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THE COMPARISON OF ENTREPRENEURSHIP ABILITY OF DAIRY FARMS IN LITHUANIA, LATVIA, ESTONIA AND POLAND

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According to the agricultural Census data, dairy farms with less than 20 cows (small-scale dairy farms) have the biggest share of dairy farms structure in Lithuania, Latvia, Estonia and Poland. It leads to the importance of entrepreneurship ability evaluation in small-scale farms among these countries. However, there are no researches about comparison of entrepreneurship ability of small-scale farms among mentioned countries. The article investigates a comparison of the farmers' entrepreneurship ability in small-scale dairy farms in mentioned countries by using distribution terms. The aim of the article is to perform calculations of small-scale dairy farms' entrepreneurship ability for each country, give comparison analysis of the data among countries and estimate fitted distributions of entrepreneurship ability for further modelling purposes. The entrepreneurship ability and fitted distributions are evaluated by using optimization methods. The complex comparison method is also provided to show the general situation of the dairy farms in the selected countries. The results of the investigation show that Poland takes relatively the best position in the dairy farms' economy. Latvia and Estonia take up relatively weaker positions. The calculation of the entrepreneurship indicators for each country shows that Estonian farmers have the highest entrepreneurship ability level. Two third of Estonian small-scale dairy farms' correspond the entrepreneurship of 0.8 and a higher level. Latvian, Lithuanian and Polish dairy farms' owners have similar average entrepreneurship ability (0.6–0.7) with different standard deviations. The best fitted distributions for all countries are normal and truncated normal distributions.

Keywords: complex comparison, distribution, entrepreneurship, optimization, small-scale dairy farm.
JEL codes: C44, Q12, L26, R51.

1. Introduction

Milk production in Lithuania, Latvia, Estonia and Poland is one of the most developed agricultural sectors with its share of 15–29% in Gross Agricultural Output (GAO) in the period 2010–2012. The biggest share of milk production in this period was in Estonia (24–29% of GAO) (Stalgiene, 2014; Malak-Rawlikowska, 2014). The population of dairy cows has decreased while productivity has increased. A large

decrease in the number (especially small ones) of dairy farms and cows shows the restructuring process of the dairy sector in all these countries. One of the major problems of the dairy sectors in these countries is the dispersion of milk production (Skarzynska, 2013). According to the agricultural Census (2010) data, farms with dairy cows less than 20 units had the biggest share. This share in Lithuania was 97%, in Latvia – 95%, in Poland – 93%, and in Estonia – 84%. In this research such farms are called the small-scale ones. This characteristic of small farms, therefore, can potentially generate different rules in the decision making process compared to large farms in order to maximize output. Thus, the traditional approach of evaluating entrepreneurial performance cannot be applied in case of small-scale farms (Salim, 2005). The assessment of the economic situation and the entrepreneurship ability of dairy farms in Lithuania, Latvia, Estonia and Poland was carried out evaluating farms in which milk production was the dominant element as a sample. The provisions of the Community Typology of Agricultural Holdings classify these farms as specializing in milk production. The data of Farm Accountancy Data Network (FADN) was used in mentioned countries.

The entrepreneurship of the rural residents and farmers was investigated by A. Stalgienė (2013), J. Ramanauskienė (2012), A. Astromskienė (2012), S. Navasaitienė (2012), A. Astromskienė (2011), R. Adamonienė (2008), P. Markevičius (2006) and T. Lans (2009). The entrepreneurship ability indicator for Lithuanian dairy farms was evaluated by A. Jedik (2013). The problem is that there are no such investigations and comparison done of farmer's entrepreneurship among few countries. Moreover, there are no researches done on estimating the entrepreneurship ability indicators distribution, which would be useful for managers, researchers and politicians for further modelling purposes.

The aim of the investigation is to compare the entrepreneurship ability and estimate best fitted distributions of small-scale dairy farms in Lithuania, Latvia, Estonia and Poland.

The object of investigation is the entrepreneurship ability in small-scale dairy farms.

2. The research methodology

To give a general picture of dairy sector's economy in Baltic countries and Poland the complex comparison method was used. (Krisciukaitiene, 2010). The following indicators and processing direction were chosen from the FADN system for each country in 2011: total inputs (min), total output (max), subsidies excluding investment (max), farm net income (max), solvency (max). According to these selected indicators the rank system for each country was applied to identify relatively the best and worst economic situation of a dairy sector in each country. The most reasonable factor that influences a ranking system was identified.

To measure the entrepreneurship ability of small-scaled dairy farms in each country the FADN data of dairy farming type have been used for the research analy-

sis. The Lithuanian database of input and output indicators consists of 166, Latvian – of 147, Estonian – of 57, Polish – of 190 responded dairy farms which have less than 20 cows.

Due to the data normalization reasons the dairy farm input and output indicators in each farm were divided by an available livestock unit (LU) of that farm. Due to the deterministic frontier's sensitivity data outliers were eliminated from analysis in each database (Wilson, 1993).

To estimate the dairy farms' entrepreneurship ability indicators the generalized transcendental logarithmic (*translog*) production function was considered:

$$f(\boldsymbol{x}_i;\boldsymbol{\beta}) = \ln y_i = \beta_0 + \beta_1 \ln x_{1i} + \beta_2 \ln x_{2i} + \beta_3 \ln x_{3i}$$
$$+ \frac{1}{2}\left[\beta_{11}(\ln x_{1i})^2 + \beta_{22}(\ln x_{2i})^2 + \beta_{33}(\ln x_{3i})^2\right]$$
$$+ \beta_{12}(\ln x_{1i} \ln x_{2i}) + \beta_{13}(\ln x_{1i} \ln x_{3i}) + \beta_{23}(\ln x_{2i} \ln x_{3i}),$$

where y_i - i^{th} farm's total production per LU, x_{1i} - i^{th} farm's total production costs per LU, x_{2i} - i^{th} farm's net worth at the end of the year per LU, x_{3i} - i^{th} farm's total labour input in hours per LU, $\boldsymbol{\beta} = (\beta_0,\ldots,\beta_{33})$ - vector of unknown coefficients, $i = 1,\ldots,N$.

Such production functional form is quite flexible. Moreover, it has less restriction on production elasticities and substitution elasticities (Pavelescu, 2011).

Estimation of unknown parameters $\hat{\boldsymbol{\beta}}$ is based on the deterministic optimum method (Battese, 1992), which involves quadratic mathematical programming algorithms. In details, the changing values $\hat{\boldsymbol{\beta}}$ correspond to the objective function

$$\sum_i \left(f(\boldsymbol{x}_i;\boldsymbol{\beta}) - f(\boldsymbol{x}_i;\hat{\boldsymbol{\beta}})\right)^2 \to \min,$$

with constraints

$$\begin{cases} f(\boldsymbol{x}_i;\boldsymbol{\beta}) \le f(\boldsymbol{x}_i;\hat{\boldsymbol{\beta}}) & (1) \\ \beta_1 + \beta_2 + \beta_3 = 1 & (2) \\ \beta_{11} + \beta_{12} + \beta_{13} = 0 & (3) \\ \beta_{12} + \beta_{22} + \beta_{23} = 0 & (4) \\ \beta_{13} + \beta_{23} + \beta_{33} = 0 & (5) \end{cases}.$$

Constraint (1) ensures the production frontier estimation and constraints (2)–(5) ensures the production frontier regularity condition existence (Coelli, 2005).

The dairy farm's entrepreneurship ability indicator is calculated as a ratio $\frac{f(\boldsymbol{x}_i;\boldsymbol{\beta})}{f(\boldsymbol{x}_i;\hat{\boldsymbol{\beta}})}$ (Salim, 2005).

To give more detailed overview of the small-scale dairy farms' entrepreneurship ability in each country the distribution terms of the entrepreneurship ability indicator were considered. The histogram and empirical density of entrepreneurship abili-

ty indicator reflects the real data distribution. For the probabilistic model building opportunity best fitted densities of the entrepreneurship ability indicators are provided in each country. According to the loglikelihood and Akaike Information Criterion (AIC) normal, gamma, exponential and Weibull distributions were considered. Because of the fixed lower and upper bounds of the entrepreneurship ability indicator (from 0 to 1) a truncated normal distribution is analyzed as well.

The entrepreneurship ability indicators are calculated by using the Frontline systems MS Excel solver add-in. Histograms and empirical densities, estimated densities of distributions are calculated by using "R" environment for statistical computing and graphics with authors' modified packages.

3. Theoretical aspects

Entrepreneurship related to small and medium sized enterprises (farms), for new ones as well as existing ones. Entrepreneurship includes the mentality and the process in which an economic activity is created and developed through the combination of risk-taking, innovation and adequate management (Hebert, 1989). Also entrepreneurship could be defined as creating an innovative economic organization which has a goal to realize profit or growth and by doing that under risk and uncertainty conditions (Dollinger, 2003). In literature on entrepreneurship some key characteristics are mentioned: locus of control, innovativeness and risk attitude. Locus of control refers to expectancy that rewards, reinforcements or outcomes in life are controlled either by one's own actions (internally) or by the other forces (externally) (Bergevoet, 2005). More characteristics of entrepreneurs could be such as: risk-taker, provider of capital, innovator and a person who identifies possibilities of profit making (Lans, 2009). Entrepreneurship requires specific competences and skills, such as opportunity, conceptual, organizing, strategical thinking. Also, it is related to personality traits. Successful entrepreneurs differ in terms of three traits: locus of control of reinforcement, problem solving abilities; social initiative through a person's dominance, liveliness and social boldness and abstractedness (McElwee, 2005).

It is quite difficult to calculate entrepreneurship due to multi-faceted interpretation of this concept. Many researchers have tried to provide a variety of entrepreneurial evaluation, but mostly it was estimation of entrepreneurial skills. According to H. Leibenstein (1987) and M. Friedman (1967), entrepreneurial ability can be specified by a production function which shows the maximum quantity of output which is capable of producing under given conditions. The analytical framework for this paper developed in the following section is based on this approach.

4. Results

To perform the adequate complex comparison analysis of dairy farms' economy in Estonia, Latvia, Lithuania and Poland, all above mentioned indicators have been grouped into 3 scenarios: as per 1 ha of utilized agricultural area (UAA), as per available work unit (AWU) and as per livestock unit (LU) (Table 1).

Table 1. Derived FADN indicators of dairy farms in Estonia, Latvia, Lithuania and Poland in 2011

Indicator / tendency	Scenario	Estonia	Latvia	Lithuania	Poland
Total output / Max	per 1 ha UAA	1138	730	867	1813
	per 1 AWU	50894	18307	15173	28626
	per 1 LU	2330	1578	1650	1630
Total inputs / Min	per 1 ha UAA	1185	732	720	1245
	per 1 AWU	52993	18366	12599	19653
	per 1 LU	2426	1583	1370	1119
Subsidies excl. Investment / Max	per 1 ha UAA	219	203	187	302
	per 1 AWU	9800	5102	3277	4768
	per 1 LU	449	440	356	272
Farm net income (gross profit + subsidies) / Max	per 1 ha UAA	218	233	399	876
	per 1 AWU	9744	5853	6982	13829
	per 1 LU	446	504	759	787
Solvency / Max	total assets/liabilities	2.6	4.7	10.2	13.1

The minimization or maximization tendency vector of each indicator is also provided. According to the tendency vector of indicators and dairy farms' derived data in each country, the complex comparison analysis has been performed (Table 2).

Table 2. Calculated ranks of Estonia, Latvia, Lithuania and Poland of dairy farms' economic environment according to selected economic indicators in 2011

Country	per 1 ha UAA		per 1 AWU		per 1 LU	
	Sum of weight	Rank	Sum of weight	Rank	Sum of weight	Rank
Estonia	0.3942	4	0.6060	2	0.5076	4
Latvia	0.4572	3	0.4527	4	0.5859	3
Lithuania	0.6483	2	0.5852	3	0.8113	2
Poland	0.9394	1	0.7504	1	0.9135	1

Comparing selected indicators for described scenarios (UAA, AWU and LU) economics environment of dairy farms in Poland takes best position in all cases because of a higher sum of indicators' weights. Lithuania almost in all cases (except AWU scenario) takes second place. The economy of dairy farms in Latvia and Estonia comes with relatively weaker positions. Analysis shows that the reason for such situation is the solvency indicator. According to the complex comparison calcula-

tions, the solvency indicator is the most reasonable and weighted indicator for all scenarios and it has biggest impact to ranking system.

The entrepreneurship ability analysis of small-scaled dairy farms in each country is provided in terms of the entrepreneurship indicators distribution (Fig.). For the empirical entrepreneurship indicators distribution in each country histograms and empirical densities are plotted.

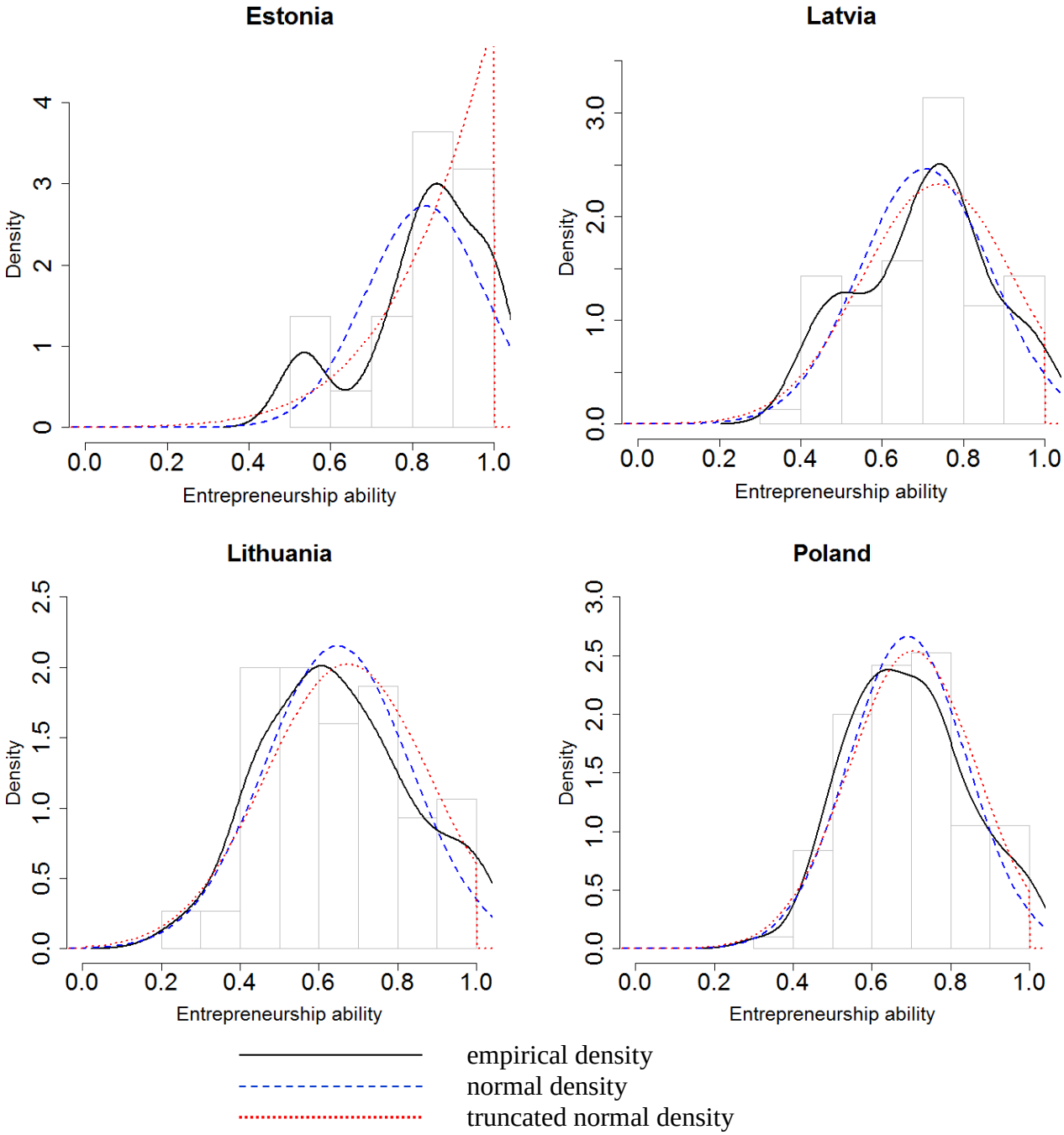

Fig. Empirical and estimated densities of small-scaled dairy farms' entrepreneurship ability indicators in each country in 2011

The research shows that Estonian small-scaled dairy farms are more enterprising: they have a higher level of the entrepreneurship ability with an empirical avera-

ge of 0.83. Additional calculations show that 63 percent of Estonian small-scale dairy farms reach the entrepreneurship level of 0.8 and higher. The reason of this could be a different structure of dairy farms in Estonia. Distributions of the entrepreneurship ability indicator in Latvia, Lithuania and Poland are quite similar with a similar empirical average (about 0.6–0.7) and with different standard deviations: higher in Lithuania (0.186) and lower in Poland (0.151). In Latvia and Poland about 22 percent of small-scaled dairy farms' owners can reach the entrepreneurship level of 0.8 and higher. In Lithuania only 14 percent of dairy farms can reach the same level.

To calculate a probability of gaining any range of values of the entrepreneurship ability indicators in each country, a statistical model should be provided for the event. Note that empirical densities of the small-scaled dairy farms' entrepreneurship indicators in Latvia, Lithuania and Poland remind form of a normal distribution. The fitting distribution analysis shows that for all countries the most fitted distribution for real data is normal distribution. The weak point of normal distribution is that it may have values larger than 1 with small probabilities (entrepreneurship ability can vary from 0 to 1). To eliminate such issue truncated normal distribution with 0 and 1 bounds was introduced. Main characteristics of truncated normal distribution can be found in Table 3.

Table 3. Main characteristics of truncated normal distribution of the small-scaled dairy farms' entrepreneurship indicators in each country in 2011

	Estonia	Latvia	Lithuania	Poland
Mean	1.5313	0.7374	0.6733	0.7040
Standard deviation	0.3730	0.1882	0.2100	0.1627
Loglikelihood	17.517	31.572	22.988	47.889
AIC	–31.035	–59.144	–41.977	–91.778
BIC	–28.853	–54.647	–37.342	–86.670

Moreover, truncated normal distribution is very similar to normal distribution (Fig.), but with a difference that values of the entrepreneurship ability of truncated normal distribution cannot exceed upper bound of 1. Estimation of the entrepreneurship's mean of truncated normal distribution in Estonia gives the value of 1.5313. This is due to data concentration near upper bound of 1. However, fitted truncated normal distribution allows calculating range values probabilities as well.

5. Conclusions

1. According to the selected economic indicators and their tendency, Poland takes relatively the best position in dairy farms' economy. Latvia and Estonia have relatively weaker positions in the ranking system. The most influential indicator in the complex comparison analysis is the solvency, which has highest impact on ranks.

2. Analysis of the calculated and structured small-scaled dairy farms' entrepreneurship indicators for each country shows that Estonian farmers have the highest entrepreneurship ability level of 0.83. Two third of Estonian small-scale dairy

farms' meet the entrepreneurship at 0.8 and higher level. Latvian, Lithuanian and Polish dairy farms' owners have the similar average entrepreneurship ability (0.6–0.7) and its standard deviation.

3. The most fitted distribution for empirical entrepreneurship data is normal and truncated normal distributions. Fitted truncated normal distribution is almost the same for Lithuania, Latvia and Poland (with mean 0.67–0.73 and standard deviation 0.16–0.21) and differs for Estonia (mean 1.53, standard deviation 0.37).

4. Fitted distributions of entrepreneurship ability can be estimated not only for the dairy sector but for other agricultural sectors. Estimated distributions could be applied for further modelling purposes.

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PIENININKYSTĖS ŪKININKŲ VERSLUMO GEBĖJIMO RODIKLIO PALYGINIMAS LIETUVOJE, LATVIJOJE, ESTIJOJE IR LENKIJOJE

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Santrauka

2010 metų surašymo duomenimis Lietuvoje, Latvijoje, Estijoje ir Lenkijoje dominuoja pieninin-kystės ūkiai, kuriuose karvių skaičius neviršija 20 (smulkūs ūkiai). Todėl atsiranda poreikis analizuoti šiuos ūkius išsamiau: įvertinti pasirinktų šalių smulkių pieninin-kystės ūkių verslumo gebėjimą. Tačiau praktiškai nėra tyrimų, kuriuose būtų palygintas verslumo gebėjimo rodiklis pasirinktose šalyse. Straipsnyje nagrinėjamas smulkių pieninin-kystės ūkininkų verslumo gebėjimo rodiklio palyginimas Lietuvoje, Latvijoje, Estijoje ir Lenkijoje naudojant rodiklio pasiskirstymo sąvoką. Straipsnio tikslas – įvertinti smulkių pieninin-kystės ūkių verslumo gebėjimo rodiklį pasirinktose šalyse, pateikti palyginimo analizę ir nustatyti geriausiai tinkantį rodiklio pasiskirstymą, kuris galėtų būti panaudotas tolimesniuose tyrimuose. Verslumo gebėjimo rodiklis bei jo pasiskirstymas įvertintas naudojant optimizavimo metodus. Taip pat atliktas pieninin-kystės krypties ūkių pasirinktų ekonominių rodiklių reitingavimas minėtose šalyse. Nustatyta, jog Lenkijos pieninin-kystės ūkiai užima santykinai geriausią poziciją pagal savo ekonominius rezultatus. Nustatyta, jog smulkūs Estijos pieninin-kystės ūkininkai turi didžiausią verslumo gebėjimo lygį lyginant su kitų nagrinėtų šalių smulkiais pieninin-kystės ūkininkais. Dviejų trečdalių Estijos smulkių pieninin-kystės ūkininkų verslumo gebėjimo rodiklis buvo 0,8 ir aukštesnis. Latvijos, Lietuvos ir Lenkijos smulkių ūkininkų verslumo gebėjimo rodikliai panašūs, ir buvo vidutinio lygio (0,6–0,7). Geriausi pasiskirstymai, tinkantys verslumo gebėjimo rodikliui aprašyti yra normalusis ir nupjautasis normalusis skirstiniai.

Reikšminiai žodžiai: kompleksinis palyginimas, optimizavimas, pasiskirstymas, smulkūs pieninin-kystės ūkiai, verslumas.

JEL kodai: C44, Q12, L26, R51.