)	On a viable farm, the annual cash flow should cover the operating costs, guarantee the income for household members to maintain their consumption (at the minimum level at least), cover the depreciation so that the capital items could be replaced in a timely manner, and cover the interests paid.
Ireland	Frawley and Commins (1996), Hennessy et al. (2008)	Ability to remunerate the family labour (given the average wage rate in agricultural sector) and ability to generate 5 per cent return on farm assets (excluding land value).
Canada	Scott (2001)	The two goals are set: farming should ensure living for the farmers and there should be sufficient return on investment.
Spain	Argilés (2001)	Farm viability is related to possibility for ensuring a proper level of remuneration for the family labour. The appropriate remuneration is obtained as opportunity costs by considering the possible remuneration in the alternative activities.
USA	Adelaja et al. (2004)	A farm can be considered as a viable one in the economic sense in case the revue generated is substantial to cover production costs (both fixed and variable), provide family members with appropriate living standard, and cover the depreciation.
Greece	Aggelopoulos	Farms are considered as viable if the income generated per family labour unit is higher than the basic level set by

	et al. (2007)	the Ministry of Agriculture Development; also, at least one labour unit should be maintained on a farm.
Europe	Vrolijk et al. (2010)	Different classes of viability can be defined: income generated on a farm is positive and covers the opportunity costs; positive income does not cover the opportunity costs; positive cash flow does not render positive income; no positive cash flow.
Scotland/Sweden	Barnes et al. (2014)	Besides the need for covering the operating expenses and interest payments, the possibilities for further expansion must exist.

Source: O'Donoghue et al., 2016.

Indicators of economic sustainability focus on relatively small number of subjects (Diazabakana et al., 2014). To assess an economic sustainability at the farm level, researchers commonly use ratios referring to a farm's profitability, liquidity, stability and productivity. For instance, Reganold et al. (2001) evaluated economic sustainability of U.S. apple farms on the basis of orchard profitability. Castoldi and Bechini (2010) assessed economic sustainability of Italian farms using variable costs, gross income and gross margin. Van der Meulen et al. (2014) used net farm income, labour productivity and solvency in order to quantify economic sustainability of Dutch dairy farms. Wrzaszcz and Zegar (2014) measured the level of economic sustainability of Polish farms using indicators of land productivity, labour profitability, market orientation of farms and sources of households' income and maintenance. Roesch et al. (2017) and Esteves et al. (2017) measured economic sustainability of Swiss farms by applying the indicators of profitability, liquidity, and stability. They argued that the profitability indicators reflect the economic success of a farm in the farming business; the indicators of liquidity reflect the capacity of a farm to meet its current liabilities, whereas the stability indicators represent the ability of a farm to maintain both profitability and liquidity in the face of unexpected changes in the business environment. According to Roesch et al. (2017), there are strong dependencies between these indicators as good profitability promotes a high degree of liquidity, and thus the stability of a farm.

Other indicators of economic sustainability are related to farm's autonomy, diversification of farm's income, and farm's durability (Fig. 5). Turning to autonomy, it can be perceived in terms of dependence on external inputs, external financing, and subsidies. According to Latruffe et al. (2016a), the first aspect of autonomy means that farms that use more external inputs (e. g., feed concentrates, mineral fertilizers) are more sensitive to prices variations and changes in inputs availability (in general, they face higher business and price risk). Similarly, autonomy can be analysed in terms of subsidies – farms which are highly dependent on public subsidies are more prone to face difficulties in case of reduction of subsidies. This might impede reduced sustainability. All these indicators can be considered separately or as an aggregate

(Esteves et al., 2017). In general, Buckwell et al. (2014) identified 95 different indicators of economic sustainability.

Profitability is one of the key elements of the economic sustainability. It can be measured in a number of ways. First, such absolute indicators as income indicate the possibility for maintaining the business in the short-run or long-run. Indeed, some definitions of viability (Table 1) also suggested positive income as a criterion for viability of a farm. The income is determined by the revenue and costs. Farm's ability to compete in the output market and input prices determine the level of income. Revenue is also linked to economic efficiency. For a given set of input and output prices, farm can adjust its input and output mixes thereby ensuring a certain degree of profit efficiency. The technical efficiency lies at the core of the production activities in the sense that the level of technical efficiency determines the level of output. Technical efficiency is related to productivity, whether partial or total factor productivity. Therefore, multiple facets of profitability can be analysed and the corresponding indicators can be included in the models for sustainability analysis.

In economic sustainability assessments at the farm level, it is important to take into account the main farm characteristics that influence farm economic situation (e. g., type, size) and regional conditions. The operation conditions can often explain differences in farm productivity. However, the factor markets are often the same for all types of farms and the competition among farms prevail irrespectively of the underlying differences in the environment of operation. Therefore, the results of sustainability analysis need to be interpreted with caution, yet they cannot be completely neglected on the basis of the differences in the operation environment. Additionally, seeking to mitigate the impacts of price and yield volatility, the expected values for the whole research period should be analysed (Roesch et al., 2017).

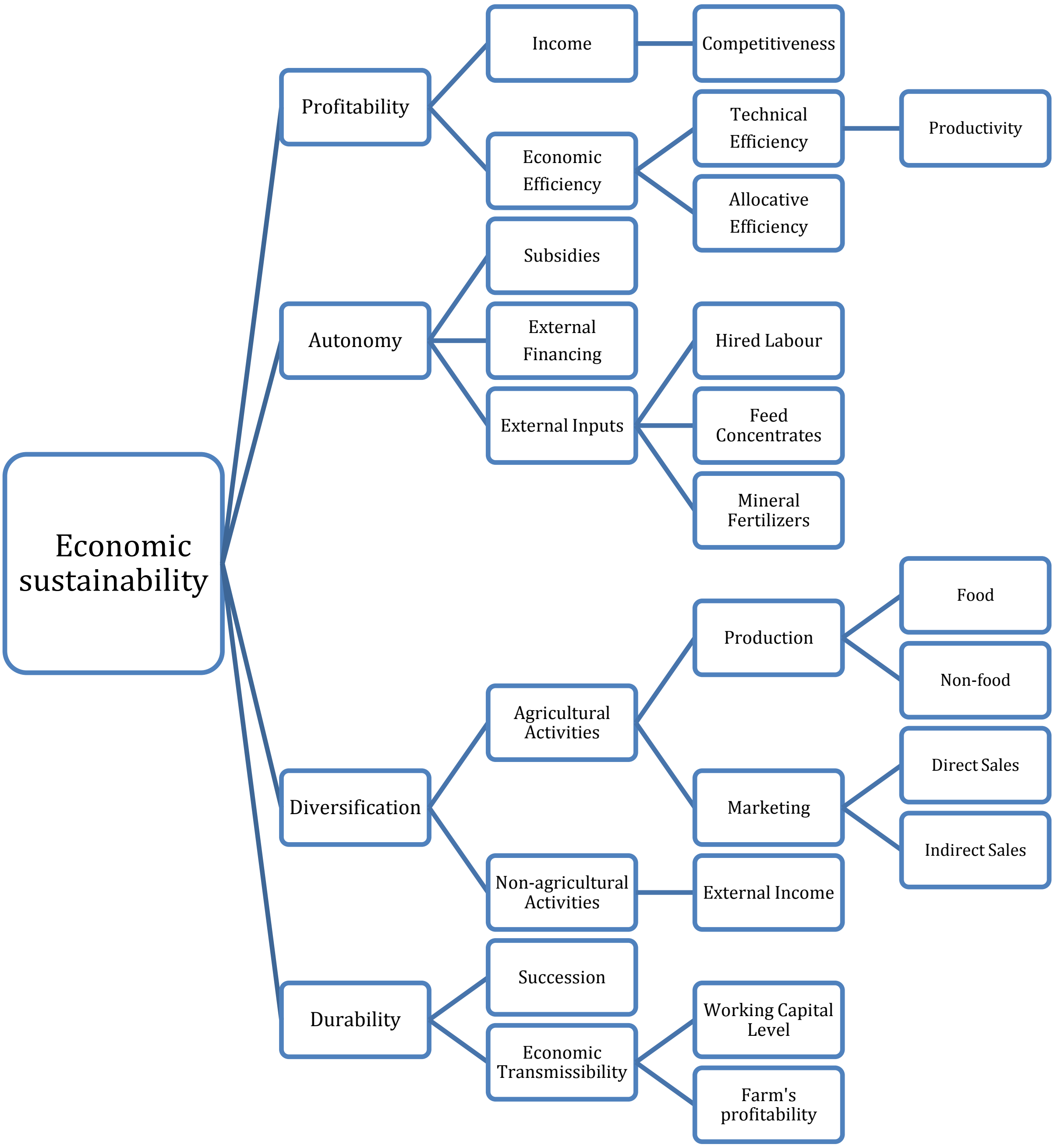


Fig. 5. Classification of indicators of economic sustainability

Source: adapted from Lebacq et al., 2013.

A multitude of factors affect the economic sustainability of farms. For instance, Wrzaszcz (2012, 2013, 2014) showed that economic sustainability of farms was positively influenced by production intensity and farmers' education level. Furthermore, crop farms had a higher probability of achieving sound economic results if compared to mixed crop-livestock farms. Zegar (2013), Guth and Smędzik-Ambroży (2017) found that the level of sustainability of farms was positively correlated with farm size. Latruffe et al. (2016b) noticed that economic sustainability was associated with farm type as horticulture farms showed the highest economic sustainability, whereas the lowest economic performance was observed for mixed livestock farms and mixed crop-livestock farms. Therefore, the level of sustainability needs to be analysed across different dimensions (time, space, and farming type, farm size) in order to identify the underlying trends in sustainability and deliver the corresponding policy guidelines.

Some other studies have suggested to measure farms sustainability using the composite indicator methodology which effectively combines different aspects of farm activity. Majewski (2013) proposed to gauge the level of farm sustainability by means of a synthetic farm sustainability indicator. The latter aggregate comprises 5 sub-indicators which rely on 56 variables in total. The constructed set of indicators allows describing different aspects of farm organization and operation. The composite indicator can be employed to assess both the level of sustainability and its dynamics in a certain farming system at the farm level. Therefore, there is a need to develop indicators which could be applied in such integrated frameworks at different levels of aggregation (farm, type of farming, country).

As previously noted, the range of factors determining the sustainability of farms is rather diverse in many regards. It is important to pay attention for new challenges for farming related to the role of knowledge spill-over (the effectiveness of extension services are important in this regard) and innovation. These factors are likely to impacts the economic performance of farms (Floriańczyk et al., 2012) besides other dimensions of sustainability. At the same time, the notion of sustainability needs to account for yet another factor – competitiveness is necessary to maintain profitable agricultural activities. Agricultural producers must constantly innovate in order to adapt the changes in the market and changes in the quality and availability of resources. The changes in quality might render higher prices and higher market integration. In addition, the use of the principles and tools available due to expansion of the sharing economy and networking in general allows creation of short value chains and improved access to the output markets. The use of information technologies can alleviate the misallocation and information asymmetry issues (Jensen, 2007). Diazabakana et al. (2014) noticed that an innovation comprises a focal element of the farm sustainability. It is due to Hennessy et al. (2013) and Ryan et al. (2014) that innovation can be represented by such variables as number of innovations in farm processes, management practices (organisational forms), and farm products.

After Lithuania's accession to the European Union (EU) on 1 May 2004, Lithuanian farmers have exploited the advantages of the EU support under the Common Agricultural Policy (CAP). In the EU, the CAP is meant to be a major driver of sustainability of farms as it has progressively introduced various sustainability-related measures over the past two decades (Diazabakana et al., 2014). Knowledge about economic sustainability of farms may help to formulate future measures to improve sustainability of farms. At the present time, when there is initiated EU-wide debate on the CAP priorities and development needs after 2020, this knowledge is especially important. Knowledge about economic sustainability of farms is also an important tool in the context of farmers' decision making as it can be used to fathom the strengths and weaknesses of farms, and to open up new directions for their future development.

1.4. Profitability as a performance indicator

Given the increasing integration of the agricultural markets and globalization processes in general, there is a need to promote the persistent development of agricultural business with focus on increase in the competitiveness and resilience to uncertainties. Under these circumstances, farmers and agricultural companies should seek for improvements in reserves for operation, introduction of the new products and services, introduction of new technologies, and improvements in activity management. In addition, they must be able to adequately react to shifts in the business environment, plan and predict their activities, and manage finances accordingly. Taking into account these issues, it is very important to analyse financial performance of the farms. As previously noted profitability is one of the main indicators which can be applied to analyse the economic dimension of farm sustainability. Profitability indicator approach is also used to evaluate the economic sustainability by Diazabakana et al. (2014). Ainsworth (1989) also argued that only sustainable agriculture can remain profitable agriculture.

European Commission (EU Agricultural… 2017) presented the report for the trends in the major EU agricultural commodity markets and agricultural income in the medium-term (up to 2030). The latter study argued that total EU agricultural income is expected to decrease considerably in real terms over the 2017-2030 period mainly due to a stronger increase in intermediate costs compared to the value of production. Based on that is very important to assess the family farms financial health which is provide the main role for future sustainable development.

The assessment of the company's financial health status is particularly significant. Companies must assess not only the key financial indicators, but also to consider development opportunities in order to ensure continuity. This problem is particularly important in increasingly competitive conditions influenced by various internal and external environmental factors. Profit plays an important role, because is central for the company's survival and allows ensuring the growth of the company. Profit is the company's economic development factor, the financial benefits, performance evaluation criteria, long-term financing source of the company's activity. Financial experts point out that profit is the most summarizing indicator of a company's activity, because it relates to all the company's performance indicators: assets, capital, liabilities, costs etc. Profits show the positive and negative side of the company, therefore, profit can be considered as a measure describing company's performance and can serve as a yardstick for evaluation of its activity. If the company is profitable it will invest in it, expand its activities, develop new products, provide services and thus expand its market share. Scott (1950) understands profit, especially net profit, as a performance indicator, which can measure the business efficiency. He appreciates net profit is determined by combination of designing efficiency, acquiring efficiency, production efficiency, selling efficiency, and financial efficiency. Kendrick and Creamer (1961) notes that profit can be useful ratio to measure of management success. Penrose (1959) argued that "in long term profit and growth are synonymous expressions for the objective of the company".

Seeking to objectively assess the efficiency of a company's activities in various aspects, its competitiveness, business continuity opportunities, it is not enough to analyse absolute profit indicators. More detailed information is obtained from the calculation of profitability ratios and their comparison with indicators of the previous year, indicators of other companies. Profitability ratios are one of the most important companies' financial condition and businesses performance characterizing indicators. According to a review by Grifell-Tatjé and Lovell (2015), the concept of profitability has a long history in the business literature, but a much shorter history in the economics literature. Also these authors represent some potential advantages to use of profitability to express business financial performance:

- Profitability is useful for the comparison of the financial performance of varying size of companies.
- Profitability does not take on zero or negative values often faced with profit.
- Profitability change can be decomposes into the product of a productivity change component and a price recovery change component.
- Profitability is/or can be made the centrepiece of much business financial ratio analysis, for example, ROA, ROE, ROCE.

Dzikevičius and Jonaitienė (2015) argued that proper monitoring of the financial ratios would help to assess company operating in any of the sectors in a more adequate manner and found that the most suitable indicators to evaluate financial position of the companies are profitability and activity indicators. Profitability indicators reveal the company's ability to make investment and financing decisions, and how effectively the profits are earned. Profit is one of the most important business performance indicators. It shows whether company effectively used the assets for its activities or whether the activities carried out are in line with the optimal use of resources. Activity indicators indicate the extent to which assets are used effectively and sales are made.

There exist different measures to measure profitability of the companies. The two groups of the profitability ratios used in the analysis can be identified: the margin ratios which are based on the comparison of the two figures provided in the income statements, and return or yield ratios, where income statement data are compared to the figures from the balance sheet. The measures of return on assets and return on equity are those widely applied in financial analysis. Return on equity (ROE) provides a quantitative measure on company's performance as measured against the level of equity. Return on assets (ROA) indicates the relative performance of the total asset use in a company. Priester and Wang (2010) argued that ROE is the major measure for the investors as it indicates the level of repayment for investments in a certain company. This ratio shows the efficiency of the company's financial activity as it reflects how efficiently company employs owner's capital in an objective manner.

Even though ROE can be successfully applied to assess the company's profitability and factors that influence profitability, Higgins (2012) distinguishes certain limitations of this indicator. More specifically, the timing problem, the risk problem, and the value problem can be considered as the major caveats associated with the measure of ROE. Successful handling of these issues can ensure a proper flow if the financial analysis within a company and, in turn, effective managerial decisions. From the time perspective the ROE ratio assesses past performance and does not indicate future operating prospects. Therefore, the company with a sound record might experience certain problems in the future irrespectively of the past values of the ROE. Also, this indicator assesses only single-period performance and cannot evaluate the full impact of multi-period decisions. In this regard, the IDA framework proposed in this study partially addresses the issue by offering a chain-linked perspective towards analysis of the ROE. The ROE ratio does not indicate the risk that the company assumes in its activities. This ratio measures the return without the degree of risk-taking being taken into consideration. One of the most important sources of risk is financial decisions shaping the capital structure or the leverage level. In order to eliminate the influence of the capital structure on the company's activities, it is proposed to calculate the return on capital employment or ROCE ratio. The ratio has also been referred to as the return on invested capital (ROIC), or return on net assets (RONA). There have been some differences among definitions of the three ratios, yet the underlying idea is much the same: to evaluate company return ignoring the effects of leverage on ROE and ROA. The value problem exists when the company is a public legal entity, because ROE shows the book value of shareholders' equity, not the market value.

Another important indicator to evaluate company performance is return on capital employment ratio, or ROCE. There is some misunderstanding with this ratio, because different scholars call this indicator differently with minor different interpretation. Higgins (2012) and Subramanyam (2014) refer to ROCE as ROIC (return on invested capital). The calculation of ROCE is somewhat more flexible and has a several alternatives. The return on capital employed shows how much the net operating profit after tax is spent for one euro on capital employed. This indicator reflects the efficiency of utilization of the company's total equity and debt capital. A higher value of the indicator reflects a more efficient capital investment. The higher value has this ratio then the higher is the return on the total debt and equity capital. For companies with money earning ability, it is recommended to calculate the "net" financial debt, i.e. short and long-term financial debt to reduce the amount of cash and cash equivalents, short-term (financial) investments and time deposits.

The return on capital employed ratio can be calculated as the product of the two indicators, the net operating margin after tax or NOPAT margin and the capital employed ratio. The first of them shows the impact of the company's entire business on the return on capital employed (excluding financial activities). The second ratio (capital employed ratio or capital turnover ratio) is the value reverse to capital intensity. It shows the amount of whole capital (equity and debt) the company needs to ensure its proper level of sales. These two indicators reflect the main factors that determine the return on capital employed.

The return on capital employed can be compared to the return on equity. The differences between these two indicators are determined by the differences in company's financing strategies, the degree of utilization the debt and its efficiency. If the company's financial debt is zero, the values of these two indicators coincide.

The ROCE ratio is broadly used to measure the return earned on the total capital employed in the business without regard for whether it is called debt or equity. Subramanyam (2014) argued that this indicator (or ROIC) gives the possibility to measure managerial effectiveness, level of profitability, and planning and control. According to this author, ROIC is a useful tool to evaluate managerial effectiveness especially for a longer time. Managers make the financing, investing, and operating decisions which shape company's business activities in a significant way. Like all other profitability indicators, this is also used to measure the company's profitability. This is an important ratio of a company's long-term financial strength and can it allows to see different operational prospects depending on different sources of financing. Finally this indicator can be used as a ration in company planning, budgeting, coordinating, evaluating, and controlling areas.

In order to fully assess the profitability of company is proposed DuPont approach or DuPont triangle. Electrical engineer F. Donaldson Brown joined Du Pont Corporation in 1909 and after nine years he was promoted to Treasurer. Based on his financial and accounting skills he proposed to invest in General Motors Corporation and developing a management accounting system now known as the DuPont triangle (Liesz 2002, Grifell-Tatjé and Lovell 2015). He modelled the functional dependence among the ratios used in the financial analysis, namely net profit margin (which indicates the level of profitability maintained in a company), total asset turnover (which reflects the degree to which assets are exploited in generating income) and ROA. Within this setting, multiplying the net profit margin and total asset turnover yields ROA. This relationship can be treated as the conventional DuPont model. Liesz (2002) notes that in 1970s the foremost objective of the corporate activities and financial management became generation of the returns for equity invested in a company buy the capital owners. This induced the shift of the focus from the measure of ROA to ROE. Such changes in the objectives of the financial analysis rendered further methodological developments. Specifically, the conventional DuPont model was extended to account for the capital structure. Therefore, the three components were put into the focus: profitability, efficiency of the asset use, and the mode for financing corporate activities (leverage). The third component of the DuPont identity became known as the equity multiplier. Specifically, it is defined as the ratio of the total assets over the equity.

The DuPont model is useful in establishing a comprehensive framework to identify strengths and weaknesses of the company's performance. In its essence, analysis based upon the DuPont model allows one to decompose the ROE with respect to the three underlying terms each associated with profitability, operating efficiency (or, more specifically, partial productivity of the assets), and financial leverage. In this context, profitability is represented by the profit margin which is obtained as a ratio of the net income over the net sales (or revenue). Operating efficiency is captured by considering the asset turnover, i.e. the ratio of net sales to total assets. The latter measure indicates the extent to which resources are managed in an effective manner and employed to generate the revenue.

Although increase in this ratio indicates a positive trend, excessively high rates of this indicator indicate underinvestment in assets required in the operation of the business. Such phenomenon adversely affects the overall performance of the company in the long run. The equity multiplies is used as a measure of financial leverage. The latter multiplier is calculated as a quotient of assets to equity. Indeed, such a measure provides information on the involvement of the owners in financing the operation of the company. Therefore, different terms involved in the DuPont identity can guide one in identifying the sources of differences in the ROE across different entities. A schematic representation of construction of the ROE indicator and the linkages underlying the DuPont identity is given in Fig. 6.

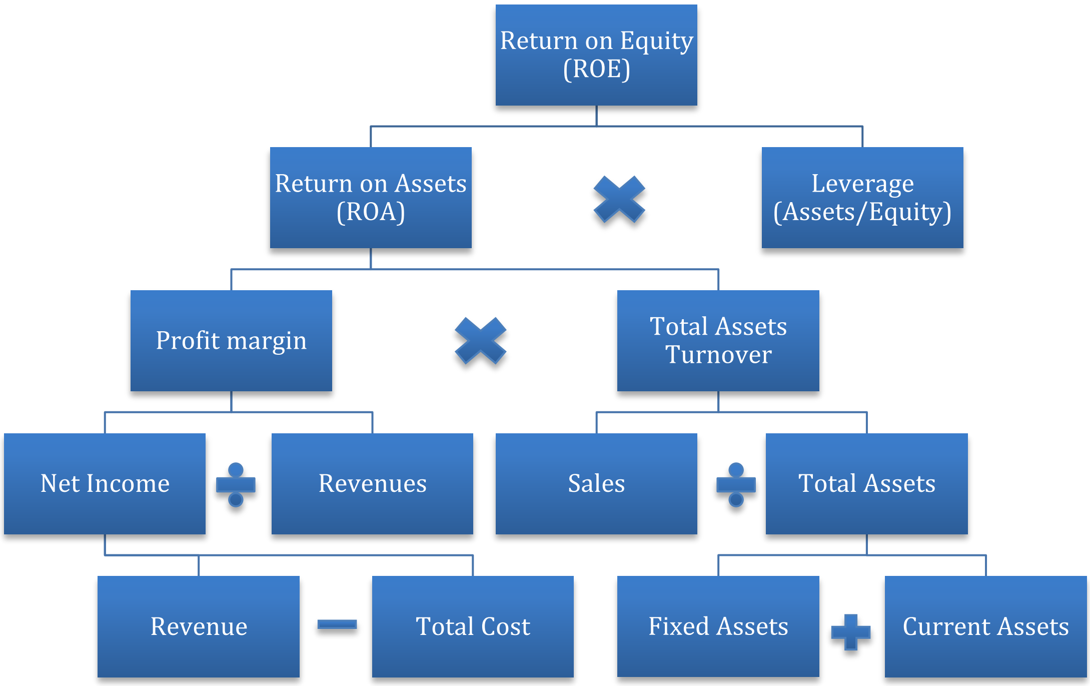


Fig. 6. DuPont analysis approach

Source: designed by the authors

Analysing the dynamics of equity profitability is evaluated not only the absolute but also relative change of this ratio. For this purpose, the index method is used, because the system of indices of factors influencing the profitability of equity is based on a chain-based approach. The numerator and denominator of each factor index are expressed as a product of factors *a, b, c,* which reflects the corresponding return on equity – both reporting and base periods – or conditional factors, taking into account factors in different time periods.

DuPont analysis provides an opportunity to clarify the true causes of changes in returns on equity over the all analysed period of time. It is expedient to carry out a relationship analysis between the return on capital and return on assets ratios. The analysis of the interconnection of these indicators is important because the assets are financed from both equity and debt capital, so it is essential to determine which type of financing activities is more profitable and the impact on the profitability of the assets. The return on assets shows the use of asset efficiency, i.e. how is it able to use assets to earn a profit regardless of the capital structure. The return of the assets is determined by two ratios – the profit margin and the assets turnover. The first indicator evaluates the final results of a company's financial activity, and the second – the efficiency of assets utilization to seek the sales (or revenues). For company's managers is essential to make a strategy to optimize the profitability. Priester and Wang (2010) proposed the steps how company can pursue a strategy based on ROE components. Table 2 shows the different strategies, which company can use to improve its performance.

Table 2. Financial strategies for the managers to maximize the ROE

Source	**Profit Margin**	**Assets Turnover**	**Leverage**
Strategy	Margins strategy	Volume strategy	Leverage strategy
Description of the strategy	Switching towards more profitable product-mix Ensuring cost efficiency	Increasing sales Streamlining asset levels	Exploiting credit market Financial engineering

Source: Priester and Wang (2010)

DuPont method has been used in different contexts (Katchova and Enlow, 2013; Bauman, 2014; Moneva and Ortas, 2010; Mishra, Moss and Erickson, 2009, Lim, 2014; Feroz, Goel and Raab, 2008; Seens, 2013; Soliman, 2008, Melvin, Boehlje et al., 2004; Mackevicius et al., 2007; Baležentis et al., 2012; Kriščiukaitienė and Baležentis, 2011; Grashuis, 2018) to investigate financial performance of the company, or industry level (agriculture, furniture, insurance and banks, oil industry, fashion business, health care industry, hotels). We will present a s literature review on applications of the DuPont approach in different sectors.

Katchova and Enlow (2013) analysed the performance of publicly-traded agribusiness companies. They applied DuPont analysis to examine financial performance of the companies and to compare the resulting ROE components across agribusinesses and the other companies. The agribusiness showed higher ROE if compared to the other companies, and further decomposition indicated that these differences were induced by asset turnover ratio. Thus, agribusiness companies outperformed the other companies in terms of the operating efficiency.

Grashuis (2018) analysed the performance of farmer cooperatives in the United States by means of the DuPont identity. The quantile regression was applied in order to explain the differences in ROE across the cooperatives in terms of different components of the DuPont identity. In general, operating profit margin appeared as they driver of ROE independent of the type or size the agricultural cooperatives. Grashuis (2018) also related the net profit margin to efficiency of operation, whereas asset turnover was considered as a proxy of productivity. However, these concepts are related to production frontiers and are not completely relevant in the case of the DuPont identity. Rather, revenue, technical, and cost efficiency should be considered.

Mishra et al. (2009, 2012) examined the factors affecting the terms of DuPont identity in the US farms. Mishra et al. (2009) reported the significant effects of the agricultural support payments on the profit margin, yet this was not the case for asset turnover (even though the level of assets was affected). Furthermore, the regional differences were identified. Mishra et al. (2012) embarked on a more detailed analysis of the determinants of the terms of ROE. In the latter case, farm-specific characteristic were used as explanatory variables for each term of the DuPont identity. Indeed, different factors were found to affect particular terms of the DuPont identity.

A study by Melvin et al. (2004) utilised the DuPont model for analysis of the financial health of farm businesses. Specifically, the production and marketing decisions were compared by using the DuPont decomposition as a benchmark. Hirsch and Schiefer (2016) considered the differences in variance of the terms comprising the DuPont identity when identifying the most important sources of misalignments in profitability of the EU food industry. ROA was decomposed and regressed on firm-specific factors as well as on time, industry, and country dummies. However, the latter group of effects appeared to be insignificant. Zouaghi et al. (2017) also looked at the determinants of the ROA of the Spanish companies operating in the agri-food industry. The analysis was also carried out in a multi-level setting. Gschwandtner and Hirsch (2017) presented analysis of the determinants of profitability as measured by the ROA ratio in the case of the US and EU food processing industry. Firm size and the underlying risk appeared as important factors of profitability at the firm level. Sector-specific variables included market concentration and growth rate.

Moneva and Ortas (2010) looked into the interlinkages between profitability and environmental performance. In general, a direct relationship was established between both types of performance. Bauman (2014) decomposed the changes in the return on net operating assets and considered the two terms, namely asset turnover and profit margin. The analysis was carried out for each direction of the change in the profit margin.

Feroz et al. (2008) offered a slacks-based data envelopment analysis model which builds upon the logics of the DuPont identity. By doing this, they were able to carry out the decomposition at the optimal levels of variables involved in the profit decomposition. Lim (2014) also relied on the DuPont model when looking into sustainable and unsustainable parts of the operation income. Soliman (2008) analysed the stock market behaviour in the sense of the indicators comprising the DuPont identity. The econometric models were set up in order to assess the factors of the expected returns on net operating assets (i.e. the expected profitability).

Baležentis et al. (2012) use financial ratios and fuzzy MCDM methods to assess the performance of sectors of Lithuanian economy. The latter study included such variables as ROA, turnover, profit margin and leverage ratios (which comprise the DuPont model). Kriščiukaitienė and Baležentis (2011) used return on fixed asset ratio to analyse the performance of Lithuanian agricultural sector.

Yazdanfar and Öhman (2015) focused on the linkages between growth and profitability in the context of the small- and medium-sized companies. The ROA ratio was used as a profitability indicator and the results obtained indicated that the current-period profitability level is directly related to company growth. Based on these findings, Yazdanfar and Öhman (2015) highlighted the need for improvements of the financial management practices which may lead to increase in profitability. This would allow for sustainable growth. Mackevicius et al. (2007) discussed the of the DuPont analysis for equity utilisation.

Summarizing the earlier research on profitability analysis one can notice diversity in regard to methods applied, data used, and sectors covered. However, some general trends can be identified. Specifically, financial ratios (e.g. ROA, ROE) have been applied to measure financial performance in many cases. The changes in the financial ratios are related to changes in absolute indicators. For instance, the changes in returns (net profit) determine the numerator of the ROA. Thus, we look at the optimal level of change in the returns in the next sub-section.

1.5. Sustainable growth paradigm

Sustainable growth paradigm was developed by Higgins (1977). Indeed, he argued that there exists a sustainable level of growth (sustainable growth). He showed that the financial policies and growth objectives are mutually incompatible and discussed the exits from situations where observed and sustainable growth rates do not coincide. Model follows the following assumption (Higgins, 1977, 2012): (i) desirable capital structure and dividend policy are known for a given company, (ii) selling new equity is not possible or desirable. The key idea is that the generation of additional sales requires increase in assets at a pre-defined rate. On the other hand, increase in sales generates income which allows for lending and increasing equity through profit retention. These two channels must be equal in order to maintain sustainable growth.

In order to show interdependence between growth and financial policy Higgins (1977) proposed model equating annual sources of capital to annual uses thereof (see Fig. 7). Seens (2013) proposed DuPont extension to evaluate SME sustainable growth based on Higgins (1977) sustainable growth model. Higgins sustainable growth rate can be expressed as a function of company return on equity and its retention rate. The DuPont model examined factors that influence both ROE and sustainable growth.

Companies can push their SGRs up through inflation of the profit retention rates, profit margins, asset turnover, and/or leverage.

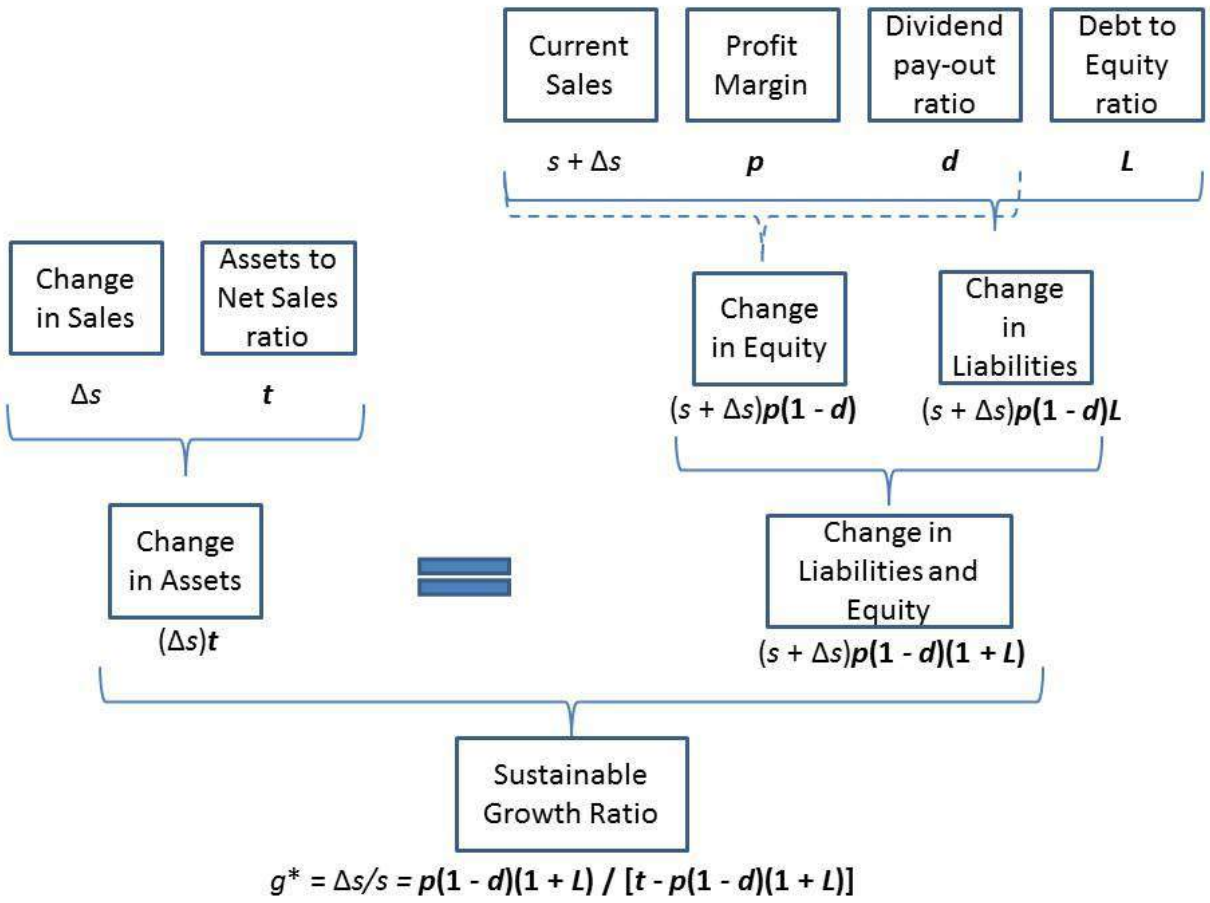


Fig. 7. Sustainable growth ratio

Source: based on Higgins (1977)

Growth is associated with the ability to capture more market share and earn higher profits. But it also has to be optimal. It is found that both fast and slow growth leads to almost the same number of bankruptcies (Higgins, 2012). The rapid company development requires resources and, if not taken adequate steps to control, it can lead to bankruptcy. Similarly, companies that do not take account of slow growth caused by the financial consequences. Therefore it is important to set limits to what available expand the activities of the company to maintain its competitive market players and to ensure the stability of the entity's operations. For this purpose, Higgins (2012) and Mackevičius (2009) calculated the company's steady growth rate, which indicates the maximum increase in sales of the company without additional sources of funding. High ratio value indicates that the company has great potential for use of internal financial resources and reduces assets financing with borrowed funds. Obviously, it is important to assess the coefficient changes over a longer period of time. Preferably, the rate is increasing consistently. Meanwhile, the big changes in this ratio indicate that the company may have unbalanced marketing, management and financial resources (Mackevičius, 2009).

Higgins (1977) argued, if actual growth in sales (g) equals to sustainable growth rate (g^*), one or some combination of the variables p, d, L or t must change (or the company must sell new shares). If actual growth in sales falls below sustainable growth rate, the company has more than enough capital to meets its investment needs. This situation urges to increase liquid assets, to reduce leverage, or increase dividends. If there occurs an opposite situation ($g^*<g$), the managers can prepare to raise new equity, or adjust d, L, p, and t until $g^*=g$, or reduce g.

Escalante et al. (2006, 2009) noted that sustainable growth challenge (SGC) model formulated by Higgins (1977) also can be used to measure farms sustainable growth, which is calculated as the difference between the growth in sales and the SGR. The difference between the observed value of g and the optimal one (i.e. SGR) should be addressed by adjusting the SGR. Solivoda (2015) also analysed the application paradigm of sustainable growth for farms.

Kijewska (2016) showed that relationship between profitability and growth in the form of the diagnosis matrix. The vertical axis measures the growth of a company, whereas the horizontal axis represents the profitability (see Fig. 8). Different combinations of the levels of profitability and growth indicate different situations in company's development.

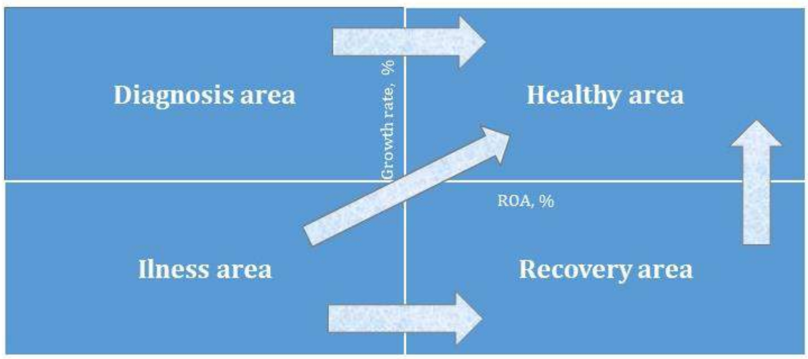


Fig. 8. Diagnosis matrix

Source: Kijewska (2016).

The matrix illustrates the correlation between sales growth and ROA with the best situation in upper right quadrant (relatively high profitability and growth). The illness area shows the quadrant in the bottom left side (low profitability and growth). The remaining areas are falling in between the latter two cases. Turning to the right lower quadrant, one arrives at relatively low growth and high profitability. The upper left quadrant indicates relatively low profitability and relatively high growth which might be subdued in the future in case low profitability persists.

1.6. State-of-the-art of the agricultural profitability and economic sustainability research

The key elements of a benchmarking framework, namely DuPont analysis and return on capital employed, might be chosen from a set of various possible instruments. Combinations of these options create certain patterns for profitability research. The second part of scientometric analysis based on economic sustainability and profitability models. We have thus performed a scientometric analysis aimed at identifying the current trends of profitability and economic sustainability benchmarking in agriculture.

The scientometric analysis is based on data retrieved from the globally renowned database Web of Science (Clarivate Analytics) which is usually employed for such analyses (Zavadskas et al., 2011). The aim of the scientometric research was to analyse the dynamics in number of citable items, namely articles, reviews, proceedings etc., related to the frontier efficiency measurement in agriculture. The research covers the period of 1990–2017. The initial query was defined by setting publication topic equal to: return on equity OR DuPont analysis OR profitability analysis AND agriculture OR family farms. The latter query refined by: document types: article and research areas: agriculture. Of course, some papers are omitted thanks to usage of acronyms. As a result, the query returned 1803 publications. The number of released publications has been growing throughout the analysed period and approached some 195 publications per annum in 2017 (Fig. 9). Meanwhile the number of citations has also been increasing and reached 14 385 citations until 2017 with over 2309 citations per annum in 2017 (Fig. 10). Profitability measurements in agriculture, therefore, can be considered as a rather prospective and expanding research area.

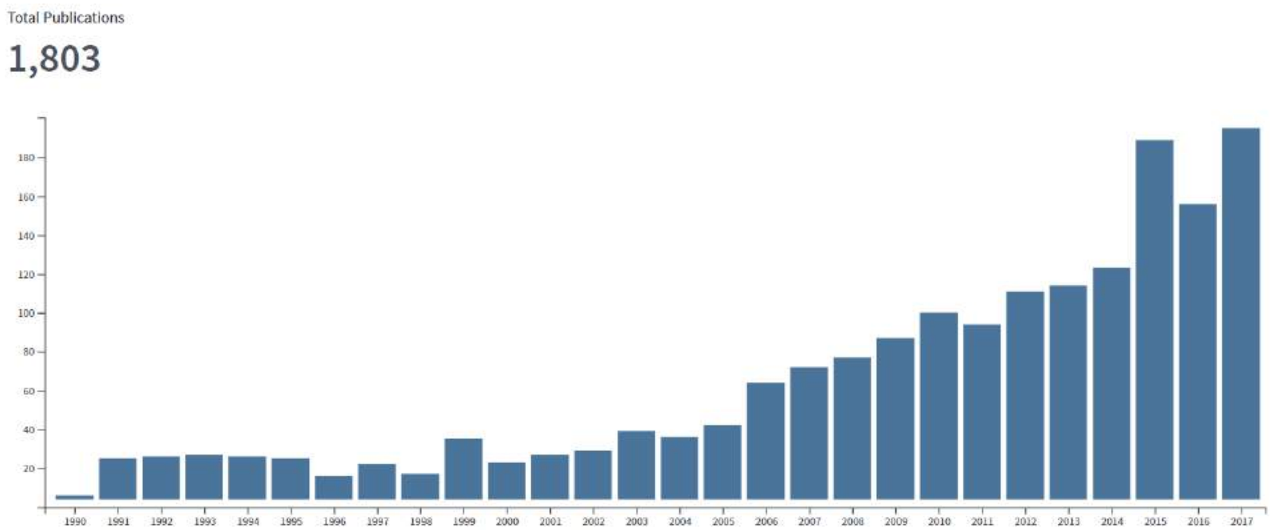


Fig. 9. Number of publications in WoS on profitability in agriculture, 1990-2017

Source: Clarivate Analytics Web of Science

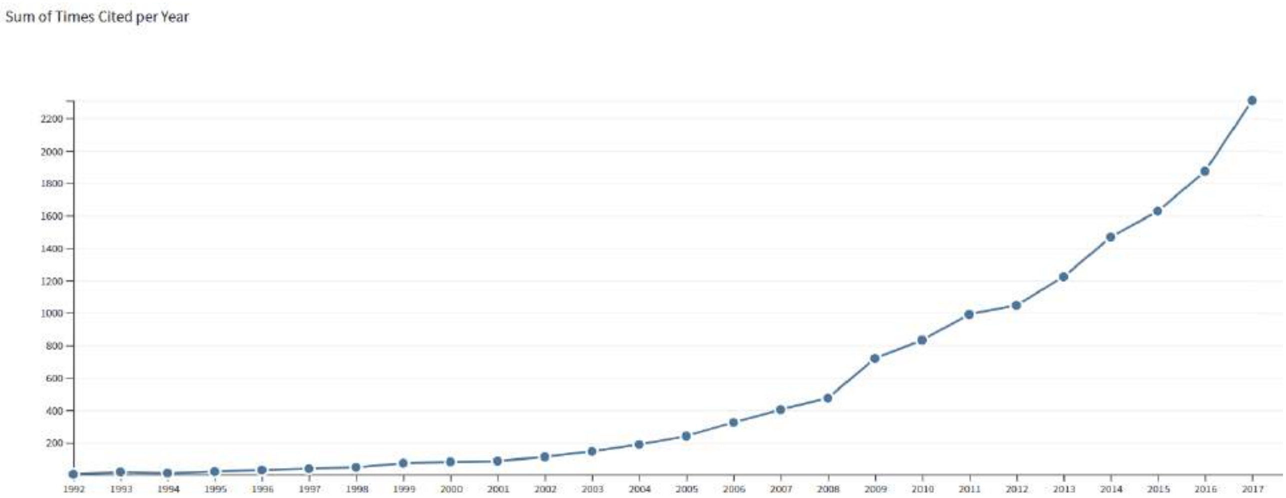


Fig. 10. Number of citations in WoS on profitability in agriculture, 1990-2017

Source: Clarivate Analytics Web of Science

Table 3 presents the main journals which constitute the basis for dissemination of the agricultural profitability research results. As one can note, Agricultural Systems and Cahiers Agricultures appear as the major sources on agricultural profitability. The remaining outlets feature rather similar shares.

Table 3. The main journals featuring publications on agricultural profitability, 1990–2017

No.	Source Titles	Record Count	Per cent share
1.	Agricultural System	84	4.7
2.	Cahiers Agricultures	69	3.8
3.	Agroforestry Systems	46	2.6
4.	Berichte Uber Landwirtschaft	45	2.5
5.	Tropical Animal Health and Production	44	2.4
6.	Agricultural Economics	42	2.3
7.	American Journal of Agricultural Economics	37	2.1
8.	Agriculture Ecosystems Environment	34	1.9
9.	Journal of Sustainable Agriculture	31	1.7
10.	Journal of Dairy Science	28	1.6

Source: Web of Science

The other query was defined by setting publication topic equal to: economic sustainability AND profitability analysis. The latter query refined by: document types: article and research areas: agriculture. As a result, the query returned 91 publications. The number of released publications has been fluctuating throughout the analysed period and approached some 13 publications per annum in 2017 (Fig. 11). Meanwhile the number of citations has been increasing and reached 875 citations until 2017 with over 131 citations per annum in 2017 (Fig. 12).

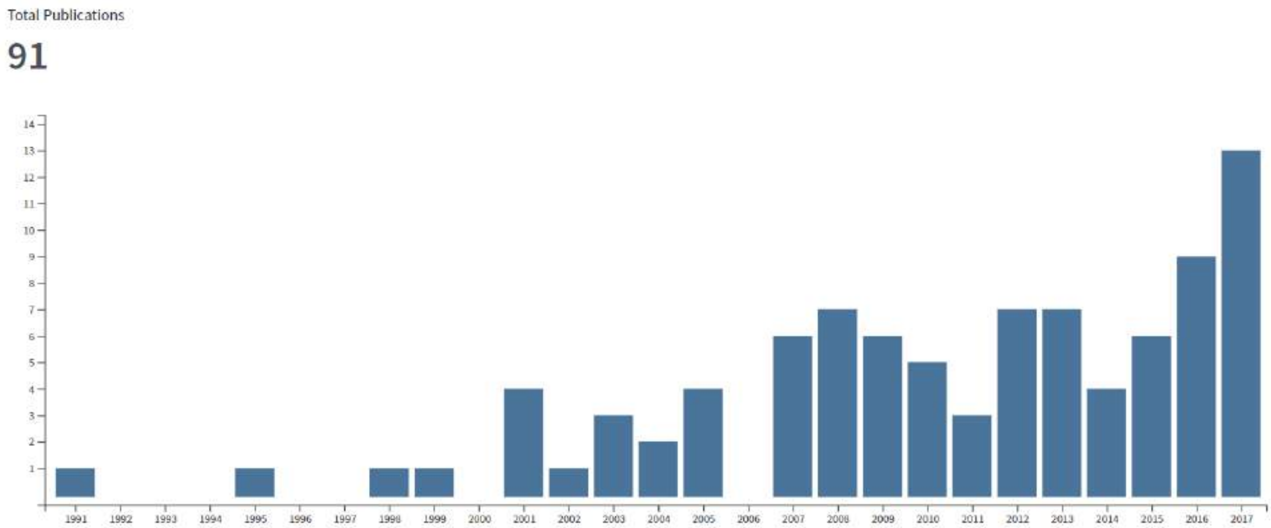


Fig. 11. Number of publications in WoS on profitability and sustainability, 1990-2017

Source: Clarivate Analytics Web of Science

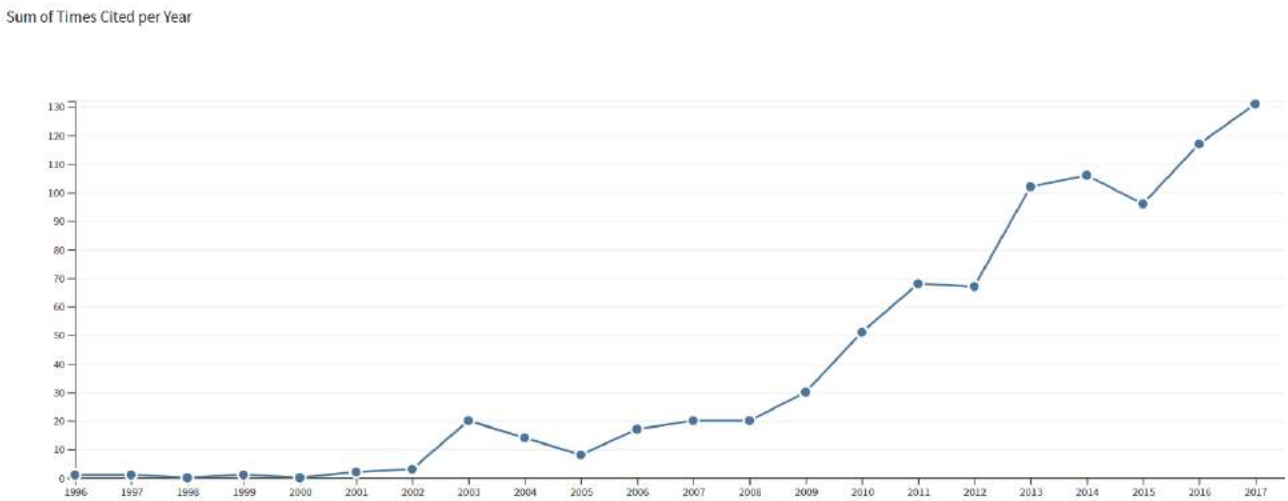


Fig. 12. Number of citations in WoS on profitability and sustainability, 1990-2017

Source: Clarivate Analytics Web of Science

Table 4 presents the main journals which constitute the basis for dissemination of the agricultural profitability research results. The two leading journals, namely Agricultural Systems and Animal Production Science, feature the shares of some 6%. The other titles are attributed with shares below 5%.

Table 4. The main journals featuring publications on agricultural economic sustainability and profitability, 1990–2017

No.	Source Titles	Record Count	Per cent share
1.	Agricultural System	6	6.6
2.	Animal Production Science	6	6.6
3.	Agroforestry Systems	4	4.4
4.	Biomass Bioenergy	4	4.4
5.	Small Ruminant Research	4	4.4
6.	Journal of Sustainable Agriculture	3	3.3
7.	Agricultural Economics	2	2.2
8.	Agronomy for Sustainable Development	2	2.2
9.	Agronomy Journal	2	2.2
10.	Australian Journal of Experimental Agriculture	2	2.2

Source: Web of Science

The carried out analysis suggests that profitability benchmarking in agriculture is a robustly developing branch of science. To be specific, the number of publications released per year on profitability in agriculture has increased eight times since 1990. Indeed, DuPont analysis is important instrument for estimating financial efficiency or profitability. The number of publications released per year on economic sustainability with relationship in profitability analysis also increased by more than five times since 2003.

2. METHODOLOGY AND DATA USED

The empirical research is mainly directed towards identification of farm profitability changes. The IDA and DuPont identity are applied to develop the indicators of profitability change which can then be used as indicators of farm economic sustainability. Fig. 13 presents the main properties of the approach taken and the conventional use of the DuPont identity.

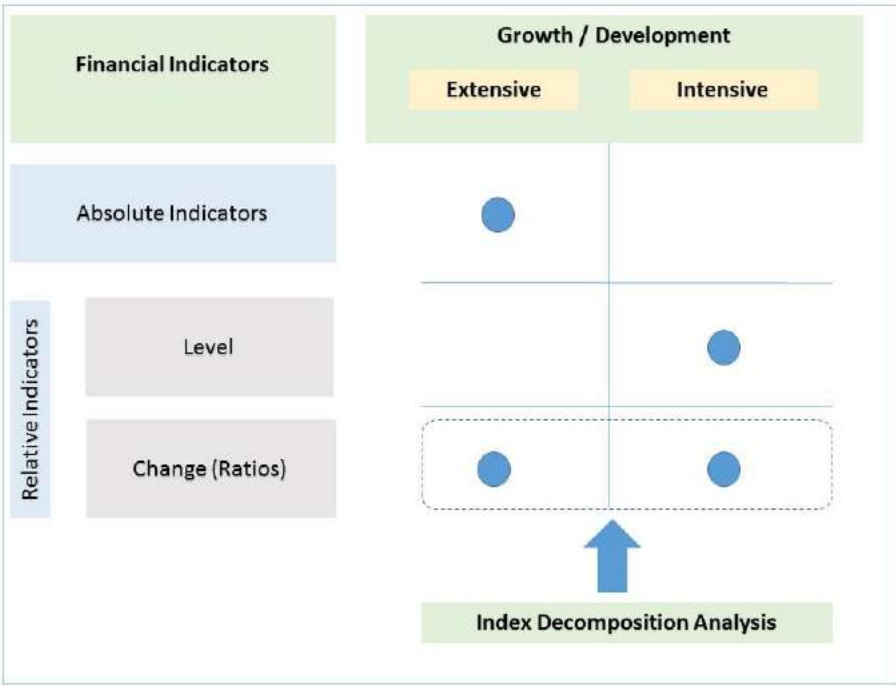


Fig. 13. Application of IDA in the context of financial ratio analysis

The use of the absolute financial indicators allows one to describe the extensive growth of a farm (or firm in general). For instance, indicators of output value, revenue or income represent the changes in the activity of a farm. The analysis of financial ratios (e.g. profitability indicators) allows for comparison across farms and represents the changes in the intensity of the activities. The changes in the ratios can be decomposed into multiple factors, both extensive and intensive ones. Taking returns on assets as example, they can be related to intensive factors (changes in profit margin and asset turnover) and extensive factor (financial leverage). Indeed, the extensive factor can be improved without qualitative changes in the production or marketing processes.

2.1. DuPont identity

The DuPont analysis can be performed in order to test the profitability of family farms and to determine impact of profit margin, asset turnover, and equity multiplier (leverage) factors on ROE. Baležentis and Novickytė (2018) presented the DuPont identity for Lithuanian family farms and decomposed the ROE. In this study, we also focus on decomposition of the ROCE indicator. We also use an additional profitability indicator – the return on capital employed – to evaluate the financial performance of the family farms. This ratio shows how much of the net operating profit after tax is spent for one euro on capital employed. ROCE ratio is decomposed into two ratios – net operating margin after tax or NOPAT margin and the capital employed ratio. Sustainable growth ratio used to test family farms growth based only on intern resources. Sustainable growth paradigm (represented by the SGC indicator) is used to test whether Lithuanian family farms growth was sustainable. BCG matrix used to evaluate relationship between growth and ROE of family farms.

DuPont model for Lithuanian family farms analysis is constructed based on Mishra et al. (2009, 2012) and Goral (2015). Mishra et al. (2009, 2012) argued that application of the DuPont model in agricultural business has traditionally been focused on the capital structure dimension of the decomposition. Based on the DuPont model, ROE decomposes as (Mishra et al., 2009, 2012; Goral, 2015):

$$\frac{R_t}{E_t} = \frac{R_t}{A_t}\frac{A_t}{E_t}, \qquad (1)$$

where R_t is profit (returns), E_t is equity, and A_t stands for assets at period t. The decomposition of the ROE can be further refined by considering the sales variable in the analysis. In this case, the three multiplicatively related terms of the ROE are established. The profit margin represents profit generation from the sales, asset turnover reflects the asset productivity and the integration in the credit market is represented by the leverage ratio. Thus, the DuPont model decomposes the ROE ratio into multipliers of the net profit margin, asset turnover, and financial leverage (or assets to equity ratio). The multiplicative relationship among the discussed variables takes the following form:

$$\frac{R_t}{E_t} = \frac{S_t - C_t}{S_t}\frac{S_t}{A_t}\frac{A_t}{E_t} = P_t N_t L_t, \qquad (2)$$

where S_t is sales and C_t is production costs for period t, and P_t, N_t, and L_t denote profit margin, asset turnover, and leverage for period t, respectively. In case of farm performance analysis, we replace the profit indicator with the net income less family remuneration (as applied in the FADN system).

Besides the DuPont model, ROCE ratio can be applied for the analysis of the farm performance. In general case, the ROCE ratio can be calculated as:

$$ROCE = \frac{Net\ operating\ profit\ after\ tax\ (NOPAT)}{Capital\ employed} =$$
$$\left(\frac{EBIT}{Sales}\right) \times (1 - Tax\ rate) \times \left(\frac{Sales}{Capital\ employed}\right) = NOPAT\ margin \times \left(\frac{Sales}{Capital\ employed}\right), \quad (3)$$

where capital employed is obtained as the sum of debt and equity with the former one including both long- and short-term debts.

For the family farms the ROCE ratio is calculated as:

$$\frac{N_t}{CE_t} = \frac{N_t}{G_t}\frac{G_t}{CE_t} = M_t CR_t, \quad (4)$$

where N_t is farm net income, G_t is gross farm income, and CE_t is the capital employed for period t. In this case, ROCE decomposes into two ratios – net operating margin after tax or NOPAT margin (M_t) and the capital employed ratio (CR_t). First ratio is defined as the ratio of Net Farm Income over the Gross Farm Income, and second is that of the Gross Farm Income over the amount of Net Worth and Financial Debt. In this analysis, we do not use the tax ratio as tax burden is relatively meagre for Lithuanian family farms.

The identities presented in this sub-section define the relationships among the variables for a certain time period t. Considering a time series for a certain farm or group of farms, one needs to consider the change in profitability indicators. However, the underlying multiplicative structure allows for decomposition of the change in the profitability. The data needed for this procedure and methodological approach are discussed in the following sub-sections.

2.2. Data issues

The EU established the FADN system in order to ensure uniform practices regarding statistics of the agricultural sector. The FADN relies on sample survey and includes both family and corporate farms. In Section 3.1, we compare Lithuania to the selected EU countries. In this case, we rely on the aggregate data from the European Commission (2018). In this case, the aggregate data include both family farms and corporate farms (juridical persons). Sections 3.2 and 3.2 rely on data from Lithuanian Institute of Agrarian Economics (2018) and thus describe activities of family farms only.

The DuPont identity describes the relationships among variables generally used in the financial statements. However, some of those variables are not suitable in the case of agricultural business. In order to apply the DuPont identity on the FADN data, one needs to identify the proper variables representing the components of Eq. 2 and Eq. 4. Table 5 shows the FADN variables associated with respective DuPont model components needed to calculate the ROE ratio, and the ROCE ratio for family farms.

Specifically, we re-define the profit margin as the ratio of the farm net income (which already captures sales revenue deducted by intermediate input costs) less Family Remuneration (i.e. the implicit cost of family labour input) over the Gross Farm

Income. The Asset Turnover is defined as the ratio of Gross Farm Income over the Total Assets. Finally, the Leverage ratio is that of Total Assets over the Net Worth.

Table 5. FADN variables used in the DuPont analysis and ROCE ratio calculation

Ratio	FADN variables
For ROE calculation:	
$Profit\ Margin = \frac{Farm\ Net\ Income - Family\ Remuneration}{Gross\ Farm\ Income}$	Farm Net Income - SE420 Gross Farm Income - SE410 Family Remuneration – Table 26 in Lithuanian … (2006-2016)
$Asset\ Turover = \frac{Gross\ Farm\ Income}{Total\ Assets}$	Gross Farm income - SE410 Total Assets - SE436
$Leverage = \frac{Total\ Assets}{Net\ Worth}$	Total Assets - SE436 Net Worth - SE501
For ROCE calculation:	
$NOPAT\ margin = \frac{Farm\ Net\ Income}{Gross\ Farm\ Income}$	Farm Net Income - SE420 Gross Farm Income - SE410
$Capital\ employed\ ratio = \frac{Gross\ Farm\ Income}{Net\ Worth + Financial\ Debt}$	Gross Farm Income - SE410 Net Worth - SE501 Financial Debt (Total Liabilities) – SE485 (Long and medium-term loans – SE490 and short-term loans – SE495)

Inclusion of family remuneration is arbitrary in that the share of income used by family members is not explicitly defined in the FADN. In this study, we use Family Remuneration variable as an example of the approach than can be applied to approximate the profit margin. However, a number of different indicators and settings can be applied in this case.

2.3. IDA model for the DuPont identity

The changes in the three factors (profit margin, asset turnover, and leverage) influence the changes in ROE, and the changes in the two factors (NOPAT margin, and capital employed ratio) influence the changes in ROCE. One can quantify these effects by applying the IDA. In this study, we propose combining DuPont identity and Shapley value to establish the IDA identity and thus facilitate decomposition of the change in ROE and ROCE ratios.

Sun (1998) and Albrecht et al. (2002) independently proposed the IDA models involving the Shapley value to decompose the changes in variables of interest. Later on, Ang et al. (2003) showed that the proposed approaches indeed collapse to the same one, i.e. the Shapley/Sun index. Indeed, the Shapley/Sun index can be regarded as a type of the Laspeyres index. Noteworthy, the Shapley/Sun index features certain desirable properties (path independency, time reversal, and, most importantly, perfect decomposition). The Shapley/Sun index has been applied in a number of researches (Ang et al., 2003, 2009).

In our case, the objective of the IDA model is to decompose the changes in a certain variable of interest, V, with respect to the three components, x_1, x_2, x_3. Let us denote the two time periods by 0 and T. Then, we establish the following additive relationship (Ang et al., 2003):

$$\Delta V = V^T - V^0 = x_1^T x_2^T x_3^T - x_1^0 x_2^0 x_3^0 = \Delta V_{x_1} + \Delta V_{x_2} + \Delta V_{x_3}, \tag{5}$$

where ΔV is the absolute change in V, and ΔV_{x_i} is the effect associated with factor x_i, for $i = 1, 2, 3$.

The concept of the Shapley value (Shapley, 1953) can be involved to appraise the effects of the explanatory variables. In our case, we focus on the three explanatory variables and, hence, apply the three-factor model:

$$\Delta V_{x_i} = \sum_{s=1}^{3} \frac{(s-1)!(3-s)!}{3!} \sum_{S: x_j \in S, |S|=s} \left(V(S) - V(S \setminus x_i) \right), \tag{6}$$

where S is a set of factors which change their values from period 0 to period T, i.e., $V(S) = \prod_{j \in S} x_j^T \prod_{j \notin S} x_j^0$, for $j \subseteq i$. For instance, ΔV_{x_1} is calculated as:

$$\begin{aligned} \Delta V_{x_1} &= \frac{1}{3}\left(x_1^T x_2^0 x_3^0 - x_1^0 x_2^0 x_3^0 \right) + \frac{1}{6}\left(x_1^T x_2^T x_3^0 - x_1^0 x_2^T x_3^0 \right) \\ &+ \frac{1}{6}\left(x_1^T x_2^0 x_3^T - x_1^0 x_2^0 x_3^T \right) + \frac{1}{3}\left(x_1^T x_2^T x_3^T - x_1^0 x_2^T x_3^T \right) \end{aligned}. \tag{7}$$

The Shapley value can be applied for the particular case of the DuPont identity in Eq. 2. Specifically, we factorize the changes in the ROE ratio by considering the three terms:

$$\Delta\left(\frac{R}{E}\right) = \frac{S_T - C_T}{S_T} - \frac{S_0 - C_0}{S_0} = \Delta P + \Delta N + \Delta L, \tag{8}$$

where $\Delta P, \Delta N, \text{and } \Delta L$ are the effects of the three factors given in Eq. 2. The contribution of each factor is obtained by applying Eq. 5.

For analysis of a two-factor model, one can consider the following general equation:

$$\Delta V_{x_i} = \sum_{s=1}^{2} \frac{(s-1)!(2-s)!}{2!} \sum_{S:x_j \in S, |S|=s} \left(V(S) - V(S \setminus x_i) \right), \tag{9}$$

where S is a set of factors which change their values from period 0 to period T, i.e., $V(S) = \prod_{j \in S} x_j^T \prod_{j \notin S} x_j^0$, for $j \subseteq i$. For instance, ΔV_{x_1} for a two-factor model is obtained as:

$$\Delta V_{x_1} = \frac{1}{2}\left(x_1^T x_2^0 - x_1^0 x_2^0 \right) + \frac{1}{2}\left(x_1^T x_2^T - x_1^0 x_2^T \right). \tag{10}$$

Considering base period associated with index 0 and the current period associated with index T, the change in ROCE decomposes as:

$$\Delta\left(\frac{N}{CE} \right) = \frac{N_T}{CE_T} - \frac{N_0}{CE_0} = \Delta M + \Delta CR. \tag{11}$$

The analysis is carried out in a chain-linked manner, i.e., two-year periods are considered for each farming type or county. One can also aggregate the results across years or farming types/counties if needed. Also, period-wise analysis can be carried out.

2.4. Sustainable growth ratio

It is due to Higgins (1977) that the sustainable growth model can be applied in order to ascertain whether the financial policies (leverage, profit retention, asset to sales ratio etc.) conform to the growth objectives for a certain firm. The SGR is obtained as follows:

$$g* = \frac{p(1-d)(1+L)}{t - p(1-d)(1+L)}, \tag{12}$$

where $g*$ represents sustainable growth rate, p stands for the profit margin, d denotes the desirable dividend pay-out ratio, L denotes the target total debt to equity ratio, t is the ratio of total assets to net sales.

Based on Eq. 12, Escalante, Turvey and Barry (2006, 2009) proposed the equation of sustainable growth rate for farms. The growth is then calculated as product of the profit margin, retention ratio, asset turnover, and financial leverage:

$$g* = \prod_{i=1}^{4} \gamma_i, \tag{13}$$

where: $\gamma_1 = \frac{Income}{Revenue}$, $\gamma_2 = \frac{Income - Withdrawals}{Income}$, $\gamma_3 = \frac{Revenue}{Assets}$, and

$$\gamma_4 = \frac{Assets}{Equity_{beginning}} = \left[1 + \frac{Debt}{Equity_{beginning}}\right].$$

Eq. 13 features a similar structure to that of the DuPont equation. Given the accounting identity ($Equity_{end} = Equity_{beginning} + Income - Withdrawals$), the growth model can be rewritten as:

$$g *= ROE\left[\frac{Equity_{end}}{Equity_{beginning}}\right] \tag{14}$$

where $Equity_{end}$ and $Equity_{beginning}$ represent Net Worth (SE501) variable from FADN at both the end and beginning of the year.

The sustainable growth challenge (SGC) model (Higgins 1977, 2012) is also used to measure the disparity between actual and sustainable growth rates, which is represented by the difference between the growth in sales or revenues and the sustainable growth rate (Escalante, Turvey and Barry, 2006, 2009):

$$SGC = ln\left[\frac{Revenue_t}{Revenue_{t-1}}\right] - g * \tag{15}$$

where *Revenue* represents the Gross farm income (SE410) variable from FADN.

The modified Boston consulting group matrix is used to test relationship between growth and profitability of Lithuanian family farms. The matrix is known as a competitiveness analysis matrix. The 2×2 matrix is constructed by presenting the relative profitability and relative growth rates on the two axes (Calandro, Lane, 2007). Kijewska (2016) suggested using the ROA ratio instead of the ROE ratio when measuring profitability.

We used the ROE ratio to measure profitability and sustainable growth ratio (g) to measure growth. Industry ROE and growth (g) are based on the weighted averages for all family farms. Therefore, the relative profitability is obtained as:

$$ROE_i^r = ROE_i - ROE, \tag{16}$$

where ROE is industry-wide measure, ROE_i is farming type or county specific measure, and ROE_i^r is relative measure for the *i-th* farming type or county. The relative growth rate is defined as:

$$g_i^r = g_i - g, \tag{17}$$

where g is industry-wide measure, g_i is farming type or county specific measure, and g_i^r is relative measure for the *i-th* farming type or county.

3. ANALYSIS OF PERFORMANCE OF LITHUANIAN FAMILY FARMS

This section presents results of the empirical research on performance of Lithuanian family farms. First, the situation in Lithuanian family farms is compared to that in the other Central and Eastern European countries. Second, we focus on profitability of Lithuanian family farms across different farm types and counties. In the case of Lithuanian family farms, we decompose the profitability change by means of the Shapley value and the DuPont identity. Furthermore, the SGC is calculated in order to identify the possible gaps between the observed and optimal growth rates of the family farms. The Boston matrix is also applied to diagnose the possible pathways of the development of Lithuanian family farms with respect to the profitability-growth nexus. The FADN database is exploited for the analysis.

3.1. The main performance indicators of the family farms in CEE countries

In order to identify the main features and possible development paths for Lithuanian family farms, we first compare the key indicators of economic performance of farms in ten Central and Eastern European countries, namely Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia. The main motivation for choosing these countries was similar farming conditions and simultaneous accession to the European Union. The data from FADN were applied for the analysis (European Commission, 2018) at the country level. The data cover years 2005–2015. In order to reduce the effect of temporal variation, the average values for the whole research period are analysed. Table 6 compares the value of total assets, buildings and machinery across selected countries.

Table 6. The value of total assets, buildings and machinery across selected EU countries (in EUR), averages for 2005–2015

Country	Per 1 ha of UAA			Per 1 AWU		
	Total assets	Buildings	Machinery	Total assets	Buildings	Machinery
Bulgaria*	2268	264	438	31578	3568	6146
Czech Rep.	3415	1118	842	113912	37106	27888
Estonia	1765	444	446	100706	24958	25485
Hungary	3085	532	552	92620	15950	16558
Latvia	1743	281	389	54324	8800	12081
Lithuania	2210	254	670	54406	6110	16563
Poland	7011	1809	1173	75875	19406	12624
Romania*	3867	1302	549	26571	8964	3732
Slovakia	1932	731	268	70196	25419	9945
Slovenia	18385	5216	2391	124410	34955	16503

Source: European Commission, 2018. * averages for 2007–2015.

The results in Table 6 indicate that there exists substantial variation in the value of total assets across the countries analysed which may be due to differences in the structure of these countries' agricultural sectors. During the period of 2005–2015, the average value of total assets per 1 ha of UAA was the highest in Slovenia, whereas Estonian and Latvian farms held the lowest amounts of assets (1765 EUR/ha and 1743 EUR/ha, respectively). The ranking of countries according to the total assets per 1 AWU is somewhat different: the position of Slovenia remained unchanged, whereas the average value of total assets per 1 AWU was the lowest in Romania, mainly due to the predominance of very small, less capital-intensive farms and low land prices. It should be noted, however, that all the countries studied showed positive rates of growth in the value of total assets during 2005–2015. These changes were mainly fuelled by support payments under the Common Agricultural Policy.

A high share of farm assets constitutes tangible fixed assets, such as buildings and machinery. Farm buildings comprised, on average, the largest share of all farm assets in Slovakia. On the other hand, buildings accounted for the smallest proportion of total assets in Lithuania. The share of farm machinery ranged in between 13% for Slovenia and 30% for Lithuania.

During the research period, the value of buildings per 1 ha of UAA varied greatly across countries. On average, the highest average value of buildings per 1 ha of UAA was observed for Slovenia, whereas Lithuania showed the lowest value of this indicator. The comparison of the value of buildings per 1 AWU across countries showed that, during the period of 2005–2015, the average value of buildings per 1 AWU was the highest in Czech Republic. On the contrary, farms in Bulgaria had, on average, the lowest value of buildings per 1 AWU.

The support payments under EU policies enabled farmers of Central and Eastern Europe to actively invest in modernization of farms, especially agricultural machinery (Magó, 2013; Kusz, 2014; Viesturs, Kopiks, 2017). During 2005–2015, the highest average value of machinery per 1 ha of UAA was observed for Slovenia. At the other end of the scale was Slovakia. Different results were obtained for the value of machinery per 1 AWU. Specifically, the average value of machinery per 1 AWU was the highest in Czech Republic during the research period, while Romania featured the lowest value of this indicator. Misalignments between farmers' needs and investment decisions may lead to inefficient use of the machinery. This issue becomes particularly important for highly specialised farms and agricultural machinery.

As shown in Table 7, the composition of assets showed wide variations across the countries analysed during the period of 2005–2015. On average, the highest share of fixed assets in total assets was observed for Slovenia, where the farms are mostly family-run. It should be noted, however, that a high share of fixed assets in total assets leads to negative consequences such as high fixed costs, slow reproduction of fixed assets (Roesch et al., 2017). Slovakia was at the other end of the scale. This is due to the predominance of very large non-family farms whose operation depends more on current assets.

On average, Slovenia showed the highest share of depreciation costs in total costs during 2005–2015. The lowest share of some 10% was observed for Czech Republic and Hungary. However, it should be emphasized that depreciation is a non-cash item, it serves as a source for replacement of fixed assets consumed in the production process.

During the research period, the highest average output per 1 EUR of total assets was achieved in Slovakia. Slovenia generated, on average, the lowest output. As regards total output per 1 EUR of buildings and machinery, the rank order of countries is somewhat different: the highest average output per 1 EUR of buildings and machinery was identified in Bulgaria, whereas the lowest output was again observed for Slovenia. Looking at the average total output per 1 EUR of depreciation costs, the highest value of this indicator was identified in Romania. At the other end of the spectrum, Slovenia had the lowest average output per 1 EUR of depreciation costs.

These findings suggest that it is important to avoid excessive investments by maintaining the balance between output growth and investments. Rational investment decisions may be encouraged by more effective policy measures aimed at the modernization of agriculture and advisory services.

Table 7. Assets use efficiency across selected EU countries, averages for 2005–2015

Country	Share of fixed assets in total assets, %	Share of depreciation costs in total costs, %	Total output per 1 EUR of total assets, EUR	Total output per 1 EUR of buildings and machinery, EUR	Total output per 1 EUR of depreciation costs, EUR
Bulgaria*	67	12	0.45	1.39	9.02
Czech Rep.	73	10	0.38	0.69	9.03
Estonia	76	13	0.41	0.80	7.50
Hungary	63	10	0.41	1.17	9.99
Latvia	67	14	0.41	1.06	6.73
Lithuania	68	19	0.32	0.77	6.11
Poland	87	19	0.22	0.49	6.42
Romania*	76	14	0.33	0.70	10.13
Slovakia	61	15	0.49	1.08	5.26
Slovenia	94	30	0.12	0.28	3.24

Source: European Commission, 2018. * averages for 2007–2015.

Table 8 shows income, liabilities and net worth of farms across selected countries. During the period of 2005–2015, the average gross farm income per 1 ha of UAA ranged in between 339 EUR for Estonia and 1210 EUR for Slovenia. Looking at the gross farm income per 1 AWU, the ranking of countries is different. Specifically, Czech Republic showed, on average, the highest gross farm income per 1 AWU during 2005–2015, mainly due to a high share of very large farms, usually generating a higher income per working unit than small farms. On the contrary, the lowest average gross farm income per 1 AWU was observed for Romania. One important reason behind this is that Romanian agriculture is more focused on less productive activities.

During the research period, the highest average farm net income per 1 ha of UAA was in Slovenia. On the other hand, Slovakia exhibited, on average, the lowest net income. Looking at the farm net income per 1 AWU, the position of Slovakia remained unchanged, whereas the highest average farm net income per 1 AWU was observed for Hungary.

The highest average total liabilities per 1 ha of UAA were in Czech Republic during 2005–2015. It should be noted, however, that high levels of liabilities may not necessarily indicate a financially vulnerable position. On the contrary, such a situation could be a sign of economic viability of farms, though there is a threshold beyond which liabilities negatively affect financial health of farms. On the other hand, Romania exhibited the lowest average total liabilities per 1 ha of UAA, which may indicate difficulties in accessing the credit markets. The comparison of total liabilities per 1 AWU across countries showed that, during the research period, the average total liabilities per 1 AWU were the highest in Estonia. At the other end of the scale was Romania.

The average net worth per 1 ha of UAA was the highest in Slovenia during the period of 2005–2015. Latvian farms had the lowest net worth per 1 ha of UAA. If we look at the average net worth per AWU, the rank order of countries changes somewhat: Slovenia retained its top ranking, whereas the lowest average net worth per 1 AWU was observed for Bulgaria and Romania (25680 EUR/AWU and 25663 EUR/AWU, respectively).

Table 8. Income, liabilities and net worth of farms across selected EU countries (in EUR), averages for 2005–2015

Country	Per 1 ha of UAA				Per 1 AWU			
	Gross Farm Income	**Farm Net Income**	**Total liabilities**	**Net worth**	**Gross Farm Income**	**Farm Net Income**	**Total liabilities**	**Net worth**
Bulgaria*	576	218	418	1850	8087	2991	5898	25680
Czech Republic	625	162	826	2589	20988	5501	27687	86225
Estonia	339	134	544	1221	19095	7223	31422	69284
Hungary	649	288	652	2433	19499	8701	19449	73171
Latvia	355	175	560	1183	10948	5303	17475	36849
Lithuania	432	297	311	1899	10673	7213	7800	46606
Poland	804	473	505	6505	8638	5086	5429	70446
Romania*	766	511	142	3725	5275	3550	907	25663
Slovakia	409	-30	315	1617	15207	-960	12163	58032
Slovenia	1210	521	400	17986	8208	3521	2750	121661

Source: European Commission, 2018. * averages for 2007–2015.

Further, we analyse key indicators of economic performance of Lithuanian farms. Specifically, we look at differences in economic situation of farms across farming types as well as across counties. The analysis is based on the data from the Lithuanian FADN (Lithuanian Institute of Agrarian Economics, 2018). Table 9 presents income, assets, liabilities and net worth of Lithuanian farms across different farming types.

Table 9. Income, assets, liabilities and net worth of Lithuanian farms across farming types (in EUR), averages for 2005–2015

Type of farming	Per 1 ha of UAA					Per 1 AWU				
	Gross Farm Income	**Farm Net Income**	**Total assets**	**Total liabilities**	**Net worth**	**Gross Farm Income**	**Farm Net Income**	**Total assets**	**Total liabilities**	**Net worth**
Sp. cereals, protein, oilseeds	360	260	1657	342	1315	19563	14201	90273	18583	71690
General field cropping	464	331	2359	367	1992	12704	9241	63433	9760	53673
Horticult., permanent crops	1368	948	5331	676	4655	9299	6453	36202	4629	31573
Specialist dairying	492	377	2549	299	2250	8790	6795	45358	5324	40034
Grazing livestock	425	309	2385	176	2209	6335	4582	36025	2897	33129
Granivores	1044	675	5086	1011	4076	9558	6439	47394	8591	38804
Field crops-grazing livestock	364	291	2022	260	1762	8700	6881	48403	6244	42158
Various mixed	556	369	3183	275	2909	5858	3937	33578	3041	30537

Source: Lithuanian Institute of Agrarian Economics (2018)

During 2005–2015, farms of horticulture and permanent crops generated the highest average gross farm income per 1 ha of UAA, whereas specialist field crops – grazing livestock and cereals, oilseeds and protein crop (COP) farms had the lowest gross farm income (364 EUR/ha and 360 EUR/ha, respectively). One possible explanation for the high income of farms of horticulture and permanent crops is that those farms specialize in higher value-added crops. If we look at the average gross farm income per 1 AWU, the ranking of farming types changes: specialist COP farms registered the highest gross farm income per AWU. At the other end of the spectrum, various mixed farms had, on average, the lowest gross farm income per AWU. This is likely due to their small size. Farm net income showed the same tendencies as it were observed for gross farm income.

Looking at the value of total assets per 1 ha of UAA, farms of horticulture and permanent crops held the highest amounts of assets. On average, the value of their assets were more than three times higher than the value of assets of COP farms, which showed the lowest value of this indicator during the research period. The comparison of the value of total assets per 1 AWU across different farming types showed that, during the period of 2005–2015, the average value of total assets per 1 AWU was the highest in COP farms. At the other end of the scale were various mixed farms.

During 2005–2015, granivores (pigs and poultry) farms recorded, on average, the highest total liabilities per 1 ha of UAA, whereas grazing livestock farms had the lowest value of this indicator. If we look at the average total liabilities per 1 AWU, the rank order of farming types changes somewhat: grazing livestock farms remained still at the bottom of the ranking, whereas specialist COP farms registered the highest total liabilities per 1 AWU. These disparities are mainly caused by differences in the scale of capital investment required and profitability of farms.

During the research period, farms of horticulture and permanent crops had, on average, the highest net worth per 1 ha of UAA. On the contrary, specialist COP farms recorded the lowest average net worth per 1 ha of UAA. As regards the average net worth per 1 AWU, specialist COP farms appeared as those specific with the highest value of this indicator. Various mixed farms featured the lowest average net worth per 1 AWU. Table 10 compares these indicators across different counties.

Table 10. Income, assets, liabilities and net worth of Lithuanian farms across counties (in EUR), averages for 2005–2015

County	Per 1 ha of UAA					Per 1 AWU				
	Gross Farm Income	**Farm Net Income**	**Total assets**	**Total liabilities**	**Net worth**	**Gross Farm Income**	**Farm Net Income**	**Total assets**	**Total liabilities**	**Net worth**
Alytus	375	292	1823	216	1608	11666	8776	57894	7037	50857
Kaunas	430	339	2116	349	1767	12287	9666	59352	9776	49576
Klaipėda	380	297	2029	328	1701	12041	9113	64257	10568	53690
Marijampolė	481	356	2409	481	1928	19613	14666	97384	19938	77446
Panevežys	383	286	1989	350	1639	11209	8334	58946	10424	48522
Šiauliai	403	298	1997	353	1644	10330	7658	50768	8959	41809
Tauragė	477	312	3103	250	2853	6496	4326	41855	3535	38320
Telšiai	431	345	2333	226	2107	9489	7503	51192	5070	46122
Utena	350	297	1667	226	1441	9008	7563	43190	6008	37181
Vilnius	390	294	2041	196	1845	9463	7066	49604	4817	44787

Source: Lithuanian Institute of Agrarian Economics (2018)

Looking at the average gross farm income per ha of UAA, the highest value of this indicator was observed for Marijampolė County, whereas Utena County was attributed with the lowest gross farm income per ha of UAA during the period of 2005–2015. As regards gross farm income per AWU, Marijampolė County remained still at the top of the ranking, mainly due to a high share of large farms, usually generating a higher income per working unit than small farms. At the other end of the spectrum, Tauragė County generated, on average, the lowest gross farm income per 1 AWU.

During 2005–2015, Marijampolė County also maintained its leading position in terms of both farm net income per 1 ha of UAA and farm net income per 1 AWU. On the contrary, the lowest average farm net income per 1 ha of UAA was observed for Panevežys County, whereas Tauragė County exhibited the lowest farm net income per 1 AWU.

During the research period, Tauragė County showed, on average, the highest value of total assets per 1 ha of UAA, whereas the lowest value of this indicator was observed for Utena County. If we look at the average value of total assets per 1 AWU, the ranking of counties changes: Tauragė county lost its position of having the highest total assets per 1 ha of UAA and dropped to the bottom of the ranking. At the other end of the scale was Marijampolė County. As we mentioned before, these disparities are due to differences in capital intensity across farms.

During the period of 2005–2015, Marijampolė County featured, on average, the highest total liabilities in terms of both UAA and AWU. The lowest average total liabilities per 1 ha of UAA were observed for Vilnius County, whereas Tauragė County showed the lowest total liabilities per 1 AWU.

As regards net worth per 1 ha of UAA, Tauragė County recorded the highest value of this indicator – the average net worth per 1 ha of UAA in Tauragė County was approximately two times higher than in Utena County, which registered the lowest net worth per 1 ha of UAA during 2005–2015. The comparison of net worth per 1 AWU across counties showed that, during the research period, the highest average net worth per 1 AWU was observed for Marijampolė County. On the contrary, Utena County showed the lowest average net worth per 1 AWU.

In general, there exist substantial differences in the economic performance of farms across Central and Eastern European countries as well as across different counties of Lithuania and farming types. However, on the basis of this analysis, we are unable to make definite identification of economic sustainability of farms. In the following section, we look at ROE and ROCE for different farming types and counties of Lithuania in order to represent economic sustainability of Lithuanian farms more clearly and completely.

3.2. Profitability analysis of the family farms

This section presents the two financial ratios analysis, which can be used to measure the economic sustainability of the Lithuanian family farms. The ROE ratio shows the farms performance relative to equity and this ratio objectively evaluate the efficiency of the farm's financial activity, because it shows how efficiently farm employs owner's capital. The second ratio used in our analysis is the ROCE ratio. It shows how much the net operating profit after tax is spent for one euro on capital employed. This indicator reflects the efficiency of utilization of the farm's total equity and debt capital. Firstly we evaluate financial performance of the Lithuanian family farms by types and secondly by counties based on these indicators.

3.2.1. Profitability analysis across farming types

In order to quantify the changes in return on equity across different farming types and Lithuanian counties used DuPont model index decomposition analysis framework. Table 11 presents the dynamics of Lithuanian family farms Return on Equity during the 2005-2015. We found that Lithuanian family farms have problem with profitability management, because since 2008 we see negative trend in ROE. Only granivores family farms present positive fluctuations of ROE during period 2009-2014 mainly influenced by positive trend in all financial ratios (see Appendix), but in 2010-2012 and 2015 this sector swoops. The drop in profitability was due mainly swine fever and avian influenza negative effects. These diseases restrictions affected the pig and poultry rearing and prices. Various mixed farms present downturns from 2007 till 2014 and in period 2011-2015 present negative ROE ratio. All family farms sector present negative fluctuation and till now it do not seek the highest pick of return on equity (0.177, in 2007); in 2015 ROE was only 0.046.

Table 11. Return on Equity ratio in Lithuanian family farms (farming types)

	2005	2007	2010	2015	Trend	Growth (2015 compared to 2005), %
Sp. cereals, protein, oilseeds	0.227	0.309	0.164	0.114	-0.019	-49.6
General field cropping	0.165	0.200	0.168	0.028	-0.016	-82.8
Horticult., permanent crops	0.180	0.225	0.190	0.062	-0.017	-65.4
Specialist dairying	0.205	0.138	0.113	-0.018	-0.020	-108.7
Grazing livestock	0.093	0.129	0.029	0.005	-0.013	-94.1
Granivores	0.111	0.092	0.042	0.029	0.000	-74.3
Field crops-grazing livestock	0.191	0.140	0.090	0.037	-0.018	-80.7
Various mixed farms	0.114	0.139	0.025	-0.028	-0.022	-124.4
Weighted average	***0.174***	***0.177***	***0.097***	***0.046***	***-0.016***	***-73.8***

Source: Balezentis, Novickyte (2018)

Specialist cereal, oilseeds and protein crops family farms present higher return than all family farms during the all analysed period. The main reasons were cereal crop area increase, yield of grain crops growth, and last but not least – average purchase price of grain was the highest in 2007-2008 and in 2011-2012, but the price fluctuates greatly. Due to the fact it is advisable to Lithuanian grain growers learn to manage risk and diversify their activities in order to maintain stable farm income in future. Also analysis shows a negative trend in ROE growth in all types of farming mostly influenced by negative change in farm net income. Table 12 presents the decomposition of ROE ratio in different types of Lithuanian family farms.

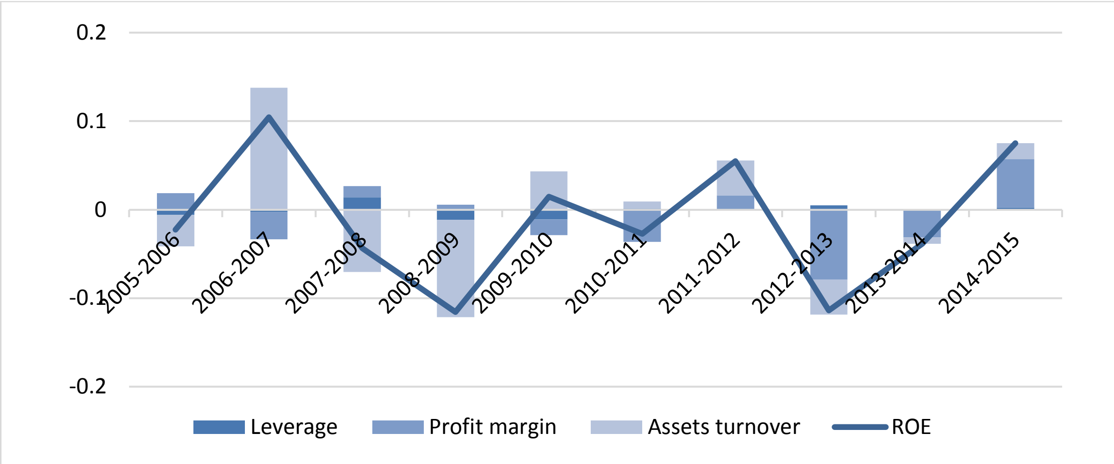
Table 12. Decomposition of Return on Equity ratio in Lithuanian family farms (farming types)

		Sp. cereals, protein, oilseeds	*General field cropping*	*Horticult., permanent crops*	*Specialist dairying*	*Grazing livestock*	*Granivores*	*Field crops-grazing livestock*	*Various mixed farms*
2005	*PM*	0.747	0.643	0.597	0.771	0.417	0.517	0.735	0.605
	AT	0.226	0.218	0.275	0.232	0.207	0.195	0.223	0.170
	L	1.343	1.177	1.095	1.147	1.075	1.104	1.170	1.116
	ROE	0.227	0.165	0.180	0.205	0.093	0.111	0.191	0.114
2015	*PM*	0.405	0.149	0.272	-0.094	0.030	0.094	0.198	-0.126
	AT	0.221	0.163	0.190	0.166	0.161	0.249	0.160	0.209
	L	1.279	1.173	1.203	1.148	1.137	1.225	1.161	1.058
	ROE	0.114	0.028	0.062	-0.018	0.005	0.029	0.037	-0.028
Trend	*PM*	-0.054	-0.059	-0.055	-0.085	-0.061	-0.029	-0.076	-0.112
	AT	-0.004	-0.005	-0.007	-0.003	-0.006	0.009	-0.004	0.001
	L	-0.010	-0.001	0.010	-0.001	0.007	0.029	0.002	-0.011
	ROE	-0.019	-0.016	-0.017	-0.020	-0.013	0.000	-0.018	-0.022
Growth, %	*PM*	-45.74	-76.85	-54.55	-112.16	-92.85	-81.88	-72.99	-120.88
	AT	-2.39	-25.30	-30.73	-28.50	-22.10	28.00	-28.16	23.22
	L	-4.77	-0.32	9.80	0.08	5.78	10.94	-0.71	-5.18
	ROE	-49.57	-82.76	-65.43	-108.70	-94.11	-74.26	-80.74	-124.40

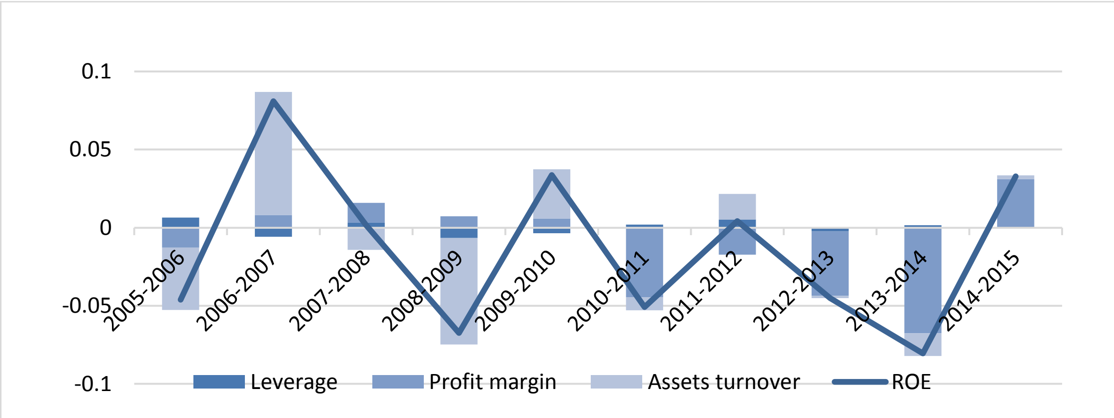
As shown in Table 12, the all farms by types has a negative growth in profit margin during 2005-2015 period, but various mixed farms shows the biggest decline in profit margin growth (-120.88%) during these period. This ratio has mainly showed a negative impact to ROE ratio changes for all Lithuanian family farms.

The smallest drop of the ROE ratio was in specialist cereal, oilseeds and protein crops family farms (only about 50% decline during 2005-2015). The biggest drop was in the same various mixed farms and in specialist dairying farms. The best use of assets in their performance has demonstrated granivores (growth 28% and positive trend with 0.009) and various mixed farms (growth 23%) which allowed at least a minimum absorption of the negative impact of profit margins for the ROE indicator.

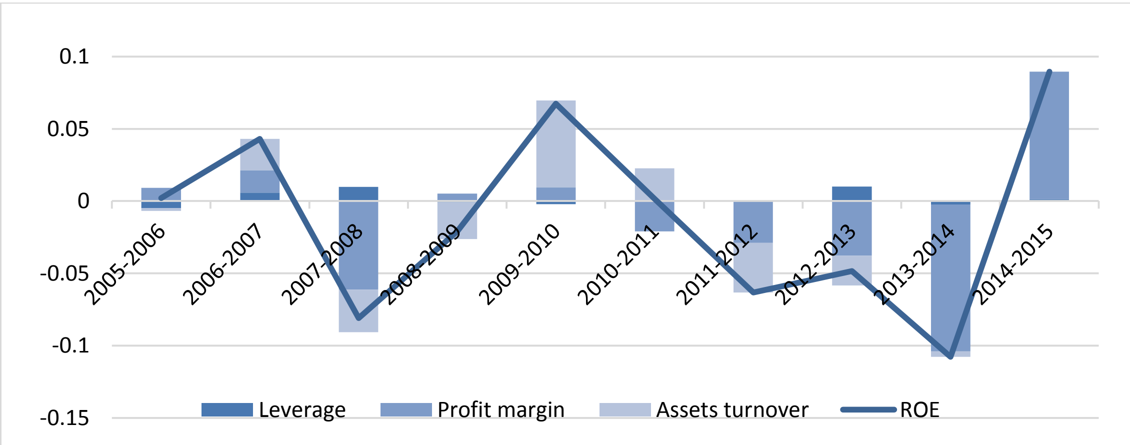
Fig. 14 shows the impact of the changes in profit margin, assets turnover, and leverage to ROE ratio during all analysed period and in different types of family farms, because is very important to identify factors (sales profitability (profit margin), asset turnover, and leverage) influenced the change in ROE. Fig. 14 represents factors and ROE changes year-by-year. Fig. 14 presents that mostly all changes in ROE ratio influenced by assets turnover ratio and profit margin changes. Positive assets turnover ratio changes represent a better asset utilization activities and operating efficiency. The results also show that different factors influence return in different period of time. In 2005-2010 period Lithuanian specialist cereal, oilseeds and protein crops, general field cropping, specialist dairying, and field crops-grazing livestock family farms ROE characterized by changes in assets turnover ratio. Since 2011 the return of these types of farms mainly influenced profit margin ratio changes. Declining or even negative profitability had a negative impact on ROE changes in all types of family farms. Financial leverage had minimal impact in ROE changes because family farms basically works on own resources.



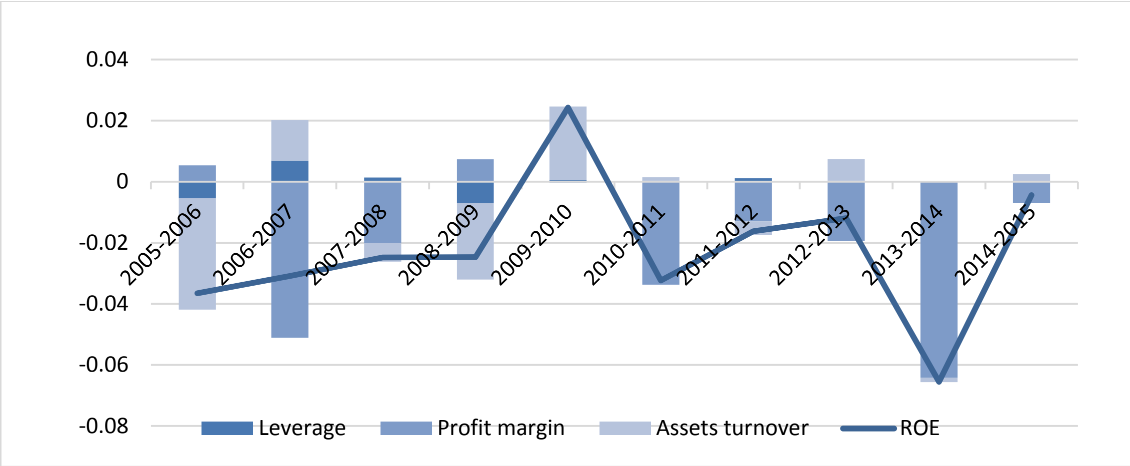
a – specialist cereal, oilseeds and protein crops



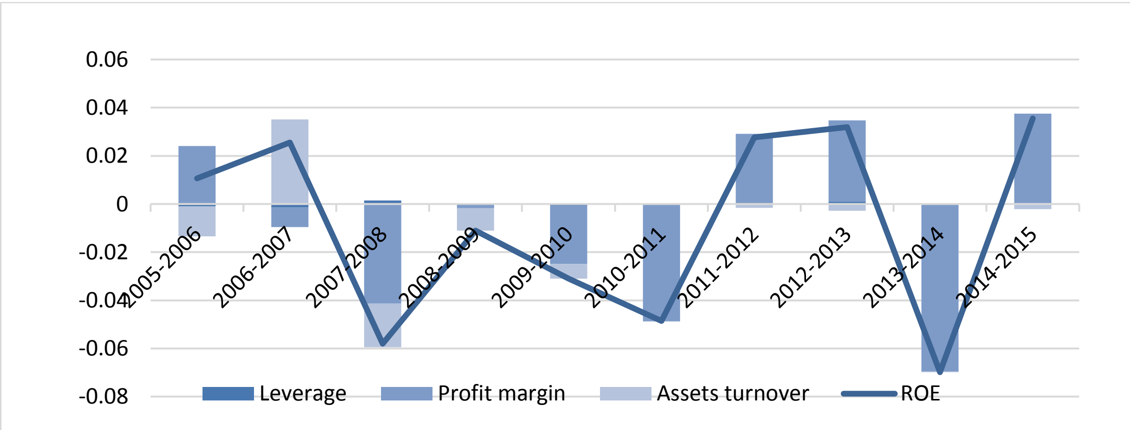
b – general field cropping



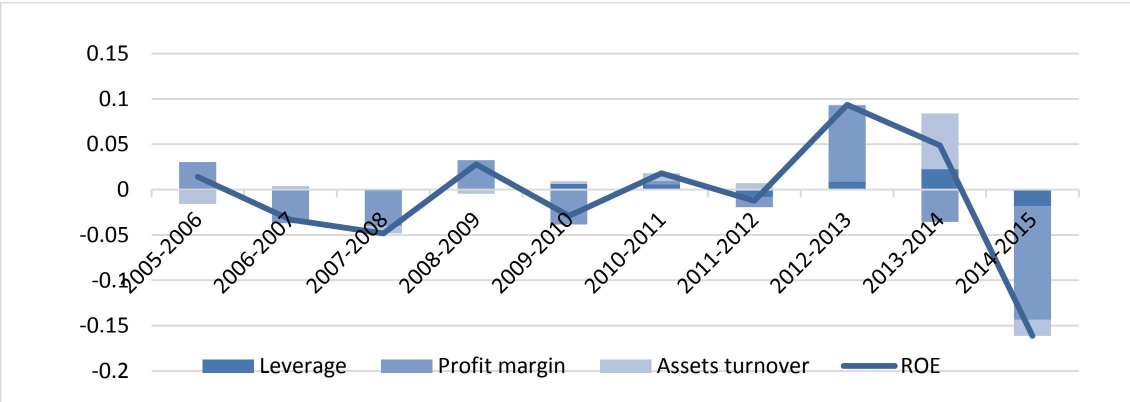
c – horticulture, permanent crops



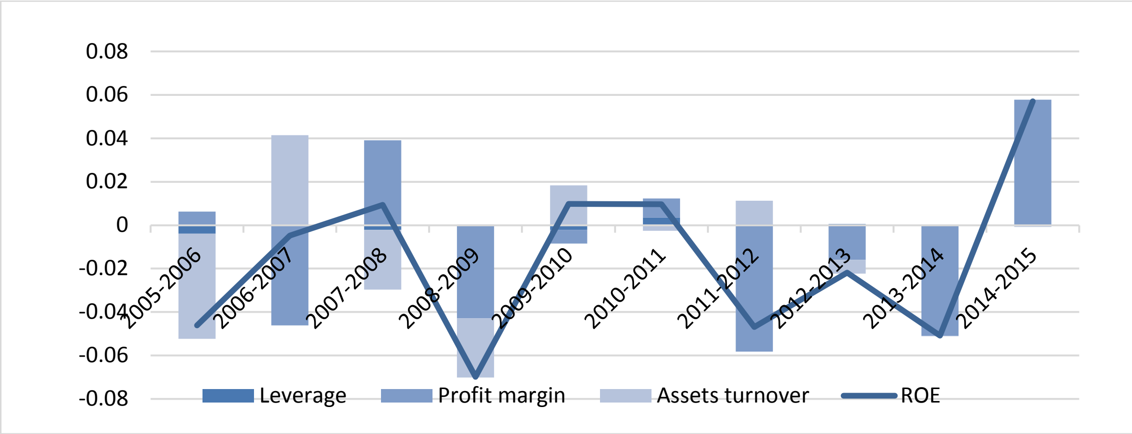
d – specialist dairying



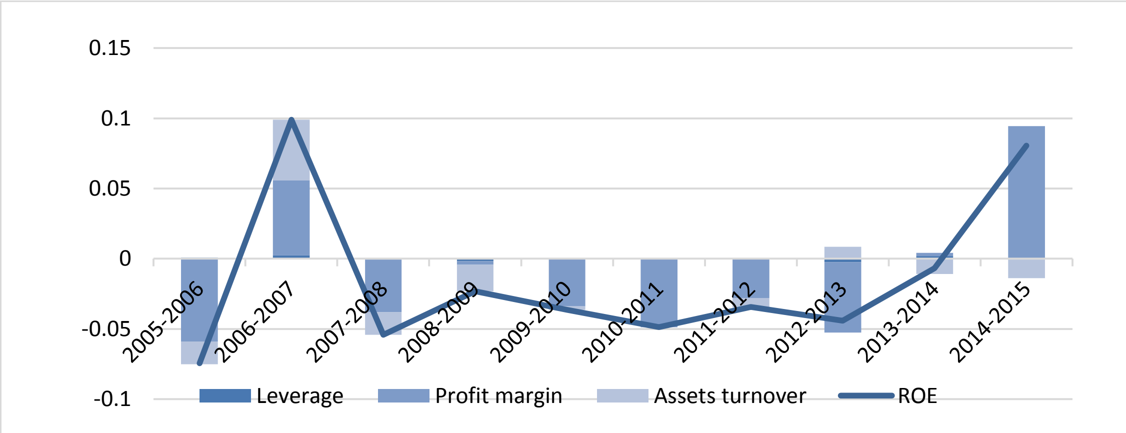
e – grazing livestock



f – granivores



g – field crops-grazing livestock



h – various mixed farms

Fig. 14. DuPont analysis (ratios influenced the change in ROE) of ROE (farming types)

Source: Balezentis, Novickyte (2018)

To illustrate the dynamics in the ROE ratio during 2005-2015 we calculated annual average growth rate. This ratio shows an average value for the annual rate of change over a period of time allowing for the compound effect of growth. Fig. 15 shows the relationship between the two ratios: AAGR of ROE and average ROE for 2005-2015. As we see almost all farming types have negative AAGR ratio and only various mixed farms, granivores, and specialist cereal, oilseeds and protein crops family farms present positive AAGR and ROE relationship. It is important to mention that though various mixed farms show positive relationship, but as we can see in earlier analysis this type has the biggest decline in ROE ratio. This is because various mixed farms in 2005-2010 has a positive though decreasing ROE ratio, but since 2011 ROE was negative due to unfavourable impact of profit margin ratio. General field cropping has the biggest negative AAGR in ROE ratio, but till now has a positive ROE ratio. This type of farming has one of the biggest ROE rate fluctuations (standard deviation of 0.066) during the period 2005-2015. Field crops-grazing livestock and horticulture and permanent crops have also the biggest ROE rate fluctuations (standard deviations of respectively 0.084 and 0.069).

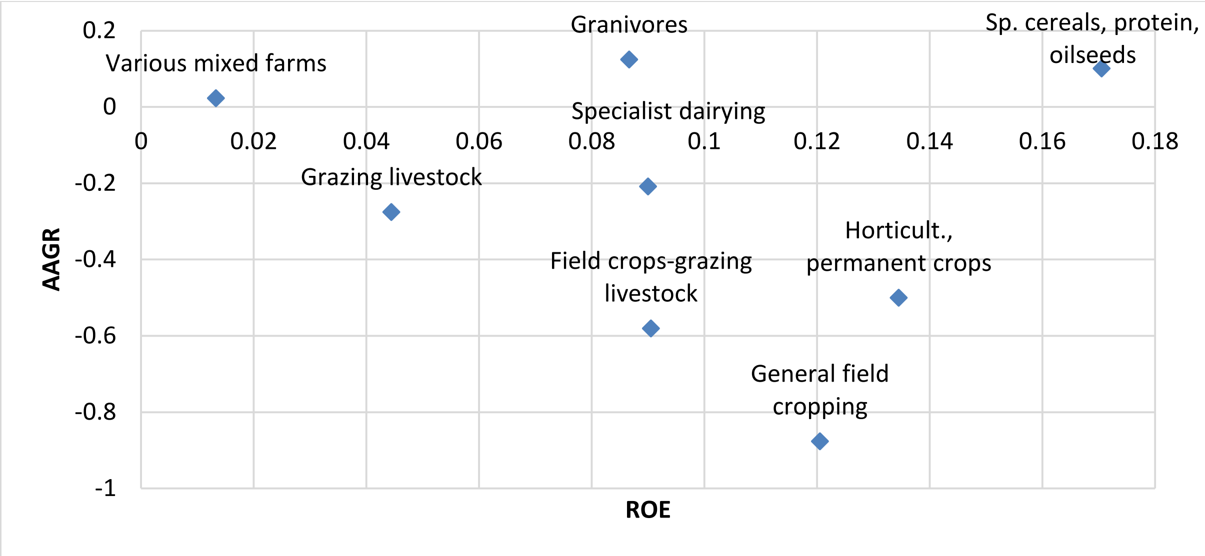


Fig. 15. Relationship between annual average growth rate and ROE ratio (farming types)

The second financial ratio used to show farms economic sustainability is the return on capital employed. In order to quantify the change in return on capital employed across different farming types and Lithuanian counties used index decomposition analysis framework. Table 13 presents the dynamics of Lithuanian family farms (by type of farming) Return on Capital Employed during the 2005-2015. We found that Lithuanian family farms have problem with management of family farms capital investments, because since 2008 we see almost only decline in ROCE. Only granivores family farms present positive fluctuations of ROCE during period 2011-2015 mainly influenced by positive trend in all financial ratios (see Annex A), but in 2010 this sector swoops. During 2012–2016, the number of pigs decreased by 17.8%, and the herd of pedigree pigs by 8%. In 2009 and in 2011, and from the beginning of 2014, swine fever spread from Belarus to Lithuania thus creating adverse effects on the profitability. Restrictions related to this disease had an impact on pig rearing and meat price.

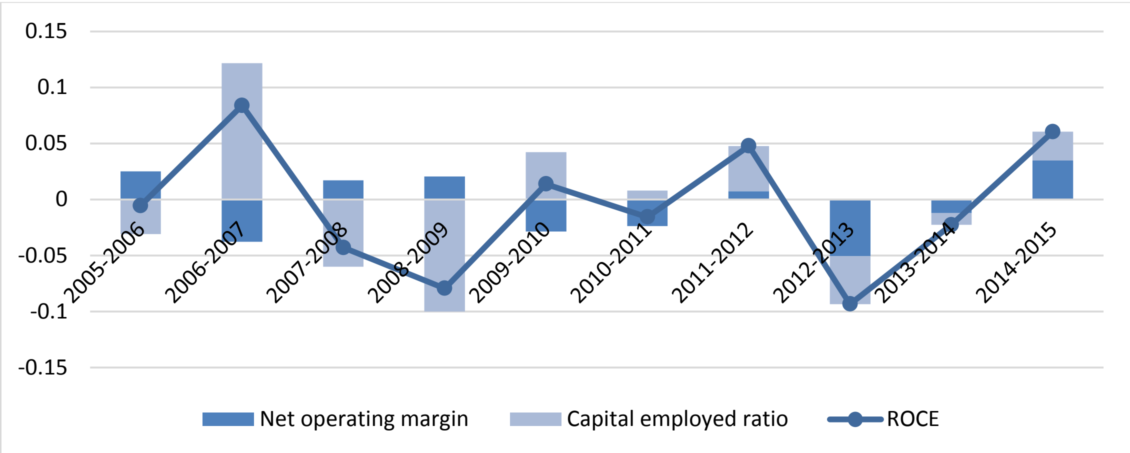
Table 13. Return on Capital Employed ratio in Lithuanian family farms (farming types)

	2005	2007	2010	2015	Trend	Growth (2015 compared to 2005), %
Sp. cereals, protein, oilseeds	0.189	0.267	0.158	0.135	-0.012	-28.6
General field cropping	0.162	0.205	0.180	0.103	-0.008	-36.8
Horticult., permanent crops	0.202	0.261	0.222	0.150	-0.010	-25.8
Specialist dairying	0.218	0.167	0.160	0.110	-0.010	-49.8
Grazing livestock	0.149	0.190	0.112	0.128	-0.007	-13.6

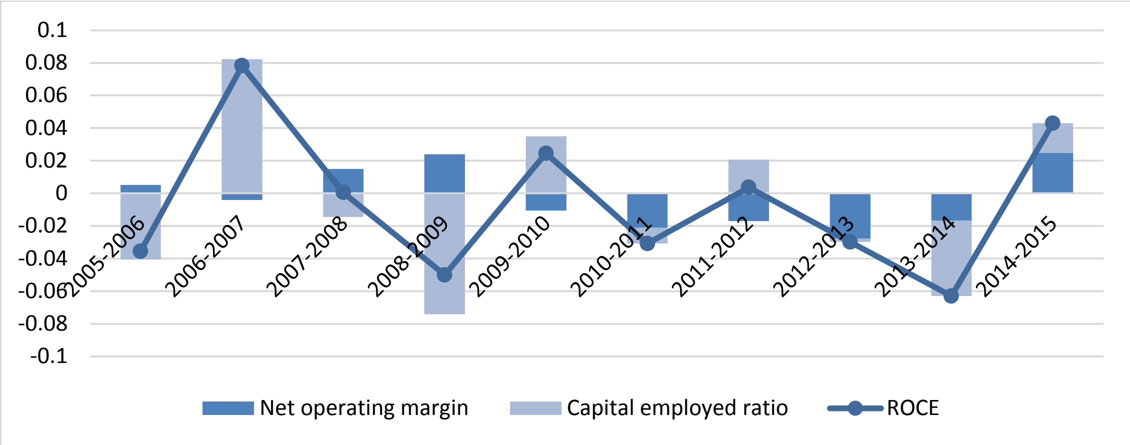
Granivores	0.163	0.143	0.077	0.206	0.001	26.6
Field crops-grazing livestock	0.200	0.176	0.138	0.128	-0.010	-36.3
Various mixed farms	0.148	0.173	0.100	0.170	-0.003	15.2
Weighted average	0.201	0.197	0.149	0.127	-0.010	-36.7

Specialist cereal, oilseeds and protein crops and horticulture and permanent crops (respectively 0.1641 and 0.1854) family farms present higher return than all family farms in all analysed period. The main reasons are the same as for ROE ratio: cereal crop area increase, yield of grain crops growth, and last but not least – average purchase price of grain was the highest in 2007-2008 and in 2011-2012, but the price fluctuates greatly. Also, the analysis shows a negative trend in ROCE change for all types of farming (except for granivores and various mixed farms) mostly influenced by negative change in capital employed ratio (see Fig. 16).

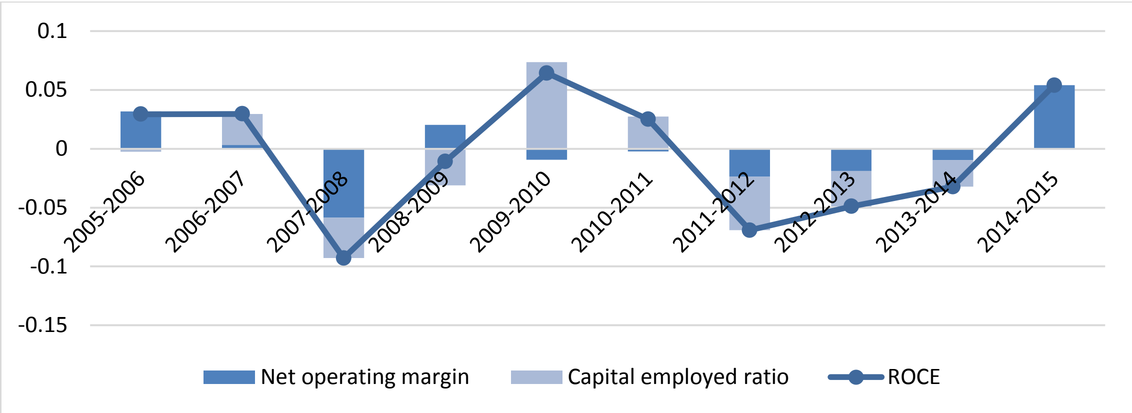
Mostly, the fluctuations in the ROCE for granivore farms are due the changes in operating margin or prices. Specialist dairying farms show the same operating efficiency impact during 2006-2007, 2010-2011, and 2012-2015. As regards the remaining types of farming, returns are mainly influenced by changes in capital employed activity. Generally, the whole period considered saw the highest impact of inefficient use of capital assets in the farm's activities.



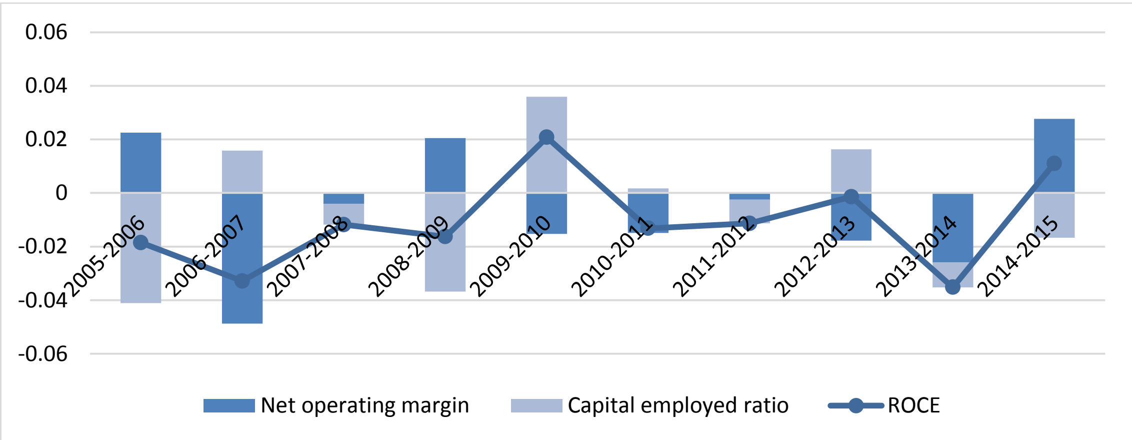
a – specialist cereal, oilseeds and protein crops



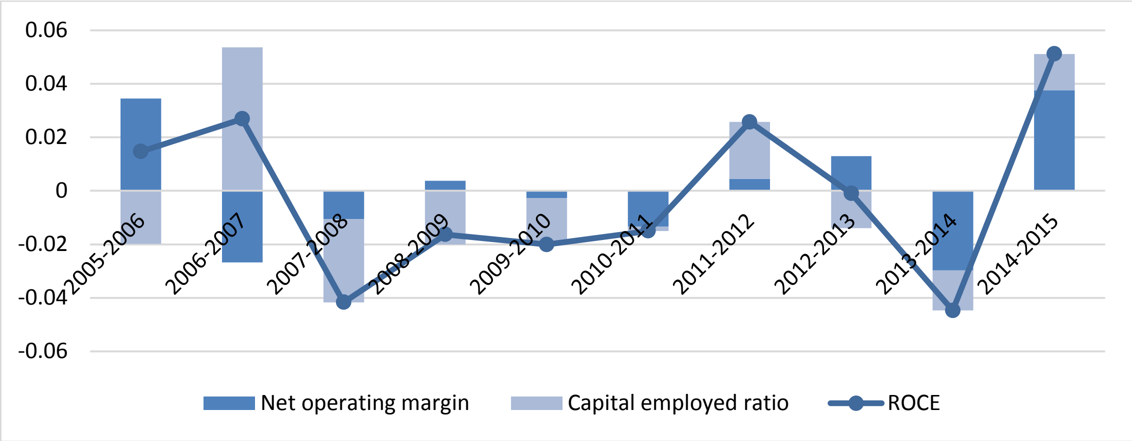
b – general field cropping



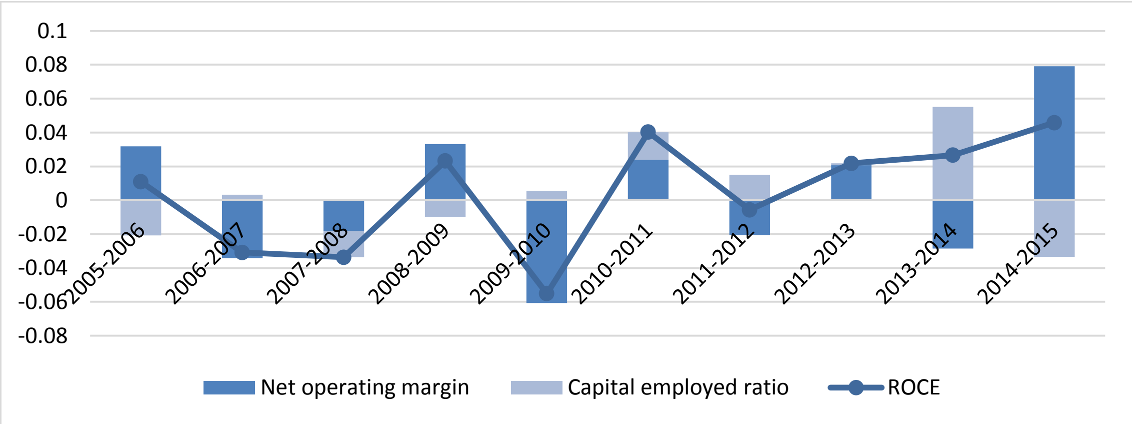
c – horticulture, permanent crop



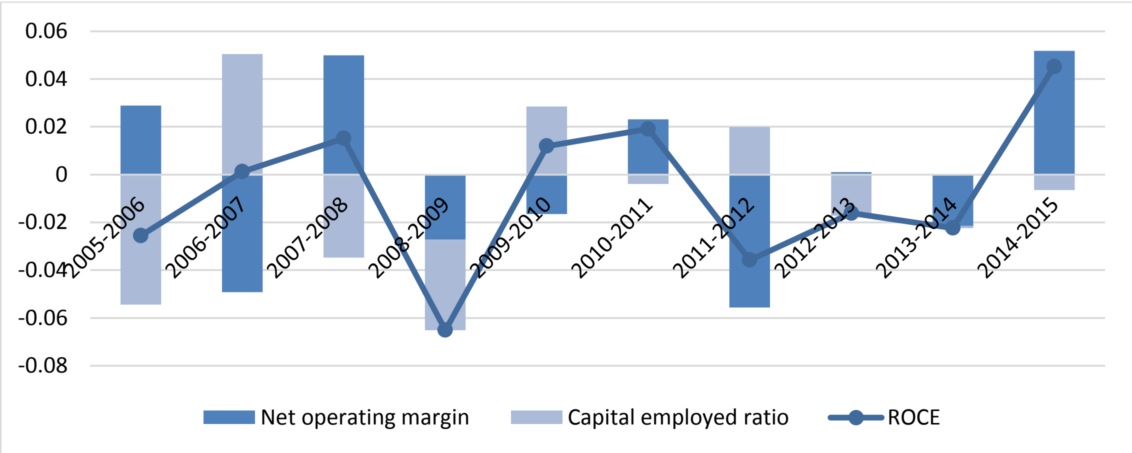
d – specialist dairying



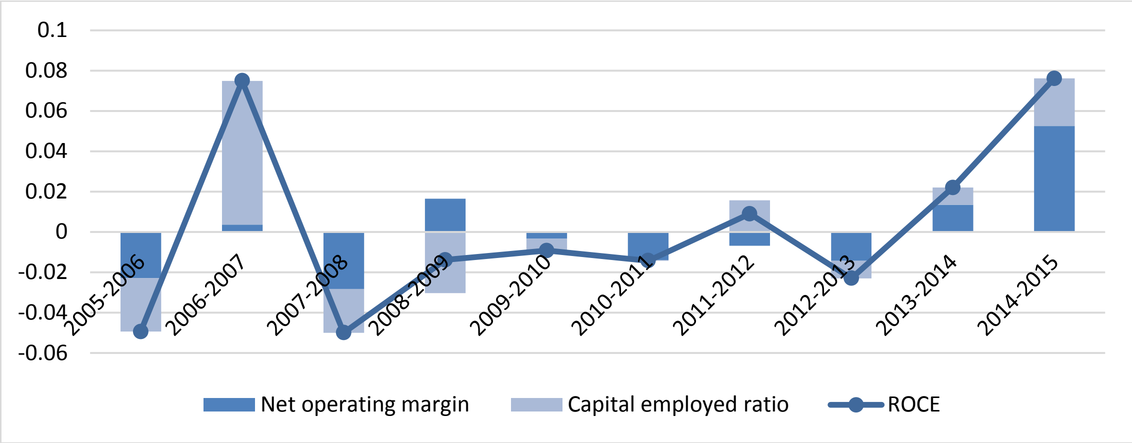
e – grazing livestock



f – granivores



g – field crops-grazing livestock



h – various mixed farms

Fig. 16. Decomposition analysis (ratios influenced the change in ROCE) of ROCE (farming types)

Fig. 17 shows the relationship between to ratios: AAGR of ROCE and average ROCE in the period of 2005-2015. As we see almost all farming types have positive AAGR ratio and only specialist dairying family farms present a negative AAGR and ROE relationship. Specialist dairying farms show the steepest deline in ROCE ratio (almost 50%) during analysed period. Also mainly this decline was due the negative impact operating margin in ROCE (7 out of 10 periods were marked as follows; see Fig. 16). Specialist cereal, oilseeds and protein crops and horticulture and permanent crops family farms has the best ROCE ratio, but also show the biggest ROCE rate fluctuations (standard deviation of respectively 0.055 and 0.0518). Various mixed farms show the highest AAGR ratio, but the smallest average ROCE ratio.

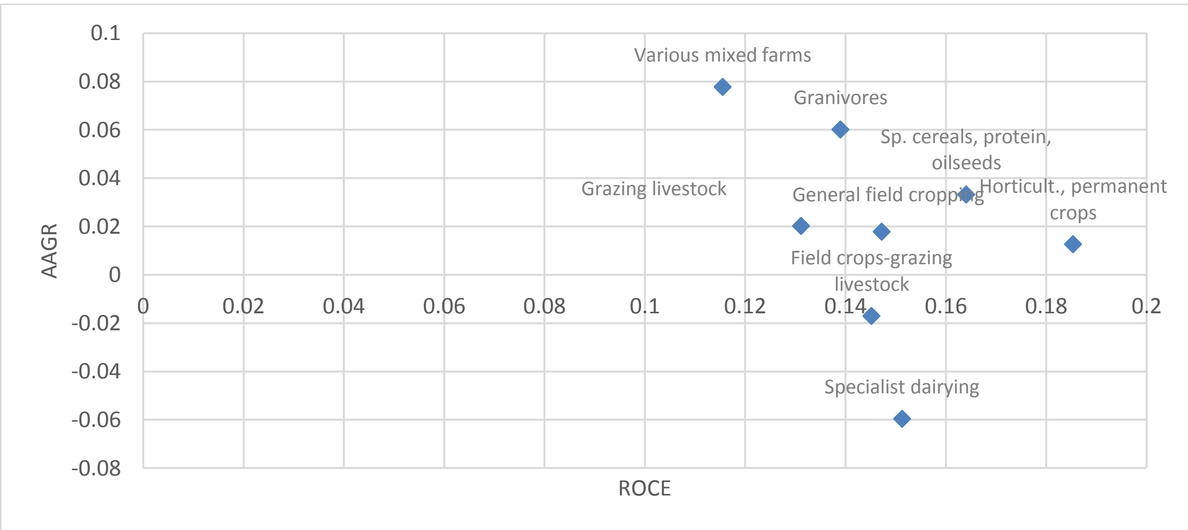
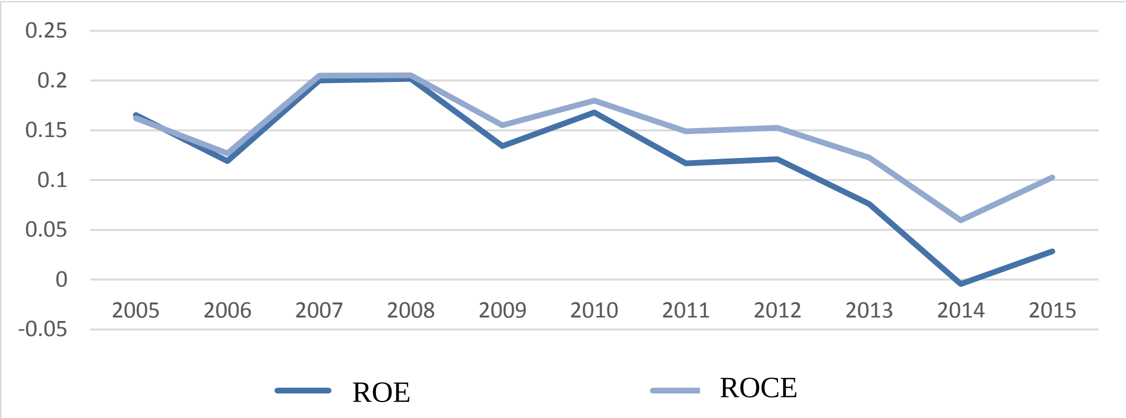


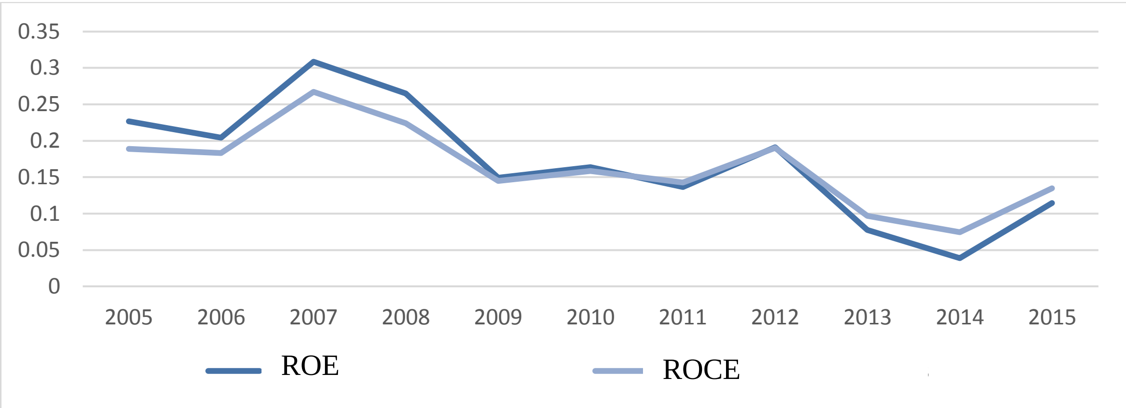
Fig. 17. Relationship between annual average growth rate and ROCE ratio (farming types)

We now turn to the relationship between two financial performance ratios – ROE and ROCE – for each farming type. As we can see in Fig. 18 all farming types present the same fluctuation in both indicators. The main difference between these two ratios is that ROCE ratio evaluates farm return preventing the effects of leverage.

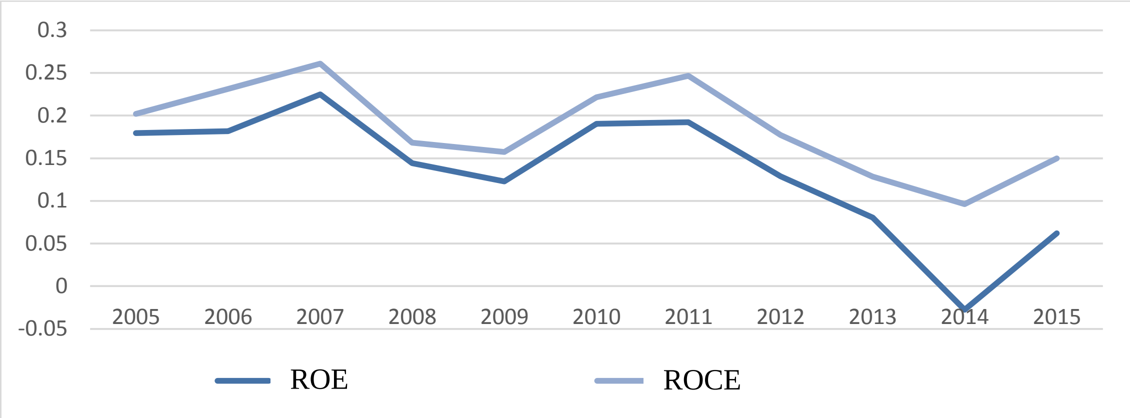
During 2005-2015 period almost all family farming types noticed higher ROCE ratio then ROE and the difference between these indicators was minimal or almost identical, but since 2009 the disparity between these two ratios increase. These differences are mostly determined by the negative trends in the profit margin.



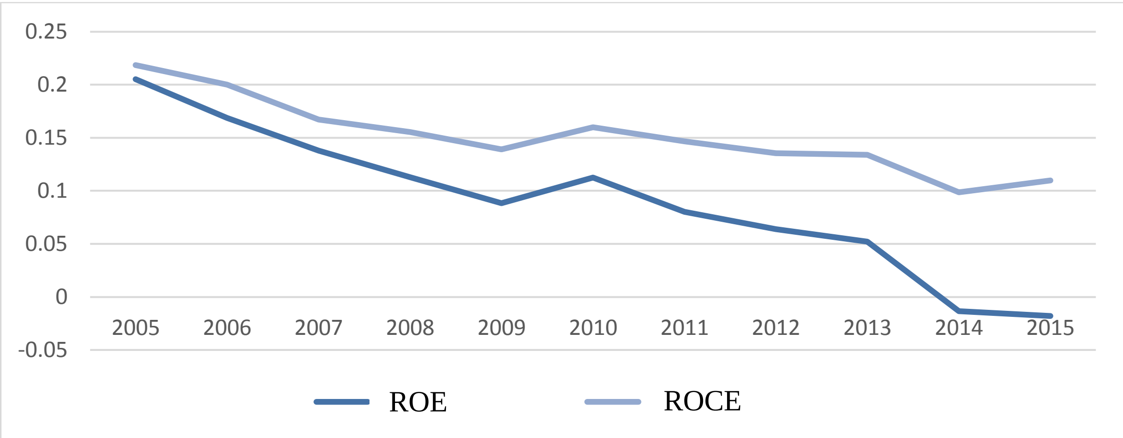
a – general field cropping



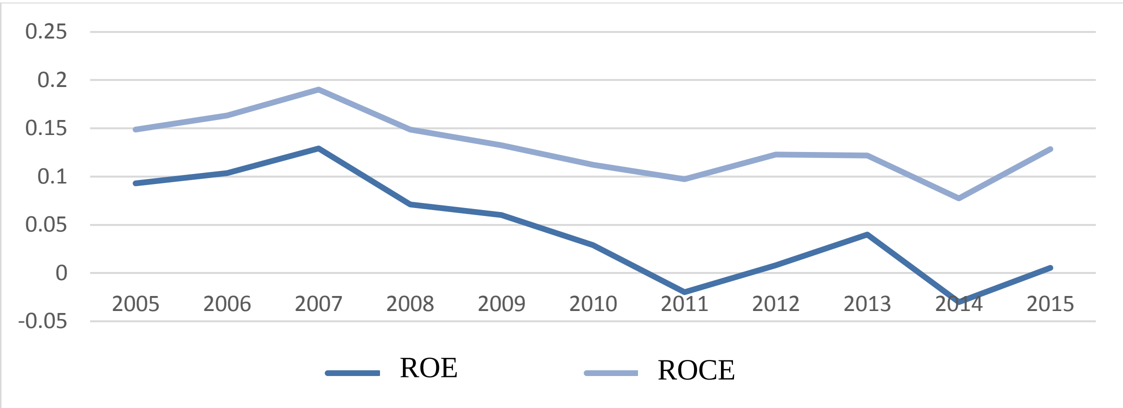
b – sp. cereals, protein, oilseed



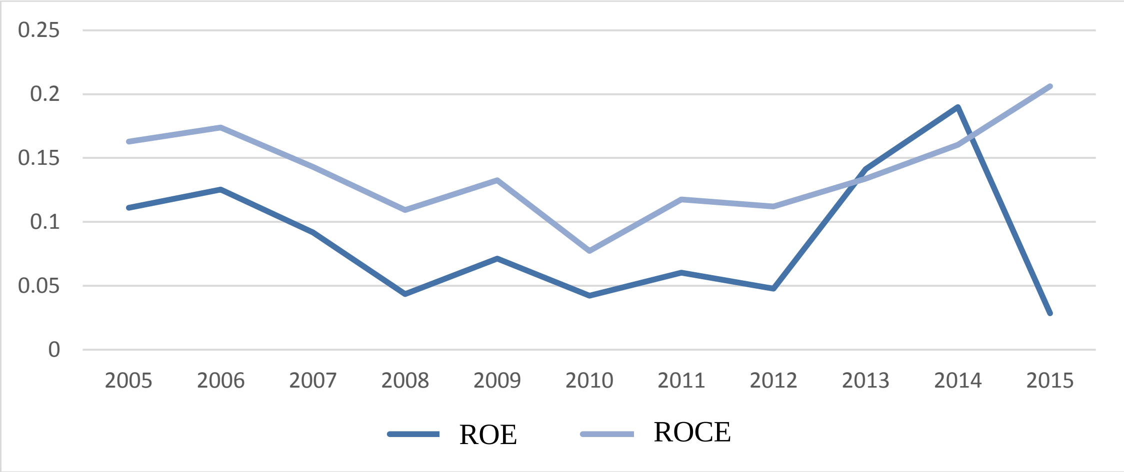
c – horticult., permanent crops



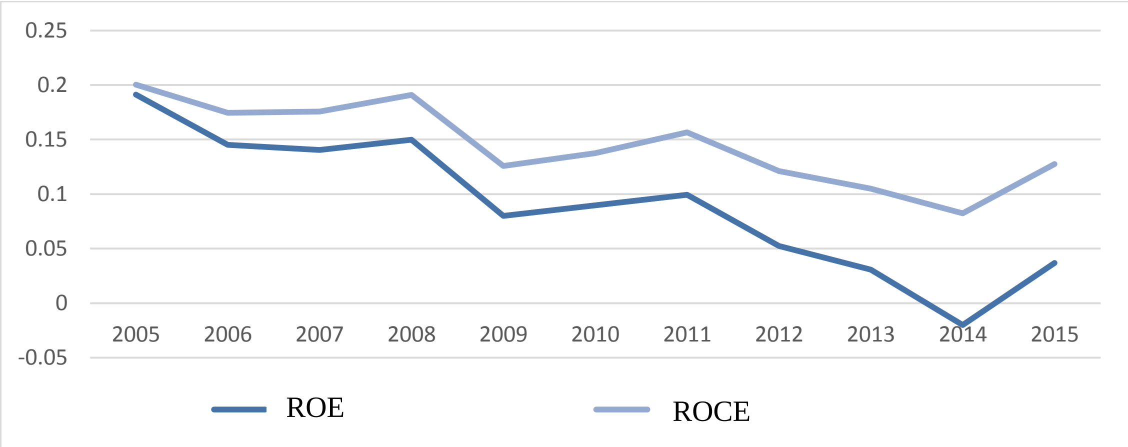
d – specialist dairying



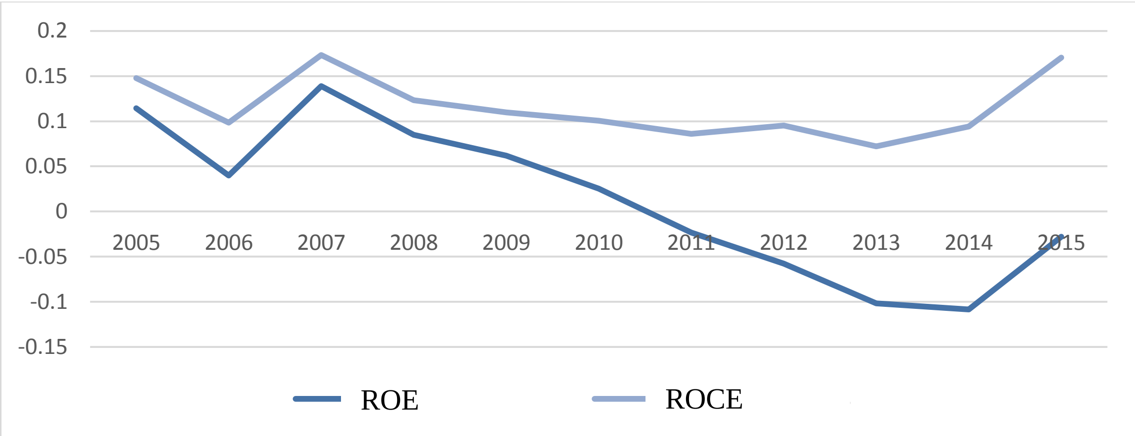
e – grazing livestock



f – granivores



g – field crops-grazing livestock



h – various mixed farms

Fig. 18. Relationship of ROE and ROCE ratios (farming types)

Fig. 18 presented the dynamics in the indicators of ROE and ROCE. The average values for the period of 2005-2015 are presented in Fig. 19. This allows one generalising the indicators from different time periods for each farming type.

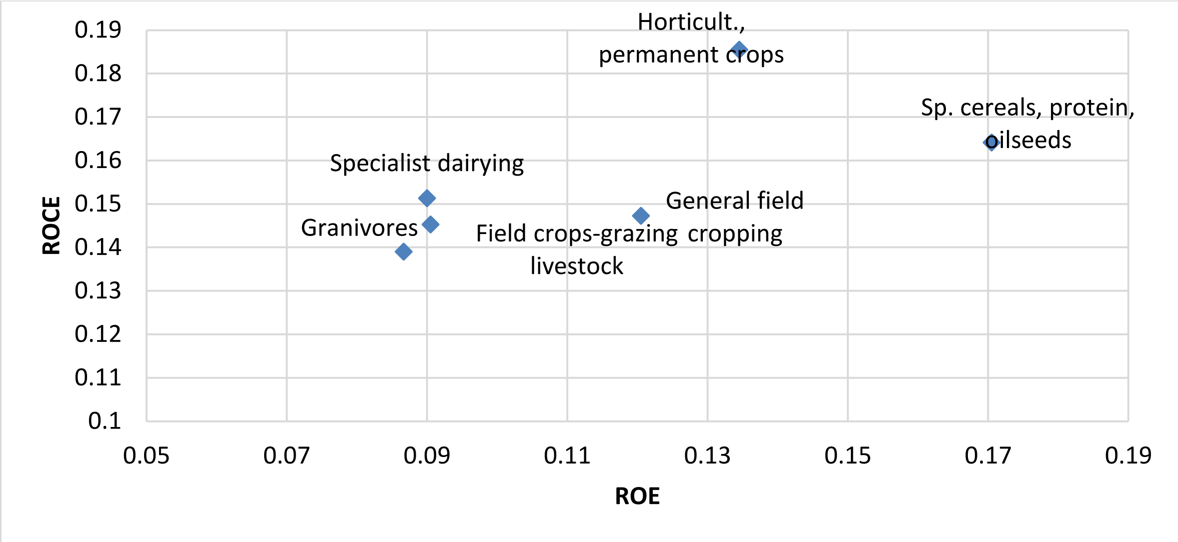


Fig. 19. Mean values of ROE and ROCE for farming types, 2005-2015

The results in Fig. 19 indicate that the mean ROCE exceeded mean ROE for most the farming types with exception of cereal farming. The highest differences were observed for horticulture, dairying and granivores farming. Indeed, the latter sectors require relatively high labour intensity and, therefore, higher contribution of the Farm Remuneration towards the reduction of the Net Income in case ROE is considered.

3.2.2. Profitability analysis across counties

The second part of profitability analysis is dedicated to determine the changes in performance of Lithuanian family farms operating in different counties. Although Lithuania is not large, there are various natural, economic, social and other differences that affect the activities of individual farms. Fig. 20 and 21 show the dissemination of the relevant profitability indicators taking into account different counties of Lithuania. Fig. 20 presents all family farms ROE ratio distribution by Counties. It is noticeable that the best profitability results are observed in Marijampole and Kaunas Counties (for more information, see Section 3.1 and Table 10).

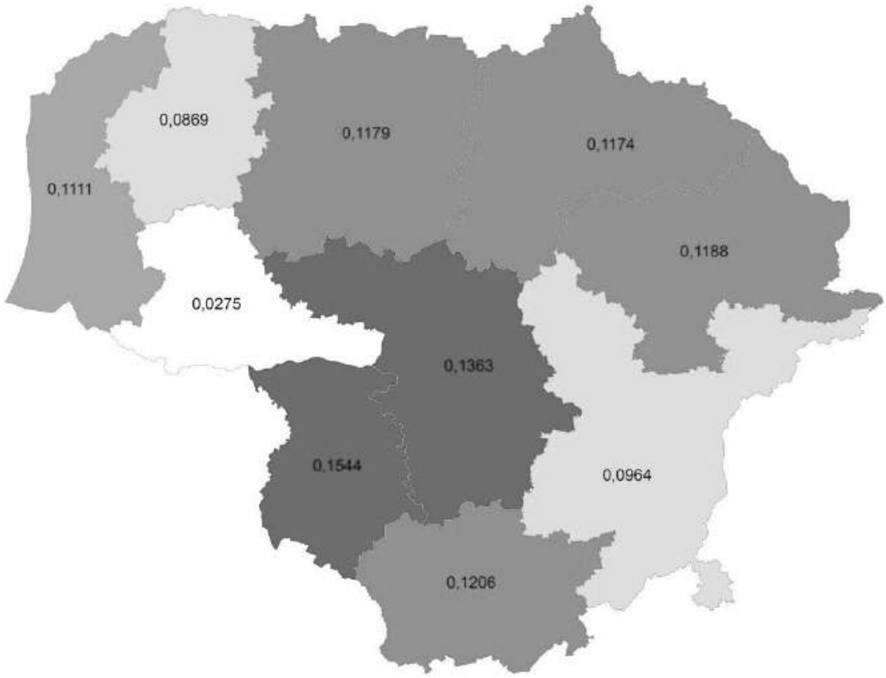


Fig. 20. ROE ratio distribution by the Lithuania Counties

Another profitability indicator used for our analysis is ROCE ratio. Fig. 21 shows differences in ROCE across counties. The best ROCE ratio is in Utena County. It shows that family farms in Utena County better use its assets in farms daily activities.

Fig. 21. ROCE ratio distribution by the Lithuania Counties

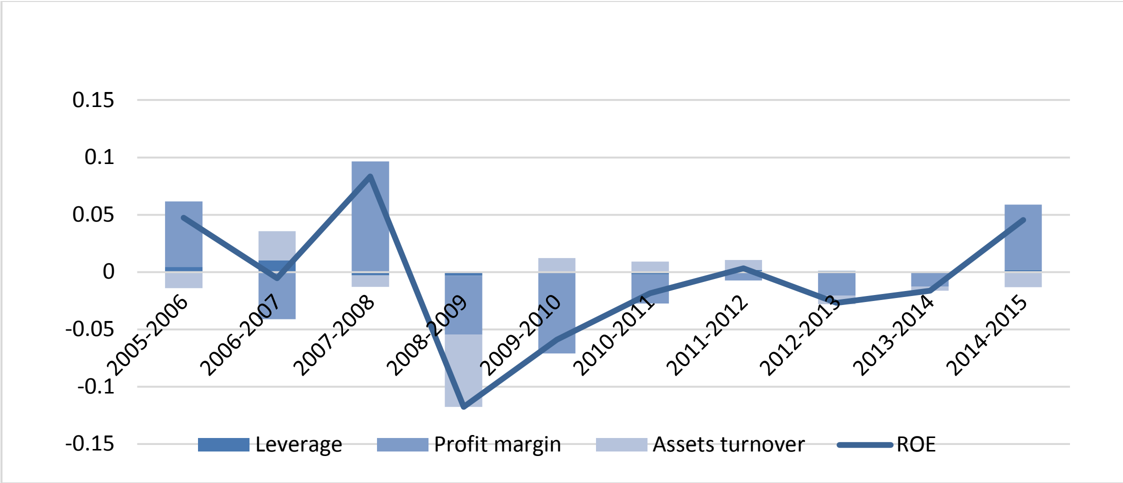
Table 14 presents the ROE ratio across different counties. The results suggest the best situation was observed in Marijampole, Kaunas, and Klaipeda Counties. The worst situation was observed in in Taurage (negative ROE in period of 2011-2015) and Siauliai (the biggest drop from 2013 to 2014) Counties. Marijampole and Kaunas counties contain the most productive farms as measured by the gross output per ha. Also, Marijampole County showed substantial income per ha, but it is important to take into account the negative trend in asset value (-516 Euro/year) and farm net income (-1432 Euro/year) there. The main factor behind the unfavourable results for Taurage County is that farms in this country are not profitable and show negative changes in all the main financial positions. As regards Alytus County, the decreasing investment support can be observed there.

Table 14. Return on Equity ratio in Lithuanian family farms (counties)

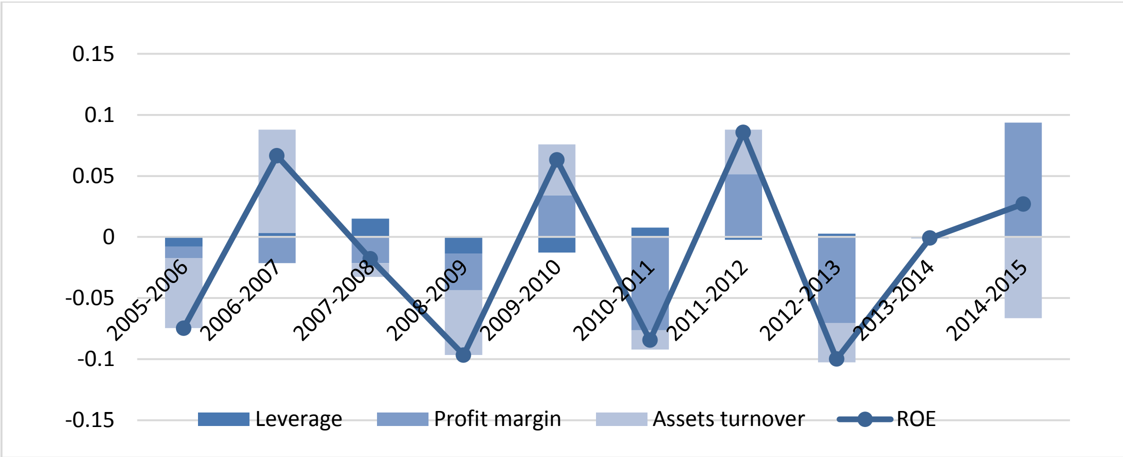
	2005	2007	2010	2015	Trend	Growth (2015 compared to 2005), %
Alytus	0.142	0.184	0.091	0.077	-0.017	-45.4
Kaunas	0.196	0.192	0.105	0.049	-0.016	-75.0
Klaipeda	0.148	0.147	0.148	0.056	-0.012	-62.1
Marijampole	0.240	0.232	0.181	0.108	-0.014	-55.1
Panevezys	0.166	0.238	0.133	0.060	-0.015	-64.2
Siauliai	0.162	0.226	0.156	0.022	-0.017	-86.1
Taurage	0.130	0.097	0.013	-0.031	-0.021	-124.1
Telsiai	0.143	0.100	0.140	0.014	-0.012	-90.1
Utena	0.182	0.172	0.164	0.083	-0.013	-54.1
Vilnius	0.193	0.163	0.101	0.053	-0.015	-72.8
Weighted average	***0.174***	***0.177***	***0.097***	***0.046***	***-0.016***	***-73.8***

Source: Balezentis, Novickyte (2018)

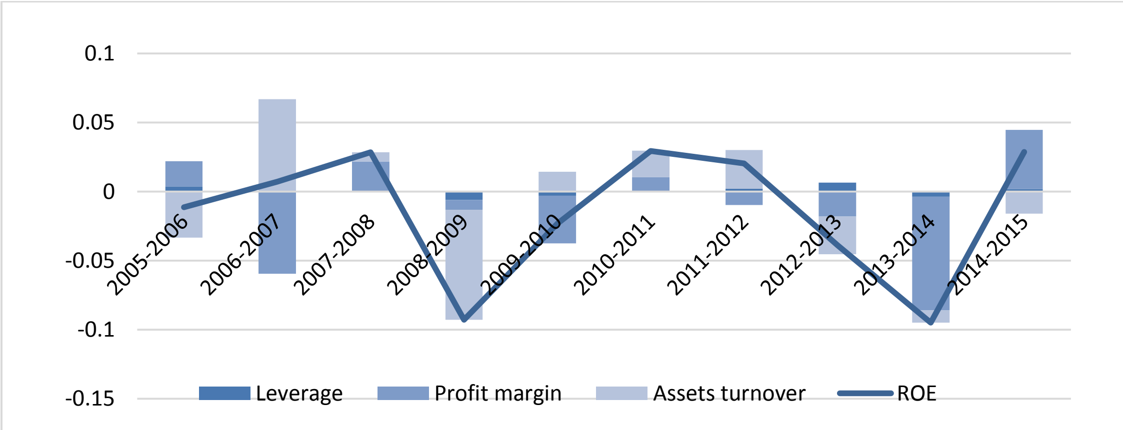
Analysing Fig. 22 we can add accuracy to explain ROE changes in family farms by counties. As we see in earlier analysis Marijampole, Kaunas, and Klaipeda show better performance in return. The main factor influenced changes in return on equity in Marijampole and Kaunas was asset turnover, and in the end of analysed period – better cost control. Klaipeda's farms in contrast distinguished better managing cost in all period and in several times contributed and operating efficiency. The main negative impact for Taurage County farms was a poor cost control (negative changes in profit margin). The biggest drop of return in Alytus County in period of 2009-2015 was caused by a decrease in investments and that confirms Fig. 22, where since 2010 there are no significant changes in the use of assets and (or) better control the costs.



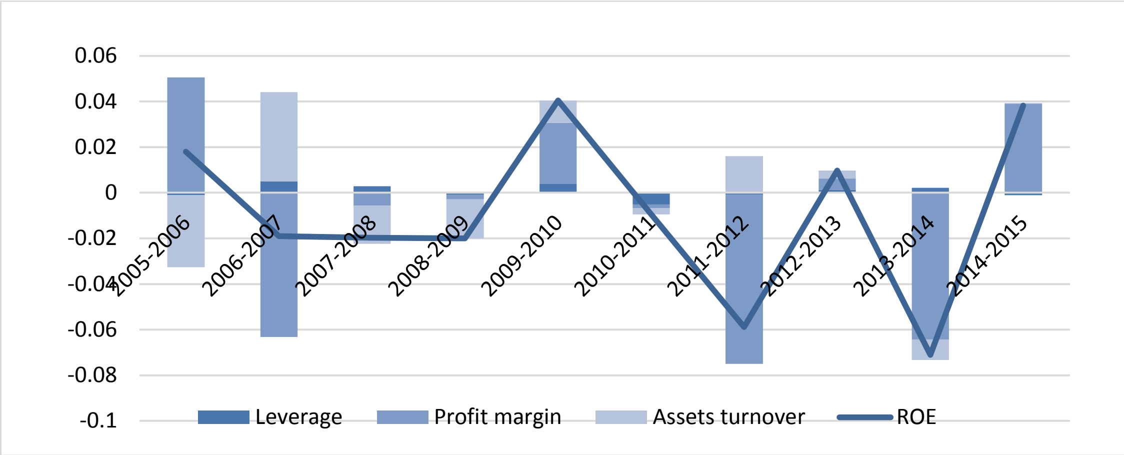
a – Alytus County



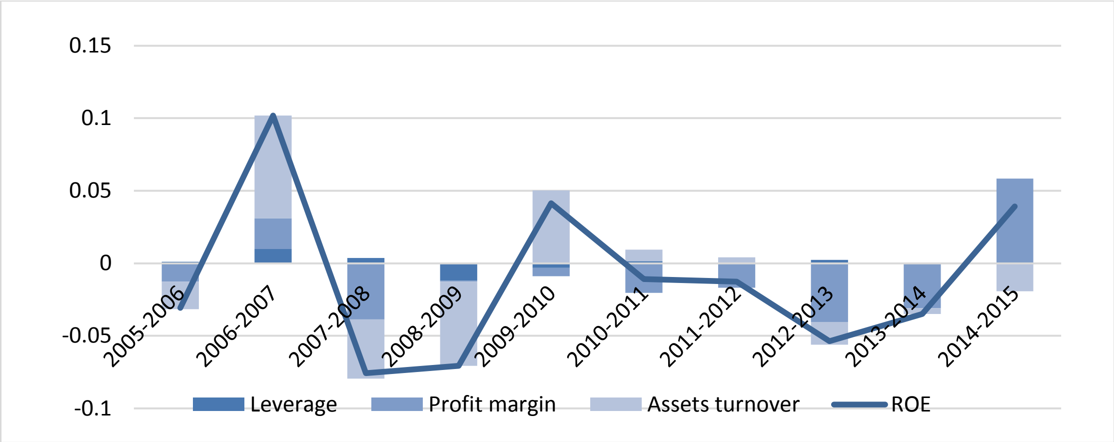
b – Marijampole County



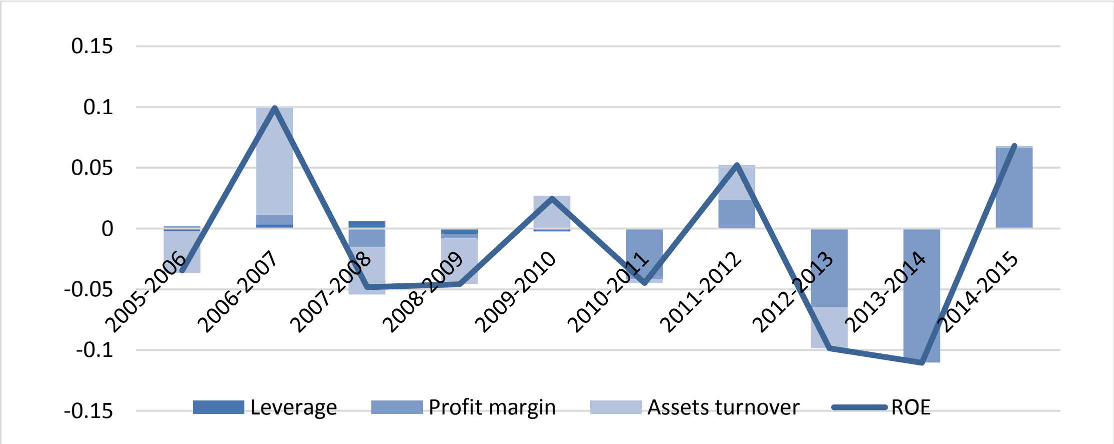
c – Kaunas County



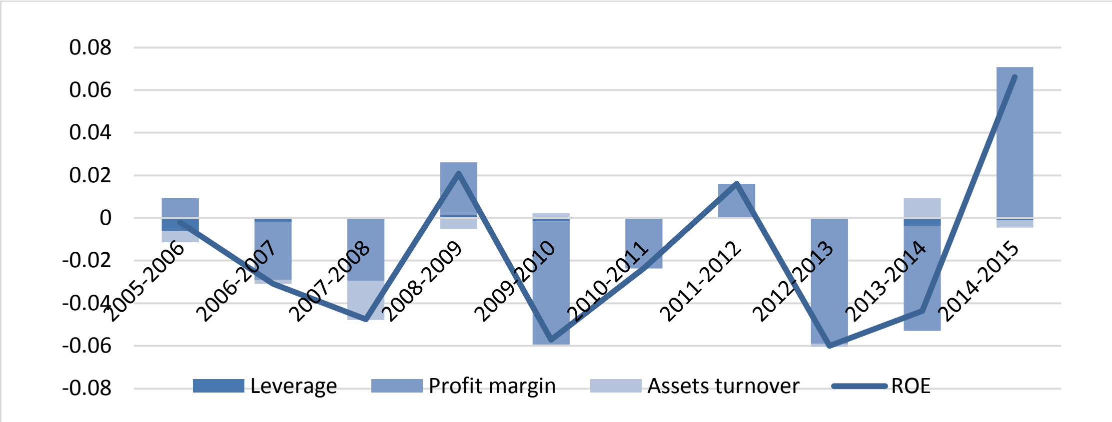
d – Klaipeda County



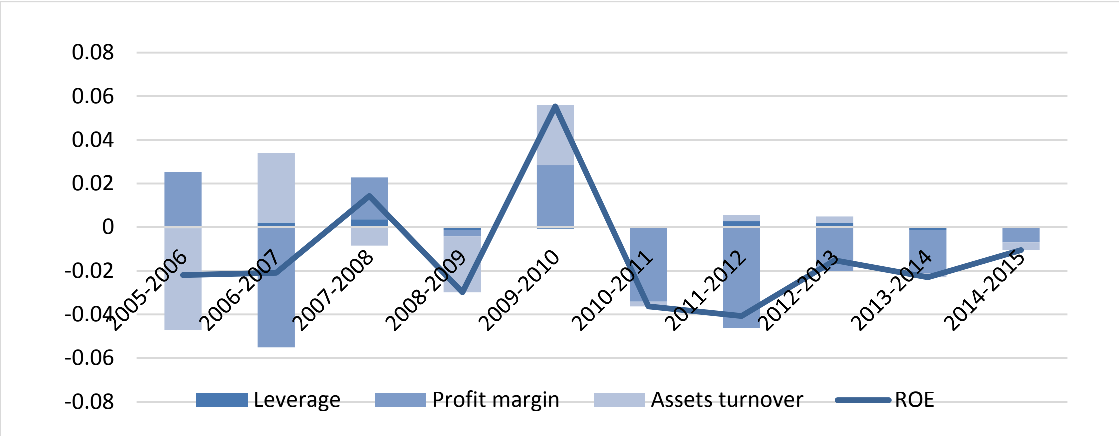
e – Panevezys County



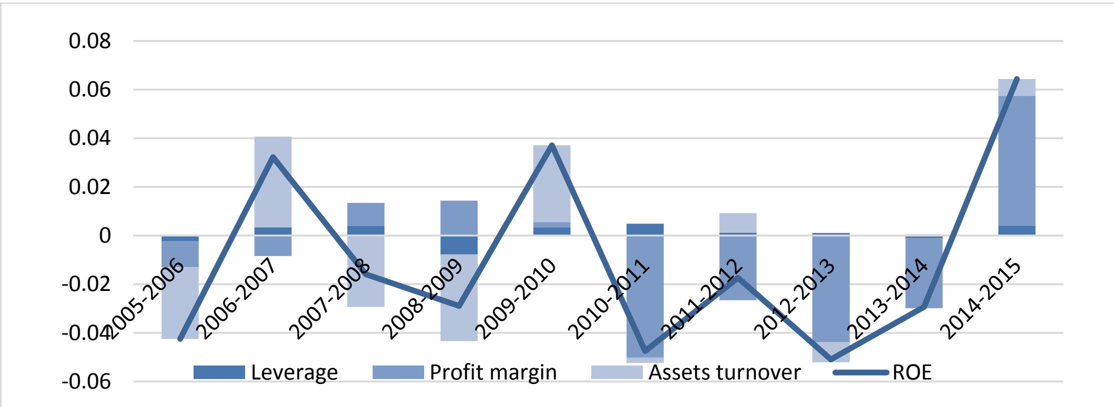
f – Siauliai County



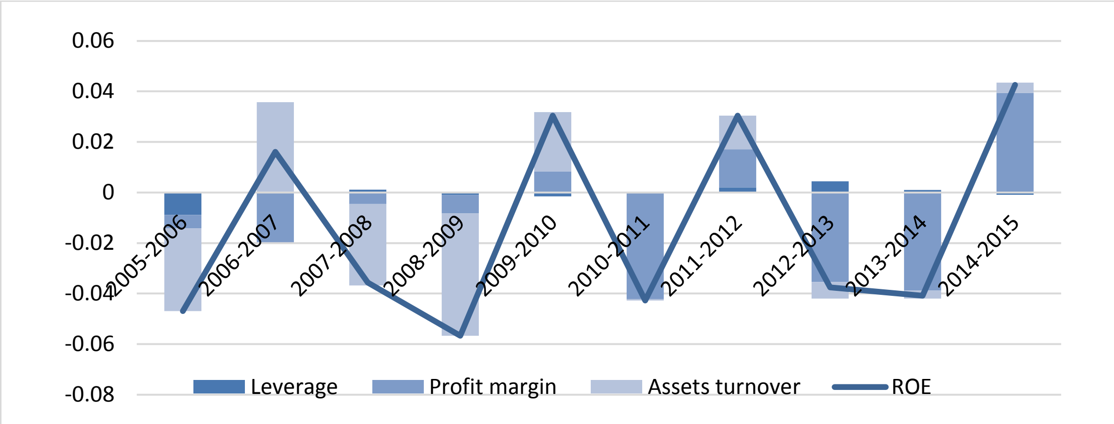
g – Taurage County



h – Telsiai County



i – Utena County



j – Vilnius County

Fig. 22. DuPont analysis (ratios influenced the change in ROE) of ROE (counties)

Source: Balezentis, Novickyte (2018)

To show how to change the ROE ratio during the 2005-2015 period we also calculated annual average growth rate for family farms by Counties. Fig. 23 shows the relationship between to ratios: AAGR of ROE and average ROE in 2005-2015 period. As we see almost all Lithuania counties demonstrate a positive AAGR ratio and only Taurage, Siauliai, and Telsiai present a negative AAGR and ROE relationship. It is important to mention that though these three counties have the biggest negative growth of ROE ratio during 2005-2015 period (respectively 124%, 86%, 90%). The main impact to decreasing ROE ratio was due to unfavourable impact of profit margin ratio (especially in Taurage and Telsiai Counties). Vilnius County has the biggest positive AAGR in ROE ratio, but till now has only moderate ROE ratio (avr. 0.0964). In this case high AAGR ratio do not represent the positive growth in ROE ratio, on the contrary Vilnius County was characterized by a fluctuation of the ROE indicator from positive to negative and vice versa. As earlier analysis shows, Marijampole County demonstrate the one of the best performance during 2005-2015 with moderate fluctuations of ROE ratio (St. Dev. respectively 0.06).

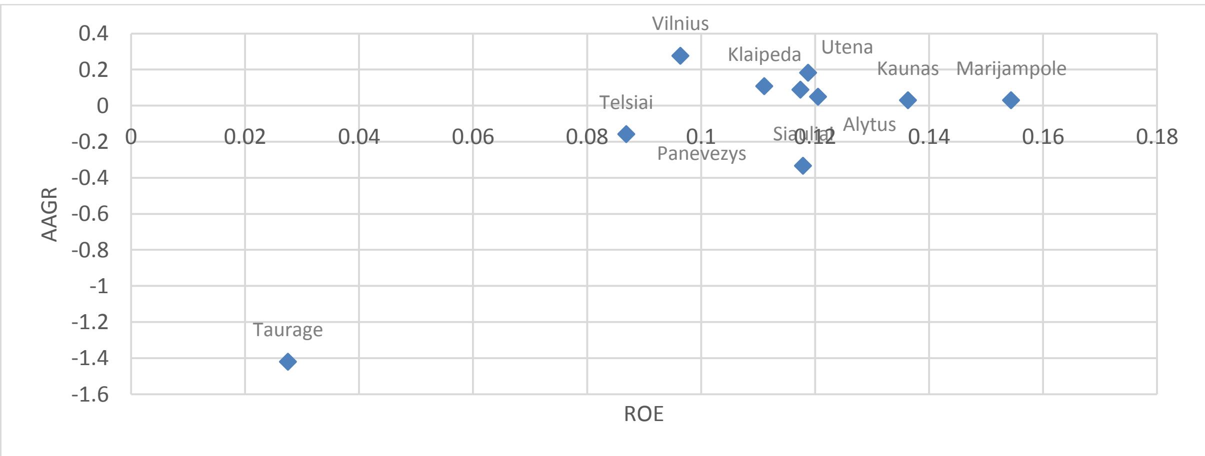


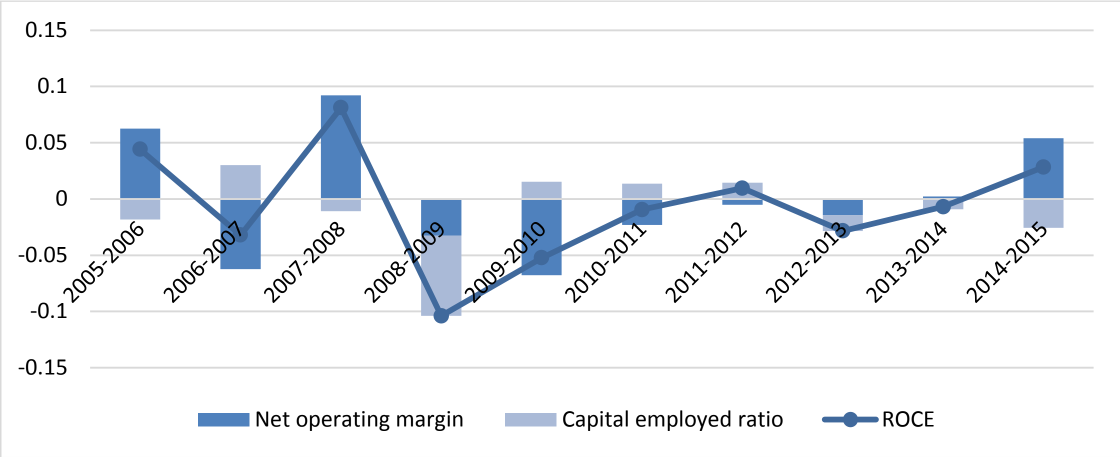
Fig. 23. Relationship between annual average growth rate and ROE ratio (counties)

Table 15 present ROCE ratio in different Counties and shows that the best situation was in Kaunas, Utena, and Klaipeda Counties. The worst situation was in Telsiai, Siauliai and Taurage (the biggest drop from 2005 to 2015) counties. The farms from Siauliai and Taurage Counties have seen the biggest drop of return in period of 2006-2014 (Siauliai: in 2007 – 0.230 to 0.052 in 2015; Taurage: in 2006 – 0.160 to 2014 – 0.025). The main factor influenced negative Taurage County results is that this county had loss-making farms and has a negative changes in all main financial position. Also, Alytus County has seen the highest growth in financial debt (501%) during 2005-2015, but the average ROCE ratio is one of the highest (0.163). This indicates that farmers from this county more effectively use all the available capital for its activities.

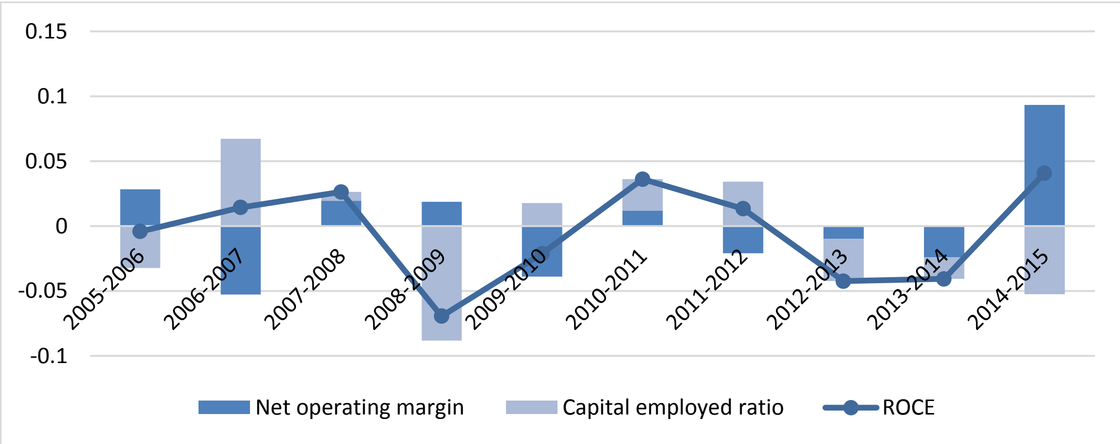
Table 15. Return on Capital Employed ratio in Lithuanian family farms (counties)

Counties	2005	2007	2010	2015	Trend	Growth (2015 compared to 2005), %
Alytus	0.193	0.205	0.129	0.123	-0.015	-36.4
Kaunas	0.187	0.197	0.132	0.139	-0.007	-25.5
Klaipeda	0.175	0.174	0.155	0.136	-0.008	-22.2
Marijampole	0.195	0.203	0.183	0.136	-0.007	-30.3
Panevezys	0.169	0.222	0.163	0.112	-0.009	-33.4
Siauliai	0.167	0.230	0.171	0.104	-0.010	-37.8
Taurage	0.154	0.140	0.085	0.098	-0.009	-36.2
Telsiai	0.191	0.162	0.180	0.116	-0.007	-39.0
Utena	0.227	0.215	0.198	0.171	-0.008	-24.5
Vilnius	0.215	0.203	0.143	0.146	-0.009	-31.9
Weighted average	0.201	0.197	0.149	0.127	-0.010	-36.7

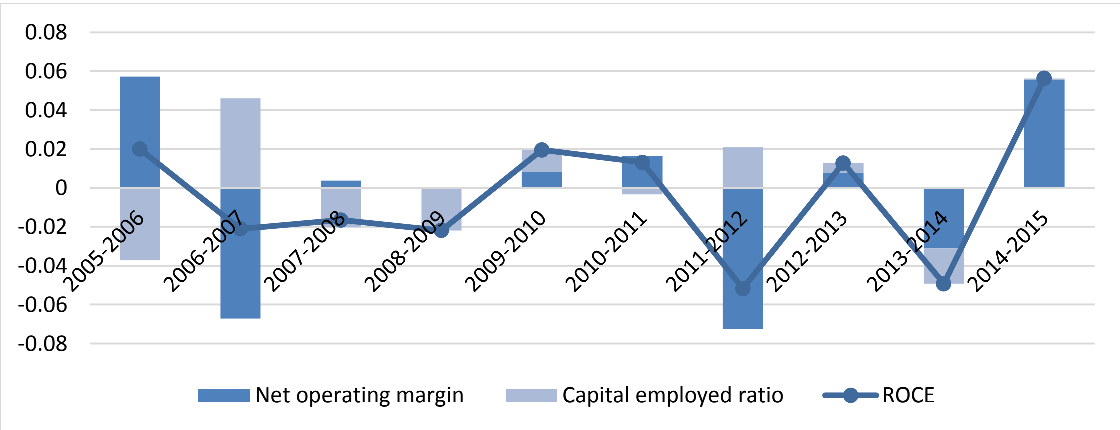
Analysing Fig. 24 we can explain the changes in ROCE of the family farms across counties more accurately. As we can see in earlier analysis, Kaunas, Utena, and Klaipeda show better performance in return. The main factor governing the changes in return on capital employed in Klaipeda and Kaunas was capital employed ratio. The farms operating in theses counties faced some difficulties in managing the operating margin or failed to respond to the changes in the market conditions. The steepest decline in the ROCE for Telsiai and Siauliai Counties was observed due to negative influence of the inefficient use of capital in 2005-2006, 2007-2009, and 2012-2015. In addition, Telsiai County exhibited poor profitability management in 2010-2013.



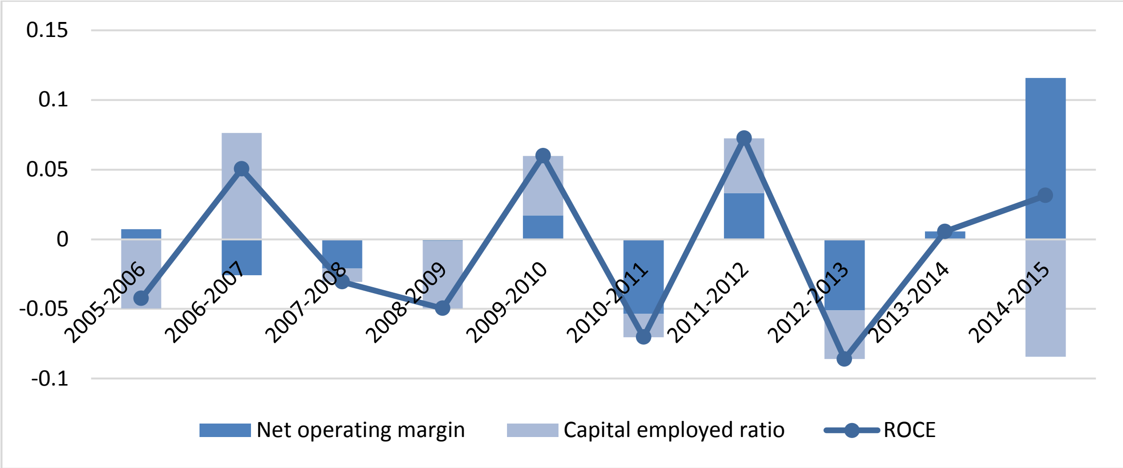
a – Alytus County



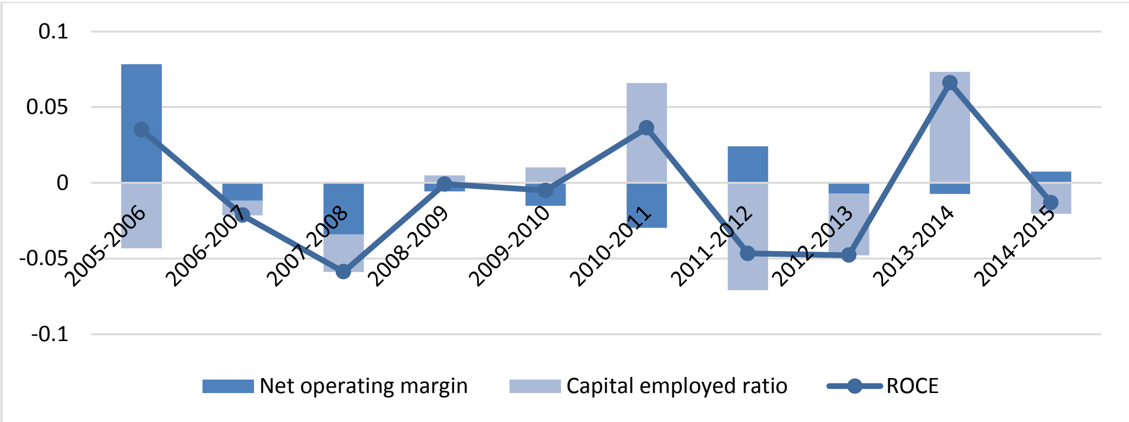
b – Kaunas County



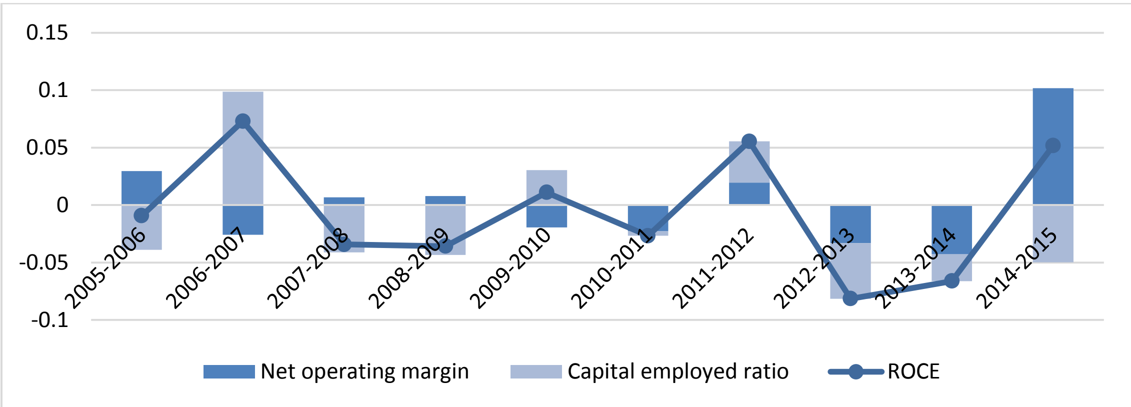
c – Klaipeda County



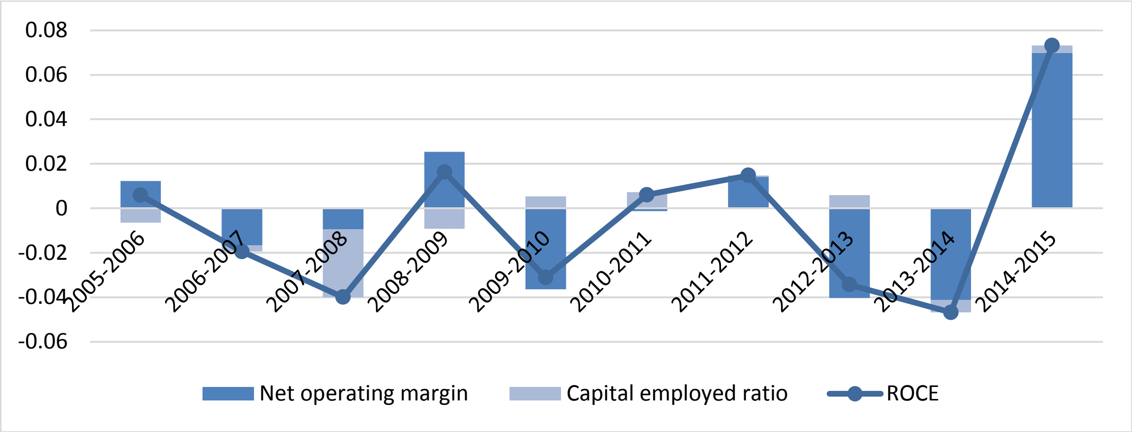
d – Marijampole County



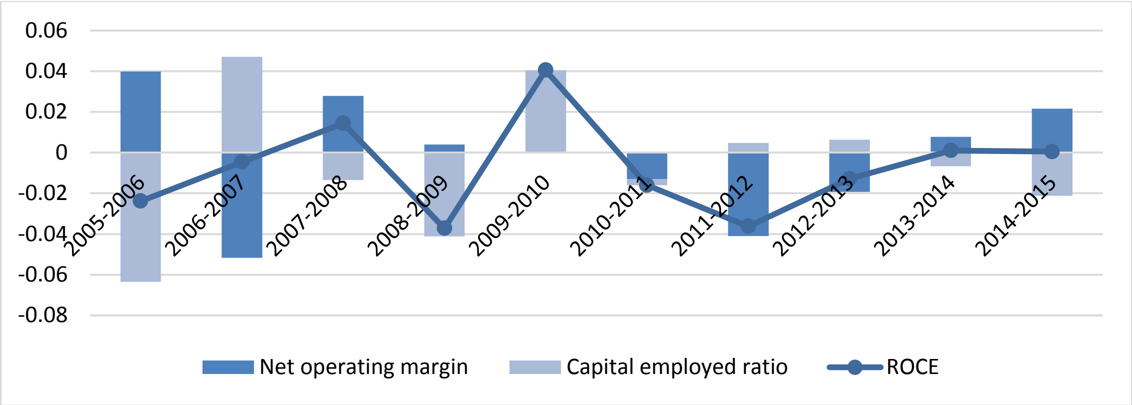
e – Panevezys County



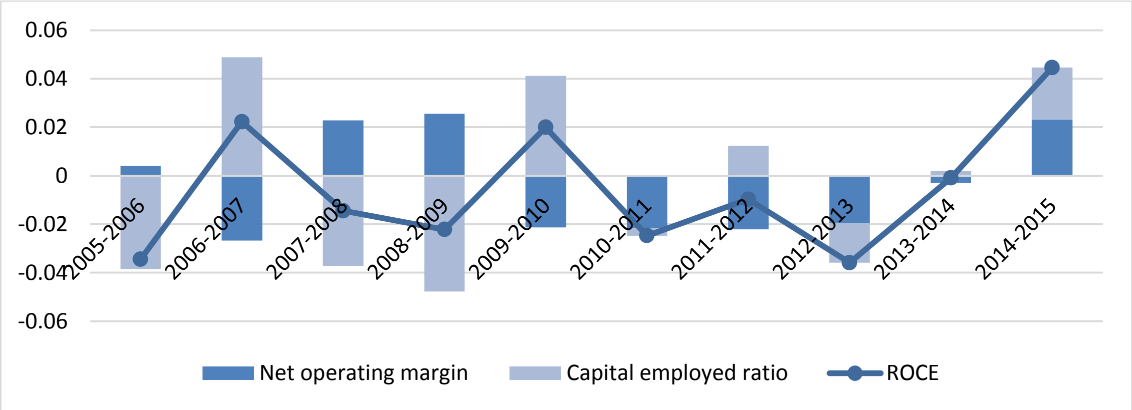
f – Siauliai County



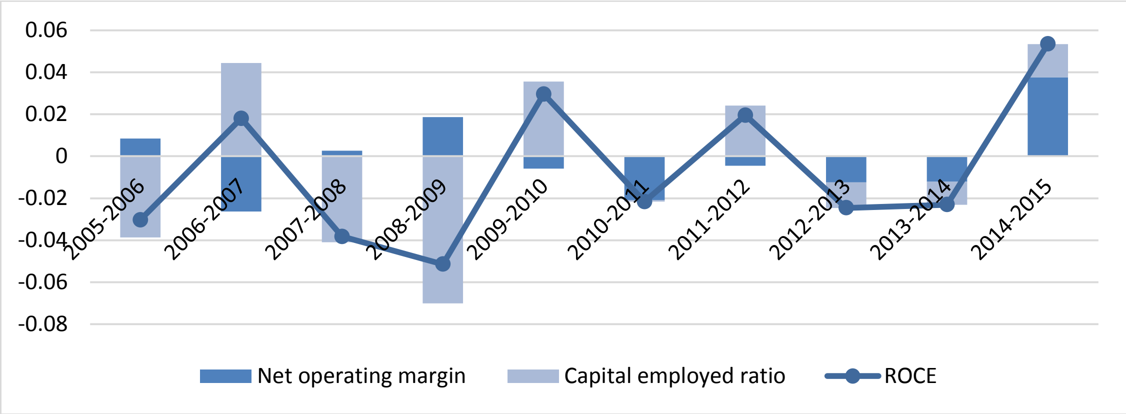
g – Taurage County



h – Telsiai County



i – Utena County



j – Vilnius County

Fig. 24. Decomposition analysis (ratios influenced the change in ROCE) of ROCE (counties)

Fig. 25 shows the relationship between to ratios: AAGR of ROCE and average ROCE for the period of 2005-2015. As we can see, more than a half of Lithuanian counties demonstrate a negative AAGR ratio. Taurage County shows the highest AAGR ratio, but this is mainly due to higher ROCE fluctuations at the end of the time period covered. Also, farms from this county have the lowest average ROCE ratio (0.10). Family farms from Alytus, Utena, and Kaunas Counties have the highest ROCE ratio, but they are also characterized by higher fluctuation of this indicator (standard deviation values are, respectively, 0.062, 0.032 and 0.035).

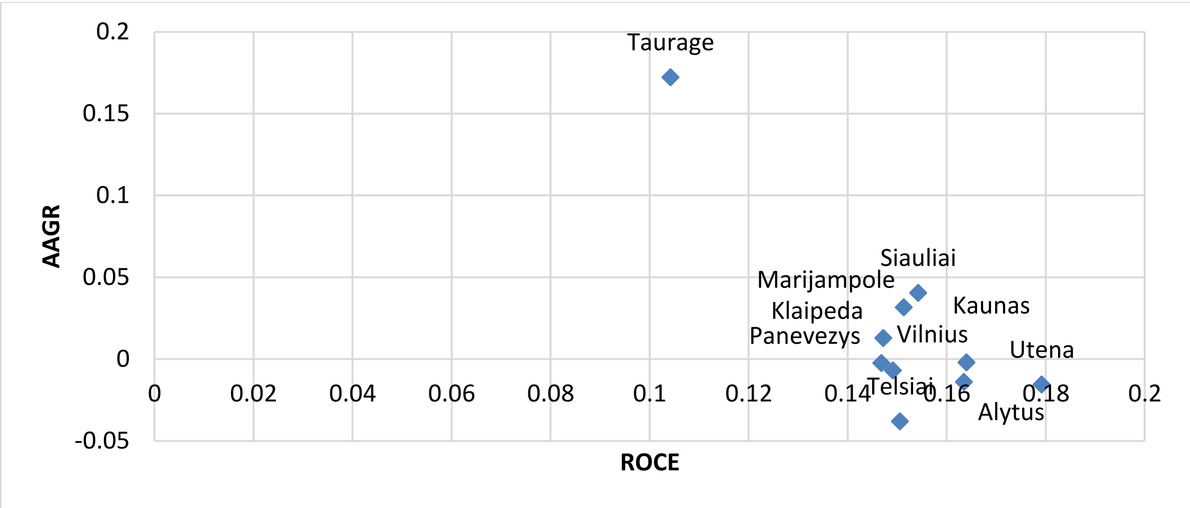
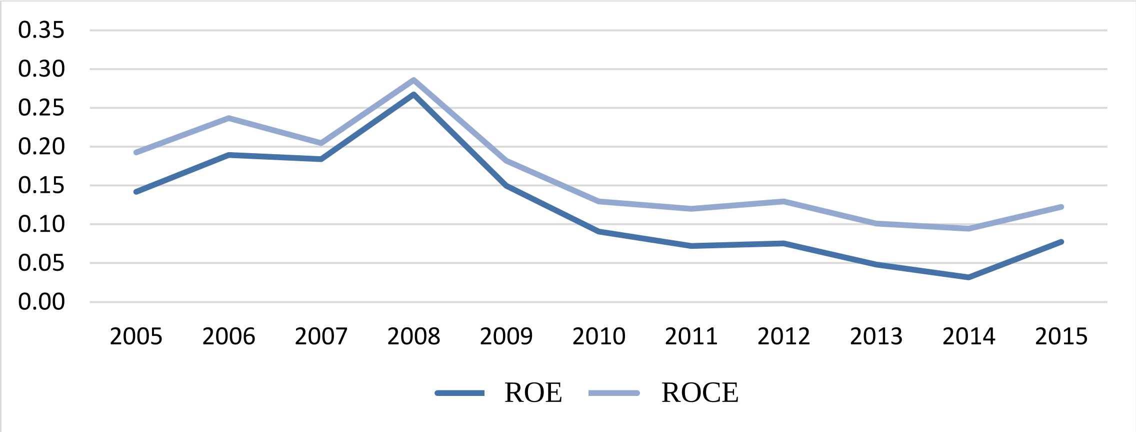


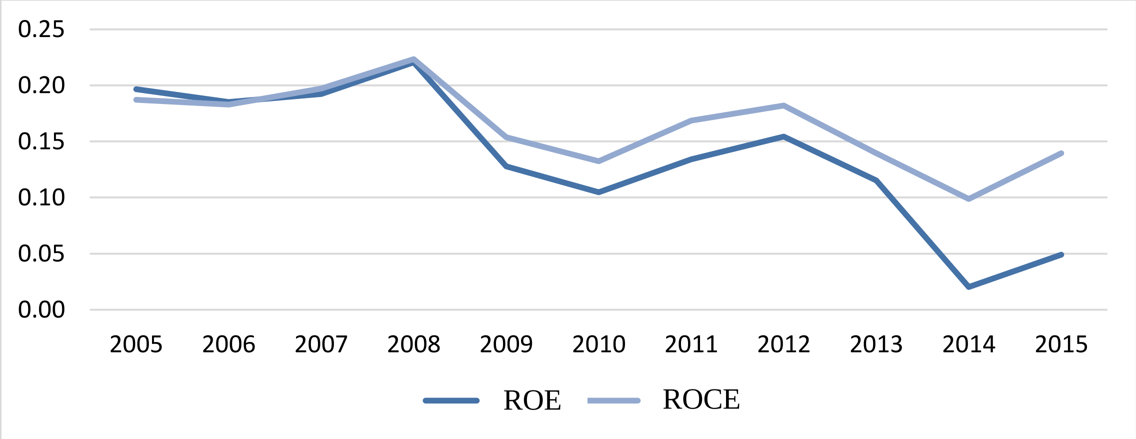
Fig. 25. Relationship between annual average growth rate and ROCE ratio (counties)

Finally, Fig. 26 shows the relationship between two analysed financial performance ratios – ROE and ROCE. As we can see in Fig. 26 all the counties present the same fluctuation in both indicators. Only the farms from Panevezys and Marijampole Counties show some differences in these two ratio fluctuations: till 2008 in Panevezys and till 2009 in Marijampole bigger was ROE ratio and that year was a turning point and began to increase in ROCE. This breaking point in Marijampole County was influenced mainly due to changes in financial debt position (the largest debt was in 2008).

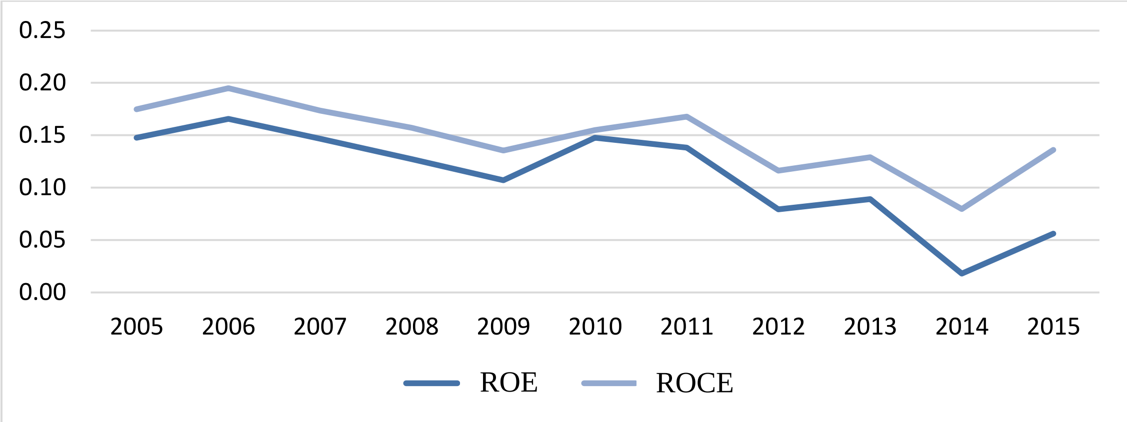
During 2005-2015 period almost all rest of farms noticed higher ROCE ratio than ROE and the difference between these indicators was fairly uniform, but since 2011 the disparity between these two ratios increase in most counties. These difference mostly determined by the negative profit margin fluctuation. It should be noted that since 2014, the trend of both indicators is increasing in almost all of the counties. Fig. 26 presents the dynamics in ROE and ROCE across different counties.



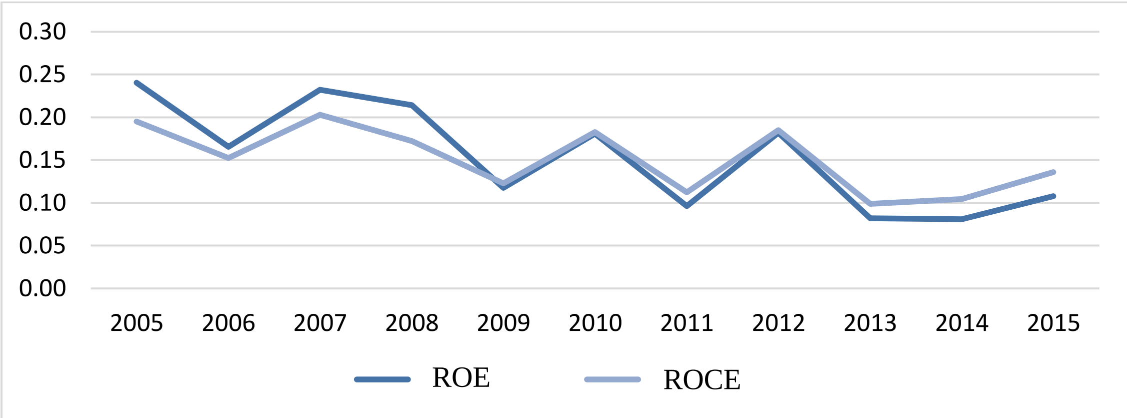
a – Alytus County



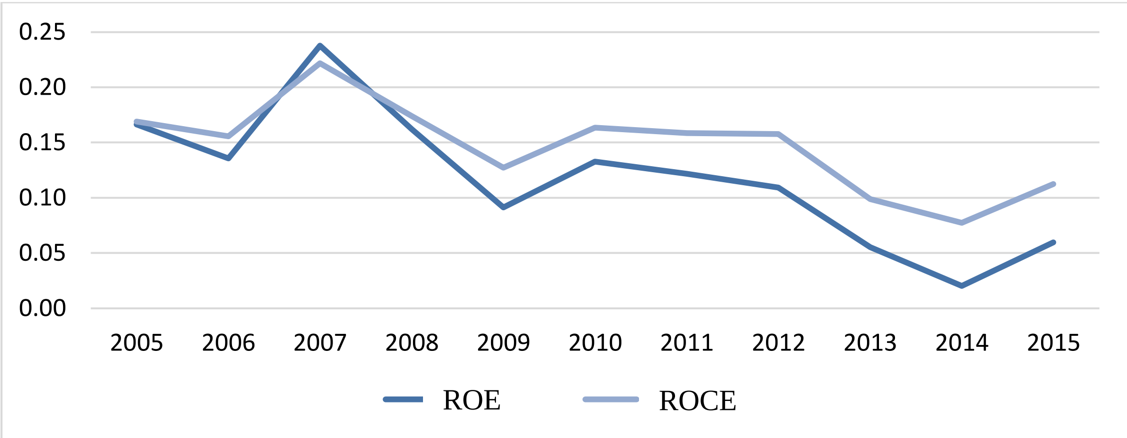
b – Kaunas County



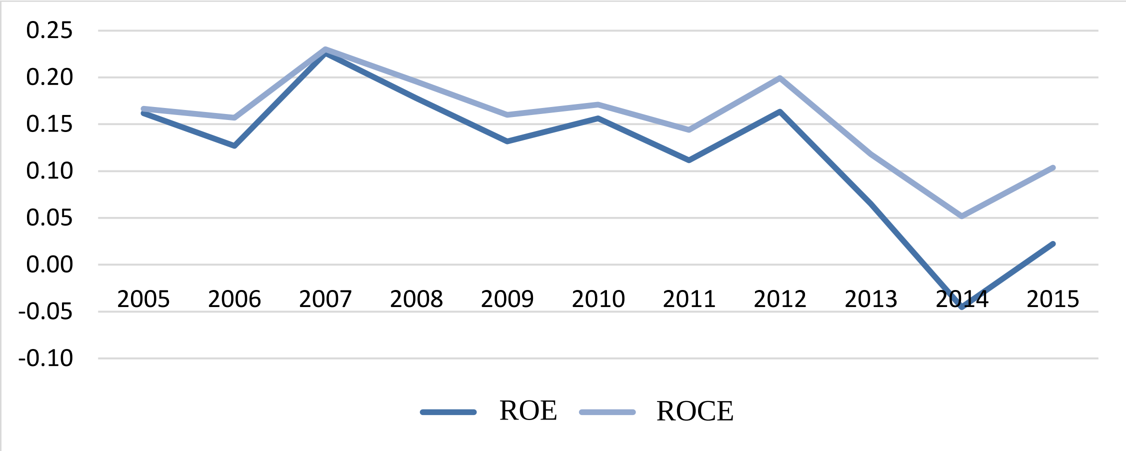
c – Klaipeda County



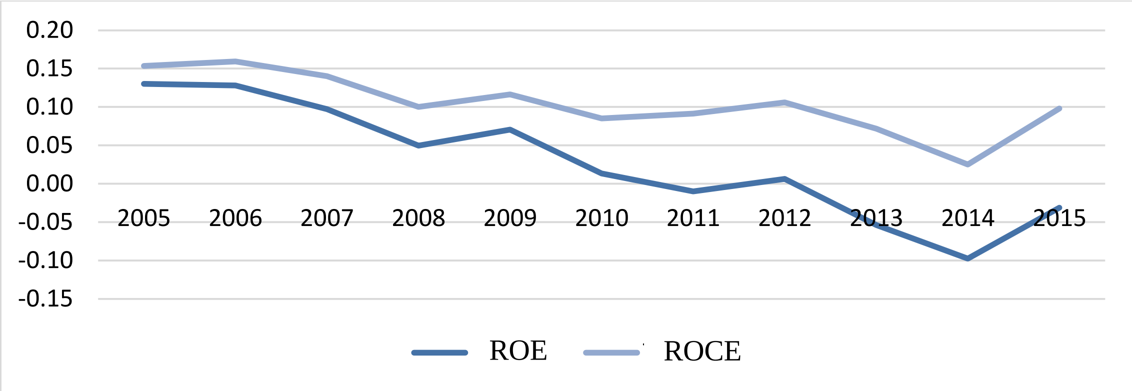
d – Marijampole County



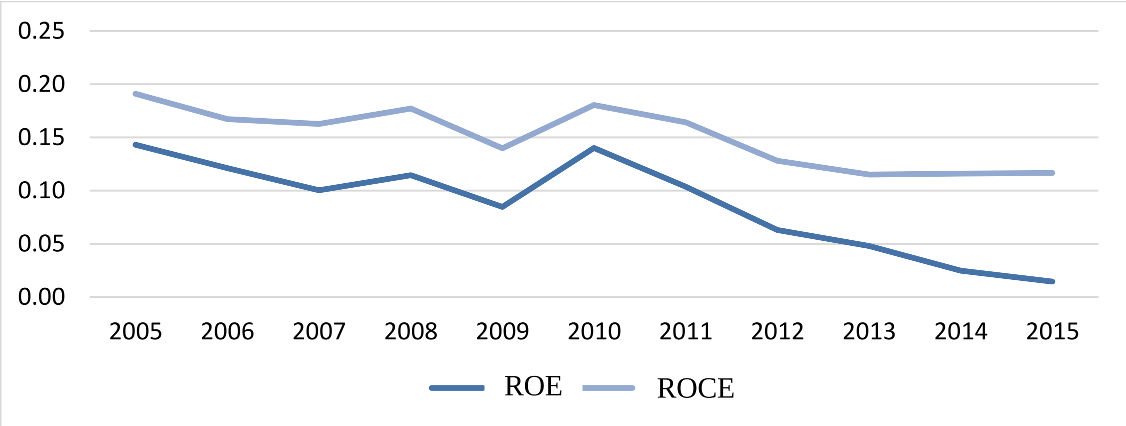
e – Panevezys County



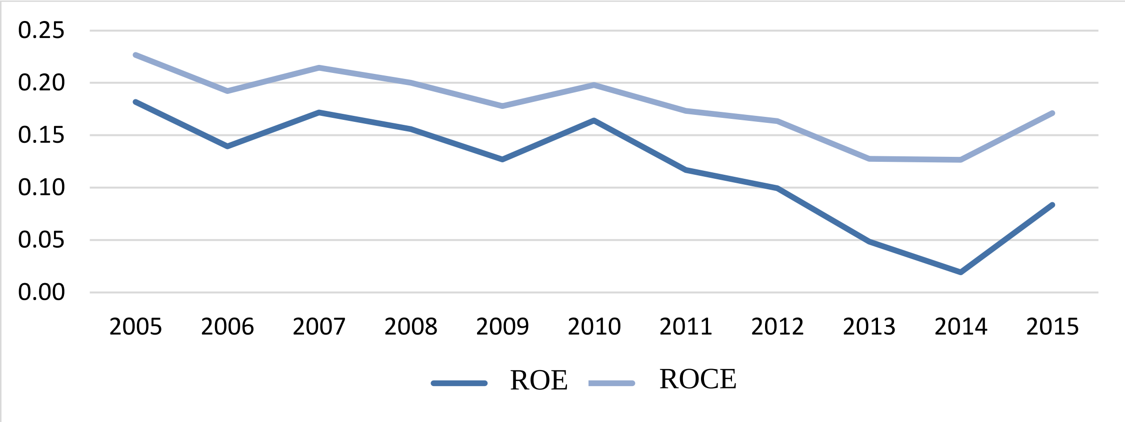
f – Siauliai County



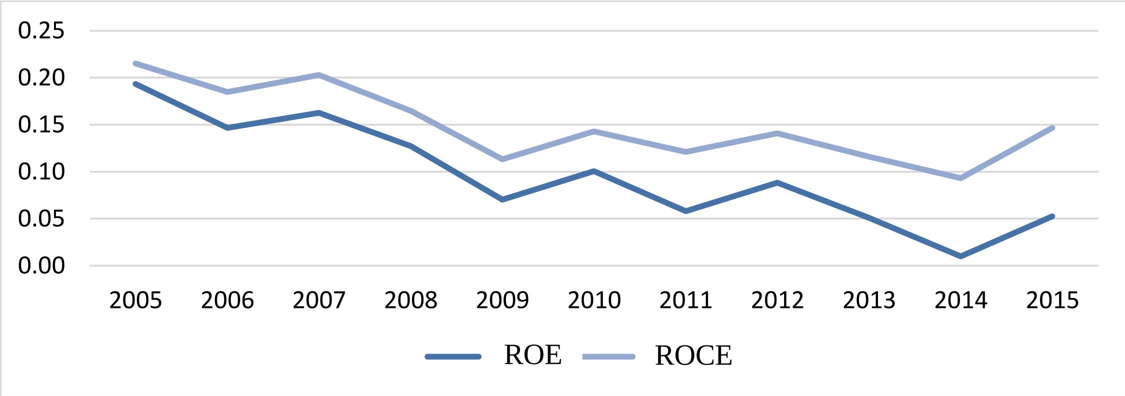
g – Taurage County



h – Telsiai County



i – Utena County



j – Vilnius County

Fig. 26. Relationship of ROE and ROCE ratios (counties)

The information for the period of 2005-2015 can be summarized by considering the average values for the whole period. Fig. 27 presents the results.

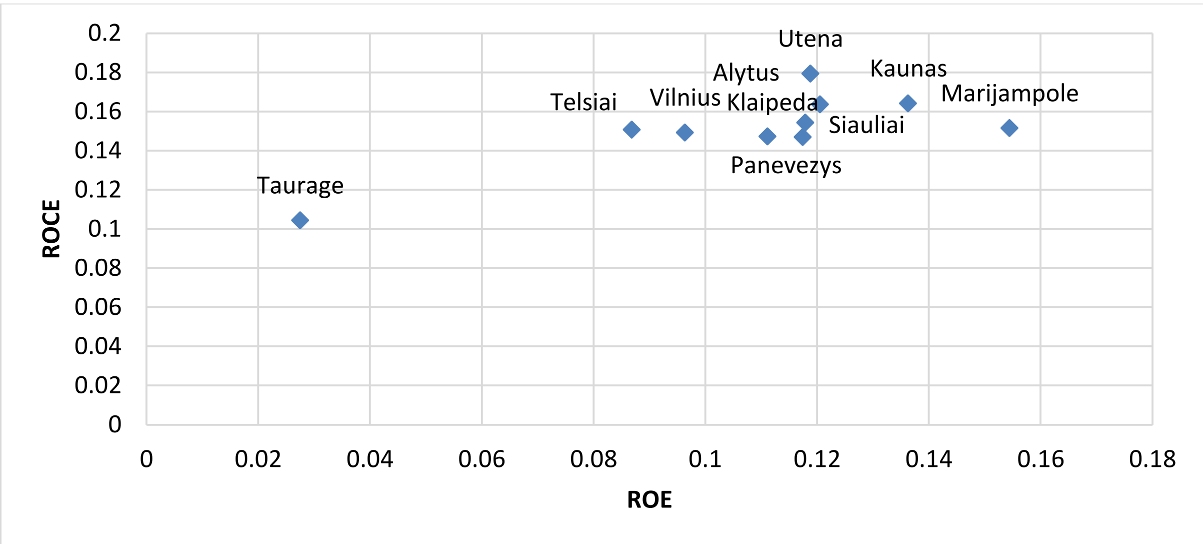


Fig. 27. The average values of ROE and ROCE for the counties, 2005-2015

The trends in ROE and ROCE tend to coincide across the counties with differences in their average levels. All the values remained positive, yet kept decreasing during 2005-2015. In addition, the ROCE ratio exceeded ROE in all the counties, which indicates the negative effect of Family Remuneration on the value of ROE. The only difference is Marijampole County where the mean values of ROE and ROCE were rather similar. The latter county also showed rather high level of Financial Debt which set off the effect of Family Remuneration.

3.3. Sustainable growth analysis

The growth in revenue can be considered as an indicator representing farm growth. However, farm growth can be achieved by employing equity or debts. Accordingly, the sustainable growth should be analysed in order to identify the possible gaps between the observed and sustainable growth rates.

Fig. 28 shows the relationship between two indicators – sustainable growth ratio and sustainable growth challenge. Note that SGC deviates from zero in case the observed growth in sales does not meet the level of the SGR. In order to ensure that the changes in both sides of the balance conform to each other, the farms may need to adjust their financial strategies when the aforementioned discrepancies between the observed and sustainable growth rates occur.

In the case of Lithuanian family farms, we observe that SGC was negative for almost all the years covered in the analysis with exception of 2012. The results for farming types are presented in Fig. 28. Escalante et al. (2006) proposed decreasing sustainable growth ratio (g^*) in order to approach the SGC of zero value. However, the results indicate this rate is almost zero (e.g. in year 2015). In order to resolve this extraordinary situation, we offer to increase sales by exploiting the assets in a more efficient manner.

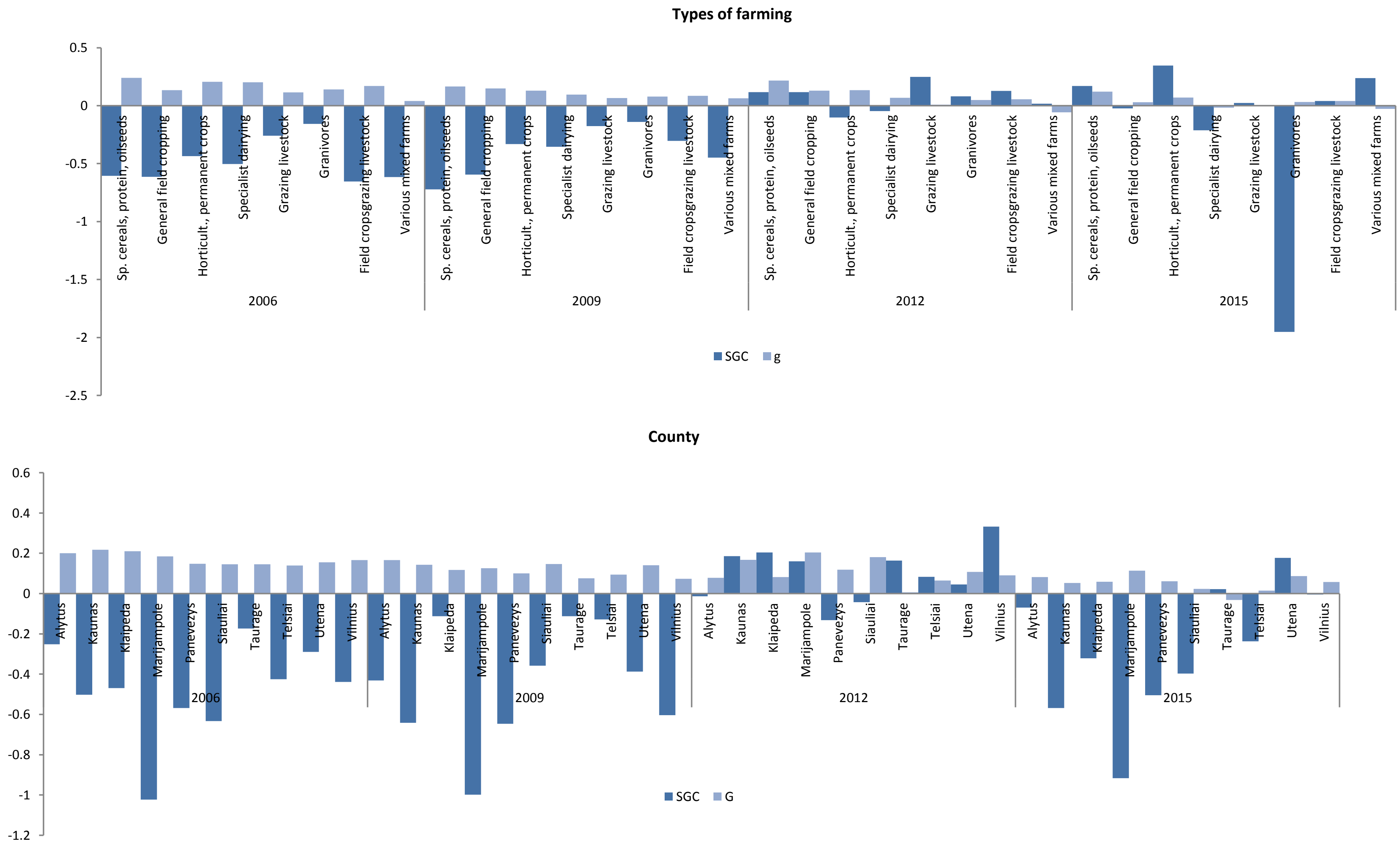


Fig. 28. Sustainable growth ratios of Lithuanian family farms

Source: Balezentis, Novickyte (2018)

The analysis of revenues, sustainable growth rate rates along with the resulting SGC rates show less fluctuations in average sustainable growth rates (see Fig. 29). The trends of sustainable growth ratio are negative and, as it was already mentioned, farmers should increase efficiency in utilization of existing resources. In addition, the changes in sales are below the sustainable growth rate for almost whole period. The high volatility in revenue and SGC was mainly influenced by asset turnover and profitability. A negative trend in profitability showed that Lithuanian family farmers should better exploit assets and to improve the scale of operations.

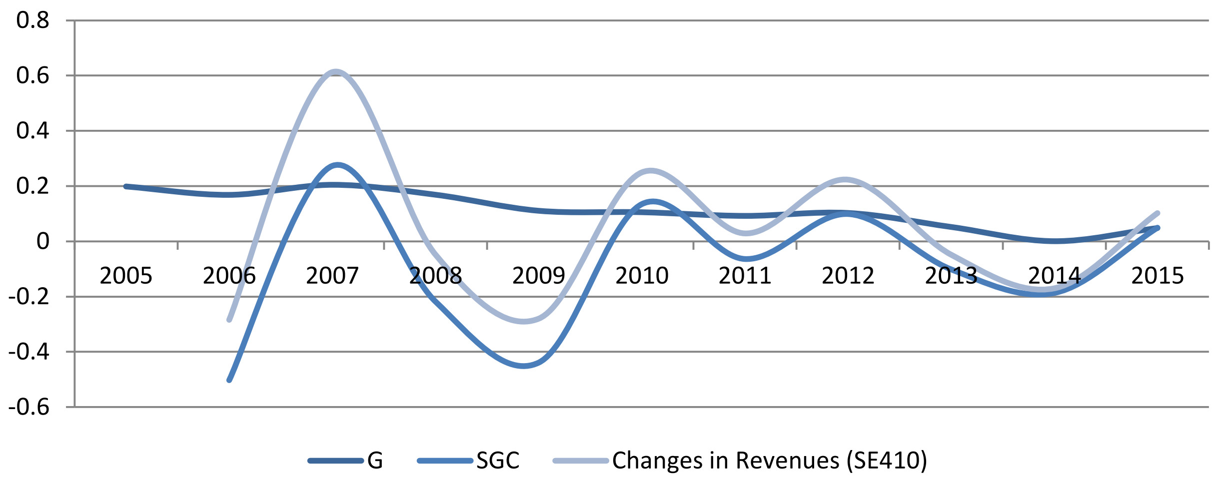


Fig. 29. Rates of revenue growth, sustainable growth and sustainable growth challenge for Lithuanian family farms

Source: Balezentis, Novickyte (2018)

Competitiveness analysis (see Fig. 30) confirmed that family farms with the best ROE ratios have better relative growth and profitability than all agriculture family farms sector. Marijampole and Kaunas counties are in the healthy area or franchise quadrant, where separate farms from these counties are both more profitable and growing faster than their industry. Also, Alytus and Siauliai counties fall in this quadrant, that shows this county have a possibility to improve the return by doing more investment or/and making more productivity per 1 ha UAA.

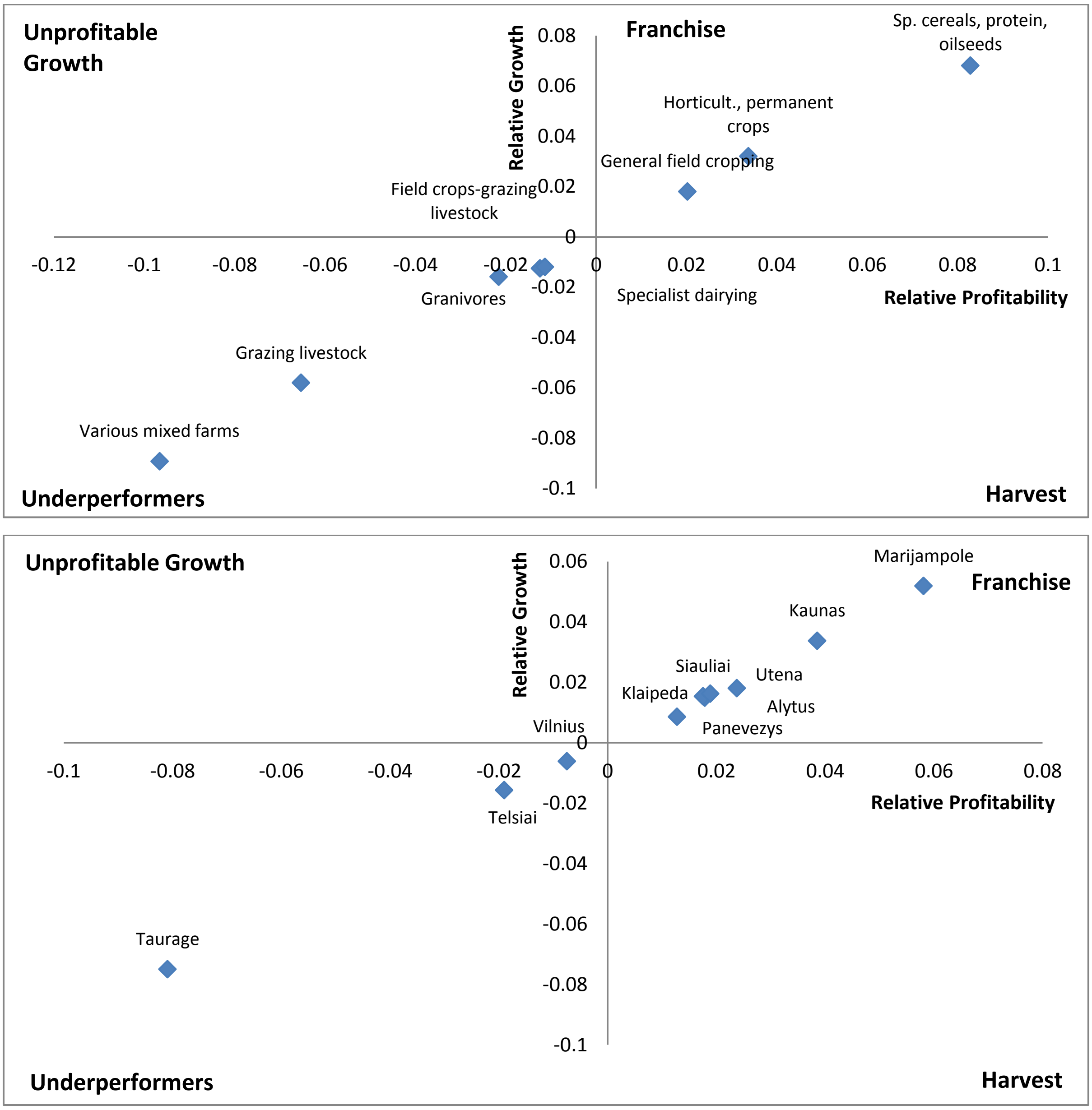


Fig. 30. Relative profitability and relative growth of Lithuanian family farms (upper plot – by farming types; lower plot – by counties)

Source: Balezentis, Novickyte (2018)

Based on the same Kijewska (2016) research we see, that only specialist cereal, oilseeds and protein crops, general field cropping, horticulture and are in the healthy area quadrant or in the quadrant where relative growth and profitability are bigger than all agriculture sector profitability and grow. This shows that only these farming types are more competitive than industry average. All remaining types of family farms are in the underperformed or illness area. It is important to pay attention, as the operating inefficiently and less profitable (or loss) sectors require interventions to improve their performance and to stabilize it. Without the necessary steps in the future, these sectors may be faced with greater a business continuity problems.

The carried out analysis showed that returns on assets tended to decline across farming types (and counties). This can be explained by investments accelerated by the investment support under the CAP and the adjustment costs which prevent the returns from growing at the same pace. The analysis of profitability indicates that the profitable farming types tended to increase their revenue, i.e. expand their scale of operation which is natural in a competitive market. A positive trend was observed in the sense of the sustainable growth challenge. More specifically, the difference between the actual growth in revenue and the sustainable growth rate tended to decline over the period of 2005-2015. These findings imply farms managed to balance their investments and productive activities to a higher degree.

CONCLUSIONS

The DuPont decomposition analysis enables us to identify and to evaluate the essential factors that have a significant impact on the Lithuanian farm financial activities during the 2005-2015. We found that Lithuanian farms confronted with adverse changes in return, where mostly all changes in ROE ratio influenced by assets turnover ratio and profit margin changes. Average ROE ratio during all period was 0,103. Specialist cereal, oilseeds and protein crops family farms present higher return than all family farms in 2005-2015. The best situation was in Marijampole, Kaunas, and Klaipeda counties, and the biggest negative growth of ROE was in Taurage.

The DuPont model based on IDA showed that different factors influence return in different period of time. Specialist cereal, oilseeds and protein crops, general field cropping, specialist dairying, and field crops-grazing livestock family farms ROE characterized by changes in assets turnover ratio till 2010, and since 2011 the return of these types of farms mainly influenced profit margin changes.

Sustainable growth analysis showed that the farms financial expansion is not reasonable and features serious fluctuations. In the future, this may have negative consequences for the survival of family farms. However, the sustainable growth challenge ratio has declined. Thus, the support policies should be adjusted so that the unsustainable farm growth would not be accelerated once again.

Competitiveness analysis confirmed that family farms with the highest ROE have better relative growth and profitability than all agriculture family farms sector. Relationship between return and growth showed that Lithuanian family farms (Telsiai and Taurage Counties; granivores, grazing livestock, field crops grazing livestock, specialist dairying and mixed family farms) have relative lower level of profitability and growth than other counties and farming types (are in illness or underperformed area). In the future this situation may have a negative impact on sustainable and profitable Lithuanian family farms growth.

The effect of leverage on the profitability appeared to be the relatively least important if contrasted to the effects of the asset turnover and profit margin. This indicates Lithuanian family farms should embark on borrowing in order to improve the leverage and, thus, profitability of the equity (net worth). Profit margin appeared as the key factor behind profitability change across all the farming types. This urges the need for improvements in the marketing strategies for Lithuanian family farms,

Further research can aim at integrating the indicators of profitability (change) into the frameworks for sustainability assessment. As multiple different indicators represent farm performance in this regard, multi-criteria approach is required to handle this issue. Therefore, creation of indicator systems and development of multi-criteria decision making techniques are required for further analysis of farm sustainability.

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ANNEX A. FINANCIAL INDICATORS FOR LITHUANIAN FAMILY FARMS, 2005-2015

Table A1. Total Assets

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Trend	Growth, %
Type of farming													
Sp. cereals, protein, oilseeds	130670	106997	119800	143732	142572	178263	178697	195246	187435	178360	185330	**8189**	**41.8**
General field cropping	118206	97026	93042	108110	104387	124696	112609	125444	117324	125404	100349	**1272**	**-15.1**
Horticult., permanent crops	64629	51964	63304	88789	87874	74464	70515	90482	112621	69624	105658	**3725**	**63.5**
Specialist dairying	85614	76906	86164	87214	86412	81937	82856	90081	89559	77654	74958	**-345**	**-12.4**
Grazing livestock	48024	47143	53647	56680	58572	51116	52131	55530	87457	81104	73146	**3220**	**52.3**
Granivores	51420	57260	63968	66916	68290	102879	79945	80009	328168	312962	54977	**17009**	**6.9**
Field crops-grazing livestock	85514	70257	75944	81736	83755	86840	90370	94062	93240	83344	96174	**1716**	**12.5**
Various mixed farms	68000	47669	71163	99430	87689	56096	52192	47197	43770	40414	43987	**-3375**	**-35.3**
County													
Alytus	55562	57487	91410	94840	99402	103720	123506	117225	121609	125911	160429	**8705**	**188.7**
Kaunas	106620	95455	89665	102964	100110	113686	113740	133258	150954	92948	83977	**1226**	**-21.2**
Klaipeda	74714	70321	90092	95038	110364	144313	127800	147334	135896	132240	100941	**5802**	**35.1**
Marijampole	215711	124441	148592	258923	150617	169462	160225	176089	184303	190930	160962	**-516**	**-25.4**
Panevezys	100019	74524	101245	99220	91983	89808	110136	105435	145361	145090	142477	**5977**	**42.5**
Siauliai	83428	65159	84763	90381	93528	120542	126843	118021	123331	102138	123008	**5001**	**47.4**
Taurage	69674	70541	67618	74490	78146	56230	54780	64519	60608	72227	72249	**-407**	**3.7**
Telsiai	59592	63688	72390	72823	91303	110062	102254	114882	130759	102380	98293	**5622**	**64.9**
Utena	51865	54494	63956	73782	74219	82883	74392	80464	81061	70730	79707	**2446**	**53.7**
Vilnius	63701	58886	65039	82329	80437	79096	80827	102747	89564	90399	83392	**3085**	**30.9**
Weighted average	**80574**	**69809**	**82506**	**91175**	**91168**	**92398**	**92840**	**100637**	**107539**	**100216**	**100127**	**2864**	**24.3**

Table A2. Net Worth

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Trend	Growth, %
Type of farming													
Sp. cereals, protein, oilseeds	97326	81865	92625	105792	110834	148532	147642	162292	150211	143868	144953	**7352**	**48.9**
General field cropping	100450	78785	78396	89624	89984	110123	98036	104538	100135	101509	85552	**1086**	**-14.8**
Horticult., permanent crops	59003	48713	57674	76668	76359	65632	62069	79975	90454	62726	87853	**2645**	**48.9**
Specialist dairying	74621	69014	73918	74012	78645	74144	74699	79890	78943	68129	65278	**-249**	**-12.5**
Grazing livestock	44681	44278	51011	53120	55381	49077	48823	50941	77143	72809	64338	**2544**	**44.0**
Granivores	46571	52472	57792	62144	63118	85455	58994	68400	254725	212269	44884	**11181**	**-3.6**
Field crops-grazing livestock	73111	61470	66331	72426	74043	78665	78867	81755	80163	70276	82816	**1352**	**13.3**
Various mixed farms	60960	42270	61284	86076	77752	50274	49769	45671	41050	38557	41587	**-2556**	**-31.8**
County													
Alytus	51666	52067	78409	82400	87670	91366	111515	103298	105498	110984	137000	**7357**	**165.2**
Kaunas	88013	77301	72900	83511	84126	98059	98383	113688	122779	80105	68952	**1274**	**-21.7**
Klaipeda	65033	61607	76523	79088	92512	117298	107670	124970	113552	105878	83219	**4418**	**28.0**
Marijampole	163252	97855	115027	187371	118490	145208	129883	145280	149034	156297	131530	**949**	**-19.4**
Panevezys	82462	61048	78630	75607	77075	77387	93788	89343	119567	119314	116921	**5203**	**41.8**
Siauliai	68985	54588	69656	72110	76795	100702	105922	97562	102287	82311	100806	**4072**	**46.1**
Taurage	61076	64823	63182	69366	71225	53250	51506	59445	56635	64253	63270	**-459**	**3.6**
Telsiai	55992	60050	66971	65139	82758	100436	93518	101667	111735	90915	88111	**4565**	**57.4**
Utena	46085	49104	56359	63481	67457	73643	63819	68258	67731	60841	62995	**1559**	**36.7**
Vilnius	56128	54677	60234	75650	74624	74669	76487	94635	77390	75422	71567	**2286**	**27.5**
Weighted average	**68276**	**60562**	**70191**	**76480**	**79027**	**81600**	**81448**	**87513**	**91062**	**84478**	**83657**	**2361**	**22.5**

Table A3. Gross Farm Income

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Trend	Growth, %
Type of farming													
Sp. cereals, protein, oilseeds	29543	20510	39462	37060	21255	35041	37020	51631	36426	30553	40899	**1207**	**38.4**
General field cropping	25809	15975	25380	27476	17581	25890	22034	28143	25946	16268	16366	**-351**	**-36.6**
Horticult., permanent crops	17742	14099	19121	22814	18657	23388	24897	25708	26238	13247	20092	**379**	**13.2**
Specialist dairying	19862	14670	17910	17271	13337	16082	16444	16795	18848	15089	12433	**-277**	**-37.4**
Grazing livestock	9949	8609	13253	11645	10431	7894	7919	10242	14394	11456	11805	**171**	**18.7**
Granivores	10001	9847	11236	10390	9768	15510	14292	16278	67400	93218	13688	**4879**	**36.9**
Field crops-grazing livestock	19039	11709	16813	14994	12052	15499	15697	18817	16014	14181	15382	**5**	**-19.2**
Various mixed farms	11527	6490	16613	20034	13628	8242	7642	8221	6866	7035	9188	**-622**	**-20.3**
County													
Alytus	12882	12240	22288	22118	16971	19529	25948	27684	25385	23935	24218	**1208**	**88.0**
Kaunas	22635	17018	22646	26869	16318	20953	24666	35125	32432	17336	10353	**-54**	**-54.3**
Klaipeda	15364	11851	19420	18115	18190	25704	22309	29718	28559	23303	17931	**1031**	**16.7**
Marijampole	45791	19818	36348	60201	25152	37605	31706	45667	37118	38424	17210	**-806**	**-62.4**
Panevezys	20242	13294	26720	21286	12320	18895	24673	24352	27614	24706	15853	**408**	**-21.7**
Siauliai	18538	11389	24734	21732	17598	27246	27945	32099	24522	15262	10503	**52**	**-43.3**
Taurage	13509	13129	12357	10529	10149	7696	8140	9654	9685	10224	10791	**-336**	**-20.1**
Telsiai	13254	9962	15006	13949	13475	20905	19072	22124	26536	19608	15705	**976**	**18.5**
Utena	12422	10856	16194	15619	12211	16974	14997	17458	15701	13914	18116	**415**	**45.8**
Vilnius	16404	12495	17339	17557	10329	13417	13633	20840	16513	15001	15826	**132**	**-3.5**

Table A4. Farm Net Income

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Trend	Growth, %
Type of farming													
Sp. cereals, protein, oilseeds	24661	19595	31988	32207	20627	28225	25481	37157	18174	13251	24968	**-459**	**1.2**
General field cropping	19169	12285	19053	22194	16200	22404	16759	19118	14378	7467	10286	**-757**	**-46.3**
Horticult., permanent crops	13063	12023	16523	14926	13822	16494	17381	16036	14447	6689	15843	**-72**	**21.3**
Specialist dairying	18706	15380	14401	13547	12016	13093	12149	12189	11994	7669	8228	**-846**	**-56.0**
Grazing livestock	7138	7700	10205	8422	7750	5736	5067	6825	10663	6265	9393	**9**	**31.6**
Granivores	8373	9955	9150	7318	9051	7966	9407	8961	43909	50184	11331	**2578**	**35.3**
Field crops-grazing livestock	17119	12264	13346	15599	10533	11953	14163	11376	9771	6869	12272	**-558**	**-28.3**
Various mixed farms	10051	4692	12338	12271	9610	5630	4495	4489	3159	3808	7491	**-587**	**-25.5**
County													
Alytus	10701	13609	18704	27106	18073	13426	14822	15191	12299	11857	19653	**-78**	**83.7**
Kaunas	19936	17450	17669	22987	15394	15056	19167	24237	21038	9163	11704	**-527**	**-41.3**
Klaipeda	13064	13697	15648	14935	14933	22341	21460	17111	17518	10532	13725	**65**	**5.1**
Marijampole	42053	18977	30156	44624	18493	30953	18012	32554	18223	19938	21859	**-1432**	**-48.0**
Panevezys	16887	11606	22443	17246	11695	14675	17443	16613	14354	11220	16020	**-233**	**-5.1**
Siauliai	13891	10236	19495	17683	14950	20593	18272	23539	14542	5284	12734	**-231**	**-8.3**
Taurage	10706	11251	9471	7457	9092	4792	4999	6841	4345	1799	7086	**-696**	**-33.8**
Telsiai	11378	10643	11760	12880	12755	19834	16783	14686	15028	11872	11442	**206**	**0.6**
Utena	11758	10478	13719	14761	13202	16399	12882	13149	10337	8953	13642	**-94**	**16.0**
Vilnius	13702	10883	13192	13551	9103	11291	9791	14452	10394	8405	12210	**-212**	**-10.9**
Weighted average	**14945**	**12148**	**16280**	**16221**	**12579**	**13797**	**12942**	**15171**	**11913**	**8237**	**12753**	**-377**	**-14.7**

Table A5. Financial Debt

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Trend	Growth, %
Type of farming													
Sp. cereals, protein, oilseeds	33344	25131	27175	37940	31738	29732	31054	32954	37223	34492	40377	**837**	**21.1**
General field cropping	17755	18241	14647	18486	14403	14573	14573	20907	17189	23895	14797	**186**	**-16.7**
Horticult., permanent crops	5626	3251	5630	12121	11515	8832	8446	10507	22167	6898	17805	**1080**	**216.5**
Specialist dairying	10993	7892	12246	13202	7767	7793	8156	10191	10616	9525	9680	**-96**	**-11.9**
Grazing livestock	3343	2865	2635	3559	3192	2039	3308	4588	10314	8295	8808	**675**	**163.5**
Granivores	4849	4787	6176	4772	5172	17425	20951	11609	73443	100693	10093	**5828**	**108.2**
Field crops-grazing livestock	12403	8787	9614	9310	9712	8176	11503	12307	13077	13068	13358	**364**	**7.7**
Various mixed farms	7041	5399	9879	13354	9937	5822	2424	1526	2719	1857	2400	**-818**	**-65.9**
County													
Alytus	3897	5420	13000	12441	11732	12353	11991	13927	16110	14927	23429	**1348**	**501.3**
Kaunas	18608	18153	16766	19453	15984	15627	15357	19570	28175	12843	15025	**-48**	**-19.3**
Klaipeda	9681	8714	13568	15950	17852	27015	20129	22364	22344	26362	17722	**1384**	**83.1**
Marijampole	52459	26586	33565	71551	32128	24254	30342	30809	35268	34632	29432	**-1465**	**-43.9**
Panevezys	17557	13476	22615	23614	14907	12422	16348	16092	25794	25776	25556	**774**	**45.6**
Siauliai	14443	10571	15107	18271	16733	19840	20921	20459	21044	19826	22202	**929**	**53.7**
Taurage	8599	5718	4436	5124	6921	2980	3274	5074	3973	7974	8979	**53**	**4.4**
Telsiai	3600	3638	5419	7683	8545	9626	8736	13214	19024	11464	10182	**1057**	**182.8**
Utena	5781	5390	7596	10300	6763	9241	10573	12206	13330	9890	16712	**886**	**189.1**
Vilnius	7573	4209	4805	6679	5814	4427	4340	8112	12174	14978	11825	**799**	**56.2**