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Integrated Risk Assessment: Case Study of Lithuanian Family Farms

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This study is designed to develop the tool for risk assessment under the integrated approach. Several problems are encountered while analyzing risk. The first one arises at the farm level – assessment of risk in the context of whole-farm rather than in a partial context, i.e. an integrated risk assessment tool is necessary. The second problem is related to the dynamic aspect when determining how the risk changes over time and what the main drivers of these changes are. All these problems are solved in the presented research, creating an integrated risk assessment index (IRAI) and testing it in Lithuanian family farms. This index assesses four types of risk: economic, financial, production, and political. The research methodology is developed to make sure that the data collected on the IRAI behavior is as diverse as possible. A model of IRAI variation by farm size illustrating risk evolution at the Lithuanian farms and, at the same time, enabling visual diversification of the dependence of integrated risk on farm size is developed. Hierarchical cluster analysis is applied for identification of the integrated risk evolution models. Assessment of the interaction between the IRAI and output and input using nonparametric Kruskal-Wallis test is used to find out whether the type of integrated risk is based on differential logic. IRAI was tested using official statistical data of 1300 family farms collected in 2004–2013 for institutional purposes. The testing revealed that the designed IRAI allows identifying types of farms by their risk evolvement profiles and the key risk (s) acting on the farm in the historical period. Four meaningful clusters representing the changing pattern of the risk are identified during the testing of IRAI: increasing risk farms; decreasing risk farms; relatively constant risk farms; varying risk farms. IRAI can be applied both for macro analysis (at a national, EU or other levels) and microanalysis (at the level of a single farm).

Keywords: *Risk; Integrated Assessment; Index; Risk Pattern; Family Farm.*

Introduction

Although some risk measurement tools such as VaR, standard deviation, beta have been developed, the gap in this research field still exists. VaR is based on the returns' standard deviation, while large and catastrophic events are extremely unlikely in a normal distribution. Risk is always considered to be negative using VaR. Moreover, it is an absolute measure. Standard deviation is focused on the entire risk distribution while beta measures only 30–40 % of risk, correlated with market portfolio, i.e. systemic. Risk assessment and management are complex processes, since risk emerges from different sources like an economy, environment, politics etc. That is why it is important to develop the tool for risk assessment under the integrated approach.

A family farm is generally understood to be a farm owned and/or operated by a family. It faces with the particular types of risk, mainly coming from natural factors (non-systemic risk), and, despite of relatively low price, responsiveness to supply and demand (systemic risk) causes output volatility in general. It is a risky business, and risk assessment and management tools have become increasingly important in recent years. In light of the diversity of risk sources, it is important to consider risk itself and farmer's attitudes towards it when planning farm production (Martins & Marques, 2007). In order to make a proper risk management decision, it is important to assess the risk under an integrated approach, i.e. taking into account all possible threats. There are a lot of types of risk, and, when seeking to control and managerisk, it is important to know its sources. The general term "risk" could be broken down into three main "actors": production risk, price risk and institutional risk (Hardaker *et al.,* 2007). Typically, according to the risk sources, risk is classified into production, economic, political, human, and financial.

Production risk is related to changes in plant yields and livestock productivity caused by the environment, animal diseases, technological innovations, etc. Economic risk is measured by the price movements of agricultural products, while political risk is reflected through the subsidization and taxation systems applied in the family farms as well as embargo and other governmental restrictions of commerce. Human risk is caused by the farmer's attitude towards risk, his or her education, age, experience, and other factors. Financial risk is measured as changes of payable interests which depend on capital structure and interest rate.

The first problem arises at farm level: assessment of risk in the whole-farm context rather than in a partial context, i.e. an integrated risk assessment tool is necessary. The second problem is related to the dynamic aspect when determining how the risk changes over time and what the main drivers of these changes are. Certain risks, such as possibility of a highly contagious animal disease or an environmental catastrophe, must be taken seriously (Kunreuther, 2002). Other risk such as decreased annual yield or productivity, temporary feed shortage, decreased market prices due to the additional supply, increased tax rate or decreased subsidies can usually be eliminated by a competent decision maker at a family farm. Despite the risk value, integrated risk assessment tool enables finding out the main factors and looking for management tools for risk reduction.

The difficulty of risk assessment at farm level arises in part because farms are often best modelled in a system context, i.e. in the whole-farm context rather than in a partial context (Hardaker & Lien, 2005). According to Pannell et al. (2000), a system view includes interacting dynamic, stochastic, biological, technical, financial and human factors. It should be noted that existing risk assessment methods – Value at Risk, standard deviation, beta coefficient – are applied in a partial context or enable measuring the variability of a particular farm's performance indicator. Various methods based on simulation, for example, quadratic risk programming (QRP) models, are used for production planning under the multi-criteria approach.

The present research is based on the holistic approach, considering risk measurement, dynamic aspect of the risk and factors influencing on the change of the risk over time. The purpose of this research is to develop integrated risk assessment tool and using this tool to assess risk in Lithuanian family farms.

The structure of the study is as follows. Section 1 presents the overview of existing risk measurement tools and their application. Section 2 presents the methodology, including sub-section 2.1 – sample and data, sub-section 2.2 – development of integrated risk assessment index, and sub-section 2.3 – verification of integrated risk assessment index. Section 3 deals with the empirical analysis, i.e. assessment of risk in Lithuanian family farms, and discussion of the main findings. The article is completed by presenting the conclusions and references.

Literature Review

One of the most popular risk assessment methods is Value at Risk (VaR). VaR is a statistical technique used to measure and quantify the level of risk within a firm or investment portfolio over a specific time frame. VaR is used by risk managers in order to measure and control the level of risk which the firm undertakes. The control must be targeted to ensure that risks are not taken beyond the level at which the firm can absorb the losses of a probable worst outcome. Though VaR can be used by farms, as other business entities, for measurement of their risk exposure, most often, it is used by banks to capture potential loss in the value of their traded portfolios. Three factors influence the usage of VaR in financial institutions (Damodaran, 2008). The first is that these institutions have limited capital. The second is that the assets held by financial institutions are primarily marketable securities, making it easier to break risk into market risk and compute VaR. Finally, the regulatory authorities demand regular reports on VaR exposure. Considering the possibilities of usage of VaR, as risk assessment tool, in the family farms, we have to put stress on some VaR limitations. First of all, in applying VaR, we assume that the multivariate return distribution is normal, since VaR is based on the returns' standard deviation, while large and catastrophic events, typical in agriculture and family farms as well, are extremely unlikely in a normal distribution, but occur sometimes. Second, history is not always a good predictor. Whereas VaR is based on historical data, time period examined can be volatile and VaR will be set too high. Third, use of VaR risk is always considered to be negative, i.e. downside. Fourth, VaR is computed over short-term periods, rather than longer ones. Finally, VaR is an absolute measure stated in terms of probability of the losses to exceed the specified value. According to Damodaran (2008), VaR is an inappropriate measure of risk for the firms which are focused on comparing investments with very different scales and returns; for these firms, more conventional scaled measures of risk (such as standard deviation or betas) that focus on the entire risk distribution will work better.

Ponti, Rijk & Ittersum (2012) have used standard deviation as the risk measure estimating the gap between conventional and organic systems. Beukes et al. (2005) calculated standard deviation to compare the risk affected by climate and price variability in a conventional, twice-a-day milking farm system with once-a-day milking and high-input systems. Wauters et al. (2011) compared individual risk-return profiles to a particular benchmark as well as evaluated risk-return profiles of conventional versus organic cropping systems. Fleege et al. (2004) investigated the performance of weather derivatives in managing risks of specialty crops in order to show how the farms can improve their net income distribution through the use of weather derivative strategies. Leblois & Quirion (2013) investigated agricultural insurances based on meteorological indices, and pointed out that the expected payout and the measures of the risk such as standard deviation and VaR can be calculated either by Monte Carlo simulations from the distribution or, in the case of simple distributions and indemnity schedules, analytically. Manfredo, Richards & McDermott (2003), using simulation methods, presented insight into how both traditional and innovative risk management practices influence the distribution of key financial variables for agricultural cooperatives. Nydene, Patrick & Baker (1999) have used standard deviation, coefficient of variation and Sharpe ratio for assessment of the effects of risk management strategies with diversified hog/crop production. Kobzar (2006) have applied a portfolio modelling approach in order to balance risk and return of alternative crop production plan under the assumption of normally distributed returns: mean and variance (standard deviation). The assumption is related to the decision maker's indifference to other characteristics: the level of asymmetry in distribution (skewness) and the measure of thickness (kurtosis). Zgajnar & Kavcic (2010) have used QRP model for measurement of efficiency of risk reduction on Slovenian livestock farms. QRP model is based on the original Markowitz formulation of the mean variance approach, whereby the objective is to minimize the total variance expressed as standard deviation.

In analysis of risk in family farms, it is useful to use an integrated approach because integrated risk assessment helps simultaneously identify threats caused by several types of risk, leading to an increased efficiency of economic decision-making. Integrated risk assessment leads to higher informative capacity; possibility of more accurate identification of losses and competitive advantage resulting from a more accurate assessment of the situation. Integrated risk assessment and its relevant interpretation contributes to achievement of desired performance results and minimisation of potential failures. Scientific literature typically focuses on integrated assessment of two risk types – credit and market risks – and limits the area of research to the banking sector.

In scientific papers, the issues of integrated risk assessment are verified by empirical research: 1) integrated assessment deals with two types of risk (market and credit risks) in the banking sector (Tanaka & Muromachi, 2003; Iscoe, Kreinin & Rosen, 1999; Medova & Smith, 2005; Dimakos *et al.,* 2004), and, due to the specific features of this sector, the research results can be useful for the banking sector only; 2) integrated assessment aims at measuring factors of one risk type arising from different sources (Greiving *et al.,* 2006; Bechmann, 2009; Zhang *et al,* 2016; Botti *et al.,* 2018; Iqbal *et al*., 2018; Severini *et al*, 2019), and the application of integrated assessment is limited to natural risks; 3) integrated assessment aims at determining the threats posed by natural hazard (Johnson, 2019; Wang et al., 2018; Lescesen *et al,* 2019; Wenda-Piesik *et al.,* 2016; Achieng Onyango *et al.,* 2016, Jia *et al.,* 2016; Naulin, 2015; Zhang *et al.,* 2017; Wang *et al.,* 2018), and application of integrated assessment is limited to production sector; 4) integrated assessment aims at evaluating optimization of project portfolio, which includes social, economic and environmental factors (Costa Dutra *et al.,* 2016).

Only few research works have analysed integrated risk assessment by integrating more than three types of risks into a single model. Toledo, Engler, Ahumada (2011) have developed an integrated risk assessment algorithm for specific regions in Chile. Researchers have used hierarchical holographic and expert evaluation methods to assess risk under the holistic approach. The main weakness of the model lies in its failure to take into consideration non-systematic risks of agribusiness entities. Su et al. (2011) have developed an integrated agricultural risk assessment model for farms. Hierarchical holographic method, fuzzy matrix, risk matrix methods were used for risk assessment. The main weakness of the model is that the calculations rely on a subjective opinion of the decision-maker in both defining the most dangerous risk factors and identifying their scope and likelihood.

A detailed analysis of the models of integrated risk assessment has revealed how an integrated assessment approach is applied to different risk types in agricultural entities, and it is essential to start from identification of the most important risk and risk factors.

With a strong emphasis on the principles and econometric focus, Just (2000) and Just & Pope (2001) have assessed the possibilities for research on risk of agricultural entities. According to Just (2000), averaging over farms (using aggregate data) distorts the distributional character of farm-level risk, and the author has therefore suggested focusing on decision making at the farm level rather than continuing to demonstrate points and methodology with aggregate data due to their availability.

Methodology

Sample and Data

Integrated risk assessment index has been developed and tested using the accounting data of family farms gathered by Lithuanian Agricultural Advisory Service. 1300 family farms on average submitted the accounting data to the Farm Accountancy Data Network (FADN) in Lithuania during 2003–2015. Selected farms cover all districts, natural zones and reflect different farming conditions. Lithuanian economic size threshold for FADN survey is 4 thousand Euro. For the experimental sample, annual data of 77 family farms during 2004–2013, i.e. 731 cases, have been used.

Integrated Risk Assessment Index

Integrated risk assessment index includes the following variables: sales revenue from crop and livestock production, variable costs of crop and livestock production, fixed costs, including depreciation expenses, taxes (excluding income tax) and subsidies related to income. Sales revenue from crop and livestock production is decomposed into crop yield and area, animal productivity and number, produced and sold quantities, and selling price. Production risk is related to variation of crop yield and area, animal productivity and number. These variables determine the volume of production.

The ratio of fixed to variable costs has increased recently due to the subsidies on investments in family farms. Agricultural business becomes more capital intensive and causes increase of systemic business risk. While changes volumes of production, depreciation expenses do not change and therefore increases profit variability. For this reason, it is reasonable to exclude depreciation costs from the fixed costs as a separate item.

Economic risk is caused by macroeconomic factors. This risk represents a major part of the systemic risk and associated with agricultural (crop and livestock) production sales volumes and selling prices, which are the components of sales revenue in the integrated risk assessment index. Most often declining supply, i.e. sales volume, increases market price, and vice versa. Nevertheless, when the competition increases, limited supply by natural conditions is compensated by the supply of other market entrants.

Political risk covers only the risk caused by the governmental decisions, i.e. subsidies and tax changes. Unlike the production and economic risk, political risk cannot be reduced by risk management tools.

Financial risk is only systemic by its nature and is caused by the ratio of fixed to variable financing costs. Fixed financing cost depends on the financial leverage and interest rates. This risk represents interest payable and is included in the integrated risk assessment index.

Integration of human risk in the index is complicated because of this risk measuring in monetary terms, and this risk is therefore not considered.

Integrated risk assessment index has the following form:

$$IRAI_i = \frac{(sr_i + s_i - c_i - t_i - i_i)^2}{(c_i + t_i + i_i)^2 - (sr_i + s_i)^2 + 1} \quad (1)$$

where sr_i represents sales revenue in year i; s_i is the subsidies related to income in year i; c_i is variable and fixed costs in year i; t_i is all taxes in year i; i_i is the interest payable in year i.

Sales revenue is the indicator of production and economic risk. Volumes of sales reflect production risk and selling prices – economic risk. Increase in sales revenue reduces the risk, and vice versa. Subsidies related to income as well as taxes are the indicators of political risk. The difference is that the relation between subsidies and risk is inverse, while relation between taxes and risk is direct. Variable and fixed costs (excluding payable interests) are the indicators of production risk. Increase in variable and fixed costs increases the risk, and vice versa. Interest payable is the indicator of financial risk. The relation between interest payable and risk is direct.

Integrated risk assessment index (IRAI) varies in the range $-1 \leq IRAI \leq 1$. The closer the index is to 1, the higher is the risk. The closer the index is to -1, the lower is the risk. Zero mean of the index not only indicates mathematical equilibrium between maximum risk and non-risk position, but also break-even point at which output covers input and profit equals zero.

The summarized formula of IRAI is following:

$$IRAI_i = \frac{(\sum output_i - \sum input_i)^2}{\sum input_i^2 - \sum output_i^2 + 1} \quad (2)$$

where $output_i$ includes sales revenue and subsidies related to income at a year *i*; $input_i$ includes variable and fixed costs, taxes and interest payable at a year *i*.

IRAI provides the opportunity to compare the risk of individual family farm to the average, highest and lowest risk in the family farms of the same type of farming and size. This index enables determining the change of risk over time, i.e. assessing the risk under the dynamic approach. This risk assessment tool helps identify the direction and scale of the impact of individual risk (production, economic, political and financial) on total risk. An appropriate risk reduction means can be chosen according to the direction and scale of the impact of individual risk on total risk.

Looking for the root factors which influence a risk level, Formula 1 can be expanded using the decomposition method. For example, sales revenue is decomposed into sales revenue from crop and livestock production, sales revenue from crop production decomposed into sales volumes and selling prices, variable costs – into raw materials, wages and salaries and other costs, fixed costs – into depreciation and other fixed costs.

IRAI can measure the risk of family farm or other business entity, the risk at the industry branch level in one state or compare the risk at the industry branch level between different states.

Verification of Integrated Risk Assessment Index

IRAI has been tested using data of family farms. Official statistical data collected for institutional purposes have been used for the research. Accuracy of these data is governed by the national laws. Only revised farm data have been used for the research, which has resulted in smaller scope, but, at the same time, has assured accuracy of the data. The research has been aimed at answering the question of what the ontological attributes of integrated risk are at the analysed farms. Consequently, collection of accurate data rather than the latest data on the research object has been sought.

It has been aimed at verifying whether the integrated risk assessment method is truly capable of registering variation of risk over time or not, and whether the integrated risk submits to the classification which are necessary for diversification of farms by their differences in risk characteristics. The risks which can be interpreted as potentially prevailing in the exploratory sample have also been identified.

The exploratory research has been selected due to high variability of the farms because of their size. This variation of an object requires extremely high confirmation sample volumes to achieve the required statistical significance. On the other hand, verification does not necessarily have to be performed under the epistemological tradition of research philosophy. It is possible to verify the object on the basis of the ontology. In this case, in contrast to the former approach, phenomenal properties of an object, conditions of their existence, essential principles determining existence of the object at a certain moment of time and under certain experimental conditions, etc.

In general, the research on an object could be broken down into three stages: object identification, description of the object and its properties, and study of its distribution in the population. The first two of the three stages listed above are more of a qualitative nature and could reasonably be associated with the tradition of exploratory research. Meanwhile, the third stage integrates both comprehensive learning of distribution of the object and quantitative learning of the scope of its mode of operation, and which is linked to the tradition of confirmation research.

An essential idea behind the research presented in this article is presentation of an object identification tool – IRAI – and demonstration of its capacity to differentiate the object by actual expression of the object properties in a real sample.

The research methodology has been developed to make sure that the data collected on the IRAI behaviour is as diverse as possible.

The following IRAI tests and assessments have been done:

- Analysis of the characteristics of integrated risk evolution at family farms by farm size is intended to indicate whether the index is actually capable of identifying the structural changes determined by differences in integrated risk evolution in specific groups of farms. As a result, a model of IRAI variation by farm size illustrating risk evolution at the Lithuanian farms and, at the same time, enabling visual diversification of the dependence of integrated risk on farm size has been developed.
- Typological modelling of long-term integrated risk of family farms. Hierarchical cluster analysis has been applied for identification of the integrated risk evolution models. 4-cluster model has been extracted. It demonstrate that the IRAI can be used grouping of farms by the long-term integrated risk evolution pattern observed at the farms. Hierarchical cluster has been selected for verification of an existence of a variety of statistical patterns in the farm integrated risk evolution scenarios. The Ward method used for hierarchical cluster analysis. The squared Euclidean

distance selected and the z standardization of the primary data has been performed before the application of the cluster analysis. This has enabled qualitative interpretation of the identified evolution patterns in the clusters.

– Assessment of the interaction between the IRAI and output and input (Nonparametric Kruskal-Wallis Test) has been used to find out whether the type of integrated risk is based on differential logic, and which is necessary in assessment of variation of such factors and output and input factors. The question has been on whether the same mathematical logic is maintained under natural conditions in the study group, in case the input decrease and the output increase the integrated risk. This test has been applied only as an auxiliary source of information.

Research Results and Discussions

Analysis of the characteristics of integrated risk evolution by farm size. The characteristics of integrated risk of farms have been analysed based on two properties: integrated risk (see axis y on Figure 1) and farm size variation (in hectares) in the period 2004–2013. Data on 731 farms that are collected as official statistics have been used for this research. Collection of used statistical data is governed by the Lithuanian laws.

An exploratory research has demonstrated that visually evident differences in integrated risk by farm size are present in the research sample. Figure 1 has shown that, in the period 2004–2013, the highest risk was mostly characteristic of 10 to 100 hectare farms. Moreover, the same graph suggests that there were two three-year growth cycles for integrated risk in the period 2004–2009, while the length of integrated risk cycles reduced to two years in the period 2010–2013.

Besides the results already mentioned above, the extra result could be identified. Collected data shows that despite the fact that the value of integrated risk has remained below zero throughout the period analysed the growth of integrated risk at the farms from the exploratory sample is quite obvious. This result has suggested that the designed integrated risk index indicates risk variation quite clearly and is sufficiently sensitive in identification of both structural variations of integrated risk and those becoming evident in a longitudinal perspective.

Assessment of the interaction between the IRAI, output and input. Kruskal-Wallis Test has been used to test hypothetically how the integrated risk is influenced by output and input. It has been found that both output and input have statistically significant interaction with integrated risk (Table 1).

As a result, it has proven in the research that an increase of the revenue at the exploratory farms being accompanied by reduction of integrated risk and an increase of the costs being accompanied by growing integrated risk (Table 2). This reasonably suggests that low risk could be associated with relatively high revenue and relatively low costs.

The conducted analysis suggests that the farm data collected as provided for by the laws are appropriate for calculation of the IRAI, and the data generated are appropriate for long-term statistical process monitoring and assessment of long-term variation of integrated risk at farms. This statement has proven to be true evidences once again that empirical properties of the integrated risk construct are in line with the theoretical ones.

Typological integrated risk modelling. Four meaningful clusters representing the changing pattern of the risk have been created in the course of analysis (Figures 2–6). One of them is the increasing risk farm type pattern, which accounts for 35 of 77 farms of the exploratory sample analysed (Figure 3).

The second type is the reducing risk farm pattern (Figure 4). There are seven farms in the sample. The exploratory sample of 77 farms does not allow for drawing a conclusion on actual distribution of integrated risk in the general sample, but the observed conditional prevalence of farms with increasing risk and the growth of integrated risk identified in the course of longitudinal research at the majority of farms from the exploratory samples enable raising the hypothesis on potentially positive risk pattern dynamics of the country's farms. It means that, in general, the risk pattern of the country's farms may possibly be growing. Any further reasonable statements in this respect require a prior full-scale research.

The third farm type identified as a relatively constant risk farm with temporary risk periods patterns. 22 farms of this type have been observed in the exploratory sample (Table 5).

Relatively constant risk farms are the farms that, compared to the population's mean, attain medium or lower risk values in the majority share of the observed time of evolution. In the case analysed, 22 farms had only one period which deviated by more than one standard deviation from the empirical mean. It could therefore be claimed that, in view of the eight periods characterizing the trivial mean of risk, these farms could be interpreted as the farms of unvarying risk with one temporary period of higher risk in 2009 (Figure 5).

Varying risk farms (see Figure 6) are the farms where at least three periods in a row maintain the same risk tendency, which is replaced with the reverse risk tendency of similar duration. This variation, if it does not cross the critical risk boundary in this particular case, is usually characteristic of the farms which have reached the stage of maturity cycle and are exposed to natural and economic evolvement cycles that adjust the risk in the specific period of development. Therefore, in future, such variation can be used as the indicator in identification of natural and economic cycles that demonstrates the effect of the factor on the risk and duration of its effect.

Conclusions

Although some risk measurement tools such as VaR, standard deviation, beta have been developed, the gap in this research field still exists. Risk emerges from different sources, so it is important to develop the tool for risk assessment under the integrated approach in order to manage it more efficiently. The designed IRAI provides integrated assessment of as many as four types of risk: economic, financial, production, and political. This index varies in the range $-1 \leq IRAI \leq 1$. The closer the index is to 1, the higher is the risk. The closer the index is to -1, the lower is the risk. Zero mean of the index not only indicates mathematical equilibrium between maximum risk and non-risk position, but also break-even point at which output covers input and profit equals zero.

The developed IRAI has been tested using data of family farms. They are operating in agricultural sector, and characterized by high risk profile, in particular, in view of its link to the natural environment, market instability. Although, in the recent years, the researchers have put considerable focus on risk assessment for agricultural entities, there is lack of holistic approach towards risk assessment in family farms. Integrated risk assessment helps identify the threats determined by different types of risk, leading to greater efficiency of the decisions adopted, better and more comprehensive understanding of the situation. Four meaningful clusters representing the changing pattern of the risk were identified during the testing of IRAI: increasing risk farms; reducing risk farms; relatively constant risk farms; varying risk farms.

To summarize the results of risk verification, the designed IRAI could be claimed to be capable of: (i) identifying the farm types by their risk evolvement patterns; (ii) enabling to identify the key risk(s) acting on the farm in the historical period; (iii) being applied to macro analysis (at a national and EU level) and micro analysis (at the level of a single farm).

IRAI can be used for risk assessment at any business entity, i.e. variables included in the index can be taken from Income Statements.

Limitations

There are two empirical research limitations. The first limitation concerns taxes: all taxes payable by family farms are included with exception of income tax because of the lack of the data. The second limitation is related with variable costs. According to the existing business accounting standards, these costs can be calculated as the cost of sales or as the cost of gross produce. The index should be constructed using the cost of sales, and accounting data at family farm level are available in the Income Statement. Accounting data of family farms for empirical research were used from the Lithuanian Agricultural Advisory Service, and they allow calculating only the cost of gross produce.

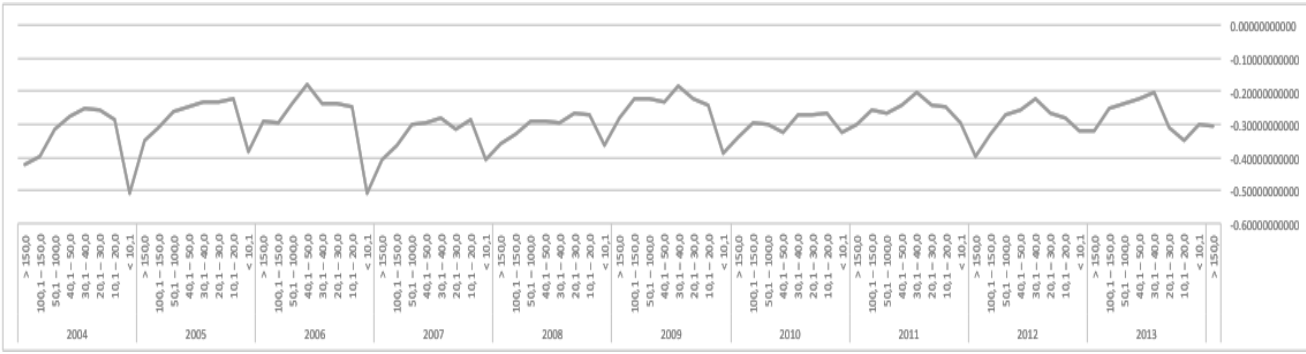

Figure 1. Model of Variation of IRAI by Farm Size (in hectares)
(y – Integrated Risk, x – Farm Size in Hectares, in the Period 2004 – 2013), N=731

Table 1

Test Statistics[a,b]

	Output (Sales revenue + subsidies)	Input (variable and fixed costs + taxes + interest payable)
Chi Square	16.331	23.402
df	2	2
Asymp. Sig.	.000	.000

a. The Kruskal-Wallis test; b. Grouping Variable: Risk

Table 2

Distribution of the Integrated Risk Rank Values

Risk		N	Rank_Avg
Output (Sales revenue + subsidies)	Low	225	351.77
	Medium	230	379.84
	High	235	305.89
	Total	690	
Input (variable and fixed costs + taxes + interest payable)	Low	208	278.11
	Medium	222	362.18
	High	229	345.94
	Total	659	

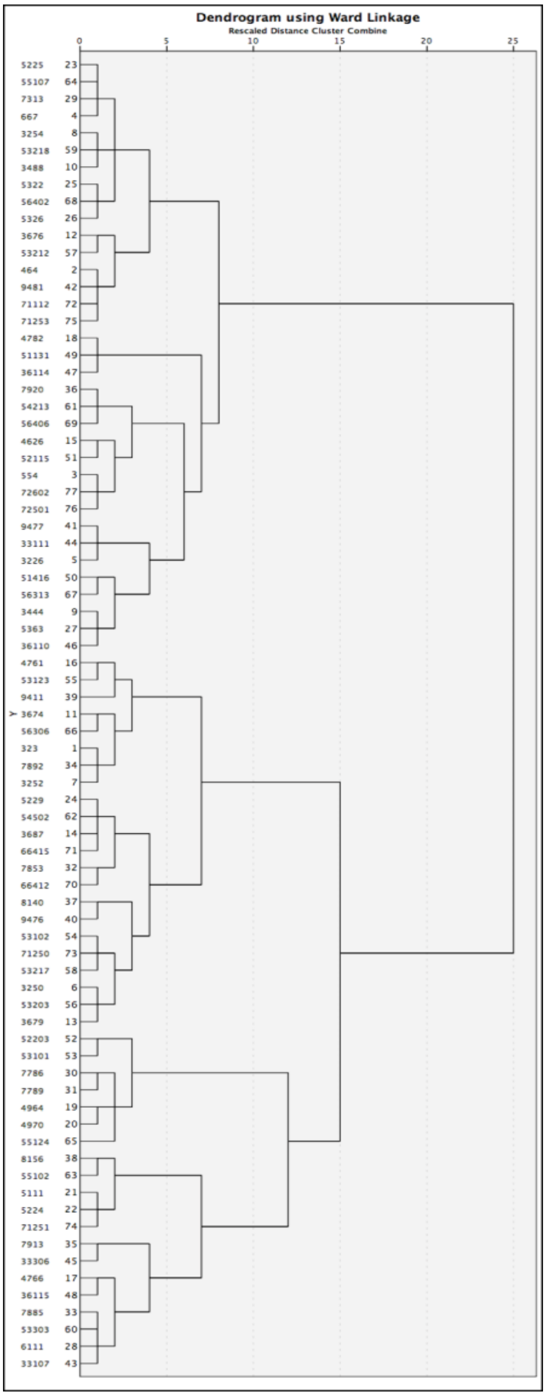

Figure 2. Distribution of the Analysed Farms According to the Model of IRAI, N=77

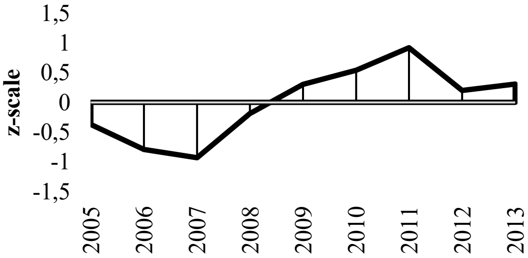

Figure 3. Increasing Risk Farm Pattern, n=35

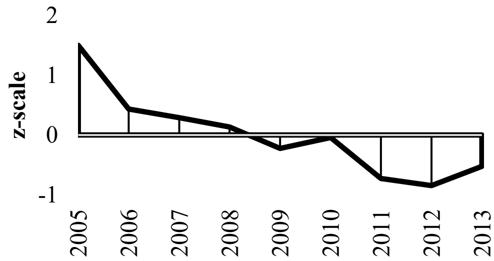

Figure 4. Reducing Risk Farm Pattern, n=7

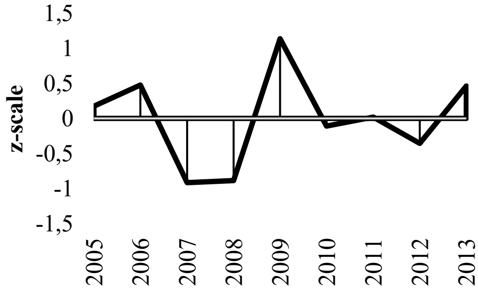

Figure 5. Relatively Constant Risk Farm Pattern, n=22

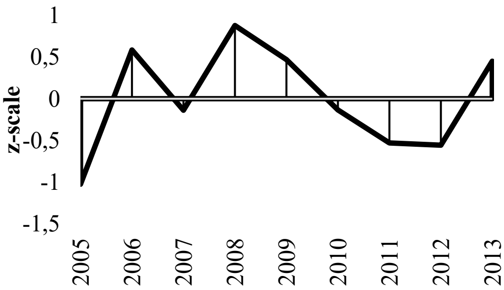

Figure 6. Varying Risk Farm Pattern, n=1

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