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The role of government in forming agricultural policy: economic resilience measuring index exploited

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Abstract: *EU member states economies are characterized by a high degree Government involvement into countries economy compared to some other Western states (Singapore, United States and etc.). There is a noticeable scientific thinking stating that too high Government involvement into the matters of its countries particular economic sector may bring adverse effects. It raises a scientific and practical problem: how to decide if Government should intervene into the particular economic sectors operations and when? In order to solve this issue, an economic resilience measuring index of agricultural sector was created. The agricultural sector consumes the biggest part of EU budget, acts as a main employer in rural regions of EU member states and is very susceptible to external perturbations, especially from the demand side, as supply cannot be timely adjusted to demand. Thus it was chosen as a target sector in our scientific research. In order to select the indicators for agricultural sector's economic resilience measuring index we conducted an expert survey. Based on an Analytic Hierarchy Process model the final set of indicators and their weights for an agricultural sector's resilience were established. The economic resilience index created in accordance to MCDM SAW method. A created index is appropriate in evaluating the resilience of agricultural sector in all open economies making it a versatile tool in a Government officials hands in order to decide the necessity of intervening actions into agricultural sector.*

Keywords: Economic resilience, Agricultural policy, Government, Analytic Hierarchy Process.

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Introduction

The common agricultural policy (CAP) is an exclusive area of policy in EU in general as well as in each member state. The CAP is financed by the EU budget, about 40 % of whole EU budget, which shows importance of ensuring the viability of the agriculture. Agricultural sector is additionally supported by national budgets; therefore the economic effectiveness of production and trade is directly addressed by every State administration in assessing the efficiency of agricultural support. As a reaction on a range of turbulences in the socio-economic environment (Russian embargo, e.g.), Government bodies of EU member states encourage the adoption of high quality management decisions based on objective considerations.

The necessity of researching an economic resilience of rural communities or economic sectors related with employment in rural areas (such as agricultural sector) was stressed in a broad specter of researches (Oliva, Lazzeretti, 2018; Moraes et. al., 2015; Gorb, 2017; Gorb et al., 2018; Greblikaite et al. 2017) showing an increased vulnerability of agricultural sector and its susceptibility to external perturbations compared to some more technologically advanced economic sectors. The new EU member states that are lacking behind the older member states in terms of technological development are more dependent on agricultural sector in keeping their rural regions economically viable. Nowadays, rural areas face lots of social problems, such as poverty, low social skills, internal migration from rural regions to cities, emigration and etc., and it lowers the social engagement.

The above mentioned issues create a natural concern of state's Government to have a sustainable and resilient agricultural sector. In this situation the state officials, responsible for the development of particular sectors of national/regional economy faces a dichotomy: should they maintain a significant Government's presence in an agricultural sector, or should they allow this economic system to develop itself quite independently, only monitoring its economic health in order to maintain its developmental path in a desired way. It becomes obvious, that Government officials need a multi-faceted versatile tool, which would help to monitor the vulnerability and resilience of particular economic sectors in order to decide, should it involve itself into the development of a particular economic sector taking some coordinative and preventive actions, or this sector is resistant, sustainable and able to withstand external pressures by itself, and Government's intervention is not needed.

The analysis of scientific papers revealed that although a number of methods on evaluating economic resilience have been proposed, there is gap in scientific methods when it comes for Government to measure the real necessity for intervention to strengthen the economic resilience of the state's agricultural sector. Thus the aim of the research is to create an assessment tool to measure that necessity levelfor Government to intervene in order to balance potential disruptions of economic resilience in agricultural sector. In order to achieve it, an economic resilience measuring index, which helps to evaluate the resilience level of state's agricultural sector, was created.

1. Literature review

The important to Governments decisionsresilience concept finds its roots in ecological literature, where two main streams of resilience studies have been introduced. The first direction was headed by Pimm (1984) focusing on the systems that are in a stable equilibrium point or close to it. In this case the resilience is being measured by the speed at which the system returns to equilibrium and is being called an engineering resilience. The other direction, proposed by Holling (1973), analyzes systems which are far away from a stable state. The main indicator of resilience here is the amount and size of external perturbations that can be absorbed before the system converges to another equilibrium state (ecological resilience) (Osth et al., 2015). The scientific literature also presents different interpretations and measurements of the resilience concept, which is being researched in economics (Martin, Sunley, 2015), disaster management (Paton & Johnston, 2017), sociology (Hall & Lamont, 2013), engineering and construction (Woods, 2015; Dinh et al., 2012), absorbing in its way such concepts as vulnerability and fragility. Despite the many disparate definitions of resilience which are being presented in ecological, economic, organizational behavior, engineering, they each identify a similar general conceptualization of rebounding after a disaster or shock event (Rose, 2017; Dormady et al., 2018), but unlike in other fields, the resilience in economics focuses not on the damage to property, which has already occurred, but on the minimization of its influence on the economic indicators. Thus, exogenous demand shocks may provide economic system an opportunity to choose a different developmental path.

The economic resilience, which helps Governments to more precisely decide on the conditions of one or another particular economic sectors of the country, has been researched from different points of view. Typically it is being studied trying to predict possible hazards to economic system, arising from the externally generated demand (Hill et al., 2008), supply (Ponomarov, Holcomb, 2009) and mixed-type (Galbusera, Giannopolos, 2018) shocks. Some scholars (Maler, 2008, Baumgartner, Strunz, 2014) treat economic resilience as some kind of insurance policy against possible switch of economic system to undesired evolutionary path. In this view economic resilience is being perceived as an additional good feature of an economic system, but not as a one of the objectives of an economic system, that has to be achieved.

In a recent past, economic resilience was understood as a manifestation of an economic success of particular economic system and was researched from four main fields: adaptability, ability to reach an optimal equilibrium from multiple choices and growth paths provided, convergence and flexibility (Christopherson et al., 2010). Some authors (Martin, 2012; Bastaminia et al., 2017; Ohanyan, Androniceanu, 2017) define an economic resilience as an economic success, which was achieved owning to: ability of economic system to recover from external shocks faster than other competing economic entities; voluntary complete and manifold reconstruction of economic entity in order to accept to growth paths; ability to resist external threats by either the economic power, internal dynamics, number of external connections, possession of unique resources and etc. In this approach to economic resilience, a system is being considered as having the capacity to absorb and adapt to significant exogenous shocks without remarkably transformingitself, or is capable of developing new instant social structures successfully (Bastaminia et al., 2017) that help to mitigate a possible severe damage to an economic system. Such an evolutionary approach, emphasizing the importance of social structures in the economic resilience broadens its perception and forces to include some social indicators in order to measure the economic resilience. The socio-economical point of view onto the phenomenon of economic resilience prevails also in Hallegatte (2014) research. In this study economic resilience serves as a social bumper, which dampers the external exogenous shocks mitigating it in order to minimize people‘s welfare losses caused by external perturbations. Such a role of a particular social shield, assigned to resilient economic system, assumes the price for such preventive measures, accepting the apprehension, that economic system being on a state of its optimal equilibrium from the efficiency and profitability point of view, may not be on the optimal equilibrium from the economic resilience perspective (Vasile, Androniceanu, 2018). Such a concept suggests that an economic resilience is a quite costly phenomenon and these costs should be accepted as unavoidable expenditures in order to maintain the desired growth path of an economic system. Such a concept of an economic resilience as a financial burden can be challenged from the systems theory perspective (Morkūnas et al., 2017), which postulates, what autopoietic economic systems adapt to exogenous perturbations and choose its desired growth path by using its inner resources and dynamic capability, so it is possible to find such an economic equilibrium in which all the indicators, measuring economic resilience is in its’ optimal state.

The recent trends in analyzing economic resilience (Martin, Sunley, 2015) produced an evolutionary adaptive scientific approach which can be used in order to definean economic resilience of a particular sector, that is, the capacity of a researched interconnected economic structure to resist external shocks and to recover from unexpected perturbations in a shortest possible time or to switch to more perspective long-term developmental growth path. This evolutionary view is based on the idea that economic resilience is perceived as a “dynamic process of robustness and adaptability, where the interdependence of space- and time-specific institutional, economic and historical elements influences the way local economies react to adverse events” (Di Caro, 2017). Such a dynamic nature of economic resilience has been exploited by Oliva, Lazzeretti (2018) stating, that economic resilience is a result of a preceding spontaneous choice of an evolutionary economic path, which has evolved into a researched phenomenon because of some external shocks. It leads to a Dormady et al. (2018) concept of adaptive dynamic economic resilience which defines the ability of an economic system experiencing sudden unexpected exogenous demand shock to devise new market mechanisms, what may not have previously existed, or to initiate new favorable national or supranational business support mechanisms and to benefit from it.

The economic resilience can be separated into inherited resilience which alludes to the routine and predicted capabilities of an economic system to deal with external threats (easy access to necessary resources, ability to substitute lost export markets by internal consumption for a period of time, change one import markets with another, substitute foreign loans with inner financial markets in the case of disruptions in financial flows, e.g. take all necessary actions in order to maintain its existing state) and adaptive resilience, which assumes the ability of economic system to maintain its operations during the effects of an exogenous shocks through learning, acquiring new skills and development encouraged by overall change. Adaptive resilience, as noticed by Bastaminia et al., (2017) extracts the experience from consequences of previous external perturbations, transforms it into new know-how and moves the thresholds of production efficiency further. It should be noted, that it does not necessarily require investment of additional financial capital.

2. Methodology

2.1 A selection of resilience indicators

Real and actual economic resilience is impossible to measure because it is a compound of everything that has an effect on the economy (Osth et al., 2015). Economic literature provides a vast number of economic indicators, measuring different components of economic resilience(Rivza, Kruzmetra, 2017; Filipishyna et al.,2018).They are being divided into three groups: economic, social and environmental-governmental (the latter one sometimes split into environmental and governmental groups). The most frequently used are (Briguglio, 2016; Chopra, Khanna, 2015; Angeon, Bates, 2015): the degree of economic openness, export concentration, debt level, fiscal deficit, import, export, international trade and GDP ratio, GDP, GNI, inoperability, dependency on import of strategic resources, tax revenues, inflation, market efficiency (all belonging to economic indicators group), literacy rate, literacy rate (gender difference), unemployment, qualifications, HDI, Gini, life expectancy at birth, school expenditure, health expenditure, (under the classification as social indicators), social governance, political stability and violence, bureaucracy (to measure it, and a government's negative influence on economic freedom, we have chosen an "easy of doing business" index), approval of environmental treaties, good governance (environmental-governmental group of indicators).

Some of above mentioned indicators are irrelevant in our survey (such as political stability, or rule of law) as we are creating a resilience measuring index for developed countries, which typically do not have problems with rule of law or political stability, so we dismissed it. Some other indicators duplicate each other or are a composite of other indicators. Like HDI, which contains life expectancy at birth, GNI, education level (which is a composite of literacy rate, school expenditure and etc.), so, if taking into account HDI, we dismiss its components from our survey.

Inoperability (Chopra, Khanna, 2015) we estimateby employingthe deviation from the desired growth path (Morkūnas et al., 2018) indicator. A Lithuanian case was taken as a base for validating our resilience measuring index, as it perfectly corresponds to all the requirements. It is a small open economy, therefore very susceptible to perturbations in World markets. Lithuania is totally dependent on strategic imports (fuel) to maintain its agricultural sector's operations. In Lithuania, agricultural sector employs about 9% of the whole workforce, so its viability is always on Government's agenda.

In order to choose the most important indicators for creating a resilience measuring index of agricultural sector, we conducted an expert interview, during it a pair wise comparison of economic indicators measuring resilience was accomplished using Analytic Hierarchy Process (AHP) model (Goepel, 2013). It helped to choose only the most important indicators, which should comprise a resilience measuring index. The number of experts, participated in our survey is 14. It is considered enough, as according Libby, Blashfield (1978) number, ofexperts, exceeding 7, guarantee a reliabilitylevelof 90%. To get more precise results, both linear (Saaty, 1980) and balanced (Salo, Hamalainen, 1997) scales were employed.

In AHP, selected experts evaluate the presented alternatives (economic indicators) to each other $\{\theta_1, \ldots, \theta_n\}$, by filling individual pairwise comparison matrices, what are obtained according formula:

$$\mathbf{P} = (\boldsymbol{p_{ij}})_{\boldsymbol{n}\times\boldsymbol{n}} \tag{1.1}$$

Here$p_{ij} = 1, \forall i = j$;($n$ = 1, 2, …,) − a priority vector

$$p_{ij} = \frac{1}{p_{ji}}, \forall i, j = 1, 2, \ldots, n. \tag{1.2}$$

After experts complete a pair wise comparison of the criteria presented, all responses (evaluations) are recorded in the form of standardized matrices, after which the arithmetic mean of all the rows is calculated. A priority rank of each expert has been obtained in such a way. After that, a procedure of consistency of matrices is being undertaken. Matrix is considered consistent, when

$$p_{ik} = p_{ij}p_{jk}, \forall i, j, k \tag{1.3}$$

and a priority vector exists, which satisfies the equation:

$$\text{w} = (\omega_1, \ldots, \omega_n), \text{ here:} p_{ij} = {}^{\omega_i}/_{\omega_j}, \forall i, j. \tag{1.4}$$

After that, the consistency index (CI) of each standardized matrix is being calculated. In order to obtain CI, an eigenvalue (λ_{max}) of each standardized matrix is calculated using formula:

$$\lambda_{max} = \sum_{j=1}^{n} \frac{(P\cdot\nu)_j}{n\cdot\nu_j}. \qquad (1.5)$$

Here λ_{max} –the largest eigenvalue of each research standardized matrix; n – number of independent rows in matrix; ν_j – eigenvalue of a matrix.

An expert comparison matrix A is considered absolutely consistent when, $\lambda_{max} = n$, although in real world it happens very rarely. In the case of small p_{ij} changes, matrix A satisfies the pre-selected compatibility condition (in this case 0.2 is selected), the λ_{max} value becomes close to n.

After calculating the eigenvalue λ_{max}, the CI is being calculated using formula:

$$\boldsymbol{CI} = \frac{\boldsymbol{\lambda_{max} - n}}{\boldsymbol{n-1}}. \qquad (1.6)$$

Here n – number of possible alternatives.

If CI meets the pre-selected compatibility condition (our case -0.2), the aggregated expert evaluation is being calculated using formula (Dong et al., 2015):

$$p_{ij}^{P} = \sqrt[n]{p_{ij}^{1} \times p_{ij}^{2} \times \ldots \times p_{ij}^{n}} \qquad (1.7)$$

Here p_{ij}^{A} –aggregated evaluation of element, belonging to i row and j-column;

n – number of matrices of the pair wise comparison of each expert.

After a new aggregated matrixes have been obtain, again a consistency validation procedure is being performed. If matrix is consistent, then preferred ranks of alternatives have been calculated using formula (Franek, Cresta, 2014):

$$\omega_j = \frac{\sqrt[i]{\prod_{j=1}^{i} \boldsymbol{p_{ij}^{P}}}}{\sum_{j=1}^{i} \sqrt[i]{\prod_{j=1}^{i} \boldsymbol{p_{ij}^{P}}}}. \qquad (1.8)$$

Here ω_j – weight of alternative j.

In order to check, if the expert opinions are consistent and valid, and they really reflect the true picture, the Goepel (2013) index of expert mutual agreement (S*) has been calculated:

$$S^* = \frac{{}^{1}\!/_{\exp(H_\beta)} - {}^{\exp(H_{\alpha\min})}\!/_{\exp(H_{\gamma\max})}}{1 - {}^{\exp(H_{\alpha\min})}\!/_{\exp(H_{\gamma\max})}}. \quad (1.9)$$

Here H_α −Shannon alpha diversity; H_β −Shannon beta diversity; H_γ −Shannon gamma diversity.

Goepel's index is varying between 0 and 100% and shows the agreement level of the experts involved.

As the number of possible resilience indicators is higher than 10 (the maximum number of alternatives possible in AHP), we repeated oursurvey four times, knocking out the indicators considered the least important in a previous surveys. The highest rated indicators were pairwise compared to each other once again in order to get the clear and undisputable results.

2.2.The computation of economic resilience measuring index

After completing calculations, we found, that the most important indicators in measuring the economic resilience of an agricultural sector are: inoperability, dependency on strategic imports (in our case – a fuel, as Lithuania is an energy importing country, which depends on oil import by 100%), marketefficiencylevel, debt level, export concentration, economic openness (all belonging to the group of economic indicators) level of qualification of decision makers, bureaucratic control of economy (belonging to indicators measuring the level of political governance), HDI and social governance (belonging to social indicators).

The detailed selection of the indicators was performed on the basis of an expert survey, taking into account the weights ((ω_n) – eigenvalue (normalized scale)) determined by the AHP method, according to the formula:

$$\omega_n = \frac{\omega_b + \omega_c}{2}. \quad (1.10)$$

Here ω_b – eigenvalue balanced scale; ω_b – eigenvalue classical scale.In this way, 10 economicresilience of agriculture indicators were subtracted (Table 1).

Table 1. Agricultural resilienceindicators and their weights determined by the AHP method.

No.	Indicator	ω_n	ω_c	ω_b
1	Inoperability	0.150	0.160	0.140
2	Dependency on strategic imports	0.142	0.145	0.138
3	Market efficiency level	0.133	0.136	0.130
4	Debt level	0.127	0.137	0.118
5	Export concentration	0.109	0.115	0.104
6	Level of qualification of decision makers	0.094	0.088	0.100
7	Bureaucratic control	0.069	0.065	0.073
8	Human Development Index	0.064	0.057	0.072
9	Social governance	0.057	0.049	0.065
10	The degree of economic openness	0.055	0.049	0.061

(*Source*: compiled by authors, 2018)

Inoperability indicator is described by volatility of revenues. This indicator takes into account the past external shocks, experienced by agricultural sector. It shows the deviation of revenues from the desired sustainable trend, calculated taking into account the growing productivity, labor costs and managerial abilities of agricultural sector. In essence, the positive deviation of revenues from the trend may seem desirable, it is not a positive thing from resilience point of view, as on a longer run it increases risks, as it becomes harder to plan a new investment in production capacities and increasing the chance of overinvestment, which may lead to higher fixed costs or, even, insolvency. A trend was based on 2006–2016 fluctuations of revenues in Lithuanian agricultural sector. As revenue indicator is not so commonly used in analyzing agricultural economy (Kelly, Grada, 2013; Galnaitytė et al., 2017), it was changed to an affiliated indicator – volatility of output of the agricultural 'industry' (V_{oai}).

The second selected indicator by importance according to the weight size is the dependency on strategic imports (D_{si}). This indicator shows the economic sector's dependence on strategic imports. One of the most commonly used strategic imports commodity (Briguglio, 2003) is fuel. Agricultural sector is not an exception. EU agriculture uses dyed fuels in agriculture, as in some countries it is required by law to dye a low-tax fuel to deter its use in applications intended for higher-taxed ones. It is commonly used in farms especially for agricultural machinery. Countries that do not have their own fuel resources are wholly dependent on imports, and those that have may be fully independent or partly dependent. The D_{si} indicator is calculated on the basis of 1 utilized agricultural area (UAA), according to the formula:

$$D_{si} = \frac{C_{Fag} - Y_{Fag}}{A}. \quad (1.11)$$

Here C_{Fag} – consumption of dyed fuel in agricultural activities (in liters); Y_{Fag} – the amount of fuel produced in the country (in liters); A – utilized agricultural area of a country (in hectares).

The third by importance economic resilience indicator in agriculture is market efficiency level (M_{el}). The indicator explains the selected countries trade of agricultural products efficiency and risk, i.e. whether sales are taking place diversified or targeting exports to several or one country. Herfindahl-Hirschman Index (HHI) (Cristea, 2011) is commonly used to describe this indicator.It is defined as the sum of the squares of the market shares of the firms within the industry, where the market shares are expressed as fractions. The result is proportional to the average market share, weighted by market share. In our case it is calculated by formula:

$$H_i = \sum_{i=1}^{N} c_i^2 \qquad (1.12)$$

Where c_i is the market share of country i in the market and N is the number of countries to which agricultural products are exporting by the analyzed country. It should be noted, that the higher is HHI, the less effective is the researched market, as market players, having bigger market share transforms it into market power, which allows them to infringe the rights of a smaller market players. So in our resilience measuring index we use market efficiency level (M_{el}).

Market efficiency level (M_{el}) is a normalizedHerfindahl index. Whereas the Herfindahl index ranges from 1/N to one, the normalized Herfindahl index ranges from 0 to 1. It is computed as:

$$\begin{cases} M_{el} = H^* = \frac{(H-\frac{1}{N})}{1-1/N}, for\ N > 1; \\ M_{el} = H^* = 1, for\ N = 1. \end{cases} \qquad (1.13)$$

Another indicator of economic resilience inagricultureis debt level (D_l). The debt level shows how an insolvency of farmers and agricultural companies. The importance of such indicator can be described in the sense that economic vulnerability and dependence are lower at a lower debt level. The level of the debt can be calculated by the amount of liabilities per 1 ha. This indicator is calculated using the FADN database, where all liabilities (long, medium and short-term loans) are divided by total UAA hectares.

The fifth by value economicresilience of agricultureindicator is export concentration (E_c) (Sapkota et al., 2018). This indicator by its nature is very close to the M_{el} indicator. However, in this case, the amounts of different exported goods are the examined objects, i.e. whether a selected country differentiates its exports, or tends to trade in one type of product. The Herfindahl-Hirschman Index principle is used for this indicator construction. However in this case c_i (see formulas 1.3 and 1.4) is the market share of agricultural product type i in the market and N is the number of agricultural product types, exported by the analyzed country.

The next five indicators have less impact on economicresilience based on the expert survey results. Level of qualification of decision makers (Q_{dm}) (see table 1) is an indicator showing the intellectual potential of agricultural sector to resist the external perturbations, or to quickly and flexibly find a new innovative solutions in order to minimize the adverse effects of exogenous demand shocks. This indicator is quite important as higher education allows for more weighted and rational decisions (Bok, 2003). This indicator reflects the share (%) of persons, who are CEO's of agricultural companies, head's of a farms, heads of various associations in agricultural sector or other persons, having influence on decision-making (without government bodies, etc.), with higher education.

In the case of expert surveys, the indicator of bureaucratic control (B_c) was also one of the more significant among the last five. The indicator shows control through the establishment of a comprehensive system of rules and procedures for directing actions or behaviors of divisions, functions, and individuals (Williamson, 1975). However, in some cases, control may not be well organized and, moreover, can be an obstacle rather than an incentive to build, expand business. The Ease of Doing Business index was used to measure this indicator (Schueth, 2015). Ease of doing business is an index published by the World Bank. It is an aggregate figure that includes different parameters which define the ease of doing business in a country (Ohanyan, Androniceanu, 2017).

Human Development Index, social governance and the degree of economic openness were the last three indicators to valuate economic resilience of agricultural sector (incl. industries) that were selected during the research. The Human Development Index (H_{DI}) is a statistic composite index of life expectancy, education, and per capita income indicators, which are used to rank countries into four tiers of human development. The H_{DI} is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living. A country scores a higher HDI when the lifespan is higher, the education level is higher, and the GDP per capita is higher (Majerova, Nevima, 2017; Vasile, Androniceanu, 2018).

Social governance (G_s) is seen as representing interests in making a variety of decisions in shaping national agrarian policy (Shucksmith, 2010). This indicator is characterized by the total number of agricultural sector associations, non-governmental organizations, confederations, councils and assesses its change over the period under review in selected country. The higher number of actors in the reference year, the bigger value of G_s, the better represented interests, what leads to agricultural sector being more resilient.

The last economicresilience indicator on the final list as provided in table 1 is the degree of economic openness (O_{de}) in agriculture (incl. industries). As trade theory provides, that a closed economy is an economy that does not interact at all with other economies, which does not establish any exchange. However, there are different degrees of openness, depending on the restrictions that the country imposes on free trade. A common basic measure of an economy's degree of openness is the percentage that the sum of exports and imports represents over the gross domestic product. According to the research field, O_{de}calculations were adapted to theagricultural sector and evaluated by formula:

$$O_{di} = \frac{X_{ag} + M_{ag}}{GVA_{ag}}. \qquad (1.14)$$

Here X_{ag} – sum of exports of agricultural goods in selected country; M_{ag} – sum of imports agricultural goods in selected country; GVA_{ag} – gross value added in agriculture in selected country.

The interpretation of the Openness Index is: the higher the index the larger the influence of trade on domestic activities and the stronger that country's economy.

According to AHP results 10 described indicators (V_{oai}; D_{si}; M_{el}; D_l; E_c; Q_{dm}; B_c; H_{DI}; G_s; O_{de}) are influencing economic resilience of Lithuanian agriculture sector. To sum them up and create a measurement in the form of a resilience index of Lithuanian agriculture sector, SAW (Simple Additive Weighting) method was employed.

In order to calculate SAW method (S_j) values of economic (incl. industries) resilience in agriculture, the values of selected indicators were normalized. Maximizing indicators values were normalized by formula (Hwang& Yoon, 1981):

$$\overline{r_{ij}} = \frac{r_{ij}}{\max_j r_{ij}} \qquad (1.15)$$

Conversion of minimized metrics into maximizes was made by formula (Hwang& Yoon, 1981):

$$\overline{r_{ij}} = \frac{\min_j r_{ij}}{r_{ij}} \qquad (1.16)$$

Here r_{ij} is the value of the i^{th} indicator for the j-object (in our case – year). $\max_j r_{ij}$ – the maximum value of the i^{th} indicator of all the alternatives (years), $\min_j r_{ij}$ – the lowest value of the i^{th} indicator.

In order to calculate normalized values of V_{oai} indicator, when best value is 0, the following transformation was made (Morkūnas et al., 2018):

$$\overline{r_{ij}} = \begin{cases} 1 + r_{ij}, if\, r_{ij} \leq 0 \\ 1 - r_{ij}, if\, r_{ij} > 0 \end{cases} \qquad (1.17)$$

The sum S_j of the normalized values weighted for all indicators is calculated for each year by formula:

$$S_j = \sum_{i=1}^{m} \omega_{ni} \tilde{r}_{ij} \qquad (1.18)$$

The assessment of the economic resilience of the agricultural sector was carried out in an empirical manner in the conditions of Lithuania for 2006–2016. The 11-year time series was selected according to an availability of data, the Eurostat database, FADN, World Bank and national statistics.

3. Empirical findings

In assessing the level of economic resilience inLithuanian agricultural sector (incl. industries) in 2006 – 2016 and in order to determine the selected data suitability, a correlation analysis of the selected indicators, presented and described in methodological part, variables was performed (table 2).

Table 2. Correlation matrix of selected indicators

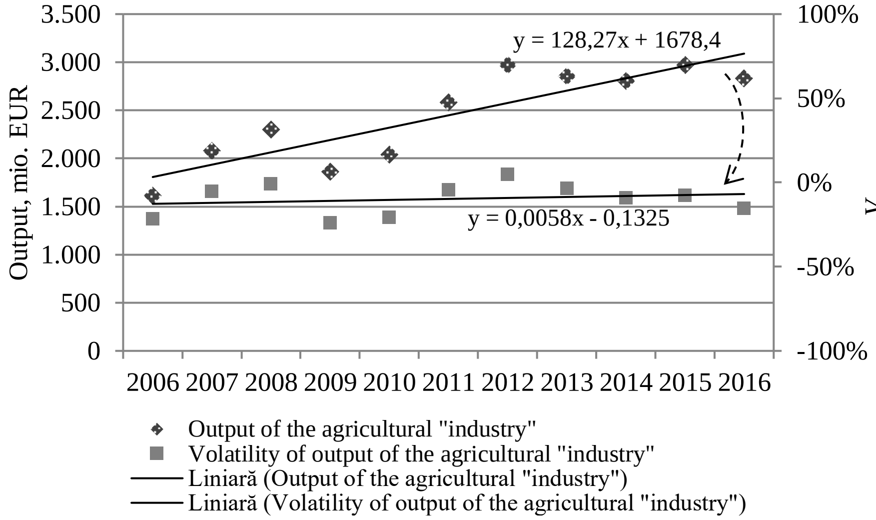
	O_{de}	D_l	H_{DI}	E_c	V_{oai}	B_c	M_{el}	G_s	D_{si}	Q_{dm}
O_{de}	1	-	-	-	-	-	-	-	-	-
D_l	0,78	1	-	-	-	-	-	-	-	-
H_{DI}	0,62	0,61	1	-	-	-	-	-	-	-
E_c	-0,71	-0,60	-0,36	1	-	-	-	-	-	-
V_{oai}	0,00	-0,13	0,23	0,17	1	-	-	-	-	-
B_c	0,49	0,35	-0,08	-0,52	0,19	1	-	-	-	-
M_{el}	-0,37	-0,54	-0,77	0,37	0,31	0,27	1	-	-	-
G_s	-0,65	-0,46	-0,90	0,46	-0,05	0,05	0,81	1	-	-
D_{si}	0,85	0,73	0,90	-0,53	0,31	0,25	-0,56	-0,82	1	-
Q_{dm}	0,73	0,67	0,94	-0,57	0,17	0,10	-0,74	-0,91	0,93	1

(*Source*: compiled by authors, 2018)

The table shows that some indicators variables (comparing 2006-2016 arrays) have a strong correlation. However, there is no direct relationship between such indicators as H_{DI} and G_s, D_{si}, Q_{dm}, as well as among other indicators with a correlation value ≥ | 0.85 |. Thus all selected indicators were evaluated in order to determine the economic resilience of the agricultural sector in Lithuania.

According to Morkūnas et.al (2018) assessing the tendency of V_{oai} from the prognostic calculated Lithuanian agricultural industry growth path, which in 2006–2016 is equal to 128.27x + 1678.4. Fig 1 shows, that there is no significant fluctuation, which indicates that in Lithuanian agriculture V_{oai} is reasonably well-balanced.

Figure 1. The output of the agricultural 'industry' and its volatility (V_{oai}) in 2006–2016



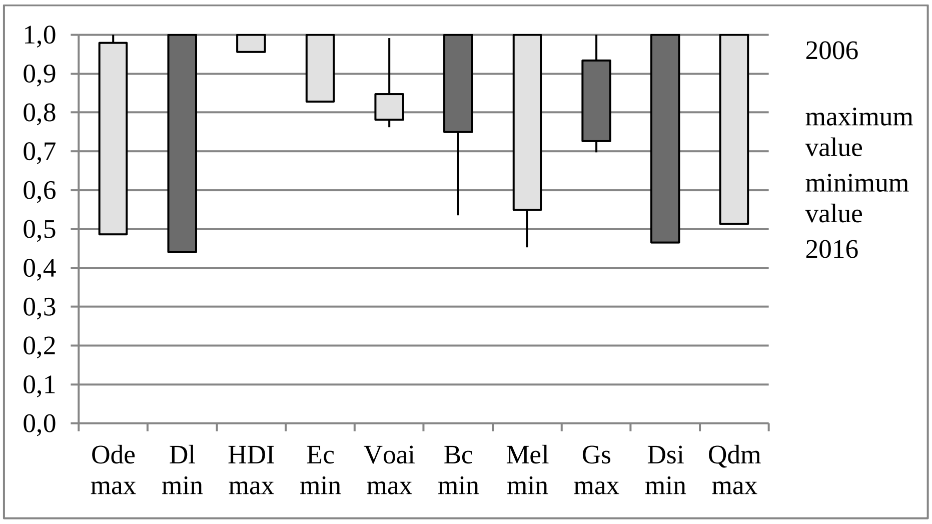
(*Source*: compiled by authors based on Eurostat, 2018)

The transformed rates rotate around trend line y =0.0058x-0.1325, the greater the distance of which shows a stronger fluctuation in comparison to the theoretical norm.

The transformation of this indicator allows the completion of the normalization of the selected indicators, as indicated in the methodology.

Normalized indicators are characterized by their impact on the resilience of the Lithuanian agrarian sector: *max* – maximizing indicators, i.e. higher value has a positive effect on the agricultural sector‘s economic resilience index; *min* – minimizing indicators, i.e. the lower value has a greater positive effect on the index. Fig. 2 shows the normalized values for all 10 selected indicators (V_{oai}; D_{si}; M_{el}; D_l; E_c; Q_{dm}; B_c; H_{DI}; G_s; O_{de}), i.e. values at the beginning and end of the 2006–2016 time series (at 2006, 2016, the maximum and minimum values of the period).In the case where the minimum and maximum values of the indicators coincide with the tails of the time series, there are only two displayed values of the column. This is precisely what happened with D_l, H_{di}, E_c, D_{si} and Q_{dm}.For indicators such as O_{de}, B_c, and M_{el}, only one of the values of the indicator coincided with the tails of the time-series, while the minimum and maximum values of the remaining indicators were in the middle of the time-series (Fig. 2).

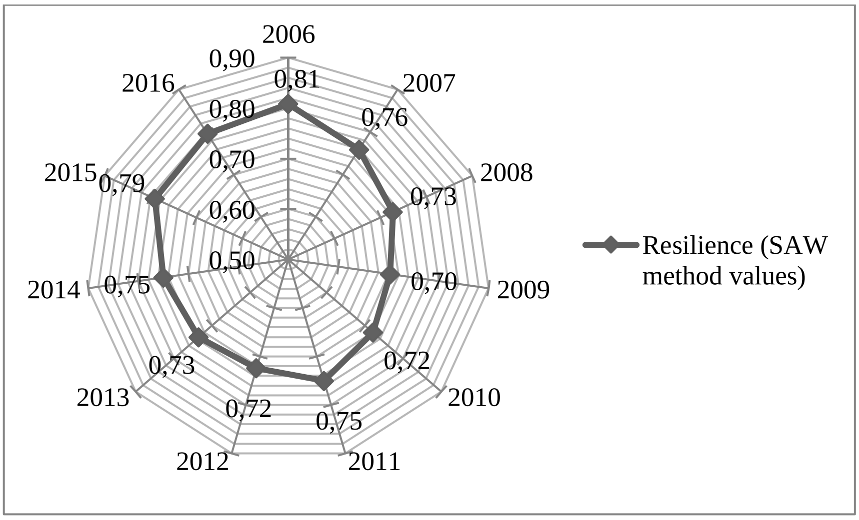
Figure 2. Extreme and time-series tail values of normalized indicators



(*Source*: compiled by authors, 2018)

It is important to pay attention to the characteristics of the values of all normalized indicators. The values of the normalized indicators cover the range from 0.4 to 1 and this is very important, because there are no insignificant indicators that would be ignored when determining the economic resilience index of Lithuanian agriculture.

Figure 3. Values of agricultural sector's resilience in 2006–2016



(*Source*: compiled by authors, 2018)

The values of the Lithuanian agricultural sector index of economic resilience show that the highest index value was achieved in 2006 (0.81). Since then and till crisis of 2009, values of resilience index has been decreasing, mainly due to market efficiency level (M_{el}); social governance (G_s) and level of qualification of decision makers (Q_{dm}).The lowest value was observed in crisis year of 2009 (0.70), 13.3% lower than the highest (2006) per 2006–2016 period.Thereafter, in 2010–2016, there can be observed a tendency of increase of economic resilience index values with some fluctuations. In particular, the situation has been improved since 2015, which was influenced by market and product diversification after the Ukrainian crisis and Russian import ban.

More detailed analysis of the dynamics of the change of individual indicators‘ values (comparing the average values of the indicators for 2006–2010 with the average values for the period 2011–2016), allowed to determine the positive and negative impacts of the individual indicator on the composite index at different levels (less than 10%), medium (10% to 30%) and strong (30% to 50%). Table 3 shows that the majority of indicators (O_{de}; H_{DI}; E_c; V_{oai}; M_{el}; Q_{dm}) have contributed positively to the economic resilience of the Lithuanian agricultural sector.

Table 3. Change in the value of the indicator and the level of impact on economicresilience in Lithuanian agricultural sector per 2006–2016

No.	Impact / Indicators	Positive impact			Negative Impact		
		>10%	10%-30%	30%-50%	>10%	10%-30%	30%-50%
1.	O_{de}			■			
2.	D_l					■	
3.	H_{DI}	■					
4.	E_c	■					
5.	V_{oai}	■					
6.	B_c					■	
7.	M_{el}		■				
8.	G_s					■	
9.	D_{si}						■
10.	Q_{dm}			■			

(*Source*: compiled by authors, 2018)

However, it is important to focus on indicators with a negative impact. First of all, it is the debt level. The opportunity to take advantage of the CAP's rural development program has opened the way for farmers to borrow more, which is also determined by the higher costs of investment in agricultural machinery. Although the indicator shows a higher risk, the activity itself is positive because it creates more efficient agriculture.

Bureaucratic control level, measured by the ease of doing business indicator, has also recently deteriorated and resulted in a very modest increase in the value of the economic resilience index in Lithuanian agriculture. Moreover, of particular importance is the increased dependency on strategic imports (more than doubled 2016 compared to 2006). On the one hand, this reflects a viable sector of the economy, while the other is a poorly assessed potential threat to both revenue and overall economic resilience of the sector.

4. Conclusions

The multidimensional nature of an economic resilience concept demands an interdisciplinary approach covering not only economical, but also social and political components, some of which is quite hard to measure. Putting emphasis on an economical point of view, we created a resilience measuring index, which is suitable for measuring resilience index of small open economy, where the agricultural sector plays an important role in a whole countries/region's economy. It is suitable for a measuring resilience of agricultural sector of quite similar developed states, for evaluating the effectiveness of Government decisions, aimed at increasing the economic viability of rural regions or the agricultural sector of a country/region, but should be applied with care to countries/regions, whose rule of law, technological development, civic participation in a decision making processes are on a noticeably different level.

Quite a low level of interconnectedness in agrarian sector serves as a basis for high index of economic resilience by itself. If there is a strong exogenous demand shock in one particular sphere (ex. growing of potatoes) it typically is not taking a cascading and aggravating nature of exogenous shocks, typical to financial sector of economy, those level of interconnectedness both to other sectors of national economy and to worlds financial system is much higher and the network of connections is more dense. The agricultural sector, owing its underdevelopment compared to financial or IT services becomes more resilient at the cost of its effectiveness in terms on return on investment. Such a revealed advantage of countries agricultural sector can help it to become a "safe haven" for investor's, searching more conservative and less risky options for investment, capital. It would lead to accumulation of financial capital in countries agricultural sector, leading to technological progress, diversification and, with a high probability, to building of a new connections, more firmly bonding the agricultural sector to other sectors of national/world's economy, leading to its higher susceptibility to external perturbations and lowering resilience.

Values of Lithuanian agricultural resilience index clearly reflect the outcomes experienced of Lithuanian economy caused by the World's financial crisis and worsening trade relations between Russia and Lithuania because of latter's support of Ukraine in its dispute with Russia over Crimea. The resilience index emphasizes the multidimensional nature of the World crisis, which lowered the values of the economic resilience index of Lithuania, but also reveals that narrow, one sided demand shocks, implemented by one of the export markets (in our case – Russia) are hampered by the resilient economic system and do not have serious adverse effects as they do not influence the chosen growth path of an economic system. These findings allow us to qualify Lithuanian agricultural sector as having a high passive economic resilience capacity.

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