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Analysis of the Behaviour of Prices of Major Staple Foods in West Africa: A Case Study of Nigeria

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Abstract

The study analyzed the price behavior of major staple foods in West Africa taking Nigeria as a case study (1966 – 2011). It described the trend of the major staple food prices and examined the linear relationship and interdependence of the major staple food prices in Nigeria. Secondary data were used for this study. The sources were; Food and Agriculture Organization (FAO), and National Bureau of Statistics (NBS). These data were transformed from their nominal value to real value and analyzed using descriptive statistics, unit root test, Pearson correlation coefficient, granger-causality test and structural equation model. The study revealed that the prices of most of the major staple foods were at the maximum value between 1991 and 1993 while their prices were at the minimum value between 1978 and 1983. The study observed that the price of cowpea is most volatile seconded by maize. The results of the unit root test showed that all the variables studied were stationary. The prices of the major staple foods were linearly correlated; some were positively correlated while some were negatively correlated. Granger-causality test on the major staple foods prices showed that the prices of most staple foods were unidirectional while only few were bi-directional. The study further revealed that the prices of staple foods were interdependent. The study recommends political stability in the country as the major staple food prices reached maximum level during the period of 1993 presidential election crisis.

Keywords:

Staple food, prices, behavior, maize, rice, yams, cowpea, sorghum and cassava.

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Introduction

The agricultural sector is an important economic sector in Nigeria's economy because it plays an important role in rapid growth and development of the economy (Famoriyo, Nwagbo, 1981). Agriculture provides food for the growing population, employment for over 70% of the population, raw materials and foreign exchange earnings for the development of industries (Giroh et al., 2010). In spite of the predominance of the petroleum sector and significant dependence of Nigeria economy on this sector, agriculture remains a major source of economic resilience and mainstay (Ojo, Akanji, 1996; NEEDS, 2004).

The performance of agriculture since 1970 in Nigeria clearly showed that it contributes more than 30% of the annual Gross Domestic Product (GDP), accounts for over 70% of the non-oil exports and provides over 80% of the food needs of the country (Adegboye, 2004). National Bureau of Statistics reported in 2008 that Agriculture contributed 42 percent of Nigeria's gross domestic product (GDP). It is the second largest export earner after crude oil and the largest employer of rural labor; thus, the sector ranks as a key contributor to wealth creation, poverty reduction and food security in the country.

However, for the past two decades, while population grew at a rate between 2.5% and 3% per annum, food production grew at a rate of about 2.5% per annum (CBN, 1999; World Bank, 2001). So, the pressure on domestic price levels persisted as the consumer prices; which reached very high levels at the end of 1993 increased further.

It is important to note that prices are the most readily available and reliable indicator that guide farmers' planting decisions in Nigeria. Farmers are confronted with food prices that are volatile (Fafchamps, 1992). A farmer's planting decisions depend on anticipated profit which in fact depends on anticipated prices of planted crops. This has made prices an important tool in the economic analysis of markets (Momoh, Agbonlahor, 2007). In addition, at this time of historically high food prices (Anderson, Themmakoon, 2015) and increases in the uncertainty surrounding food prices is problem (Bellemare, 2015), there is a need to study to study how the prices of the major staple foods behave. Today, it is indeed disheartening and disgusting to note that a country endowed with abundant natural resources is experiencing acute starvation possibly caused by staple foods shortage and their continuous price increase. Now, the economic effect of this was that it resulted to poor health of an average Nigerian which imposes a constraint to the economic development of the country.

While most studies on agricultural product prices in Nigeria focused on vertical dynamic analysis and market integration (Olayemi, 1977; Oludimu, 1982; Adekanye, 1988; Afolami, 1998; Adeyokunnu, 1973; Ladipo, Fabiyi, 1982), it is therefore pertinent to study how the prices of the major staple foods behave so as to put in place measures that would regulate the prices in such a way that the farmers and the consumers would be better off. Based on the foregoing, this study seeks to describe the trend of the major staple food prices and also examine the price behavior of the major staple foods in Nigeria.

The findings from this study would contribute to the increased understanding of behavior of staple food prices in the economy. Also, the results from this study would be useful for the policy makers and other researchers as well.

Empirical and analytical frame work

Unit Root Test

A stationary series is one with a mean value which will not vary with the sampling period. In contrast, a non-stationary series will exhibit a time varying mean (Juselius, 2006). Before examining integration relationships between or among variables, it is essential to test for unit root, and identify the order of stationarity, denoted as I (0) or I (1). This is necessary to avoid spurious and misleading regression estimates.

Obasi (2007) used Augmented Dickey-Fuller tests for the order of integration of relative price variability and inflation. The result revealed that Inflation was not stationary at the level, but it was stationary at the first difference while food price variability was stationary at the level for the first and zero lags. Cash crops price variability was stationary at zero lag. Also, Aliyu (2008) quantitatively assessed the impact of exchange rate volatility on non-oil export flows in Nigeria through the use of Unit root tests. The empirical results showed evidence of stationarity at level for some variables while for some at first difference. In 2010 Mesike et al. conducted unit root test using ADF to test for the order of integrations of price variability of cash crops and inflation. The test was applied over the period of 1970-2008 without a time trend. The test results strongly supported the null hypothesis that price variability is I (1) or non-stationary while inflation is stationary at I (0) level. Following from this, they differenced the price variability to become stationary. Jin and Kim (2012) developed method to measure time series data that are non-stationary using South Korea price indices of crops such as rice. In determine the stationary of the data, Jin and Kim (2012) used Augmented Dickey-Fuller unit tests. Acosta (2012) also used Augmented Dickey-Fuller unit tests. Additionally, In Modeling Nigerian Government Revenues and Total Expenditure: An Error Correction Model Approach, Ayinde et al. (2013) reported the results of the unit root from the use of Phillip-Perron and Augmented Dickey-Fuller unit tests. The results showed that all the original variables were non-stationary but their first differencing was stationary. Thus, they are integrated of order one i.e. I (1).

Pearson Correlation Coefficients

Rosa and Vasciaveo (2012) employed Pearson correlation coefficients to study the relationship between Oil and Agricultural market. The study established that high correlation coefficients of the agricultural commodity prices were consistent with the high degree of integration among agricultural markets; showing that a shock to an agri-commodity price might have an influence on other agri-commodities prices.

Emakoro and Ayantoyinbo (2014) studied market integration and price variation in rice marketing in Osun state using Pearson Correlation Coefficients. The Pearson correlation coefficients revealed high and significant correlation of the price series which indicated co-movement in the prices. The positive correlation showed that an increase in the retail

price in one market would follow the price increase in the other market.

Ibironke (2014) also employed Pearson Correlation Coefficients in a study titled how effective is the Nigerian Oil-Price-Based Fiscal Rule. The study showed that there was negative association between the real government expenditure and real oil revenue after the introduction of fiscal rule.

Granger-Causality Test

The Granger causality analysis was proposed by Granger in 1969. The Granger causality test uses a one-sided distributed lag where by the incremental forecasting value of past (often plus present) history of one variable on another variable is used as the yardstick. It stated that, "Y_t is causing X_t if the formal is better able to predict the later using all available information".

In Granger (1969) bi-variate framework, X is said to cause Y if the past plus the current values of X facilitate the forecasting of Y when employed in conjunction with the past value of

Y as compared with when only past values of Y are employed. This means that some information must be contained in the past and current X values which are absent in the past Y values. To examine the incremental forecasting value; regress the current Y value on the past Y values plus present and past X values. Causation from X to Y is identified if the coefficient of the present and past X values are significantly different from zero as a group. The appropriate significance test is the conventional statistical F-test.

Granger-Causality model is based on the assumption that X and Y are jointly covariance stationary which is a rather strong assumption concerning economic time series. To make the series more stationary therefore, the original data are often first-differenced or seasonal – differenced and it has been shown by Pierce and Haugh, (1977) that such linear transpirations still preserve any causality that may be present in the original data.

Many studies had been carried out using granger-causality model but only the recent ones are discussed. Ayinde et al. (2010) empirically study climate change and agricultural production in Nigeria using granger causality test. The Granger causality test revealed that change in rainfall (climatic parameter) positively affects agricultural production in Nigeria. Also, research conducted using granger-causality model by Olatunji et al. (2012) revealed there was unidirectional causation from inflation to agricultural output change, thus inflation in Nigeria depends on agricultural output change during the time frame.

Rosa and Vasciaveo (2012) applied the granger-causality test to the study of Agri-Commodity Price Dynamics: The relationship between Oil and Agricultural Market. The study established that no causal effect between the Oil (Brent) of Italian agric-commodities and united state agric-model but joining the two markets, there was causal effect. Also, in analysis of market integration and price variation in rice marketing, Emakoro and Ayantoyinbo (2014) reported that some markets granger-cause each other while some did not granger-cause.

Materials and methods

Study Area

Source: Nokculture 2010

Figure 1: Map of Africa showing Nigeria

The study area is Nigeria (Fig. 1). It is officially the Federal Republic of Nigeria, is a federal constitutional republic comprising 36 states and its Federal Capital Territory, Abuja. The country is located in West Africa and shares land borders with the Republic of Benin in the west, Chad and Cameroon in the east, and Niger in the north. It shares a 4,047 kilometers (2,515 mi) border with Benin (773 km), Niger (1497 km), Chad (87 km), Cameroon (1690 km), and has a coastline of at least 853 km. Nigeria lies between latitudes 4° and 14°N, and longitudes 2° and 15°E. Its coast in the south lies on the Gulf of Guinea on the Atlantic Ocean and rainfall is between 20 and 60 inches (508 and 1,524 mm) per year. Agriculture used to be the principal foreign exchange earner of Nigeria. At one time, Nigeria

was the world's largest exporter of groundnuts, cocoa, and palm oil and a significant producer of coconuts, citrus fruits, maize, pearl millet, cassava, yams and sugar cane. About 60% of Nigerians work in the agricultural sector, and Nigeria has vast areas of underutilized arable land.

Sources and collection of data

Secondary data were used for this study. The times series data from year 1966 to 2011 was collected from different sources because of different crops and prices involved in the study. The sources were: World Bank Database, Food and Agriculture Organization (FAOSTAT), Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS) and Federal Ministry of Agriculture and Rural Development (FMARD). In carrying out this study, six major staple foods were purposively selected as they are among the food products of majority of the population in Nigeria and even in African countries. The selected major staple foods were maize, cassava, cowpea, yams, sorghum and rice. For each staple food selected, data on price over forty years (1966-2011) were collected from World Bank Database, Food and Agriculture Organization (FAOSTAT), Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS) and Federal Ministry of Agriculture and Rural Development (FMARD).

Analytical techniques

The data were analyzed using descriptive statistics, Pearson correlation coefficient and Granger-causality test. The statistical packages employed were Eviews 8, Gretl and SPSS 16 and Stata 10 (statistical software) and statistical processes were employed in order to achieve an appropriate analysis. To deal with national currency fluctuations, which might cause price to look as though they are integrated; all prices were quoted in naira per tonne (₦/tonne) and series of prices were all deflated by using Consumer Price Index (CPI). The real prices obtained were then used for the analyses.

$$Real\ Price = \frac{Nominal\ Price}{Consumer\ Price\ Index} \times 100 \qquad (1)$$

Descriptive statistics

Descriptive statistics such as graphs, mean, minimum, maximum and standard deviation were employed to achieve the specific objective one (1) stated earlier. They were used to describe the trend of the price of each of the selected major staple foods.

Unit Root Test, Pearson Correlation and Granger Causality Models

Unit root test was conducted to test for the stationarity of staple food prices while the Pearson price correlation coefficient and Granger Causality test were used to examine the price relationship of major staple foods in Nigeria, 1966 – 2011. These models were adapted from Ravallion (1986), Mohammad (2005), Ayinde et al. (2010) and Emakoro and Ayantoyinbo (2014).

Unit Root Test

The unit root test is the most widely adopted test of stationarity or non-stationarity over the past year which is mainly conducted on time series data. Test of the stationarity of the variables is paramount to avoid a spurious result. There are several methods for testing the presence of unit roots. The most widely used method is Augmented Dickey-Fuller (ADF). This method was employed in this study (Gujarati, 2003). The unit root model is stated below.

$$\delta X_t = \alpha + \delta X_{t-1} + \sum_{k=1}^{p} \beta \delta X_{t-k} + \varepsilon_t \qquad (2)$$

Where:

X_t = price at time t

δ = first difference operator

t = time indicator

ε_t = the error term

δ, α and β = parameters to be estimated

k = number of lag of the price variables to be included.

Pearson Correlation Coefficients

Pearson correlation coefficients were used to examine the strength of price linkages among the major staple foods. Given the price series of each staple food at time t, X_t and Y_t, the degree of linear association between the staple foods were measured by the sign and magnitude of the correlation coefficient, r. The model is stated below.

$$r = \frac{\sum_{i=1}^{n}((X_i - \bar{X})(Y_i - \bar{Y}))}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2 \sum_{i=1}^{n}(Y_i - \bar{Y})^2}} \qquad (3)$$

Where:

r = Pearson price correlation coefficient,

X_i and Y_i = price variables at time t

$\bar{X}$ and $\bar{Y}$ = mean of the variables

Granger Causality Test

The Granger Causality test was adopted to further examine the relationship of major staple food prices. It was used to provide additional evidence as to whether and in which direction price of staple food cause one another.

Where

n = number of observation

m = number of lag

Y_t = price of a particular staple foods (maize, cowpea, cassava, sorghum, rice or yams)

X_t = price of staple food (maize, cowpea, cassava, sorghum, rice or yams)

ε_t = error term

α and β = parameters to be estimated.

This model is adapted from Rosa and Vasciaveo (2012) and Emakoro and Ayantoyinbo (2014).

Choice of Lag Length

To choose lag Length, a rule of thumb is to compute ACF (Autocorrelation Function) up to one-third (1/3) to one-quarter (1/4) the length of the time series. The statistical criterion such as Akaike and Schwarz information criterion were then used to select the optimal lag length.

AIC and SIC were reported because they impose harsher penalty than $\bar{R}$^2 (adjusted R square) for adding more regressors. In comparing models, the model with lowest value of AIC and SIC is preferred.

Structural Equation Model (SEM)

Structural equation model consisted of more than one equation for each of the jointly endogenous variables. The model for this study as adapted from Babatunde and Qaim (2010) is specified below.

$$lnP_{yam} = \alpha_0 + \beta_1 lnP_{cas} + \beta_2 lnP_{cow} + \beta_3 lnP_{ric} + \beta_4 lnP_{maz} + \beta_5 lnP_{sor} + \varepsilon_1 \quad (5)$$

$$lnP_{maz} = \alpha_1 + \beta_6 lnP_{cas} + \beta_7 lnP_{cow} + \beta_8 lnP_{ric} + \beta_9 lnP_{yam} + \varepsilon_2 \quad (6)$$

$$lnP_{cow} = \alpha_2 + \beta_{10} lnP_{cas} + \beta_{11} lnP_{yam} + \varepsilon_3 \quad (7)$$

$$lnP_{cas} = \alpha_3 + \beta_{12} lnP_{yam} + \varepsilon_4 \quad (8)$$

$$lnP_{ric} = \alpha_4 + \beta_{13} lnP_{cas} + \beta_{14} lnP_{cow} + \beta_{15} lnP_{maz} + \beta_{16} lnP_{yam} + \varepsilon_5 \quad (9)$$

$$lnP_{sor} = \alpha_5 + \beta_{17} lnP_{cas} + \beta_{18} lnP_{cow} + \beta_{19} lnP_{ric} + \beta_{20} lnP_{maz} + \beta_{21} lnP_{yam} + \varepsilon_6 \quad (10)$$

Where:

P_{yam} = price of yams = (₦ per tonne)

P_{maz} = price of maize (₦ per tonne)

P_{cas} = price of cassava (₦ per tonne)

P_{cow} = price of cowpea (₦ per tonne)

P_{ric} = price of rice (₦ per tonne)

P_{sor} = price of sorghum (₦ per tonne)

α_0 - α_5 = intercepts

β_1 - β_{21} = structural parameters or coefficients

Note: The model was fitted based on the granger-causality test results and theoretical ground. This was done to identify each equation in the model. Identification of each equation in the equation system was necessary to obtain numerical estimates of the parameters of the structural equation from the estimated reduced-form coefficients. Some of the equations in the model were exactly identified while some were over-identified.

The procedures for equation identification were stated below;

If $k = g - 1$, the equation is exactly identified.

If $k > g - 1$, the equation is over-identified.

If $k < g - 1$, the equation is under-identified (Maddala, 2001).

Where:

k = number of excluded endogenous variable plus excluded exogenous variable.

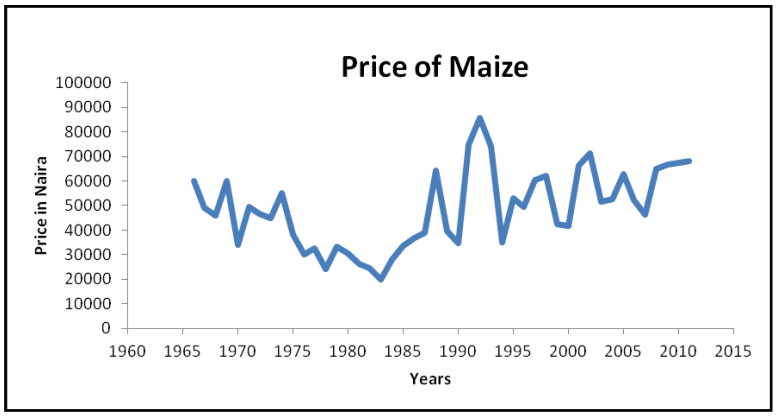
g = number of endogenous variable in the system.

Results and discussion

This section deals with the presentation, interpretation and discussion of data collected for the study after being analyzed. The study uses figures (graphs) and tables to present the results for easy understanding.

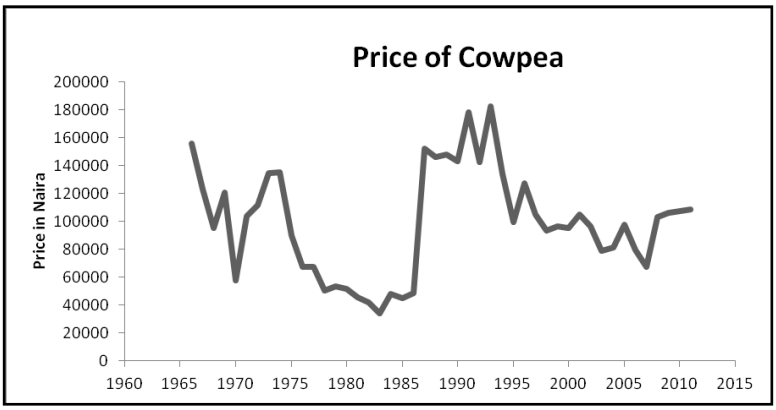
Description of the trend of the major staple food prices in Nigeria (1966 – 2011)

The graphs 1 to 6 describe the trend of major staple food prices in Nigeria over the studied periods. The lowest and highest prices of each staple food were identified and the study also discussed the trend of staple food for the past five years being the recent prices. This is done to know how the prices of staple food would behave for at least the next five years.



Source: Author's illustration using data from FAOSTAT, 2014

Graph 1: Trend of price per tonne of maize in Nigeria (1966 – 2011).



Source: Author's illustration using data from FAOSTAT, 2014

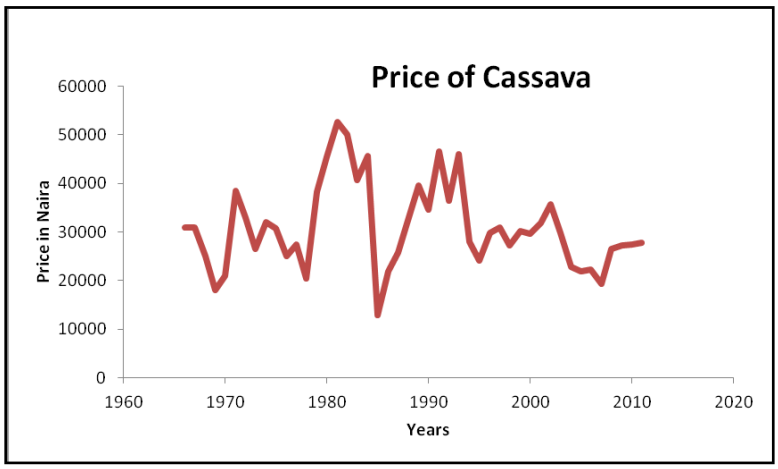
Graph 2: Trend of price per tonne of cowpea in Nigeria (1966 – 2011).

Graph 1 shows the price of maize in Nigeria from 1966 to 2011. The price of maize moved in a zigzag manner over the period under study. The trend line equation is *y = 535.0x - 1E+06*. The price fluctuated between the lowest value of ₦ 19,853 in 1983 and highest value of ₦ 85, 821 in 1992 with the mean of ₦ 4.84E4 and standard deviation of 15931.055. Considering last five years price movement, it is observed that the price of maize increased sharply from ₦ 46285.81 in 2007 to ₦ 64784.24 in 2008 followed by gradual increase in 2009 (₦ 66583.1), 2010 (₦ 67321.25) and 2011 (₦ 68241.87).

Graph 2 shows the price of cowpea in Nigeria from 1966 to 2011. The price of cowpea fluctuated over the period under study. The trend line equation is *y = 169.8x - 23866*. The price moved from the lowest amount of ₦ 34,222 in 1983 to the highest amount of ₦ 182,612 in 1993 with the mean of ₦ 9.9E4 and standard deviation of 37984.804. In the last five years, the price of cowpea rose sharply from ₦ 67104.6 in 2007 to ₦ 103235.8 in 2008 and then by gradually increased in 2009 (₦ 106102.4), 2010 (₦ 107278.6) and 2011 (₦ 108745.7).

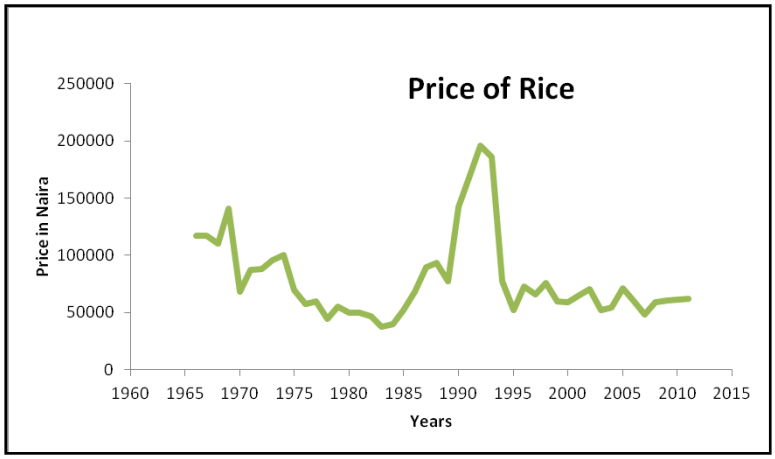
Graph 3 represents the price of cassava in Nigeria from 1966 to 2011. The price of cassava varied over the period under the studied periods. The trend line equation is *y = 20796 - 89.04x*. The price moved from the minimum value of ₦ 12,845 in 1981 to the maximum value of ₦ 52,684 in 1985 with the mean of N 3.09E4 and standard deviation of 8,813.615. It is observed there was a sharp fall in cassava price between 1984 and 1985. The sharp fall in price of cassava in 1985 might due to effectiveness of agricultural policies and fiscal policies during that period. In the last five years, it was observed that the price of cassava rose slightly from ₦ 19252.15 in 2007 to ₦ 26436.36 in 2008 and then by steady increase in 2009 (₦ 27170.42), 2010 (₦ 27471.62) and 2011 (₦ 27847.29).

Graph 4 depicts the price of rice in Nigeria from 1966 to 2011. The price of rice swung over the period study period. The trend line



Source: Author's illustration using data from FAOSTAT, 2014

Graph 3: Trend of price per tonne of cassava in Nigeria (1966 – 2011).



Source: Author's illustration using data from FAOSTAT, 2014

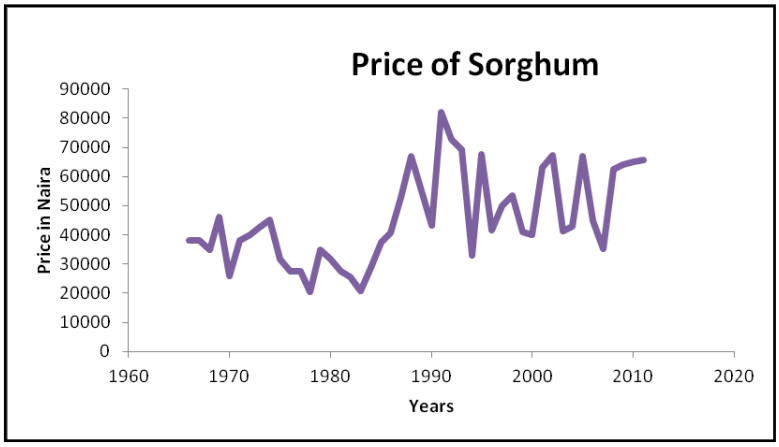
Graph 4: Trend of rrice per tonne of rice in Nigeria 1966 - 2011.

equation is y = *1E+06 - 613.3x*. The price moved from the lowest value of ₦ 37,814 in 1983 to the highest value of ₦ 196,202 in 1992 with the mean of ₦ 7.91E4 and standard deviation of 37077.565. It is observed that the price of rice was relatively low before the sudden increase which reached the highest value in 1992. Then, the price fell sharply in 1994 after slight falling in 1993. After which the price fluctuated slightly from 1994 to 2011.

Graph 5 shows the price of sorghum in Nigeria from 1966 to 2011. The price of sorghum undulated over the period under study. The trend line equation is *y = 649.3x - 1E+06*. The price fluctuated between the lowest value of ₦ 20,480 in 1978 and ₦ 82,096 in 1991 with the mean of ₦ 4.55E4 and standard deviation of 15631.532. In the last five years, it is observed that the price of sorghum increased sharply from ₦ 35353.46 in 2007 to ₦ 62427.08 in 2008 then, followed by steady increase in 2009 (₦ 64160.49), 2010 (₦ 64871.75) and 2011 (₦ 65758.92).

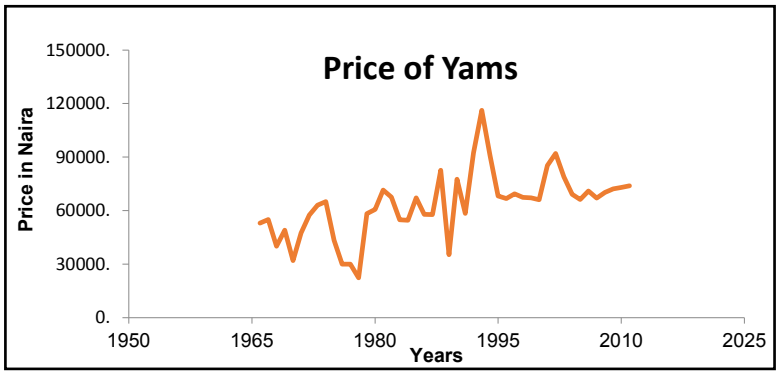
Graph 6 illustrates the price of yams in Nigeria from 1966 to 2011. The price of yams varied over the period studied. The trend line equation is *y = 784.6x - 1E+06*. The price moved from the minimum value of ₦ 22,342 in 1978 to the maximum value of ₦ 116,262 in 1993 with the mean of ₦ 6.34E4 and standard deviation of 18095.685. It is observed that within last five years the price continued increasing steadily.

Table 1 shows the minimum, maximum, mean and standard deviation of the major staple food prices. The study reveals that price of cowpea is most volatile among all the major staple food prices next by rice price. This means that the prices of cowpea and rice changed often



Source: Author's illustration using data from FAOSTAT, 2014

Graph 5: Trend of price per tonne of sorghum in Nigeria 1966 - 2011.



Source: Author's illustration using data from FAOSTAT, 2014

Graph 6: Trend of price per tonne of yams in Nigeria (1966 – 2011).

Major staple foods	Minimum price per tonne (N)	Maximum price per tonne (N)	Mean price per tonne (N)	Std deviation
Maize	19, 853 (1983)	85, 821 (1992)	484000	15931.055 (5th)
Cowpea	34, 222 (1983)	183, 612 (1993)	991000	37984.804 (1st)
Cassava	12, 845 (1985)	52, 684 (1981)	30900	8813.615 (6th)
Rice	37, 814 (1983)	196, 202 (1992)	791000	37077.565 (2nd)
Sorghum	20, 480 (1978)	82, 096 (1991)	45500	15631.532 (4th)
Yams	22, 342 (1978)	116, 262 (1993)	63400	18095.685 (3rd)

Source: Author's Computation using data from FAOSTAT, 2014

Table 1: Descriptive statistics of major staple food prices.

over the periods under study and the implication of this is that it could be difficult to predict the future prices of these crops. The high volatility of cowpea price could be due to constant fluctuations in its production - a consequence of climate variability and insect infestation while that of rice could be due to low rice production in the country and in the effort to augment rice production with imports, the rice price becomes more volatile. The implication of this is that many local farmers are being discouraged to increase their production since they have become the price takers and is even difficult for them to predict the next year price. Conversely, the volatility of cassava price is the lowest among the studied major staple food prices next by price of maize. The less volatility of cassava price might due to the fact Nigeria is the world leading cassava producer and thereby the effect of external factors on its price is minimal. The finding of this study supported the earlier studies on the analysis of incentives and disincentives for cassava in Nigeria and effect

of Climate Variability on Agricultural Production and Innovation in Guinea Savannah Region of Nigeria (FAO, 2013 and Ayinde et al., 2013).

The Price Relationship of the Major Staple Foods in Nigeria

Unit Root Test on the price of major staple foods in Nigeria

The Augmented Dickey-Fuller (ADF) unit root tests were carried out on all the variables of the analysis. One lag was used for the random walk regressions of major staple food prices because they are annual series and any autocorrelation problems they might have are expected to be corrected after one period. The results are presented in table 2.

The results of stationarity test for the staple food prices using Augmented Dickey-Fuller (ADF) unit roots tests indicated that the variables were all stationary at their levels and first differencing, precisely at lag 1 except price of rice that was stationary at lag six. This finding corroborates earlier findings that food commodity price series are mostly stationary of order 1 i.e. I (0) (Chirwa, 2000, Mafimisebi, 2008, Desi, 2012, Ojiako, 2012; Emakoro, Ayantoyinbo, 2014).

Linear Relationship of Prices of major staple foods in Nigeria

The Correlation between the staple food prices for the period of study is estimated to determine the level of the linear relationship. The Pearson correlation coefficients among the price series signal the positive or negative linear correlation between the staple food prices. It suggests the co-movements between the price series. The high correlation coefficients of some staple food prices are consistent with the high degree of integration among staple food markets; showing that a shock to a staple food price may have an influence on other staple food prices. This supports the earlier findings of Emakoro and Ayantoyinbo (2014) which revealed that the positive correlation of food markets showed an increase

Major staple foods	Level with drift	1st difference with drift	Remarks
RPMAIZE	-3.225**	-7.801***	Stationary
RPCOWPEA	-2.865*	-8.358***	Stationary
RPCASSAVA	-3.655***	-8.352***	Stationary
RPRICE	-2.645*	-4.666***	Stationary
RPSORGHUM	-3.498**	-7.780***	Stationary
RPYAMS	-3.362**	-9.211***	Stationary

Note: *** indicates stationarity at 1%; ** points to stationarity at 5% of significance, and * indicates stationarity at 10% level of significance

Source: Author's computation using data from FAOSTAT, 2014

Table 2: Unit Root Test on the price of major staple foods in Nigeria.

Staple food prices						
Maize	Maize	Cowpea	Cassava	Rice	Sorghum	Yams
Cowpea	1	0.640***	-0.074	0.540***	0.882***	0.551***
		0	-0.624	0	0	0
Cassava		1	0.085	0.766***	0.645***	0.359**
			-0.574	0	0	-0.014
Rice			1	0.176	0.16	0.228
				-0.242	-0.914	-0.128
Sorghum				1	0.462***	0.286*
					-0.001	-0.054
Yams					1	0.567***
						0
						1

Note: *** indicates 1% level of significance; ** indicates 5% level of significance; * indicates 10% level of significance

Source: Author's computation using data from FAOSTAT, 2014

Table 3: Results of Pearson Correlation Coefficients of Prices of Major Staple Foods (1966-2011).

in the retail price of rice in one market would follow the price increase in the other market. The results are shown in table 3.

Table 3 shows the linear relationships among major staple food prices under study. The study shows that all the major staple food prices are positively correlated except Maize-Cassava prices that were negatively correlated (-0.074). The negative correlation might due to the fact that maize and cassava compete for the available farm resources when planted on the same piece of land (i.e. mixed cropping system which is common in Nigeria). This means that increase in the production one leads to decrease in the production of the other; this could be responsible for the negative correlation of their prices. The positive correlation indicates that an increase in the price of one staple food would lead to increase in the prices of the other staple foods but at different degrees since their Pearson correlation coefficients differ while negative correlation indicates that an increase in the prices of one staple would lead to decrease in the other staple food prices. The Pearson correlation coefficients of major staple food prices are statistically significant at 1%, 5% and 10% levels except the prices of maize-cassava, cowpea-cassava, cassava-rice, cassava-sorghum and cassava-yams. The study further reveals that the Pearson correlation coefficient (r) of Maize-Sorghum is the highest (0.882) followed by that of cowpea-rice (0.766). This might be due to the fact that maize and sorghum crops are substitute commodities, meaning that if the price of maize increases the demand for sorghum increases which could later cause the price of sorghum to rise and vice versa. Cowpea-Cassava prices have the lowest Pearson correlation coefficient which is not even significant at various statistical significant levels considered. This implies that if the price of cowpea increases, it would not cause any immediate change in the price of cassava and vice versa.

Linear Granger Causality Test of the prices of major staple foods in Nigeria

Granger causality-test was carried out to study how a particular staple food price influences the other. The results of granger causality test are presented along with some optimal lag length indicators. The Akaike Information Criterion and Schwarz information criterion were used to select the optimal lag length. The results are presented in Table 4.

The granger causality test was used to determine the influence of staple food prices on one another. It provides additional evidence as to whether and in which direction the price of staple food relate. The results in table 5 suggest that the direction of causality is unidirectional in most of the staple food prices while direction of causality is bilateral in few staple food prices. The study reveals that the price of cassava granger-cause (influences) the prices of cowpea (0.0389), maize (0.0053), rice (0.0071) and sorghum (0.0393) while the cassava price does not granger-cause the price of yams; the price of cowpea granger-cause the prices of maize (0.0227), yams (0.0265), sorghum (0.0053) and rice (0.0021) while cowpea price does not granger-cause the price of cassava; the price of yams granger-cause the prices of maize (0.0663), cowpea (0.0237), sorghum (0.0032), cassava (0.0962) and rice (0.0046) while cowpea price does not granger-cause the the price of maize granger-cause the prices of rice (0.0680), sorghum (0.1009) and yams (0.0718) while maize does not granger-cause the prices of cassava and cowpea; the price of rice granger-cause the prices of maize (0.0234), yams (0.0939) and sorghum (0.0048) while the rice price does not granger-cause the prices of cowpea and cassava and the price of sorghum granger cause price of yams (0.0765) only. The study further discovers that there is bilateral causality between yams-cowpea, rice-maize, rice-yams, sorghum-yams and yams-maize.

In the previous discussion, the study has established that staple food prices were linearly correlated and also granger-cause each other. However, the mechanisms through which this relationship occurs were not completely clear. This is therefore shown in table 5.

The coefficients in rows 1 of table 5 shows that if the prices of cassava and sorghum increase by ₦ 1 each, the price yams would increase by ₦ 0.34 and ₦ 0.54 respectively. The coefficients in row 2 shows ₦ 1 increase in each price of yams and cowpea would lead to ₦ 0.39 and ₦ 0.49 increases in the price of maize while ₦ 1 increase in the price of cassava would lead to ₦ 0.27 decreases in the price of maize. Row 3 shows that the ₦ 1 increase in each price of yams and rice would increase the price of cowpea by ₦ 0 .24 and ₦ 0.81 respectively. Row 4 the price of cassava would increase by ₦ 0.29 if the price of yams increases by let say ₦ 1. Row 5 shows that if the price of cowpea increases by ₦ 1, the price of rice would increase by ₦ 0.71. Row 6 reveals that N 1 increase in each price of yams, maize and cowpea would increase the price of sorghum by ₦ 0.19, ₦ 0.71 and ₦ 0.19

Staple Food Prices	F- stat	P-value	AIC	SIC	Optimal lag length	Direction of causality
Cowpea → Cassava	1.0438	0.4452	772.8119	788.921		
Cassava → Cowpea	2.6245	0.0389**	866.3466	882.4558	9	Unidirectional
Maize → Cassava	0.7045	0.6845	792.6254	807.3637		
Cassava → Maize	3.9697	0.0053***	836.865	851.6032	8	Unidirectional
Rice → Cassava	0.2019	0.9907	772.8119	788.921		
Cassava → Rice	3.8583	0.0071***	853.7516	869.8607	9	Unidirectional
Sorghum → Cassava	0.5777	0.8138	732.7927	751.4569		
Cassava → Sorghum	2.9213	0.0393**	780.0093	798.6735	11	Unidirectional
Yams → Cassava	2.4876	0.0962*	917.1351	922.4877		
Cassava → Yams	0.852	0.4343	974.7034	980.056	2	Unidirectional
Yams → Cassava	0.8643	0.5821	754.0736	771.4923		
Cassava → Yams	2.6932	0.0407**	804.1819	821.6006	10	
Maize → Cowpea	0.9796	0.4784	887.277	902.0153		
Cowpea → Maize	2.9373	0.0227**	836.865	851.6032	8	Unidirectional
Rice → Cowpea	0.81752	0.6181	841.1902	858.6089		
Cowpea → Rice	5.27341	0.0021***	833.0882	850.5069	10	Unidirectional
Sorghum → Cowpea	0.6273	0.7696	841.1902	858.6089		
Cowpea → Sorghum	4.37107	0.0053***	801.5198	850.5069	10	Unidirectional
Yams → Cowpea	2.96585	0.0237**	866.3466	882.4558		
Cowpea → Yams	2.8889	0.0265**	826.8647	842.9739	9	Bi-directional
Rice → Maize	2.97614	0.0234**	817.5269	833.6361		
Maize → Rice	2.25344	0.0680*	853.7516	869.8607	9	Bi-directional
Rice → Sorghum	4.02671	0.0048***	862.4564	875.7649		
Sorghum → Rice	1.24164	0.3197	896.8658	910.1743	7	Unidirectional
Rice → Yams	2.02203	0.0939*	868.7869	882.0954		
Yams → Rice	4.04395	0.0046***	898.8658	910.1743	7	Bi-directional
Sorghum → Maize	1.63996	0.1722	857.6418	870.9503		
Maize → Sorghum	1.97695	0.1009*	862.4564	875.7649	7	Unidirectional
Sorghum → Yams	2.15017	0.0765*	846.9475	861.6858		
Yams → Sorghum	4.35532	0.0032***	842.4066	857.1449	8	Bi-directional
Yams → Maize	2.24285	0.0663*	857.6418	870.9503		
Maize → Yams	2.19159	0.0718*	868.7869	882.0954	7	Bi-directional

Note: → means non Granger causality hypothesis. ***/**/* denote statistical significance at 1%, 5% and 10% level, respectively. The optimal lag length was selected by Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC).

Source: Author's computation using data from FAOSTAT, 2014

Table 4: Pair-wise Granger Causality Test for major staple food prices.

	Staple Food Prices					
Variables	lnP_{yam}	lnP_{maz}	lnP_{cow}	lnP_{cas}	lnP_{ric}	lnP_{sor}
Constant	2.5455 (1.9398)	3.1203** (1.5348)	0.6727 (1.9143)	9.1399*** (1.5591)	2.3639 (1.9056)	-0.2736 (1.1636)
lnP_{yam}		0.1918 -0.2681	-0.1658 -0.1841	0.2977** -0.1409	-0.0506 -0.1618	0.5438** -0.2549
lnP_{maz}	0.3899 -0.1056		0.4933*** -0.1235	-0.2652** -0.1132	0.037 -0.1294	
lnP_{cow}	0.2385* -0.1266			-0.0939 -0.1407	0.8120*** -0.1021	
lnP_{cas}	0.2962** -0.1595	-0.364 -0.2618				0.1691 -0.2781
lnP_{ric}	-0.1082 -0.1459	0.0538 -0.188	0.7116*** -0.1358	0.1279 -0.1439		
lnP_{sor}	0.1879** -0.8805	0.7048*** -0.1128	0.1879* -0.1052	0.3691 -0.8711	-0.1088 -0.0936	
$\bar{R}^2$	0.4304	0.6677	0.6413	0.1171	0.6201	0.831

Notes: The number of observations in this structural equation model is N = 46. Figures in parentheses are std. Error *, **, *** indicates significant level at the 10%, 5% and 1% level, respectively.

Source: Author's computation using data from FAOSTAT, 2014

Table 5: Interdependence of Staple Food Prices in Nigeria.

respectively. Summarily, table 5 establishes that prices of staple food interdependent i.e. increase in price of staple food causes simultaneous changes in the prices of the others and vice versa.

Conclusion

The study concluded that the price of cowpea is most volatile seconded by maize. The results of the unit root test showed that all the variables studied were stationary. The prices of the major staple foods were linearly correlated; some were positively correlated while some were negatively correlated. Granger-causality test on the major staple foods prices showed that the prices of most staple foods were unidirectional while only few were bi-directional. The study further revealed that the prices of staple foods were interdependent.

It is therefore recommended the government should ensure political stability. This is necessary because most of the staple foods recorded highest prices between 1991 and 1993 which could be traced to the period when the country experienced serious political crisis (i.e. 1993 Presidential Election Crisis).

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Developing the Metodology to Form Integrated Reporting of Agroholdings in the Russian Federation

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Abstract

The article represents the efficient methodological principles on preparing the integrated reporting, as well as the scheme of the agroholding coherently integrated registration system based on the analysis of the concept and methodology in the field of the integrated reporting; it specifies "growth points" of the methodology development and best practical applications of the concept of uniform reporting on a global scale. The authors propose the developed by them "road map" on the organization process forming the integrated reports, and define the guidelines on improving the process of preparing and quality of the integrated reporting for the medium-term period.

Keywords:

Methodology of integrated reporting; uniform accounting system; agro-industrial holdings; organization of integrated accounting; road map; guidelines on methodology development.

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Introduction

The current state of modern agriculture in the Russian Federation requires intensive development both of agro-industrial production (technologies, selection) and improvement of control system for the agricultural enterprises to solve the tasks of import substitution, economic security of the country in the period of applying sanctions against Russia and retaliatory food embargo (Medvedev, Putin et al., 2015).

Large diversified integrated agroindustrial holdings are of special importance in this process. We believe that the reporting of such entities as an element of effective management should be of fundamentally different (higher) level and different quality (Ovchinnikov et al., 2014). In 2012 - 2015 in the world and Russia the regulations for corporate reporting changed significantly: the G4 version of the Reporting Guide in the field of sustainable development (GRI) was published; the International standard for the integrated reporting was developed and came into effect; the National concept of development of public non-financial reporting in the Russian Federation and new version of the Corporate Management Code are expected to be published (Pavlova et al., 2014).

In our researches, we developed the concept of the formation of coherently integrated reporting for agricultural holdings, revealed the prerequisites for developing the author concept, as well as specified the opportunities for integrated reporting application in accounting practice of agricultural holdings (Melikhov, et al., 2014). Besides there were represented the fundamental principles of coherence between accounting and disclosure of financial and non-financial information, and basic aspects and parameters of the concept (Balashova et al., 2014).

At the present stage, the task is to develop methodology to form the integrated reporting for large integrated structures, and in particular, to elaborate the methods and ways of obtaining information for reports, to adopt the strategy in order to organize a system of single, unified accounting. There are various works and issues relating to the theoretical methodology elements, e.g. an International Standard for Integrated Reporting, etc. (Conceptual framework for financial reporting, 2013; Consultant project

of the international structure integrated reporting, 2012; International standard on the integrated reporting, 2014), but in the practical methodology, which is focused on solving practical problems, and aimed at implementing the concept of integrated reporting, there is a shortage of programs (algorithms), tools (techniques and methods) correlating different accounting systems in a single system and forming a unified reporting based on accounting data that are generated in the system.

Having analyzed best international practices in the preparing integrated reports, we may note that not all the methods are qualitative and effective. Research activities should be focused on the methodological, organizational and technical tasks, in order to find the principles of achieving the purpose to form, present and verify qualitative relevant and pertinent unified reporting.

Research purposes and aims

Conducting our research, we aim to develop and propose to use tool that helps to develop the methodology of formation and verification of integrated reporting for agricultural holdings in Russia.

To achieve the purpose we have set the following objectives:

1. To analyze and summarize globally all the methodological and procedural frameworks on preparing the integrated reports on the basis of functioning of the unified or separate accounting systems;
2. To propose a structure for the system of coherently integrated accounting;
3. To determine the "points of growth" of methodology development for integrated reporting and the practices of applying the concept of integrated reporting;
4. To develop and recommend a road map of the process of preparing the integrated reporting for agricultural holdings (to determine the logical structure, procedures, objects, forms, means, methods, results of the accounting and control process and the timing to implement the project: phases, stages, steps).
5. To recommend actions to develop the methodology organizing the system of preparing and forming the process of integrated reporting for the medium-term period (3 years): the structure of the report, accounting policies, technical regulations, chart of accounts, workflow, technique for information correlation, a formal system to collect data, registers, data verification.

Materials and methods

The key issue to implement effectively integrated reporting project is a qualitative justification of a common methodology to form a single, unified reporting (principles, norms for sustainable functioning of the accounting system of the agricultural holding, which help to obtain the required data format).

We use a conceptual approach as the main research method; to implement it we analyze the phenomena and processes associated with the process of preparing integrated reports, as well as reveal a complex of their elements and relationship between the constitutive elements of the integrated reporting concept. It is important to introduce the character and the limits of the interactions and to determine the processes of convergence of data from different accounting systems. The method is based on observation, analysis and synthesis of theoretical opinions on the research topic.

The second approach, constituting a single complex, is a formal one that promotes establishing strong connection between the elements of coherently integrated accounting through formalized algorithm organizing the system. A formal methodology for the preparation of integrated reporting is closely related to the analysis of research methods from the point of view of logical structure and formalized approaches to the construction of the theoretical knowledge, its truth and reasoned argument.

Methodology of integrated reporting

In the research process, we conducted a review of all legal documents on integrated reporting in the global and national scale and presented the author generalization of the methodological principles to prepare the first set of integrated reporting (Table1). While implementing, the project of integrated reporting should be consistent with the action plan based on the International Integrated Reporting Framework (IIRF) methodology, the methodological recommendations to be practically applied in a more effective way. The methodological aspects of organizing the system of integrated reporting for agricultural holdings have their own specifics, as different industries have different business models, business strategies and the mechanisms of value creation.

Normative documents (standards)	Brief description
Conceptual framework of IIRF (International Integrated Reporting Framework)	Helps companies supplying financial capital to explain how they create value over time
The CDP information requests (Climate change, deforestation, water, supply chain management)	Application of information disclosure for management purposes helps to measure, manage and reduce negative impacts on the environment and increase sustainability of the business, providing high quality of information on the market
The CDSB guidance on the limits of the report disclosing environmental information and the composition of natural capital (the approach to information in a single report)	Assisting the holdings in preparing and presenting the environmental information in the integrated reports to ensure consistent, comparable and accurate formation of relevant information for investors (natural based capital; environmental performance; environmental risks)
Accounting standards adopted by FASB (Financial Accounting Standards Board)	Establishing and improving standards for financial accounting and reporting that foster financial reporting on nongovernmental entities to provide investors and creditors with useful information (so called GAAP)
The GRI methodology (Sustainable Development Reporting Guidance) and G4 (sector of information disclosure)	Recommendations for all companies (regardless of size, industry or location) - to provide information in the field of sustainable development, i. e. significant information.
For example: 1) Human capital	Conditions of employment, relationships in the team, management, labor safety, training, education, equal opportunities, labor practices, human rights, investment, processing complaints mechanism
2) Social communication and capital	Economic performance, market presence, indirect economic impacts, procurement practices, local communities, anti-corruption measures, public policy, norms compliance, processing complaints mechanisms, marketing communications
3) Natural capital	Materials, energy, water, biodiversity, emissions, sewage waters and wastes, products and services, norms compliance, transport, audit company (environmental assessment), environmental complaints
International Financial Reporting Standards	Providing high quality, transparency and comparability of financial information to investors, associating global capital markets, promoting stability of the capital market
Standards of management accounting (Institute of Management Accountants (IMA))	Allow the company to apply standard approaches to calculating the cost of production and sales, developing and implementing accounting policies and systems of cost management
Standards of social responsibility (ISO 26000)	Give instructions on how holding companies can operate in a socially responsible manner
Sustainability in the public sector (accounting standards)	Assistance to state corporations in disclosing information about the resistance in SEC mandatory documents, e.g. 10-K and 20-F

Source: Brožová (2009), Higgins (1952), International standard on the integrated reporting, Medvedev (2015)

Table 1: Methodological principles to form the first set of integrated reporting for holding company.

Results and discussion

The concept of integrated reporting has been occupying the first pages of the world professional accounting journals. Integrated reporting (IR) brings together financial and non-financial information and reflects the organization's ability to create and sustain its value in the short, medium and long term (Cheng et al., 2013, Dhaliwal et al., 2011, Eccles et al., 2011). Jim Singh, CFO of Nestle, said that "...if you need to improve the credibility of your company in the long run, then integrated reporting is your choice " (Integrated reporting Discussion Paper, 2011).

Integrated reporting was firmly on the agenda at the World Congress of Accountants 2014 in Rome. All panelists described the benefits their organizations had experienced through integrated thinking and reporting.

For example, Mr. Holland spoke enthusiastically about Integrated reporting being a bridge to investors for Gold Fields, and its importance in attracting a wider investor base (Tomorrow's Business Success, 2014). Neil Stevenson, Managing Director of Global Implementation at the IIRC has written a blog about the Congress and how it paves the way to adoption of IR (Stevenson et al., 2014).

These illustrate a shift in outlook in business towards a wider concept of value creation – a theme echoed by a number of speakers. They also reflect the reality of today's business, as summarized by IIRC CEO, Paul Druckman, who said that "speed and interconnectedness are norms in business

today". Business needs to respond by planning to achieve long-term outcomes while managing the short term (Druckman et al., 2014).

Integrate: Doing Business in the 21st Century, written by Professor Mervyn King, Chairman, IIRC, and Leigh Roberts, South African Institute of Chartered Accountants, sets out the new corporate tools that businesses should be using. As described by the authors, Integrate "is about why doing business in the 21st Century is different and the challenges and opportunities this presents to companies. It scrutinizes the contents of the existing corporate toolbox and offers suggestions for new tools". Integrate brings to life the four corporate tools that businesses should be using in the 21st century: stakeholder relationships, corporate governance, integrated thinking and the integrated report (King et al., 2014).

George Serafeim, Harvard Business School, in the paper shows that investor activism on environmental or social issues or a large number of concerns about a firm's environmental or social impact leads a firm to practice more IR and that this investor or crisis - induced IR affects the composition of a firm's investor base. Finally, firms that report more information about the different forms of capital or follow more closely the guiding principles as described in the IR Framework of the IIRC exhibit a more long-term oriented investor base (Ioannou and Serafeim, 2014). It has been shown that these problems can actually be solved by the development of accounting registers, corresponding to the requirements of the existing legislation in the Republic which allow to fully take into account the economic activity of small businesses (peasant (farm) enterprises, limited liability partnerships, co-operatives. (Iacondini, A. at all.) The issue of a methodology of reporting also addresses Bayboltaeva at all., Brožová and Iacondini at all.

Koichi Kaneda, Senior Director Pharmaceutical Company, discusses how the company got involved in Integrated Reporting, and some of the hurdles they have passed on way. Diana McEwan, Corporate Communications Manager Stockland, discusses how IR can bring value creation to life (IR Yearbook, 2014).

Sabina Ratti, Sustainability Senior Vice President at energy firm Eni, explains why, to her, corporate reporting without IR is like trying to understand.

Delivering the 2014 Richard Dimbleby Lecture, Christine Lagarde focused on "the breakneck pattern of integration and interconnectedness that defines our time".

Research led by Professor Gillian Yeo from Nanyang Business School, Singapore, explored the relationship between effective adoption of IR and corporate valuation. Integrated reporting and corporate valuation examined the results of early adoption in South Africa and found that, "In essence, holding other factors constant, if a firm improves in its IR score across time, it is likely to experience an increase in market valuation" (EY's Excellence in Integrated Reporting Awards, 2014).

Financial accounting, even when recognized for its vital importance to records and controls, is not so used as a managing tool. Having set this stage, it becomes important to check the relevance given to costs systems by the small companies, once the lack of its use may cause the companies to be vulnerable to the global competition. (Zamberlan, C. O.; Zamberlan, J.F. 2009)

Thorsten Pinkepank, Director Sustainability Relations at BASF, talks about the report trilemma of materiality, comparability and audience. Reporting companies find themselves in a colorful landscape of codes, frameworks, indicators. Many of these companies – not only SMEs – are concerned and overburdened by this complexity. Many discussions are summed up with one thing most agree on: the need for "alignment" of the different frameworks or approaches, which suggests principles or indicators.

Having analyzed the materials of the International Integrated Reporting Council and the best practices of application of the International standard for integrated reporting we present all significant results in Table 2.

Accounting system of the holding company is understood here as a combination of types of accounting (financial, managerial, non-financial), correlated with unity of coherent "growth points" that form the basis of the International standard for integrated reporting (capital: human, manufacturing, natural, social, etc.; business strategy; business model; mechanism of value creation) (Melikhov, Perepelkina et al., 2014) (Figure 1).

Presented principles generate relevant and pertinent information for stakeholder groups. During project implementation, it is important to observe the principle of expediency, i.e. the expenditures for the project should not exceed the effect of the system operation and formation of the reports

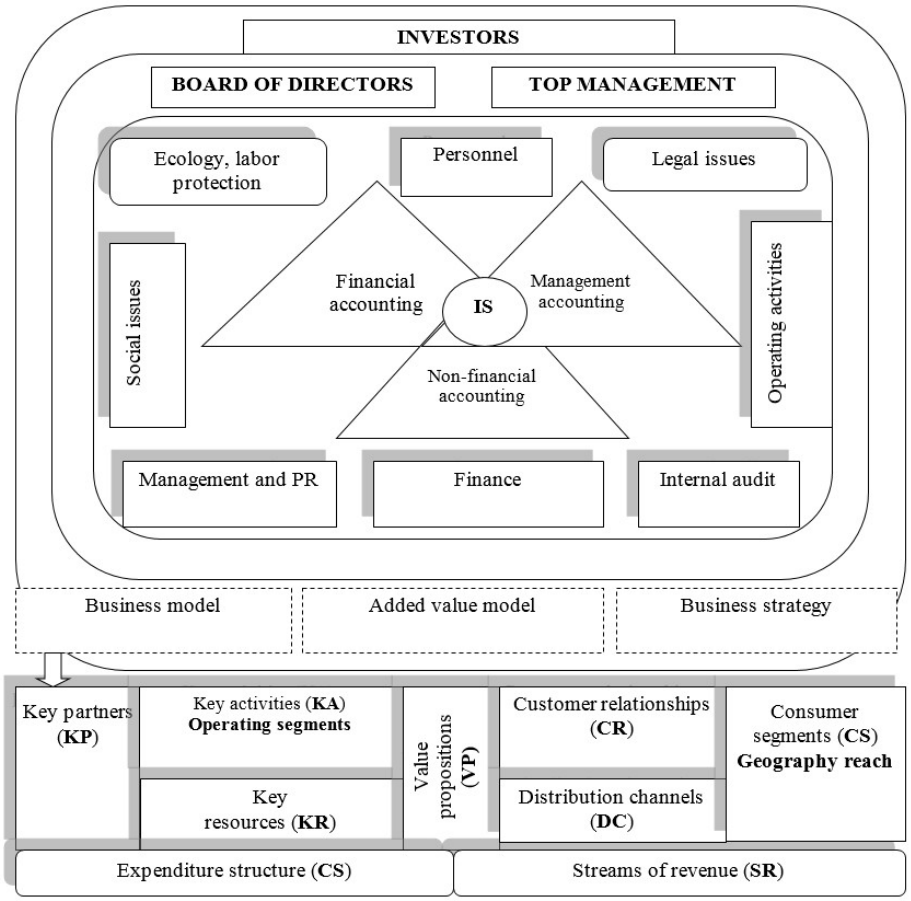
Growth point	Year	An example of the application practice
IIRC Pilot Programme launches	October 2011	
Microsoft's Bob Laux: CFOs should care about IR	December 2011	
	January 2012	Indra Annual Report 2011
	March 2012	ARM Annual Report 2011
Regional IR Americas meeting	August 2012	
Yearbook released	September 2012	Launch of Emerging IR Database
	October 2012	Gold Fields Annual Review 2012
Research shows positive impact of IR	November 2012	
Investor Network gives backing for IR	December 2012	National Australia Bank Annual Review 2012
FREUND's planned approach to IR	January 2013	Stockland Annual Review 2012
- Why IR matters to US company Clorox	May 2013	Transnet Integrated Report 2013
- DBS Bank: IR from buy-in to benefits		
Why Telefonica has committed to IR	July 2013	Investors critique reports of companies moving to IR
Third IIRC Pilot Programme Conference	September 2013	New book offers practical guidance
IIRC Pilot Programme 2013 Yearbook	November 2013	
CFO of New Zealand Post backs IR	December 2013	Aegon's 2013 Integrated Review
		Entergy Integrated Report 2013
		Itaú Unibanco Integrated Report 2013
		Munich Airport's reporting approach
		Strate Integrated Report 2013
		Novo Nordisk Annual Report 2013
The CEO of CPFL Energia on the importance of an integrated view	January 2014	The Crown Estate Annual Report and Accounts 2013
		DBS Annual Report 2013
		Eskom Integrated Report 2014
EnBW on aligning internal stakeholders	February 2014	Eni Annual Report 2013
Research: IR and corporate valuation	April 2014	New Zealand Post Group Annual Review 2014
New research reveals 'what good looks like'	June 2014	BASF: the trilemma of reporting
IR Technology Initiative announced	September 2014	
The Global Commission on the Economy and Climate calls for IR	November 2014	
Governor of the Bank of England endorses IR	January 2015	World Congress of Accountants paves way to adoption

Source: Bavboltayeva et al. (2015), Dhaliwal et al. (2011), Putin (2015), Serafeim (2014)

Table 2: Growth points for developing the integrated reporting methodology and practices of applying the concept.

for the company management and the stakeholders. The effect depends on the quality of managerial decision-making based on the information in the reports.

In this context the roadmap is understood as the phased plan of organizational and methodical actions in order to form a coordinated (coherent) vision of progressive accounting and analytical technologies, new tools and standards for financial, managerial and non-financial accounting, new forms and configurations of reporting, potential stakeholders (interested users), the impacts of implementing the integrated accounting as well as forecast of formation and presentation of new reporting for industrial and agricultural holdings in the Russian Federation. Roadmaps formation, in our opinion, makes it possible to clarify the goals of the holdings in the field of corporate public reporting and to identify the ways of achieving them. To solve the above-defined purpose we set the task to develop and present a roadmap to organize the system of integrated reporting, i.e. to provide clearly (visually and in informative way) step-by-step scenario of development of the system of coherently integrated accounting resulted in the formation of a set of integrated reporting. The action plan is based on modern standards regarding international integrated reporting and best practices of the application of these rules. We consider



Source: Bavboltayeva et al. (2015), Dhaliwal et al. (2011), Putin (2015), Serafeim (2014)

Table 2: Growth points for developing the integrated reporting methodology and practices of applying the concept.

AVERAGE DURATION OF THE PROJECT IMPLEMENTATION IS 14 MONTHS

	PHASE 1	PHASE 2		PHASE 3
	Preliminary stage	Project management	Components assessment and decision-making	Transition	Implementation of changes
MAIN TASKS	- Assessment of the impact of the transition to the IIRF on the financial reporting -Assessment of the impact on management processes -Assessment of resources; -Adoption of the requirements of financial reporting external users;	-Project management structure; -The appointment of the project team, assigning responsibilities, developing training strategies; - Finalization of project plan and discussion of the project strategy	-Development of accounting policies and making decisions on complex issues, the choice of alternative accounting options -Developing reporting templates, conducting component analysis to determine adjustments	-Calculation of IIRF adjustments -Collecting information for disclosures - Preparing reports on IR -Analysis of the results	- Training -A systematic approach to collecting information -Development of procedures for reporting/ implementation of system changes -Implementation of changes in business processes
ACTIONS	- To combine units into a single structure; approach to the cost price formation - Inventory control of balances - Scheduling organization of accounting, technical regulations; - Calculation of economic efficiency of integration	-Development and implementation of a unified scheme of accounts -Unification of accounting records, internal management reports, accounting policies -Centralization and automation of accounting	-Methodological framework -Assessment of the impact on the reporting format, business processes and systems -Optimal procedure of workflow; -Building a system of timely closing of accounts	- Selecting format of data acquisition - Performers assignment -Options of structural units and delegation of responsibilities	- Development of manuals and trainings - Justification of the first transition to the IIRF reporting - Developing internal methodology of verification reporting
RESULT	Recommendations on the content and strategy of the project reporting, detailed plan Preliminary analysis of the impact on reporting -General structure of the project	-Developing the concept of report preparing management -Coordination of the project strategy	Accounting policy in accordance with IIRF -Determination of the adjustments list; -Template of reporting in accordance with IIRF - Preparing financial reporting in accordance with IIRF	IIRF - reporting for 1 year -Assessment of the impact on business processes	The mechanism of reporting preparation in accordance with IIRF and the process of its verification
Period	**6 weeks**	**12 weeks**	**16 weeks**	**12 weeks**	**10 weeks**

Source: own processing.

Figure 2: Road map" for the process implementation concerning formation of the integrated reporting.

the following elements of road mapping: a separate integrated report, group of reports (first and second volumes), the accounting policy to form integrated reporting, groups of accounting and analytical, control technologies, timelines, and business units that form reports.

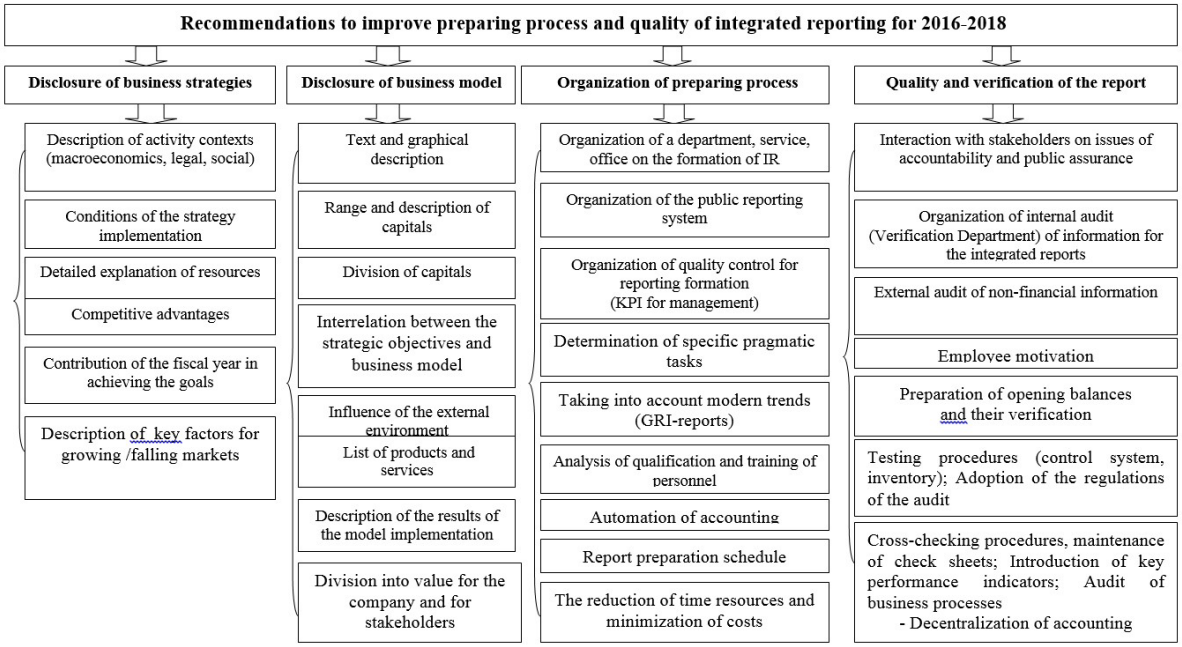
The main objective of the actions for the main stage (phase 2) on organizing coherently integrated accounting is the unification of financial accounting data (based on Russian accounting standards, IFRS, IAS, PISC), according to traditional national standards (e.g. US GAAP), with the management accounting system and the system of accounting other (non-financial) information. This implies developing and adopting a uniform chart of accounts of coherently integrated accounting, optimizing single for all units (components) of the agroholding account registers, reference books of analytics of revenue and expenses, internal management reports. Thus, it is important to develop an accounting policy for the purposes of the coherently integrated accounting, unifying preliminarily principal statements of accounting policies of the component companies (financial accounting, management accounting, and financial accounting). In our opinion, it is the base for correct (performing settings) converting of the national accounting data (or IFRS) in the chart of accounts according to coherently integrated accounting.

To solve the set tasks within phase 2 (road map) we have identified two processes: 1. Determining report content (volume of recommended procedures; team building; defining the content of the sections and subsections of the report); 2. Text preparing process (development of the report structure; mechanism for the collection of information; procedures for preparing the report).

In order to implement effectively the process of preparing single reports, it is important to observe the following conditions: a) the company operates in the field of sustainable development, thus the management supports the initiatives of sustainable development trend; b) the company is engaged in non-financial accounting; c) the employees understand the strategy and business model and have the opportunity to define essential aspects of the company; d) taking into account key performance indicators (financial and non-financial) at the company level; e) identifying its stakeholders and understanding their interests and needs; f) organizing the formalized system of data collection, including non-financial indicators in all segments.

At the same time the verification of the process, completeness and accuracy of the information, i.e. the fact of internal audit of non-financial data and interaction with stakeholders in the reports preparing process (feedback) is of high priority. Specifying the final stage of organizational activities, it is noteworthy that structures carrying out the verification of the content of coherently integrated report are to be provided with the justification of the first transition to a system of coherently integrated accounting and reporting (submission of the orders on transition to the IIRF (concept of international standard on integrated reporting), accounting policies, annual assessments of assets and liabilities (estimated values), books of transformational amendments, methodological basis of differences.

This article presents the author recommendations to overcome the complexities of reporting preparation and ways to improve the methodology (Figure 3). We believe that the efficiency of the coherently integrated accounting system is directly affected by creating an optimal workflow procedure, forming a timely closing of the accounts, the flexibility of a formalized system of data collection. Progressive system of organizing accounting for agroholding involves the introduction of electronic document management system, which is to raise the level of interaction between the employees, as well as segments of the group. The main aim is to reduce the time of approval, execution of accounting and control procedures, to eliminate delays and loss of primary documents, to comply with the closing reporting deadlines, to prevent instances of fraud or errors that leads to the quality improved and correlation of accounting. The recommended procedures reduce delays in reporting preparing over the medium term and improve cross-functional interaction.



Source: own processing.

Figure 3: Recommendations to improve preparing process and quality of integrated reporting over the medium term.

Conclusion

Preparing the integrated reporting is currently one of the most significant trends in the sphere of information disclosure regarding the activities of agricultural holdings. Its emergence and development arose from the gradual change of approaches to the assessment of businesses value and to identifying the factors of their long-term sustainability. Preparing integrated reporting gives companies the advantages, however, its implementation is rather difficult.

The transition to integrated reporting will require significant transformations, efforts and costs from the company through the following processes:

- Organization of internal communication and motivation of employees as part of the reporting process;
- Review of corporate documents and business processes;
- Improvement of the methodology to prepare IR;
- Ensuring the functioning of formalized system of information collection and improving the risk management system.

Preparing integrated reporting the holdings obtain a number of benefits, including developing clearer understanding of business model and ensuring the effectiveness of business processes, as well as increasing the confidence of investors and other stakeholders, strengthening relations with them.

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Augmented Reality As a Working Aid for Intellectually Disabled Persons For Work in Horticulture

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Anotace

Hlavním zaměřením tohoto článku je experimentálně ověřit možnosti využití rozšířené reality jako platformy pro zobrazování vzdělávacích materiálů z oblasti zahradnictví v reálném prostředí pro osoby s mentálním postižením. Experimentálního ověření se zúčastnilo osm osob s různou úrovní mentálního postižení. Účastníkům byl předložen vzdělávací materiál ve formě videa, který byl dosažitelný pomocí platformy Wikitude na základě specifických GPS souřadnic. K nalezení a zobrazení obsahu účastníci využívali zařízení iPad2 a Android tablet. I přes velký potenciál technologie rozšířené reality nelze na základě provedených šetření v současné době tento způsob vzdělávání pro osoby s mentálním postižením doporučit.

Klíčová slova

Přístupnost, rozšířená realita, mentální postižení, zahradnictví.

Abstract

The main focus of this article is to verify experimentally the possibility of using Augmented Reality as a platform for display educational materials in the field of horticulture in the real world for people with intellectual disabilities. Experimental verification was attended by eight people with varying levels of mental disability. The educational material was presented to the research participants in the form of a video, which was accessible via Wikitude platform based on the specific GPS coordinates. To find and display the content, participants used iPad2 and Android tablet devices. Despite the great potential of Augmented Reality technology, on the basis of undertaken studies it is still not possible to recommend this type of education for people with intellectual disabilities.

Keywords:

Accessibility, Augmented Reality, intellectual disability, horticulture.

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Introduction

The main motive for the verification of educational possibilities for people with intellectual disabilities for work in horticulture using Augmented Reality is to support their work activities in real environment and to help address better certain specifics of the mental processes for this group of employees by use of Augmented Reality. Valenta and Müller (2003) divide the specifics of mental processes of mentally disabled persons as follows:

- Thinking - is hampered by excessive concreteness, inaccuracies and mistakes in analysis and synthesis. It is incapable of higher abstraction, thinking is inconsistent concepts are created ponderously, judgments are inaccurate;
- Memory – they acquire new knowledge slowly and only by multiple repetitions, they quickly forgetting and are unable to assert new knowledge into practice on time;
- Attention - shows a low range of the reference field, instability and ease fatigue;
- Will - specific feature is a failure of will, indecision, lack of will, reduction of free activities, the inability to commence their operations.

By supporting this idea there are also general economic and social reasons. Černá (2009) finds the long-term care more expensive than supported independence and meaningful work. Even low paid employment or part-time job gives a person with mental disability status of the adult who contributes to the society and this employment also efficiently stimulates and maintains its skills and habits.

According to the information published by Tyrychtr et al. (2015) agribusiness could have enough power to support this group of employees: As to the investments to IT, there is a positive rating of the level of information technologies in agribusiness. Most of expenditures on hardware are now directed to mobile technologies.

Thanks to the positive outcome, the support workers were very enthusiastic with the beneficial effects of the touch screen, in particular, the increased attention span and the fact that the students with moderate intellectual disability could act on the computer. Students with moderate intellectual disability often had motor skill deficits that hampered them from manipulating the computer mouse. Because of having the touch screen, their movements did not need to be very precise (Denaes, 2012).

According to the conducted research and in comparison with scientific publications (Huguenin, 2000; Van de Ven and de Haan, 2003; Denaes, 2012; Benda and Šmejkalová, 2015) can be mentioned touch screen as the most suitable technology for controlling web applications by persons with mental disabilities, so these people are able to use and navigate simple mobile learning environment. Goksu and Atici (2013) ads that using mobile learning environment gives learners an opportunity to access the information whenever and wherever they want. Therefore, mobile devices which are sometimes criticized as one of the learning tools and which are developing in extend of size and features have recently been used intensively and they have increased the effectiveness of learning environments. It is also predicted that Augmented Reality will develop and it will increase the efficiency of mobile learning, and also it will be very common in educational institutions.

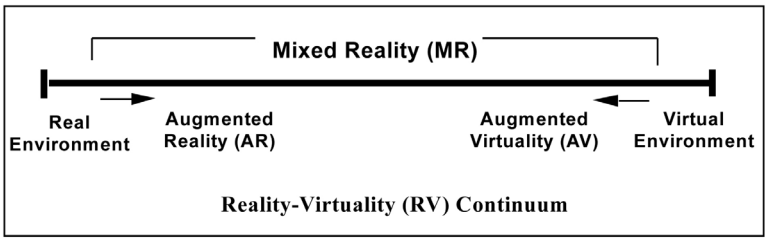
Gomez et al. (2015) and Hervas et al. (2014) presented a novel wayfinding system adapted for people with cognitive disabilities with use of Augmented Reality. The path planning and presentation have been specifically developed to meet their needs. Therefore, instead of showing complex instructions on maps, it was decided to break down the route into atomic instructions and make use of images at the decision points.

Materials and methods

Augmented Reality is still a new concept and it is not commonly used by general public despite the fact that it has been described in the nineties already (Azuma, 1997; Bimber and Raskal, 2005; Schmalstieg and Wagner, 2007). This fact can be confirmed also in 2015. Despite the high expectations, the Augmented Reality technology is still not used massively.

Milgram and Kishino (1994) defined a continuum of real-to-virtual environments, in which Augmented Reality is one part of the general area of mixed reality, shown in Figure 1. In both augmented virtuality, in which real objects are added to virtual ones, and virtual environments (or virtual reality), the surrounding environment is virtual, while in Augmented Reality the surrounding environment is real.

Augmented Reality enhances a user's perception of and interaction with the real world. The virtual objects display information that the user cannot directly detect with his own senses. The information conveyed by the virtual objects helps a user perform real-world tasks (Azuma, 1997).



Source: Milgram and Kishino, 1994

Figure 1: Mixed Reality continuum.

Lyu et al. (2005) state Augmented Reality as a variation of Virtual Reality as it is more commonly called. Virtual Reality technologies completely immerse a user inside a synthetic environment. While immersed, the user cannot see the real world around him. In contrast, Augmented Reality allows the user to see the real world, with virtual objects superimposed upon or composited with the real world. Therefore, AR supplements reality, rather than completely replacing it. Ideally, it would appear to the user that the virtual and real objects coexisted in the same space.

Bimber and Raskar (2005) extend this assertion in the contrast to traditional Virtual Reality. In Augmented Reality the real environment is not completely suppressed, instead it plays a dominant role. Rather than immersing a person into a completely synthetic world, Augmented Reality attempts to embed synthetic supplements into the real environment (or into a live video through the camera of the real environment).

For the assessment of Augmented Reality use appropriateness in terms of working aid for intellectually disabled persons for work in horticulture platform Wikitude was chosen. The second platform who was also been tested was Layar. Wikitude currently offers a comprehensive all-in-one SDK - Software Development Kit, including vision-based as well as location-based augmented reality platform for Android, iOS, Cordova, Xamarin, and others.

Both compared platforms allow views of the real world, supplemented by virtual information using a mobile device. Virtual information is supplemented with GPS position where should be displayed the requested supplementary information. On the specified GPS coordinates the user is able to see, through the mobile camera view and the necessary application software, not only the real world, but the real world complemented with the virtual information. Both platforms allow to create own applications and virtual layers using paid SDK. For testing by the research participants it was important to offer them final appearance of the user interface without the need for the development of extensive application.

Wikitude platform allows the user to create a simple virtual layer through integration with established user profile. Therefore it was selected for testing.

Currently, August 2015, it is also the world's most widely used platform for Augmented Reality and the world's leading augmented reality SDK (Wikitude GmbH, 2015). The whole testing was performed under the Wikitude trial license.

Results and discussion

Through the creation of several virtual points, that have been placed by GPS coordinates into the area of the Department of Horticulture CULS - at Experimental and Demonstrational Station in Troja – Podhoří, there was tested the ability to view teaching materials using web based Wikitude application on the iPad2 and Android tablet Asus Transformer. Four virtual points were located in places where gardening activities has been taught and also in places intended for the verification of participants capabilities. When the participant stood on the specified location and looking through a camera of a tablet, on the display there was shown real view enriched by the virtual pictogram with reference to the educational material on the web. The required material is possible to trigger by clicking the pictogram on the virtual display, or subsequently in an internet browser.

Research was regularly attended by eight participants. Research participants were people with varying levels of mental disability. In all cases, these people permanently live in nursing homes or centers for persons with disabilities, they are not currently employed anywhere and within therapeutic activities they work in sheltered workshops, etc. The research was carried out on the same sample of people as in the case of article (Benda and Šmejkalová, 2015) Web Interface for Education of Mentally Disabled Persons for Work in Horticulture.

Interface has been selected on the basis of the conclusions of the same article (Benda and Šmejkalová, 2015):

- The education of mentally disabled persons is based on a continuous exchange of information highlighted by pictograms;
- Touch screen is the most suitable technology for controlling the web page or application.

It was also important to decide what kind of navigation items should be used. Based on prior research (Benda and Šmejkalová, 2015) it can be stated that the image navigation represented only by pictograms is groping whether the pictogram truly represents the desired horticultural operation. By combining this type of navigation with the text description all participants proved the best results. Correct orientation in the navigation consisting of the finding of learned pictogram

and verifying the correctness also via text label. In this case all participants pressed intended navigation pictogram without hesitation. All participants correctly identified pictogram as a navigation item and pressed it. Performed observations and measured values show that the most appropriate form of an interface in the form of navigation is the use of pictograms with descriptive text label.

The following figure shows a draft of the application solution using the platform Wikitude. On selected GPS coordinates there has been placed a pictogram of gardening activity with a label. After clicking the pictogram it was possible to play a short video with instructions. The same pictograms are used throughout the whole educational process and knowledge evaluation.

Wikitude SDK (Wikitude GmbH, 2015b) code example appears as follows:

```
//POI definition
var myJsonData = [{
    "id": "01",
    "longitude":"50.1218689",
    "latitude":"14.400049",
    "description":"Hrabání",
    "altitude":"189.00000",
    "name":"Hrabani",
        "video":"http://kitlab.pef.czu.cz/~bendap/ar/
        hrabani.mp4",
        "imgDrawable":" http://kitlab.pef.czu.
        cz/~bendap/ar/hrabani.jpg"
}
];
// implementation of AR-Experience (aka "World")
var World = {
// true once data was fetched
initiallyLoadedData: false,

// different POI-Marker assets
markerDrawable_idle: null,
markerDrawable_selected: null,

// list of AR.GeoObjects that are currently shown in
the scene / World
markerList: [],

// The last selected marker
currentMarker: null,

//calledtoinjectnewPOIdataloadPoisFromJsonData:
function loadPoisFromJsonDataFn(poiData) {
        // empty list of visible markers
        World.markerList = [];
        // start loading marker assets
        World.markerDrawable_idle = new
        AR.ImageResource("assets/marker_idle.
        png");
        World.markerDrawable_selected = new
        AR.ImageResource("assets/marker_
        selected.png");
        // loop through POI-information and create
        an AR.GeoObject (=Marker) per POI
        for (var currentPlaceNr = 0; currentPlaceNr
        < poiData.length; currentPlaceNr++) {
                var singlePoi = {
            "id": poiData[currentPlaceNr].id,
            "latitude":
            parseFloat(poiData[currentPlaceNr].
            latitude),
            "longitude":
            parseFloat(poiData[currentPlaceNr].
            longitude),
            "altitude":
            parseFloat(poiData[currentPlaceNr].
            altitude),
            "title": poiData[currentPlaceNr].
            name,
            "description":
            poiData[currentPlaceNr].description
"video":poiData[currentPlaceNr].video,
"url":poiData[currentPlaceNr].url
        };

        /*
To be able to deselect a marker while the user taps on the empty screen, the World object holds an array that contains each marker.
        */
                World.markerList.push(new
                Marker(singlePoi));
}
        World.
        updateStatusMessage(currentPlaceNr
        + ' places loaded');
}, …
```

The results of Augmented Reality utilization were not satisfactory. This form of material distribution

Source: own processing

Figure 2: Draft of the application solution.

was confusing for participants, and the need to orient themselves in space through the screen of the iPad2 or Android tablet was also very demanding. None of the research participants could view the material exposed in the form of a virtual point and use it effectively. The need to focus on the required operations outweighed own perception of distributed content. Interface and display method of Augmented Reality content should be considered not only in terms of accessibility, but also usability with more focus on each individual.

Usability test depends heavily on each individual user background, information literacy and previous experience with similar web applications. Without proper testing subject selection, it can provide vastly distorted results (Šimek, Vaněk and Pavlík, 2015).

Another issue is the possibility of automatic functionality to start the content based on GPS position only without requiring to trace the pictogram or a combination of both solutions.

Conclusion

Despite the great potential of Augmented Reality technology it is still not possible to recommend this type of education for people with intellectual disabilities for work in horticulture to support their work activities in real environment. On the basis of undertaken studies, this form of navigation in real environment is still too demanding and confusing for the most of research participants. But there is still scope for new research. E.g. creation of an application for mobile devices according to the principles of WCAG 2.0 accessibility methodology and to the principles of usability that would directly display needed material without requiring to control it manually. This kind of approach would allow the user easier orientation in space and easier handling the device. It is also possible to try other ICT for display Augmented Reality.

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Market Power in the European Dairy Industry

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Anotace

Článek je zaměřen na analýzu tržní síly na trhu mléčných výrobků. Konkrétně článek identifikuje tržní sílu zpracovatelského trhu mléka ve 24 zemích Evropské unie. Analýza tržní síly je založena na tzv. mark-up modelu a aplikaci přístupu stochastické hraniční funkce. Výsledky prokazují tržní selhání na zpracovatelském trhu mléka v Evropské unii. Zmíněné zneužití oligopolní tržní síly není v průměru velké. Mezi analyzovanými zeměmi však existují významné rozdíly. Rozdělení tržní síly je sešikmené směrem k nižším hodnotám, což znamená, že většina společností disponuje nízkou nebo téměř žádnou tržní silou. Na druhou stranu zde však existují i společnosti (okolo 10 %) se značně vysokou tržní silou.

Klíčová slova

Mléko, tržní síla, oligopol, SFA, Evropská unie.

Abstract

The paper presents an analysis of market power in the output milk-processing market. In particular, the paper identifies market failures in the output milk-processing market in 24 EU member states. The analysis is based on a mark-up model and the application of stochastic frontier methodology. The results show that market failures are pronounced on the EU output milk-processing market. However, the abuse of oligopoly market power is not large on average, despite the fact that we can find significant differences among the countries. The mark-up distribution is skewed toward lower values. That is, the majority of companies are characterized by only a small or almost no degree of market power; however, there are companies (about 10 %) with considerably high oligopoly market power.

Keywords:

Milk, market power, oligopoly, SFA, European Union.

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Introduction

Market power is defined as the ability of a firm or group of firms to raise the price of a good or service above the competitive level (Kutlu and Sickles, 2012). Morrison Paul (2001) added that evaluating market power involves modelling and measuring the difference between market price and marginal factor cost for inputs (mark-down), or price and marginal cost for outputs (mark-up). Since 1980 there have been numerous studies based on a New Empirical Industrial Organization theoretical background focused on detecting market power or, in general, market imperfections in the agricultural or food-processing market, as the case may be. Most of these studies are based on the Lerner index (Lerner, 1934). Nevertheless, Kumbhakar et al. (2012) point out several weaknesses of this approach, namely the optimization errors, possibility of negative market power, assumption of constant returns to scale and price data requirement. Another approach for measuring market power is to estimate a conduct parameter rather than use the Lerner index (Kutlu and Sickles, 2012, Muth and Wohlgenant, 1999). This approach uses a conjectural variations

approach and treats the conduct as a parameter to be estimated. Finally, Kumbhakar et al. (2012) introduced an approach based on stochastic frontier analysis.

The results of previous studies mostly found that food processors have oligopsony market power (e.g. Morrison Paul, 2000), but there are also studies which failed to find any evidence of oligopsony power (e.g. Muth and Wohlgenant, 1999, Perekhozhuk and Grings, 2006) or found only weak oligopsony power (Scalco and Brage, 2014). Moreover, McCorriston (2002) concluded that food markets are now more typically oligopolistic. Studies using firm-level data are not so numerous and include, for example, Hockmann and Vöneki (2009), Bakucs et al. (2009), Perekhozhuk et al. (2013) and Acharya et al. (2011).

This paper extends the above-mentioned studies on the analysis of market imperfections. The aim is to conduct a comparative analysis among the EU member countries and identify the degree of market imperfections in the output milk-processing market. In particular, the paper addresses the following research questions. The first question concerns market imperfections in the output milk-processing market. The aim is to identify the degree of oligopoly market power. The second question relates to the country specifics, especially whether output milk-processing markets differ significantly among EU countries, and what the development is in the analysed period.

The paper is organized as follows: the Materials and methods section presents the estimation strategy and describes the data set; the Results and discussion section presents the results of the mark-up model and the relative mark-up in EU member states; and the Conclusions section contains concluding remarks.

Materials and methods

The research questions will be addressed by estimating a mark-up model and employing stochastic frontier methodology. The mark-up model is derived from the standard profit maximization problem. The solution of the optimization problem results in product price equalling marginal costs for a competitive market, and price exceeding marginal costs for a non-competitive (oligopolistic) market:

$$p \geq \frac{\partial C(\mathbf{w}, y_i, t)}{\partial y_i}, \tag{1}$$

where p is a price of output (product), Y is an output, and C stands for total costs.

If we multiply relation (1) by the share of output on total costs, we can write:

$$\frac{p \cdot y}{C} \geq \frac{\partial C(\mathbf{w}, y_i, t)}{\partial y_i} \cdot \frac{y}{C} = \frac{\partial \ln C}{\partial \ln y}, \tag{2}$$

The inequality can be transformed to an equality by adding a non-negative, one-sided error term (u), i.e. u represents a measure of market failures – relation (3). Then, relation (3) can be estimated using stochastic frontier methodology. The stochastic frontier approach for detecting the degree of monopoly power was first introduced by Kumbhakar et al. (2012).

$$\frac{p \cdot y}{C} = \frac{\partial \ln C}{\partial \ln y} + u, u \geq 0, \tag{3}$$

Relation (3) asks for estimation of the first derivative of the cost function. If the database does not contain prices, the duality theorem can be employed, and the first derivative of the input distance function can be estimated instead (Kumbhakar et al., 2012):

$$\frac{p \cdot y}{C} = \frac{\partial \ln C}{\partial \ln y} + u = \frac{\partial \ln D^I}{\partial \ln y} + u, u \geq 0, \tag{4}$$

Assuming that the input distance function has a translog form:

$$\ln D^I = \alpha_0 + \alpha_t t + \frac{1}{2}\alpha_{tt} t^2 + \alpha_y \ln y + \alpha_{yt} \ln y t + \frac{1}{2}\alpha_{yy} (\ln y)^2 + \boldsymbol{\alpha}_x' \ln \tilde{\mathbf{x}} + \boldsymbol{\alpha}_{xt}' \ln \tilde{\mathbf{x}} t + \frac{1}{2} \ln \tilde{\mathbf{x}}' \mathbf{A}_{xx} \ln \tilde{\mathbf{x}} + \ln \tilde{\mathbf{x}}' \mathbf{A}_{xy} \ln y \tag{5}$$

where $\tilde{x}_j = {}^{x_j}/_{x_J}$ for $j=1,...,J-1$, are normalized input quantities and T is a time variable, then adding a variable capturing the statistical noise (v), we get:

$$\frac{\partial \ln D^I}{\partial \ln y} = \alpha_y + \alpha_{yt} t + \alpha_{yy} \ln y + \boldsymbol{\alpha}_{xy}' \ln \tilde{\mathbf{x}} + u + v, \tag{6}$$

That is, the model estimated in the empirical part has the form:

$$\frac{p \cdot y}{C} = \alpha_y + \alpha_{yt} t + \alpha_{yy} \ln y + \boldsymbol{\alpha}_{xy}' \ln \tilde{\mathbf{x}} + u + v, \tag{7}$$

Defining the relative mark-up (φ) as $\varphi = \frac{p - MC}{MC}$ we get the estimate of relative mark-up as:

$$\hat{\varphi} = \frac{\hat{u}}{\alpha_y + \alpha_{yt} t + \alpha_{yy} \ln y + \boldsymbol{\alpha}_{yx}' \ln \mathbf{x}} \tag{8}$$

Moreover, since we respect the heterogeneity in production structures we employ the extended version of the random parameter model (Tsionas, 2002) and the fixed management model (Alvarez et al., 2003 and 2004); that is, relation (7) becomes:

$$\frac{p \cdot y}{C} = \alpha_y + \alpha_{yt} t + \alpha_{yy} \ln y_{it} + \boldsymbol{\alpha}_{xy}' \ln \tilde{\mathbf{x}}_{it}$$
$$+ \alpha_m m_i^* + \frac{1}{2}\alpha_{mm} m_i^{*2} + \alpha_{tm} m_i^* t + \alpha_{ym} m_i^* y_{it} + \boldsymbol{\alpha}_{xm} m_i^{*\prime} \ln \tilde{\mathbf{x}}_{it} + u_{it} + v_{it}, \quad (9)$$

where $m_i^* \sim \bullet(0,1)$ represents unobservable heterogeneity (the symbol $\bullet$ represents that m_i^* could possess any distribution with zero mean and unit variance). Subscripts i and t stand for the i-th producer at time t. Model (9) is fitted by maximum simulated likelihood with the software NLOGIT 5.0. u_{it} is estimated according to Jondrow et al. (1982).

The data we use in the analysis is drawn from the Amadeus database, which contains financial information for public and private companies across Europe. The database provides detailed information about (standardised) annual accounts, financial ratios, sectoral activities and ownership information. The panel data set that we use in our analysis contains companies whose main activity is milk processing, according to the NACE classification. It is an unbalanced panel data set, which represents the period from 2003 to 2012 and contains 6,367 observations of milk-processing companies from 24 EU countries (only Croatia, Cyprus, Luxembourg and Malta are missing).

The following variables were used in the analysis:

Revenue share = Revenue/Costs, Output, normalized Material and Labour. Revenue is represented by the operating revenue (Turnover) of the company. Costs are the sum of Labour costs, Material costs and Capital costs. Labour costs are represented by the cost of employees, Material costs are the total costs of materials and energy consumption per company, and Capital costs are calculated as the book value of fixed assets multiplied by the interest rate according to convergence criteria. Output is represented by operating revenue (Turnover) of the company and is deflated by the sectoral index of milk-processing prices (EU-level – 27 countries or country-level if it was disposable, respectively; 2010 = 100). Material and Labour are normalized by Capital. Material is the total costs of materials and energy deflated by the index of producer prices in the milk industry (country-level; 2010 = 100). Labour is represented by the total number of employees and Capital is the book value of fixed assets deflated by the index of producer prices in the industry (country-level; 2010 = 100).

Moreover, we rejected producers with fewer than three observations (on average) to decrease the problem associated with the entry and exit of producers from the database. The country sample descriptive statistics are provided in the Appendix – Table A1.

Results and discussion

Table 1 provides a parameter estimate of the mark-up model for the milk output processing market in the 24 EU member states. As expected, almost all parameters are highly significant. The only exceptions are the time variable and material in interaction with the heterogeneity component. Moreover, the high significance of most of the coefficients of the unobservable heterogeneity component (fixed management) confirms that the chosen specification approximates well the estimated relationship. That is, the heterogeneity among firms is an important characteristic of the milk food-processing sector.

The estimates show the positive impact of the output and labour inputs on revenue share in the milk food-processing sector. On the other hand, material inputs determine negatively the revenue share. This is in line with our expectations. Higher labour inputs are connected

Means for random parameters				Coefficient on unobservable fixed management			
Variable	Coeff.	SE	P [|z|>Z*]	Variable	Coeff.	SE	P [|z|>Z*]
Const.	1.1384	0.0069	0.0000	Alpha_m	0.9056	0.0081	0.0000
Time	0.0001	0.0003	0.6680	Time	-0.0025	0.0003	0.0000
Output	0.0122	0.0007	0.0000	Output	-0.0832	0.0008	0.0000
Labour	0.0454	0.0009	0.0000	Labour	-0.0167	0.0009	0.0000
Material	-0.0490	0.0009	0.0000	Material	0.0006	0.0009	0.5184
				Alpha_mm	0.2986	0.0018	0.0000
Sigma	0.1252	0.0005	0.0000	Lambda	1.8631	0.0213	0.0000

Source: own calculation

Table 1: Parameter estimates.

with a production characterized by higher value added. The opposite can be expected for material inputs, ceteris paribus. Finally, the firms with higher output have a higher revenue share. This could also be connected with higher market power.

The unobservable heterogeneity component (management) contributes positively to the revenue share. Moreover, this positive impact is accelerating. As far as the relation between management and the mark-up component is concerned, we can conclude that an increase in the heterogeneity component (management) leads to a decrease in the mark-up component. Moreover, higher output leads to a smaller mark-up component for a given level of management. Labour determines negatively the mark-up component, and the material inputs are not statistically significant. The impact of time on market imperfections is negative, although very low. These results may suggest slightly increasing competitiveness in the EU food-processing output market in the dairy sector.

Finally, the parameter λ is highly significant, and greater than one. That is, the estimate indicates that non-competitive behaviour can be found in the EU output milk-processing market. Moreover, the variation in the mark-up component u_{it} is more pronounced than the variation in the random component (statistical noise) v_{it}, which suggests significant differences in the market behaviour among milk processors.

Table 2 presents the estimates of relative mark-up for European milk processors. The relative mark-up takes values in the interval from zero to one. Zero indicates competitive behaviour on the output market, as the case may be, i.e. the situation where marginal cost equals the price of the output. Then, a relative mark-up value higher than zero represents non-competitive behaviour. In particular, an increasing relative mark-up is associated with increasing market failures or the oligopolistic power of milk processors, respectively. The results show that the estimated

	Mean	Std.Dev	Min.	Max.	1st decile	9th decile	1st quartile	3rd quartile	Cases
EU	0.121	0.074	0.004	0.875	0.047	0.210	0.073	0.151	6287
Austria	0.152	0.046	0.076	0.291	0.106	0.211	0.117	0.176	37
Belgium	0.134	0.056	0.014	0.323	0.074	0.226	0.103	0.158	274
Bulgaria	0.088	0.082	0.017	0.441	0.025	0.214	0.033	0.101	79
Czech Republic	0.103	0.062	0.007	0.443	0.044	0.181	0.061	0.129	278
Germany	0.127	0.056	0.009	0.328	0.056	0.199	0.092	0.157	404
Denmark	0.120	0.044	0.067	0.255	0.077	0.153	0.095	0.134	15
Estonia	0.105	0.048	0.027	0.231	0.048	0.165	0.062	0.138	43
Spain	0.126	0.077	0.008	0.552	0.046	0.225	0.074	0.163	569
Finland	0.150	0.053	0.068	0.300	0.096	0.234	0.106	0.185	84
France	0.138	0.069	0.004	0.463	0.054	0.226	0.095	0.176	619
United Kingdom	0.077	0.044	0.008	0.308	0.034	0.128	0.046	0.098	447
Greece	0.112	0.059	0.013	0.332	0.052	0.192	0.074	0.144	203
Hungary	0.162	0.115	0.050	0.544	0.076	0.304	0.087	0.193	64
Italy	0.136	0.077	0.007	0.646	0.055	0.228	0.088	0.166	1656
Ireland	0.076	0.025	0.044	0.121	0.047	0.114	0.055	0.090	17
Latvia	0.108	0.050	0.012	0.277	0.061	0.165	0.073	0.131	70
Lithuania	0.086	0.044	0.021	0.206	0.041	0.162	0.050	0.112	99
Netherlands	0.182	0.080	0.041	0.496	0.112	0.269	0.132	0.227	60
Poland	0.097	0.056	0.009	0.427	0.051	0.154	0.067	0.108	749
Portugal	0.157	0.072	0.005	0.334	0.078	0.259	0.103	0.206	75
Romania	0.119	0.123	0.010	0.875	0.024	0.238	0.048	0.141	305
Sweden	0.084	0.045	0.014	0.217	0.036	0.140	0.046	0.105	27
Slovenia	0.125	0.040	0.067	0.210	0.080	0.182	0.098	0.149	27
Slovakia	0.100	0.044	0.032	0.263	0.049	0.151	0.067	0.121	86

Source: own calculation

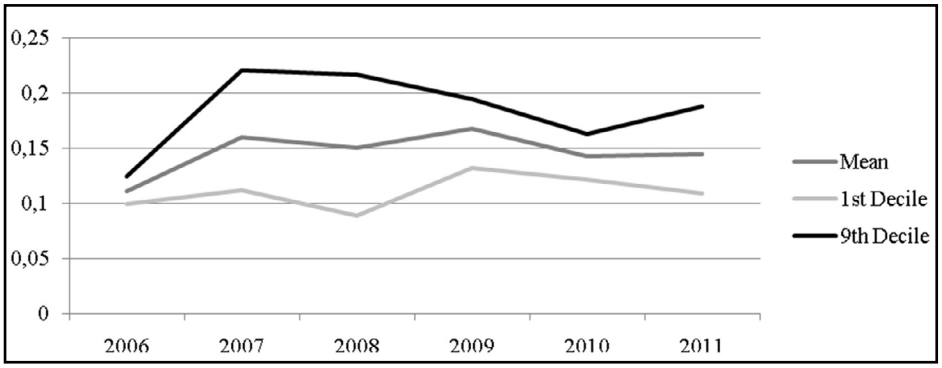
Table 2: Relative mark-up estimates.

overall mean of the relative mark-up is 0.12. That is, the European milk-processing output market is characterized by some degree of market failure or abuse of market power, as the case may be. Since the distribution of the mark-up is relatively narrow, with a standard deviation of 0.07, and skewed toward smaller values, the majority of milk processors are characterized by only a small or almost no degree of market power. However, significant differences between the 1st and 9th deciles can be found. The first decile indicates that 10 % of producers are very close to competitive behaviour (mark-up lower than 0.05). On the other hand, the last 10 % of producers reach a relative mark-up higher than 0.21. That is, the results indicate a considerable degree of non-competitive behaviour on the dairy output market for these producers.

The overall means of the relative mark-up differ among the individual member states. The means of the relative mark-up can be found in the interval 0.08 to 0.18, and their standard deviations take values from 0.025 to 0.123. Producers in Bulgaria (0.09), the United Kingdom (0.08), Ireland (0.076), Lithuania (0.09) and Sweden (0.08) exercise a lower degree of non-competitive behaviour, on average, as compared to producers in Austria (0.15), Finland (0.15), Hungary (0.16) and Portugal (0.16). Moreover, the distribution of relative mark-up is narrower in the countries with the lowest means of the mark-up indicating rather small market imperfections in these countries. On the other hand, the highest differences among producers can be found in Hungary and Romania, where the standard deviation is 0.115 and 0.123, respectively. Hungary and Romania are characterized by large differences between the first and ninth deciles of the relative mark-up. This suggests that Hungarian milk processors with the highest mark-up could have considerable power to determine the market price and market environment, which could have a negative impact on companies with a small relative mark-up. A similar situation can also be found in Romania, Bulgaria, Spain, Portugal, Italy and France. In addition, the first decile for Romania and Bulgaria is very close to zero, suggesting that many companies are price takers in these countries.

Moreover, we can also find countries where non-competitive behaviour is significant for all dairy producers – Austria and the Netherlands. In these countries, the companies gathered in the first decile exercise significantly higher mark-up power than in the rest of the countries.

Figure 1 provides the development of relative mark-up in the EU output milk-processing market. We can observe a slight increase in the years 2007 and 2009, when the average value of mark-up increased similarly by 0.009. Then, the mean value of mark-up decreased in 2010 and stabilized around the value 0.015. Moreover, Figure 1 shows that the spread between the first and ninth decile was pretty low in the year 2006. Then it significantly increased in 2007 and 2008 and became narrower over the next two years. The last year (2011) is characterized by another change. In particular, the mark-up differences among the companies started to increase again. This development suggests that the time of economic crises decreased the differences among the companies as far as relative mark-up is concerned. Specifically, we can observe a decrease in relative mark-up for companies with higher market power (ninth decile). The opposite is true for companies



Note: Figure 1 presents the development of mark-up in the time period 2006-2011, for which there is a sufficient number of observations for each year.

Source: own calculation

Figure 1: Development of relative mark-up.

in the first decile, i.e. companies with low relative mark-up.

The development of relative mark-up can also be analysed with respect to technical efficiency development, as provided in Kutlu and Sickles (2012). To analyse this relationship in the EU dairy sector, we can use the results of Cechura et al. (2014), who analysed the development of technical efficiency in European milk-processing companies. The results show that the technical efficiency of European milk processors decreased in 2007, 2008 and 2010 and increased in 2009 and 2011. That is, we can observe some similarities in the development of technical efficiency and relative mark-up, except for 2007. Since technical efficiency can be associated with the use of capacities, and taking into account the dairy market situation in the analysed period, the results suggest that the value of relative mark-up could be connected with the use of milk processors' capacities. On the other hand, the opposite development of technical efficiency and relative mark-up in 2007 could be associated with the role of management, in particular, "…firms may use their market power to allow inefficient allocation of resources." Kutlu and Sickles (2007, page 2).

Table 3 presents the mark-up development in the analysed countries. We can observe that the majority of EU member states have an almost identical development of the relative mark-up. The mark-up increased in 2007 and 2009 and decreased in 2010 and 2011. However, some exceptions can be found. The mark-up in the Netherlands, in particular, had an opposite development. It decreased in 2009 and increased in 2010 and 2011.

As far as the new member states are concerned, we can conclude that the relative mark-up mainly increased the year after the accession. Only the Czech Republic and Lithuania are exceptions. This could be the result of milk quotas, which strongly affected the situation in the milk market. This conclusion is supported by the increase in mark-up in the years of strong release of the quota (e.g. 2008 for the Czech Republic).

Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Trend function	R^2
EU	0.118	0.115	0.115	0.118	0.127	0.126	0.135	0.12	0.113	0.115	y = 0.119 - 0.0002t	0.009
Austria	NA	NA	NA	0.112	0.16	0.151	0.168	0.144	0.145	NA	y = 0.133 - 0.004t	0.138
Belgium	0.127	0.134	0.133	0.133	0.125	0.14	0.156	0.131	0.124	NA	y = 0.131 + 0.001t	0.021
Bulgaria	0.143	0.051	0.127	0.108	0.06	0.076	0.11	0.084	0.052	NA	y = 0.118 - 0.006t	0.205
Czech Republic	0.092	0.098	0.075	0.1	0.123	0.101	0.127	0.104	0.108	0.094	y = 0.092 + 0.002t	0.128
Germany	0.137	0.122	0.108	0.117	0.12	0.126	0.142	0.137	0.125	0.132	y = 0.12 + 0.001t	0.132
Denmark	NA	NA	NA	NA	0.109	0.121	0.159	0.09	0.102	0.139	y = 0.117 + 0.001t	0.003
Estonia	0.102	0.06	0.087	0.147	0.128	0.127	0.155	0.091	0.082	0.148	y = 0.092 + 0.004t	0.117
Spain	0.123	0.126	0.128	0.133	0.114	0.119	0.146	0.129	0.112	0.046	y = 0.143 - 0.005t	0.256
Finland	0.129	0.145	0.149	0.158	0.133	0.159	0.161	0.149	0.159	NA	y = 0.136 + 0.003t	0.377
France	0.146	0.138	0.138	0.147	0.148	0.137	0.136	0.131	0.126	0.096	y = 0.155 - 0.004t	0.549
Great Britain	0.084	0.074	0.08	0.087	0.079	0.076	0.078	0.073	0.068	0.078	y = 0.083 - 0.001t	0.302
Greece	0.091	0.103	0.1	0.114	0.118	0.118	0.127	0.121	0.104	0.136	y = 0.095 + 0.003t	0.563
Hungary	0.094	0.099	0.149	0.119	0.159	0.152	0.199	0.169	0.143	NA	y = 0.098 + 0.009t	0.53
Italy	0.131	0.127	0.133	0.133	0.133	0.133	0.157	0.141	0.13	0.155	y = 0.126 + 0.002t	0.382
Ireland	NA	NA	0.069	0.07	0.073	0.068	0.075	0.07	0.098	NA	y = 0.062 + 0.003t	0.437
Latvia	0.097	0.078	0.091	0.106	0.126	0.126	0.139	0.085	0.107	0.157	y = 0.084 + 0.005t	0.347
Lithuania	0.096	0.103	0.094	0.08	0.109	0.064	0.081	0.078	0.069	0.103	y = 0.098 - 0.002t	0.123
Netherlands	0.175	0.18	0.19	0.144	0.164	0.202	0.175	0.191	0.244	0.143	y = 0.171 + 0.002t	0.208
Poland	0.1	0.097	0.094	0.085	0.098	0.093	0.113	0.102	0.087	NA	y = 0.095 + 0.0002t	0.007
Portugal	0.192	0.165	0.171	0.17	0.162	0.166	0.172	0.136	0.123	NA	y = 0.193 - 0.006t	0.662
Romania	0.111	0.096	0.072	0.064	0.219	0.242	0.107	0.083	0.081	NA	y = 0.112 + 0.002t	0.004
Sweden	0.035	0.046	0.056	0.089	0.1	0.102	0.109	0.102	0.114	NA	y = 0.034 + 0.01t	0.857
Slovenia	0.119	0.087	0.09	0.088	0.131	0.16	0.172	0.154	0.125	NA	y = 0.087 + 0.008t	0.419
Slovakia	0.07	0.081	0.086	0.083	0.106	0.1	0.14	0.111	0.115	NA	y = 0.067 + 0.007t	0.700

Source: own calculation

Table 3: Development of relative mark-up

From the development in individual countries we can observe that the most significant decrease was in Estonia. On the other hand, the mark-up increased in Austria, the Czech Republic, Germany, Finland, Hungary, the Netherlands, Poland, Romania, Sweden, Slovenia and Slovakia. The highest increase was achieved in Slovenia, followed by Austria and Slovakia.

As far as the decile distribution development is concerned, we can observe that the companies in the 9th decile in Estonia, France, Hungary, Romania and Slovenia significantly increased their market power in 2007 and then slightly decreased until 2010. This corresponds to the development on the EU level. Moreover, we can also find countries where the relative mark-up of the 9th decile significantly increased during the analysed time period; however, the relative mark-up of the 1st decile decreased, namely in Sweden, Italy and Ireland. This suggests increasing differences among the companies with regard to abuse of market power in these countries. The opposite trend can be found in Austria, the Czech Republic, Germany, Denmark, Estonia, Spain, Portugal, Romania and Slovenia.

Conclusion

The European milk-processing market is characterized by some degree of market failure or abuse of market power, as the case may be. This abuse of oligopoly market power is not large, on average, but significant differences exist among the EU countries. Since the distribution of the mark-up is relatively narrow and skewed toward smaller values, the majority of milk processors are characterized by only a small or almost no degree of market power. On the other hand, 10 % of producers reach a considerably high mark-up.

Focusing on the differences among EU countries, we can specify a group of countries with very low oligopoly market power: Bulgaria, the United Kingdom, Lithuania and Sweden, and a group of countries with high oligopoly market power: Austria, Hungary, Finland and Portugal.

Relative mark-up power developed differently in these countries. The mark-up increased in Austria, the Czech Republic, Germany, Finland, Hungary, the Netherlands, Poland, Romania, Sweden, Slovenia and Slovakia in the analysed time period. The highest increase was achieved in Slovenia, followed by Austria and Slovakia. On the other hand, the most significant decrease was in Estonia.

The development of relative mark-up was connected with the development of the market situation. In particular, we can find similarities between the development of relative mark-up and technical efficiency, which could be associated with the use of milk processor capacities. Moreover, the development of relative mark-up power was influenced by government instruments such as milk quotas. Specifically, the mark-up increased in the years of strong release of the quota. Thus, the results suggest that the recent abolition of milk quotas may have a negative effect on competitive behaviour in the milk-processing market.

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Appendix

EU member country	Revenue share		Output		Labour		Capital		Material		Cases
	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	
Austria	1.1954	0.0623	92737.91	92619.44	174.85	127.03	19220.31	20605.07	67505.84	64938.91	39
Belgium	1.2259	0.1380	119009.53	158101.03	224.05	323.04	29010.03	98144.58	87911.66	116705.26	276
Bulgaria	1.2732	0.2414	12750.47	12187.12	187.88	130.15	6477.57	5955.50	8338.91	6833.12	76
Czech Republic	1.2276	0.1883	40169.18	44254.62	250.87	277.84	6329.18	7527.59	30976.20	34141.31	282
Germany	1.1705	0.1686	204393.79	297311.04	327.98	623.94	29109.30	49245.12	165727.55	238507.13	414
Denmark	1.1294	0.0817	2314193.09	3244577.21	5655.93	7881.13	806052.40	1137111.08	1837613.48	2568995.11	15
Estonia	1.1853	0.1041	22060.50	12941.60	165.32	65.96	8859.25	4191.88	17200.97	10532.23	34
Spain	1.2866	0.2335	97318.62	207871.39	217.55	389.85	33195.77	60794.21	59165.08	98875.76	570
Finland	1.2035	0.1501	233762.15	556660.35	543.01	1296.52	60870.46	146832.59	160166.93	371622.12	84
France	1.3375	0.2703	163090.07	363438.57	394.29	1221.47	37287.62	130303.10	103121.37	216797.25	623
Great Britain	1.0692	0.1104	213097.92	414726.49	653.52	1424.41	65954.16	187000.12	174474.41	330398.53	450
Greece	1.2145	0.1907	33124.48	51782.51	143.51	215.26	21551.84	40357.23	25126.31	33915.50	206
Hungary	1.2847	0.1855	45867.35	41610.41	347.71	286.75	13412.99	19474.07	25799.00	26312.96	79
Ireland	1.0363	0.0623	936141.31	1029748.10	1584.47	1726.40	334514.62	363620.58	799553.63	876715.06	17
Italy	1.2548	0.1720	58544.38	280054.04	131.12	884.89	21966.70	132564.95	36715.53	137415.48	1666
Lithuania	1.1988	0.1218	67461.16	63525.43	513.60	542.51	19391.36	20308.45	57503.08	53283.34	99
Latvia	1.2132	0.1302	26954.79	21212.66	285.23	162.49	10694.06	8011.34	23017.85	18470.78	70
Netherlands	1.1601	0.1326	743312.06	1157316.50	721.11	1789.57	111523.66	286703.80	692966.42	1099254.90	64
Poland	1.1741	0.1506	43544.02	75287.36	270.84	264.81	11128.04	34450.71	34441.66	58196.16	754
Portugal	1.3821	0.3090	54811.82	49628.36	221.63	179.63	22555.00	21683.09	30801.51	21691.28	75
Romania	1.3469	0.2773	16167.80	21185.43	263.93	227.31	7339.68	9406.16	9909.07	11970.90	317
Sweden	1.2651	0.2453	486515.00	699217.69	1288.93	1774.46	211794.57	303555.15	419235.93	608013.29	27
Slovenia	1.1944	0.0645	85541.10	53874.98	364.63	264.64	34005.77	28643.02	64351.01	39421.62	27
Slovakia	1.1531	0.0816	39086.04	30051.27	223.43	116.57	12510.88	9038.48	31360.52	25045.08	87

Note: Output (ths. EUR), Labour (AWU), Capital (ths. EUR), Material (ths. EUR)
Source: own calculation

Appendix A.1: Sample descriptive statistics – dairy.

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Why Do Agricultural Producers Exhibit at Bread Basket?

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Anotace

Studium odborné literatury prokázalo, že prezentace na veletrhu, je významným marketingovým nástrojem, který umožňuje vystavovatelům představit a testovat nové výrobky, monitorovat konkurenty a rozvíjet vztahy se zákazníky. Tento článek rozšiřuje dosavadní poznatky o faktorech, které motivují vystavovatele k účasti na veletrhu. Výzkum je prováděn na mezinárodním veletrhu Země živitelka. Vystavovatelé v oblasti živočišné a rostlinné produkce i zemědělských technologií hodnotili set motivů pomocí Likertovy škály. Následně provedená faktorová analýza odhalila čtyři klíčové faktory účasti na veletrhu, konkrétně získávání informací a rozvoj společnosti, rozvoj výrobku, zaměření se okolí společnosti a možnosti nových trhů. Logistická regrese poté odhalila, jak vybrané proměnné (klasifikace NACE, rok založení podniku, či četnost účasti na veletrhu) ovlivňují stanovené faktory motivů vystavovatelů k účasti na veletrhu.

Klíčová slova

Veletrh, vystavovatel, motiv, Země živitelka.

Abstract

A literature survey proved that trade shows are important marketing tools, enabling sellers to present and test new products, to monitor their competitors, and to establish personal contacts with customers. The paper extends the current research of trade shows by analyzing exhibitors´ motives for exhibiting. The research is conducted for a traditional international agricultural fair - Bread Basket. Exhibitors, including animal production exhibitors, crop production exhibitors and agriculture technology exhibitors, were offered a list of potential motives for exhibiting and were asked to indicate their agreement (disagreement) on a 5-point Likert scale. Subsequently, a factor analysis revealed four key factors for exhibiting, including searching for information and company development, product development, focus on company surroundings and new market possibilities. Finally, exhibitors were surveyed again in order to choose one of these factors to be the most important one for exhibiting. Logistic regression revealed how the specific variables (NACE classification, year of establishment and frequency of exhibiting) influence the selected factors.

Keywords:

Milk, market power, oligopoly, SFA, European Union.

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Introduction

Trade shows, trade fairs and exhibitions are special types of events in which sellers meet their customers. Sanders (2013) defines a trade show as an event where companies in a specific industry gather to showcase and demonstrate their new products and services. A trade fair, on the other hand, is more business-to-client or customer type event. Exhibitions focus primarily to showcase products and services. Sanders also pointed out that language differences play a part in terms of this definition because the term "trade show" is more popular in the USA, whereas "trade fair" is traditionally more frequently used in the UK[1]. Kellezi (2013) points out that even the academics consider a trade show in different ways including exhibitions, fairs, or trade fairs, all of them agree

[1] For the purpose of the conducted research, the terms "trade show" and "trade fair" are considered to be mutually replaceable.

that a trade show is a regularly scheduled event, where companies meet their customers and other important parts of an industry.

Kirchgeorg et al. (2010) defines a trade show as an event that is held on specific days and where a large number of companies present their specific products and sell them to customers. Godar and O´Connor (2001) perceive trade shows as a venue at which it is possible to discern a mutual interest between buyers and sellers and to start future cooperation. Trade shows are usually limited in time and provide direct customer contacts. A customer has an opportunity to see the real product and can try it out on the spot. Trade shows help to build and strengthen the company's image and brand, and therefore they are a perfect venue for innovations and news (Přikrylová and Jahodová, 2010). Bonoma (1983) extended this idea and proved that trade shows improve the company image with competitors, customers and the industry in general. Smith (1998) points out that one of the motives for taking part in a trade show is a desire to build up corporate image and reputation.

Trade shows enable firms not only to present their products and receive orders, but also to receive important reactions and feedbacks concerning their product, its distribution and how it is presented (Frain, 1999). Trade shows and fairs are characterized by their multi-functionality. This means that they can perform many functions at once (sales and related customer satisfaction, new information and trends in the field, getting information about the competition or training) and they are also able to help the company to achieve other desirable goals. This is confirmed also by Vysekalová (2014), who mentions that trade fairs represent a multi-functional aspect because they can connect representation of a company with implementation of a production program and establish personal contacts with customers. Trade shows take an advantage of concentration of target customers, building up personal contacts with potential customers, concentration of useful information and adequate surroundings for communication and dealing. Hansen (1996) shows that boosting and keeping up the morale of company employees and of customers are moderately important activities for exhibitors. Barczyk et al. (1989) indicates another motive for exhibiting at trade shows, namely the sales force morale. Shoham (1992) also proves that trade shows can be used to train and motivate the sales force.

Sharland and Balgoh (1996) see trade shows as an effective communication tool and mention that trade shows, from the visitors´ point of view, provide an opportunity to get useful information at low cost. Kerin and Cron (1987) and Lilien (1983) point out the importance of relations with customers and the advantage of having personal contacts with customers. Also Yuksel and Voola (2010) find out that the key motivation for participating in travel trade shows is to improve relationships with customers.

Hansen (2004) stresses the need of research dealing with the value of trade shows and buyer -seller relations. The research conducted by AUMA (2011) among German companies found out that 85% of researched companies find trade fairs and exhibitions important. The highest importance was given only to the company’s own homepage. They find personal sales, direct mailing, trade journals, Internet sales, events and public relations as less important. Also Cop and Cara (2014) find out in their study that 97% respondents considered trade fairs as the most important marketing tool.

Czech entrepreneurs exhibit at trade shows and trade fairs as well. According to an analysis made by SOVA ČR, the trade show and exhibition market was successful in 2014. In 2014, there were organized 276 trade shows and exhibitions by 39 organizations. These tradeshows and exhibitions were visited by 3.19 million visitors. In total, over one million square meters of the exhibition area were leased. All this data means an increase compared to last years, and can be comparable with the year 2008, after which a decline was registered.

The article extends the current research of trade shows by analyzing exhibitors´ motives for participating. The research is conducted for a traditional international agricultural fair called Bread Basket.

Materials and methods

The research focused on the studying of exhibitors´ motives for exhibiting at the trade show. It aims to answer two basic research questions:

- What are the key reasons (factors) for exhibiting?
- How do selected variables affect these factors?

To answer the determined research questions, a factor analysis is conducted in order to identify key factors (reasons) of exhibitors exhibiting at the trade show. Subsequently, logistic regression

makes it possible to reveal how selected variables affect these factors.

Studied trade show – Bread Basket

The Bread Basket trade fair is the oldest and most visited Czech agricultural fair organized since 1960. It takes place every year at the fair and exhibition center in České Budějovice. Last year (2014) the trade fair covered 36,121 square meters by 505 exhibitors' stands (18 of them being international). The Bread Basket event was visited by 98,652 visitors. According to the NACE classification, exhibitor categories included 11 crop production classes; 17 animal production classes and 152 agriculture technology types.

Analysis of exhibitors´ reasons

The literature survey provided a list of possible reasons and motives for exhibiting at a trade show. This list is based on the following studies Bareczyk et al. (1998), Bello et al. (1990), and Kerin and Cron (1987), latterly adopted by Hansen (2004), Lee and Kim (2008) or Korneliussen (2011). Determined motives were tested in a pilot survey conducted among the agricultural companies attending Bread Basket in 2014. In this pilot survey, respondents had a possibility to add other motives for exhibiting at a trade show. The final list of motives was thus determined by the literature survey and pilot survey findings, demonstrated in an alphabetic order in the table 1.

Bring attention to the company existence
Collect information about competitors
Consolidate relations with media
Introduce new products
Keep the tradition of being here
Maintain and develop contacts with current customers
Maintain and improve the brand image
Maintain and improve the company image
Make contacts with new and potential customers
Make contracts/deals
Open up to new markets
Provide information about product changes, improvements
Search information about customers
Search information about new technologies
Search information about suppliers
Social and informal contacts with business partners
Test new products/services/technologies
Train and develop the sales team

Source: own processing

Table 1: Table 1: A list of motives used for the survey.

The respondents were asked to evaluate a comprehensive list of 17 items on the 5-point scale ("strongly agree" to "strongly disagree"). A total of 103 companies were surveyed during the trade show time. According to Gardner in Small (2007), a minimum requirement for a factor analysis is typically the ratio of five cases to one variable, so this criterion was met. The reliability of data was subsequently tested by Cronbach's alpha, which was 0.799. Cronbach's alpha was also used to identify internal consistency in the revealed factor, and consequently a factor analysis with VARIMAX rotation was applied as well. The Kaiser-Meyer-Olkin measure of sampling adequacy was higher than 0.6, which is the required measure for a good factor analysis (Tabachnick, Fidell, 1996).

Analysis of exhibitors´ odds to exhibit at trade show

The factors revealed in the factor analysis served for further analysis of exhibitors´ motives to exhibit at trade show. After revealing the factors, exhibitors were surveyed again. The survey was conducted by e-mail communication and phone calls, based on the contacts gained at the trade show. The exhibitors were asked to identify which of the revealed factors is the most important for exhibiting at a trade show. Logistic regression was applied to reveal exhibitors´ odds in relation to exhibitors´ NACE classification, number of employees, year of establishment and frequency of exhibiting at trade shows. The general logistic regression function is determined as follows:

Model: ln (revealed factor) = α + β1 (NACE classification) + β2 (number of employees) + β3 (year of company establishment) + β1 (regular attendance at trade show) + e,

where α is constant, β is coefficient of dependent variable, and e is error term.

The independent categorical variables were subsequently coded according to the studied variables. NACA classification of surveyed exhibitors was coded as: p-crop production; a-animal production; the reference category being agriculture technology. Number of employees and year of company establishment were continuous variables. Finally, regular attendance was coded as 1 - one to five years, 5 - five to ten years, the reference category being exhibitors exhibiting more than ten years. To test the developed model, Chi – square test, Cox&Snell R Square and Nagelkerke R Square were applied.

Results and discussion

The research shows that 78.9 % of surveyed agricultural companies are present at the Bread Basket trade show on a yearly basis. Altogether 89.3 % of these companies attended Bread Basket regularly during the last five years, and 69.2 % of them even in the last ten years. The conducted survey building upon Likers scaling showed up that the most-agree motives for the trade show exhibiting are: making contacts with new and potential customers (mean value 1.24), maintaining and developing contacts with current customers (mean value 1.32), and finally searching information about customers (mean value 1.43). On the other hand, less important motives for exhibiting in the trade show is to train and develop the sales team (mean value 3.89), to bring attention to the company existence (2.99), and to consolidate relations with media (mean value 2.55), see table 2.

	Mean	S.D.
Bring attention to the company existence	2.99	0.78
Collect information about competitors	1.46	0.73
Consolidate relations with media	2.55	0.34
Introduce new products	1.78	1.11
Keep the tradition of being here	1.47	0.23
Maintain and develop contacts with current customers	1.32	0.73
Maintain and improve the brand image	1.85	0.69
Maintain and improve the company image	1.85	0.56
Make contacts with new and potential customers	1.24	0.45
Open up to new markets	1.50	0.72
Provide information about product changes, improvements	1.69	1.02
Search information about customers	1.43	0.56
Search information about new technologies	1.45	0.51
Search information about suppliers	1.45	0.63
Social and informal contacts with business partners	1.87	0.44
Test new products/services/technologies	1.78	0.74
Train and develop the sales team	3.89	1.16

Source: own processing

Table 2: Evaluation of motives for exhibiting.

Determination of key factors

The factor analysis revealed seven primary factors. However, an analysis of the screen plot showed that 4 factors were actually more suitable (see table 3). In summary, they included the "searching information and company development" factor (factor 1), incorporating motives of searching information about customers, suppliers and company development in terms of extending activities with business partners and customers. Another factor (factor 2) can be named as "focus on company surroundings" in the terms of focus on media and competitors[2]. Factor 3 can be characterized as "product development" presenting information about new products, testing a new product, as well as searching information about new technologies to improve current products. "New market possibilities" form the last factor (factor 4), including the opening up to new markets with new products. Factor 3 has excellent internal consistency, factors 1 and 4 have good internal consistency, and only factor 2 has merely acceptable consistency.

	Factor 1	Factor 2	Factor 3	Factor 4
Maintain and improve the company image	0.767			
Maintain and develop contacts with current customers	0.738			
Maintain and improve the brand image	0.781			
Make contacts with new and potential customers	0.659			
Search information about customers	0.830			
Search information about suppliers	0.722			
Social and informal contacts with business partners	0.742			
Collect information about competitors		0.758		
Consolidate relations with media		0.792		
Keep the tradition of being here		0.473		
Bring attention to the company existence			0.280	
Provide information about product changes, improvements			0.631	
Search information about new technologies			0.702	
Test new products/services/ technologies			0.821	
Train and develop the sales team			0.482	
Open up to new market				0.630
Introduce new products				0.732
Variance explained	18.16	16.89	14.98	12.15
Cronbach´s alpha	0.845	0.623	0.902	0.897

Source: own processing

Table 3: Factor analysis results.

Odds of exhibitors at the trade show

A survey of agricultural exhibitors which was conducted subsequently and in which the exhibitors were asked to identify the most important factors[3] for exhibiting at the trade show, revealed that

[2] Factor 3 includes the motive of bringing attention to the company existence. This impact is not interpreted because it had a lower loading than 0.32, which is, according to Tabachnick and Fidell (1996), less than the required minimum for interpretation.

[3] The factors were described at a detailed level in order to provide respondents with a precise idea about motives included in the factors.

the most important factor is s*earching information and company development* (38.3% respondents). The second most important factor is product development (31.0% respondents), followed by *focus on company surroundings* (21.4% respondents), and *new market possibilities* (8.6% respondents).

Searching information and company development

Model 1: ln (searching information and company development) = -1.353 + 0.857 NACE classification (p) – 0.435 NACE classification (a) – 0.020 year of company establishment + 1.035 attendance at trade show (1) + 0.634 attendance at trade show (5).

The model analyzed reveals that companies oriented on crop production are 2.35 times more likely to exhibit at the trade show for searching information and company development than agriculture technology exhibitors. On the other hand, agriculture technology exhibitors are 2.77 times more likely to attend the trade show because of searching information and company development than animal production exhibitors. The length of the company existence has negative tendencies, but this predictor is not statistically significant in the developed model. The predictor of frequency of exhibiting at the trade show indicates that agriculture companies which exhibit at the Bread Basket not more than ten times are more likely to exhibit for searching information and company development than companies with more than a 10-year tradition (table 4 and table 5).

Focus on company surroundings

Factor 2: ln (focus on company surroundings) = -1.420 – 0.573 NACE classification (p) – 0.294 NACE classification (a) – 0.002 year of company establishment + 1.125 attendance at trade show (1) + 1.294 attendance at trade show (5).

Logistic regression revealed that exhibitors in crop and animal production are less likely to exhibit for focusing on company surroundings than agriculture technology producers. Agriculture technology producers are 2.27 times more likely to do so than crop production exhibitors and 4.0 times more likely than animal production producers. The year of company establishment is statistically significant, however, the exp(β) coefficient is close to one, therefore no evident relation can be interpreted. Concerning the frequency of exhibiting at the trade show, only the parameter describing companies with five to ten years of history is statistically significant. Those exhibitors are 3.65 times more likely to exhibit for focusing on company surroundings than exhibitors with more than ten years of tradition (table 4 and table 5).

Product development

Factor 3: ln (product development) = - 0.693 + 0.659 NACE classification (p) + 1.263 NACE classification (a) + 0.102 year of company establishment – 0.327 attendance at trade show (1) + 0.634 attendance at trade show (5).

The developed logit model showed that plant production exhibitors are 1.99 times more likely to exhibit at the trade show motivated by product development than agriculture technology exhibitors. Similarly, animal production exhibitors are 3.53 times more likely to exhibit at a trade show motivated by product development than agriculture technology exhibitors. The model revealed that exhibitors with five to ten years of tradition at the trade show are 1.88 more likely to exhibit than exhibitors with more than ten years of tradition (table 4 and table 5).

New market possibilities

Factor 4: ln (new market possibilities) = -1.154 - 0.628 NACE classification (p) – 0.173 NACE classification (a) – 0.285 year of company establishment + 1.634 attendance at trade show (1) + 1.824 attendance at trade show (5)

An analysis of the factor called new market possibilities brings only one statistical parameter, which revealed that agriculture technology exhibitors are 6.25 times more likely to exhibit, being motivated by new market possibilities, than animal production exhibitors (see table 4 and table 5).

	Factor 1	Factor 2	Factor 3	Factor 4
	Exp(β)	Exp(β)	Exp(β)	Exp(β)
NACE classification (p)	2.35**	0.56**	1.99**	0.53
NACE classification (a)	0.64*	0.75**	3.53*	0.84*
Year of company establishment	0.98	0.99*	1.11	0.75
Exhibiting at trade show (1)	2.81*	3.08	0.72	5.12
Exhibiting at trade show (5)	1.89*	3.65*	1.88*	6.19

Note: Statistically significant at a level of α=5%**; α=10%*
Source: own processing

Table 4: Logit model exp(β) coefficients.

	Factor 1	Factor 2	Factor 3	Factor 4
Chi-square (sig.)	0.003	0.001	0.004	0.006
2 Log Likelihood	336.656	564.076	213.413	506.101
Cox&Snell Square	0.031	0.062	0.038	0.092
Nagelkerke R Square	0.062	0.100	0.102	0.131
Hosmer and Lemeshow Test (sig.)	0.865	0.335	0.756	0.366
Percentage of right prediction	86.6	65.4	92.1	67.9

Note: Statistically significant at a level of α=5%**; α=10%*
Source: own processing

Table 5: Logit Models values.

Conclusion

The results presented in this paper come out from the studying of exhibitors´ motives to participate and exhibit at the trade show. Exhibitors at the international agriculture fair "Bread Basket" were surveyed, including plant producers, animal producers and agriculture technology exhibitors. A list of potential motives to exhibit was offered to exhibitors and the analysis proved that the most important motives for exhibiting are making contacts with new and potential customers and maintaining and developing contacts with current customers. This is confirmed by the findings in Lilen´s (1983) study and Kerin and Corn´s (1987) study. The least important motives revealed for exhibiting were training and developing sales team, which cannot be supported by Barczyks´et al. (1989) and Shoham´s (1992) findings.

The factor analysis revealed four main motives. These motives can be named as searching information and company development, focus on surroundings, product development and new market possibilities. The subsequent exhibitors´ survey revealed that the most important factor was searching information and company development. These findings are in compliance with Smith (1998), or Přikrylová and Jahodová (2010). Also product development showed to be important for exhibitors, agreeing with Frain (1999).

Further analysis focused on explaining exhibitors' odds for exhibiting at the trade show according to the factors which were revealed in the factor analysis. Logistic regression revealed that plant production exhibitors are more likely to exhibit at the trade show motivated by searching information and company development and product development than agriculture technology exhibitors. On the other hand, they are less likely to exhibit due to a focus on company surroundings and new market possibilities, compared to agriculture technology exhibitors. In comparison to agriculture technology exhibitors, animal production exhibitors are more likely to exhibit at the events motivated by product development, and less likely to exhibit at the events motivated by searching information and company development, product development and new market possibilities. The parameter of the number of years of exhibitors´ existence was not interpretable in the developed models. Finally, the parameter of tradition of the Bread Basket Fair attendance revealed that exhibitors with five to ten years of tradition are more likely to exhibit at the trade show motivated by all the analyzed factors than those exhibitors with more than a ten-year tradition.

Literature survey proves that trade shows are important promotional tool, supported by Hansen (2004), Joeng and Arcilla (2014) or Situma (2012). Revealed motives in conducted research can help potential exhibitors in their decision-making process of exhibiting at a trade show. It makes also contribution to exhibitors in strategies formation in the terms of adding value to exhibitors.

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E-trade with Direct Lending and Normalized Money

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Abstract

The article presents the advanced technology of the normalized commodity-money relations. The technology is considered as updating the model of the normalized economic mechanism. The core of this technology is the e-trade with direct lending where deferred portion of the payment is documented as the buyer's debt to the seller (not to the bank!). The technology of e-trade with direct lending provides the possibility of early repayment of debt amounts to the sellers of priority goods. This repayment is fulfilled by the debt department of the state central bank. Rules of emission of debt amounts are presented in the advanced model of normalized money. The important innovation in normalized e-trade is the rule of obligatory state online certification of transactions.

Keywords:

E-trade with direct lending, normalized money, system of property statuses, normalized economic mechanism, e-service, normalized e-banking.

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Introduction

Economic indicators in each country depend on the structure and rules of functioning of its **economic mechanism (EM)**, methods of implementation and monitoring of following these rules, technologies of information service for economic agents (individuals and entities), technologies of documenting property statuses of economic agents and their transactions (Ilyin, Ilyin, 2011). Current economic mechanism serves economic agents, above all, as the instrument of obtaining extraterritorial profit. It is not conducive to enhancing the potential of a country. Besides that, the mechanism structure does not meet modern organizational and technological capabilities of informatization of economic activities (Ilyin, 1996; Ilyin, Ilyin, 2014 [9]).

In (Ilyin, Ilyin, 2014 [9]) it was noted that the most dangerous trends of the last decades are climate change, intensification of pollution, inefficient land use, poorly managed migration of the working population (Taran, 2011; Meyfroidt et al., 2013; Helin, 2013; Skevas, Lansink, 2014; Lwasa et al., 2014) and the intensive growth of the non-producing but actively consuming part of population (which requires a continuous increase in budgetary expenditure on social assistance). Agricultural sector is most vulnerable to these trends: farms lose not only the necessary human and natural resources, but also a significant part of budget support. Researchers, engineers and environmentalists are looking for approaches to solving the problem of environmentally sound economic development (Valin, 2014; Lorek, Spangenberg, 2014). Implementation of unified technologies for multi-currency e-trade and e-investment is especially important for the agricultural sector because many farms are in need of expanding the market, attracting and making investments (Maart-Noelck, Musshoff, 2013).

The authors proceed from the fact that the complexes of scientific and technical problems of designing EM and the state mechanism are indissolubly linked. Both mechanisms are considered as an organizational base of a country's life-support system (Ilyin, 1996). Structure of these mechanisms and relationship between them should be changed depending on what is meant by the prosperity of the country and what problems of economic development are to be solved. Design of the mechanisms should certainly take into account the relationships with economic and state mechanisms of other countries.

Socio-economic role and **the s-model**[1] **of money in the era of e-services**, implementation of the system of property statuses and technologies of commodity-money relations in **the normalized economic mechanism (NEM)** - these and other things considered in this paper are studied in the framework of scientific research "Creating the methodology of informatization of normalized economic mechanism and software implementation of expert resource planning based on e-services". The research is executed in the Institute of Informatics Problems at the Federal Research Center "Computer Science and Control" of the Russian Academy of Sciences. The first phase of implementation of the NEM information technologies includes a set of online services for expert resource planning. The authors have completed creation of the theoretical foundations of the NEM information technologies implementation and have published methodology, principles of work and description of use of the e-service "Cost Planning" (Ilyin, 2013; Ilyin, Ilyin, 2014 [8]). The method of interval planning implemented in this e-service (**www.res-plan.com**) does not have known analogues.

[1] Hereinafter, the prefix s- means that the term belongs to the methodology of symbolic modeling of arbitrary objects in the human-machine environment (Ilyin, Ilyin, 2009).

The article describes basics of the concept of normalized commodity-money circulation and the approach to implementation. The article is considered as the complement to (Ilyin, Ilyin, 2014 [9]) and updating the model of the normalized economic mechanism.

Analogous methodologies of e-trade with direct lending and normalization of commodity-money relations are not known to the authors. Critical analysis of the economic concepts of extraterritorial profit was published in (Ilyin, 2009; Ilyin, 2010) in Russian and (Ilyin, Ilyin, 2014 [9]) in English. A part of discussion on the first version of the model of normalized economics (Ilyin, 2009) is contained in the chapter 5.1 of the monograph (Ilyin, 2010), including answers to comments from reviewer (5.1.1) and from Egor T. Gaidar (5.1.2). The chapter 5.2 of this book contains critical analysis of the ideology of financial domination.

Materials and methods

1. The approach to informatization of the economic mechanism

Informatization is considered as a gradual transition from existing EM to the NEM (Table 1).

EA-management **(Economic Activity management)**	**RC-production (Real Commodities production)**
The complex includes state institutions (ministries and the central bank) and commercial institutions (boards of directors, etc). Basic functions: - to set the goals for development of the NEM complexes - to direct and stimulate economic activity through taxes, excise, duties and other means of economic regulation - to solve the problems of unemployment - to coordinate achievement of the objectives; to control the achieved results	Farms and plants should be built in accordance with the principle of constructing complexes from unified modules. This is the key method to solve the problem of unemployment among employable population. **VG-stockpiling (Vital Goods stockpiling)** In addition to the state reserves it is desirable to develop a non-government stockpiling of vital goods. Vital goods in the depositary networks of state and non-government VG-stockpiles are a useful trade buffer (both for consumers and producers and for those engaged in wholesaling). **Multi-currency market** **(on the basis of e-trade with direct lending)** Domestic e-trade is done according to the rules that are set by the laws of the state under whose jurisdiction the NEM-system operates. The e-trade deals between economic agents from different NEM-systems should be done following the given obligatory rules: - the applicable set of national currencies is represented by an intersection of the sets of currencies that are approved by central banks of the NEM-systems whose economic agents execute the deal; - restrictions should be made corresponding to the list of commodities that are allowed for import and export, as defined by law and by international treaties. **E-investment** Contractual money investment targeted at the development of NEM complexes.

Source: own processing

Table 1: Basic NEM complexes.

	EA-documentation (Economic Activity documentation) - PS-system (**system of Property Statuses**): ◦ **EA-accounts (accounts of Economic Agents)** ◦ **normalized money** - **Normalized E-banking:** central bank, banks-providers, personal e-banks (PEBs), corporate e-banks (CEBs) **The state budget, reserves, taxes and duties** If the multi-currency funds of the state are placed as investments in the NEM-system of this state, then the safety of these funds is guaranteed by collateralized property of investment recipients. In this case, the invested funds are used to increase the potential of the country to which they belong. **Regional budgets and taxes** **Social security funds**

Source: own processing

Table 1: Basic NEM complexes (continuation).

NEM is a market economic mechanism where central bank is obliged to monitor implementation of rules of commodity-money circulation which are established by law. The monitoring of activities of banks-providers, CEBs and PEBs works on the basis of electronic services (Ilyin, Ilyin, 2011; Ilyin, Ilyin, 2014 [9]; Ilyin, Ilyin, 2014 [8]; Ilyin, 2013). The relevance of the theme of state regulation of economic mechanism never decreases. Here is the example of discussion on this topic in ResearchGate: **https://www.researchgate.net/post/What_should_be_the_main_objectives_of_state_regulation_of_economic_activity_in_countries_with_developed_market_economies.** Structure and rules of the NEM, established by state laws, stimulate citizens to conduct business activities focused on increasing the economic potential of their country (Ilyin, 1996). This is to be done by means of taxes, duties and other economic instruments. The NEM does not suppress striving of economic agents (EA-agents) for obtaining an extraterritorial profit. It is supported in all cases when a transaction (sale, investment or other) does not contradict the objective to increase the potential of the country.

2. The system of property statuses

The system of property status (PS-system) is the system of e-documentary representation of monetary and non-monetary components that reflect property statuses of economic agents. Monetary components are represented by amounts of normalized money in different currency sections of unique unified multi-currency accounts of economic agents (EA-accounts). Non monetary components are represented by e-documents confirming the ownership of real estate, transport and other property which, if necessary, can be considered as collateral.

EA-account is unified e-document which contains several currency sections activated by the central bank. Since EA-account has a multi-currency structure, it can be applied to record the results of internal and overseas economic activities. Usage of EA-accounts assumes that each economic agent has own unique identifier (a conceptually similar project "National Strategy for Trusted Identities in Cyberspace" was published in the USA (THE WHITE HOUSE, 2011)).

2.1. The axiom of admissibility of operations on EA-account

Any change of the sums on EA-account can be done only after the documented encrypted confirmation of the EA-account's owner.

In the NEM it has to be implemented on software/hardware level. Operation becomes permissible (for purchase and sale transactions, investments, etc.) only when each owner of EA-account, involved in the operation, has given the encrypted confirmation. Each confirmation is included in e-document which describes the operation. The e-document is received by the owners of EA-accounts; its copy is kept on banks-providers' servers within a predefined time.

2.2. State online certification of operations on EA-accounts

EA-account can be changed only after online state certification of the operation permissibility. The certification is executed by special e-service

from central bank. The certification is based on data of the operation which is to be performed (purchase and sale, contract investment et al.) This prevents any violations of the rules of commodity-money circulation established by law (illegal economic transactions, non-payment of taxes, etc.).

3. Normalized money

Normalized money is programmatically implemented documentary representation of value of goods and property statuses of EA-agents, as well as the means of payment for goods, taxes and accumulation of wealth. NEM-money is represented by records in EA-accounts. The records certify property rights to a share of the commodity value of the NEM-system and property liabilities in relation to other economic agents, which are expressed by debts and received investments. Signed real numbers are used to present the sums in EA-accounts: the minus sign is used for those sums that are to be returned, the plus sign - for those sums which have been received in accordance with contracts of closed deals.

Two states are possible for normalized money: “assigned” (a debt due to a commodity purchase; investment; tax, or other sum to be paid) and “non-assigned” (sums in the “I own” sections of EA-accounts). Assigned money may be used only for a certain purpose [e.g. those received from investors can be used in accordance with the investment contract (purchase of new equipment, etc.)]. Non-assigned money is used according to the self-determination of the owner of EA-account (in any permissible deal).

Changes over time in purchasing power of NEM-money for different commodity types reflect changes in the supply-and-demand situation for commodities of these types. If manufacturers of certain type of real commodities, using excess of demand over supply, increase prices without increasing the functionality and quality of the commodities, then for some time, such manufacturers will benefit (until the market will not reach a balance of supply and demand). At the same time such manufacturers tend to lose some wholesale customers and, as a result, may lose a market share for their commodities.

The continuous decrease of the purchasing power of money in economic systems of extraterritorial profit is caused by money emission and bank trade in credits which are not tied to purchases of real commodities. In fact, the sums of money not backed by real commodities, are thrown onto the market, and it leads to excess of solvent demand over supply and to the rise in prices. Such organized decrease in the purchasing power of money is the fraud to take a part of money belonging to those who produce real commodities and do not increase their prices. This fraud was invented to “make money” without producing real commodities, and theorists of economy of extraterritorial profit explain it as inevitable attribute of market (Fisher, 1922; Keynes, 1936; Friedman, 2005).

4. Normalized e-banking

E-banking system of the NEM includes personal electronic banks (PEBs), corporate e-banks (CEBs), banks-providers and the state central bank, which controls functioning of all other banks.

The central bank possesses a network of servers located on the territory of a country under whose jurisdiction the NEM-system operates. The following functions of the central bank have to be implemented as e-services:

- issuance and revocation of licenses for banking activities (to owners of PEBs, CEBs and banks-providers);
- activation and deactivation of the currency sections of EA-accounts;
- monitoring the adherence to the rules of banking activities, including online certification of the transaction permissibility;
- analysis of the financial component of economic activity and presentation of results in the form established by law;
- development, modification and approval of the tested standardized forms of bank documents (including EA-accounts);
- monitoring the efficiency of allocation of normalized money belonging to state reserve funds, state social protection funds, other funds with state participation.

Bank-provider is a commercial institution established by legal entity (or by association of legal entities and individuals) involved in RC-production, RC-trade or VG-stockpiling. The bank-provider possesses a network of servers, designed to process the queries from clients' PEBs and CEBs, and to interact with the servers of a central bank.

The e-services from bank-provider are:

- processing requests from EA-accounts' owners, which are sent from PEBs and CEBs when a deal is to be made, including queries

to check the partner's EA-account state, sent upon permission of the partner;

- storage and update of encrypted copies of EA-accounts belonging to the bank clients;
- analysis of investment inquiries of clients (prospective investors and investment recipients): banks-providers can execute orders of investment recipients to consolidate investments;
- registration of contracts (with control of permissibility) and maintaining the contracts database which contains encrypted copies of documents on transactions served within predefined time period;
- legal support of deals.

The rules governing the process of establishing, operation and liquidation of banks-providers shall be established by law. Owners of banks-providers should have the property statuses with sufficient monetary and non-monetary components.

PEBs and CEBs are, as usual, portable electronic devices (like tablet PC) having smartphone functions. CEBs may be based on desktop computers. PEBs and CEBs keep (in encrypted form) the original EA-accounts and documents on transactions. Mobile banking software (certified by central bank) is the core of applications on PEBs and CEBs. Encrypted database of EA-account is stored in the device memory, and its copy – on memory card. Records in the files of EA-accounts may be initiated only by accounts' owners who make a deal.

Results and discussion

These days the approaches to implementation of normalized commodity-money circulation and e-trade with direct lending (described below) are discussed the most intensively. (Here is one example of discussion with the English-speaking participants: **https://www.researchgate.net/post/Why_is_trading_with_direct_lending_an_effective_anti-inflationary_tool)**.

5. E-trade with direct lending

One of the urgent measures to normalize economic mechanism is the e-trade with direct lending, where the deferred portion of payment is documented as the buyer's debt to the seller (not to the bank). This technology is applied to purchases of any commodity, any seller and buyer. Repayment schedule is fixed in the contract. The contract also specifies penalties for violation of the schedule and improper quality of the commodity. In extreme case the buyer has to pay by collateral. In such trading, all the benefits and risks are shared between buyers and sellers only. The legal and technological assistance to the seller and the buyer is done by their banks-providers.

5.1. Debt repayment: state support

In general case, debt repayment is determined by the contract.

When a debt is result of purchase of the priority vital goods, the rules of early repayment from the central bank funds can be applied. These rules are defined by the central bank and act for the sellers of commodities included in the priority list defined by law. The sellers can receive the debt portion of the purchase price much more earlier than it is determined by repayment schedule in the contract. A seller sends a request to the debt department of the central bank, using special online service. In case of positive decision, the central bank transfers the debt amount to the seller's EA-account, and then the buyer pays the debt to the department of the central bank. A seller informs buyer about such way of repayment before making a deal.

Early repayment of debts from the central bank funds implements the state program to support production and sale of priority commodities.

5.2. Emission of debt amounts

The central bank makes emission only when it does not have necessary sum to return a debt amount to seller of priority commodities. The emitted sum is the difference between the debt amount and the sum available on the debt department account.

Emission of debt amounts is used for the state regulation of total sum of normalized money in economic system and their purchasing power. Rules of emission of debt amounts exclude a possibility of emission of money not backed by real commodities.

5.3. Stimulation of sales for national currency

On the NEM' multi-currency market the e-trade with direct lending stimulates sales of priority products with payment in national currency: sellers have the possibility to quickly return the debt portion of the purchase price only when sale is made with payment in national currency.

5.4. E-trade with direct lending as anti-inflationary instrument

E-trade with direct lending makes use of current bank loans unnecessary. Such trade serves as effective anti-inflationary tool: change in the total

amount of money is always strictly related to the change in the total value of goods sold in the economic system.

In the first stage of normalization of banking activity the central bank has to oblige other banks to provide and serve the trade accounts which reflect operations of e-trade with direct lending.

Conclusion

In the system of property statuses of the NEM the normalized money is used as means of electronic documenting the value of goods, the volume of property rights and other economic entities related to property exchange (evaluation of collateral, values of debt and profit, contractual investments, taxes etc.) Normalized money is not a commodity unlike the one that the current banking system produces (by means of money emissions) and trades (in the form of loans).

It is technologically impossible to use the sums of normalized money, stored on the EA-accounts, without permission of the accounts owners. It is also impossible to use the normalized money in illegal deals due to obligatory online state certification of the transaction permissibility by e-service from the central bank.

The technology of normalized commodity-money circulation (including technology of e-trade with direct lending) is an effective anti-inflationary instrument, because a significant reduction in the purchasing power of money is possible only with a corresponding reduction of supply on the market. The rules of emission of debt amounts and cancellation of trade in credits exclude the occurrence of money not backed by real goods, stimulate production of the priority goods and selling them for the national currency. List of priority goods and rules of transaction permissibility are formed and updated by parliament with participation of central bank and business community.

The implementation of technology of e-trade with direct lending will significantly reduce farmers' dependence on bank loans. Such trade allows farmers to buy machinery, fertilizers and others products, paying directly with sellers of goods. Farmers could carry out transactions using their personal and corporate e-banks. Banks-providers should technologically support those transactions.

In the normalized economic system the central bank and the banks-providers are the core of the system of documenting the results of economic activity. This system processes the requests of economic agents sent from their CEBs and PEBs.

The approach to normalization of the money system is designed with taking into account the possibility of gradual change of the current monetary system. The change can be implemented without losses for the producers of real commodities and the state.

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Geospatial Data Infrastructure Components Deployed for LTER -Europe Researchers' Community

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Abstract

Assessing the status and trends of the environment requires the collection, management and publication of spatially referred observations. Since many years, Long-Term Ecological Research sites in Europe collect ecological data, resulting in long-term data series. Nowadays, advanced software tools can enable discovering, accessing, and distributing collected data in a user friendly way. Based on Open Geospatial Consortium (OGC) standards, Web based Geographic Information System allows access to interoperable distributed repositories of observations. The present paper gives an overview of the methods and solutions proposed and tested in the LIFE+ project EnvEurope for the community of researchers of the Long-Term Ecosystem Research (LTER) Network in Europe. These solutions consist in a straightforward online environment for metadata management and discovery, shaped on the ecological community and its practices; components of a Spatial Data Infrastructure including both a network of repositories deploying observations via OGC SOS (Sensor Observation Service) services and Web user interfaces to access and visualize them. The success of the presented approach is linked to the development and availability of easy to define, ready to use tools, enabling site managers to create their own repositories and services.

Keywords:

Geospatial data infrastructure (GDI); metadata; observations; LTER Network; DEIMS; INSPIRE; Sensor Observation Service (SOS).

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Introduction

More than 400 Long-Term Ecological Research (LTER) sites are disseminated throughout Europe and are precious sources of ecological data collected since many years (Adamescu et al, 2007; Mirtl, 2010). These sites are even more useful when studies on climate change and assessment of environmental trends (Metzger et al, 2010) at different scales are becoming a priority in the socio-economic and political agenda. Data collected at LTER sites refer to three main natural environmental categories, i.e., forest, sea and freshwater. This is however a source of environmental heterogeneity, besides the diversity of languages, national laws and country-based practices, etc. Researchers at each local site struggle with following a balance between the heritage of long local tradition of data collection and the new requirements of sharing, harmonizing and comparing data at the European level. Information Technology tools seem not to improve the situation, since they are often perceived as a further burden to the daily activities of ecologists. Easily and safely storing data, distributing them following harmonized rules, either maintaining local data centres or feeding remote data collectors, are all actions that can be felt as an extraneous, unwelcome task.

In this context, the challenges for new, advanced IT solutions are:

- To offer ecologists user-friendly, online tools to enter and to store their own observations in a way which is respectful to both community practices and to the new European directive (INSPIRE

– Infrastructure for Spatial Information in Europe) (European Commission, 2007), which requires open data structures.

- To allow research sites both to maintain their own data repositories and to share data in an easy, interoperable way.
- To create user interfaces on the Web, allowing on the one hand discovering the provided data, on the other hand to subsequently visualize and access them, thus fostering data analysis.

The LIFE+ project EnvEurope (Kliment et al, 2013; Pugnetti et al, 2013) intended to initiate the creation of a common IT platform and to provide standards and guidelines for the entire LTER-Europe network (Mirtl, 2010). Within the project, a pilot platform for LTER-Europe was created in order to meet the above listed challenges, including:

- An online tool that allows entering metadata of sites, researchers and observations, linked together; the same tool allows online discovery of the information of interest filtered by location, time range, collected parameters, country, etc. Metadata follows the Ecological Metadata Language (EML) metadata specifications (Michener, 2006), but are also harmonized with the European directive INSPIRE metadata regulation (European Commission, 2008).
- Geospatial Data Infrastructure (GDI) components as Catalogue Service for Web (CSW) deploying compliant metadata catalogue, geospatial data services providing access to a network of distributed repositories of observations shared as OGC SOS services and online user interfaces to access and visualize sites locations, observations offered and their trends in time.

Materials and methods

1. Metadata online tool

In order to enable data discovery, interpretation and, if applicable, data analysis, information about the "how, where, when, what, who …" needs to be captured in an accessible and understandable manner (Nogueras-Iso et al, 2005). If adequate metadata is available, data can be reused after years or decades, either on its own or in combination with data from other sources (Karasti et al, 2008). In the EnvEurope project, an online metadata tool was developed based on three metadata models in order to facilitate the LTER-Europe network community of researchers in information discovery and sharing. The tool is based on the Drupal Ecological Information Management System (DEIMS) developed by the US LTER.

1.1. Metadata models

A complete model defining the descriptive information – metadata integrated in the system was defined through the conceptual schema overview including three metadata models as follows:

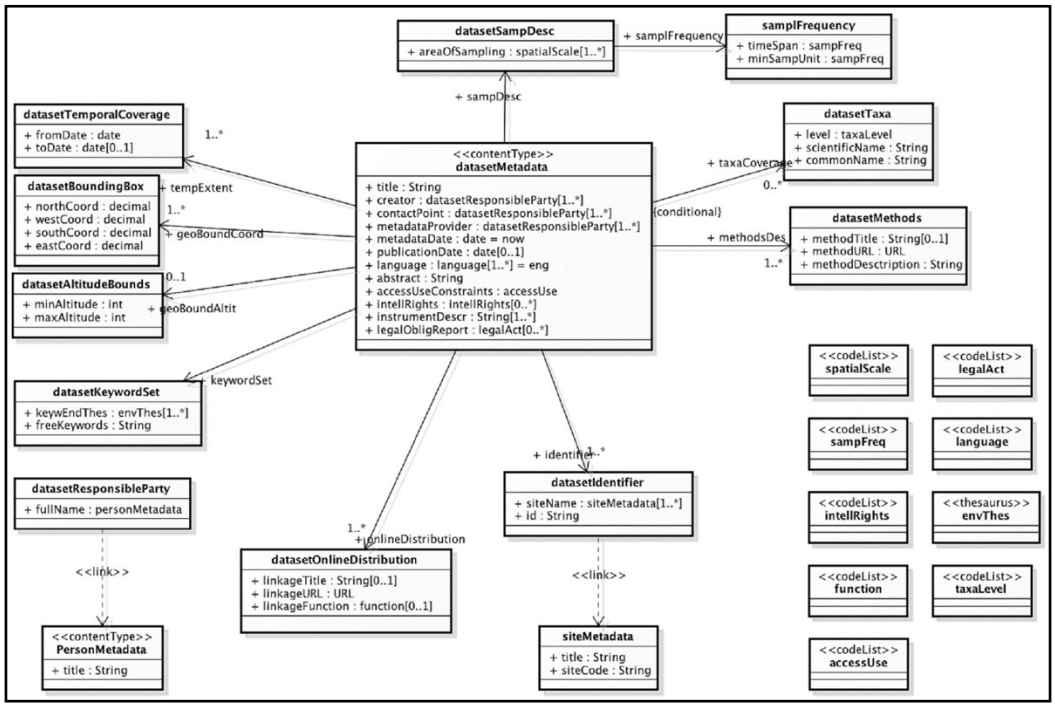
1. Research Site Metadata Model (RSMM) (Peterseil et al, 2012): To get a fast overview about the participating sites in a network there is a strong need for metadata about the inner structure, administration, data management and observations taken at the site or platform level . The previously used LTER InfoBase system was designed as a tri-component system by ALTER-Net providing site level metadata which described the LTER Sites and LTSER Platforms as a whole (Adamescu et al, 2010) and which formed the site network of ALTER-Net and LTER-Europe (Haberl et al, 2006; Mirtl et al, 2007). The RSMM application schema has been migrated from the LTER InfoBase into the DEIMS database and improved according to the user needs.
2. Person Metadata Model (PMM): The PMM serves several purposes. First, it provides a source for dataset metadata creators, contact points, and metadata providers. In addition, the person component serves as a personnel directory, allowing individuals to add information about their expertise, subjects investigated, role in their national LTER network, and networks in which they participate in addition to LTER-Europe. Persons can be associated with both datasets and publications. In order to be associated with a dataset, the person needs to be selected as a metadata creator, contact point, or metadata provider when creating a dataset metadata record. The PMM has been based on US-LTER model and extended for the user needs.
3. Dataset Metadata Model (DSMM) (Kliment et al, 2011) has been introduced for the first time into the LTER-Europe network community within EnvEurope. This brings a significant benefit for the community: researchers are able to share not only information about their research sites, or people who

perform individual tasks, but they can also bridge the former to information about the collected observational data instances aggregated as datasets. This information makes researchers easily aware of the existence of datasets from other research sites, which might be of interest for particular cross-domain analysis. The definition of metadata fields in the DSMM is based on the following categories of sources:

a. Ecological Metadata Language (EML) - semantic description and syntactic definition of individual metadata elements was taken from the EML metadata specification (KNB, 2014), due to its recognition in the LTER networks around the globe.

b. Global and European Environmental Data Infrastructures - Global and European data e-infrastructures define data themes with a close relation to the data collected within LTER-Europe network. For example, an infrastructure available through GEOSS divides information resources into nine social benefit areas, out of which two are related to LTER domains - Ecosystems and Biodiversity. On the European level, infrastructure for geospatial information, which is defined by the INSPIRE directive has the main goal to provide harmonized geospatial data to support environmental and related policies in EU. Therefore apart of the reference data themes, several domain specific data themes as Species distribution, Habitats and biotopes, Environmental monitoring facilities, etc. have strong overlap with LTER.

c. LTER-Europe network researchers expressed a set of requirements about the DSMM that were collected during the technical meetings. Beneficiaries were explained the meaning of dataset metadata and what would be the advantages and benefit of having their datasets documented by standardized information. The common metadata model was established and further implemented into the metadata editing form described later.



Source: own processing

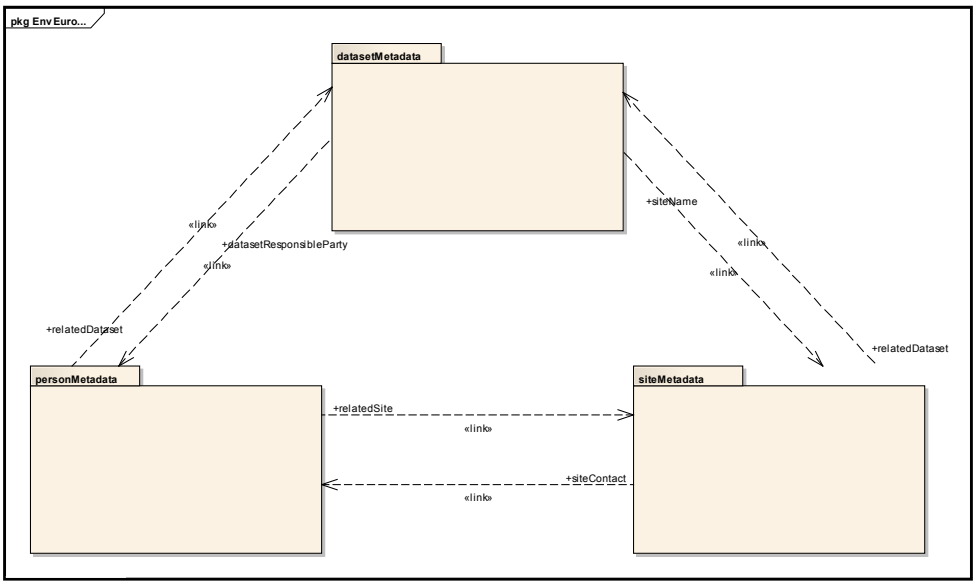
Figure 1: UML class diagram modelling the dataset metadata class consisting of information resulted from requirements analysis.

The main class datasetMetadata consists of 21 metadata categories that contain individual metadata elements of the DSMM (Figure 1). Detailed description of individual metadata categories and associated elements is provided in the metadata specification document (Kliment et al, 2011).

The UML package diagram in Figure 2 represents the relation of DSMM to other metadata models.

1.2. Implementation

Drupal Content Management System (CMS) was used to develop the metadata management platform as free and open source software package that allows easily organizing, managing and publishing content on the Web. This development environment has been chosen due to previously ongoing development actions carried out by the US LTER data management working groups. They developed first an ecological metadata editor based on Drupal CMS (San Gil et al, 2010) and continue in further improvements of the entire system. Drupal's code base is PHP scripting language and can be deployed in web servers, e.g. Apache HTTP Server. The underneath Database Management System (DBMS) used is MySQL; however, other DBMSs (e.g. PostgreSQL) are supported, too. JavaScript web scripting language is used to add additional functionalities for the data, modifying the content of HTML document displayed in the web browser, interacting with users and many other features. Individual pieces of data are represented as nodes, term well known in the Drupal community, which refers to a record in a content table in the database. Each web page contains information from one or more nodes. Different types of information are represented by Content Types, which define groups of information for a specific category of information (e.g. Dataset metadata). Nodes of individual content types can be interlinked based on the conceptual definition and principles of relational databases. For example, one node from the Dataset content type may contain links to several nodes of the research site and person content types. Additional features as various field types, taxonomies, content views, search interfaces, etc. are available through a bulk of modules developed by the Drupal community of developers, and thus can be added to web pages without further programming works. Drupal Themes that define styles of the web page content displaying ensure the graphical user interface layout of the application front end. The web administrator can change some of the style characteristics (e.g. font size, font family, and grid layout). For more complex changes, a high-level knowledge of CSS mechanism is needed. Drupal provides an easy way to maintain the content of an information system within any area of interest. The tool required to interact with a Drupal site instance is an Internet browser, which almost all can perform the operations. In order to create the default Drupal site accommodating the requirements of a specific community (e.g. LTER -Europe), customization needs to be performed. By example, defining new content types, serving the content in various commonly used formats



Source: own processing

Figure 2: DEIMS metadata models designed with bidirectional links.

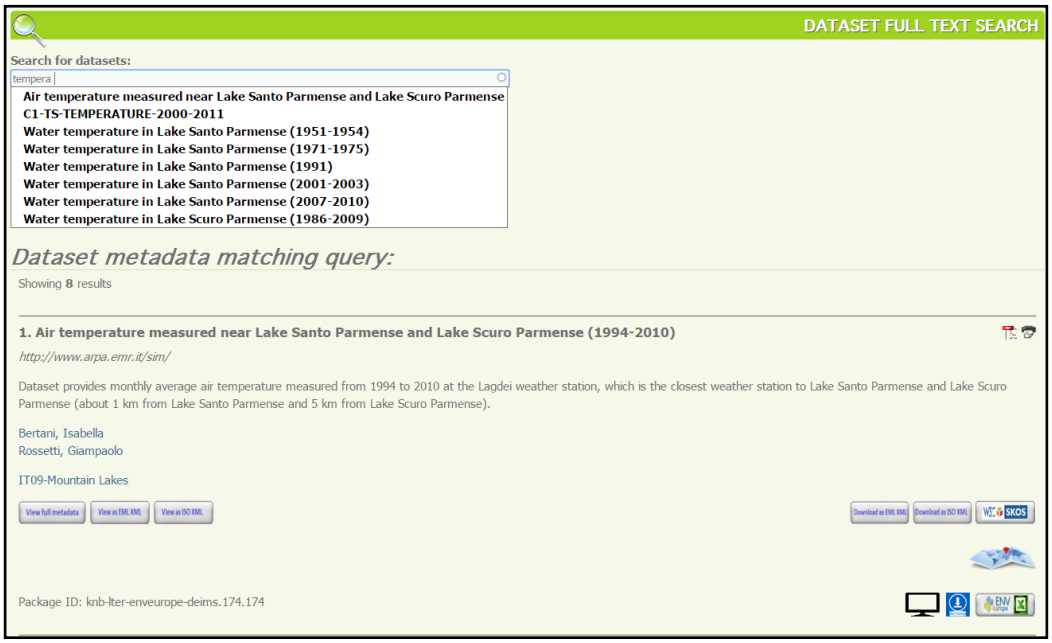
(XML, Excel spreadsheets, PDF files, etc.), or defining various views to offer the content in user friendly and intuitive ways. The Views module provides user-friendly definition interface for SQL queries together with the actual final web layout. Using the web GUI, authorized user with admin rights can configure the query (fields, filters), and the layout (style, page settings etc.) (Rumbauhg et al, 2004). Moreover, since its version 6, Drupal provides a module for taxonomy definitions in order to define semantic relationships among keywords within a particular area (e.g. LTER) ideally coming from a controlled vocabulary like EnvThes - The EnvEurope Thesaurus (Peterseil et al, 2012).

Based on the conceptual model described above, the dataset metadata content type was created in order to provide users with an online editing form. Individual categories (e.g. 19. Dataset sampling description) and nested metadata fields (e.g. Sampling time span) of various types (e.g. free text, autocomplete, select list, etc.) were defined. The editing form consists of three main sections: basic guidelines, editing section, and action buttons. The form has the following selected features that were developed to facilitate the metadata collection: i) linking to associated person and site metadata via autocomplete functionality; ii) Annotating datasets with concepts from EnvThes through autocomplete functionality with multiple value definition; iii) Geographic extent definition with an automatic geographic bounds calculation performed from multiple polygons drawn on a map; iv) Instrumentation, Sampling description and Methods taken from the ECOPAR (Parameters and Methods for Ecosystem Research & Monitoring) database and provided through autocomplete functionality; v) List of predefined values with option to add new values - spatial scale, sampling time span, minimum sampling unit, intellectual rights, etc.

The metadata collected serve primarily for data discovery. Additionally, data evaluation can be performed in order to support the comparison of similar datasets. Therefore, several searching interfaces were developed combining functionalities of several Drupal modules. Namely, Views, Faceted Search, Finder, etc. were used. The following searching clients are available:

- Simple full text search: provided for each information type (dataset, person, and site) separately with simple searching box querying titles of metadata records available in the system extended by autocomplete functionality (Figure 3).

- Guided search: available for all information or each type individually. A searching pattern provides a keyword search with a possibility to refine the query with the predefined categories (resource type, organization, language, etc.).



Source: own processing

Figure 3: Simple full text search user interface for dataset metadata and result records with links to metadata and data representations.

2. Geospatial data infrastructure components for sharing LTER features and observations

Concepts like interoperability are fundamental in realizing a linkup among data characterized by spatial (e.g. depth, geographical projection or location, relative position), temporal (e.g. time zone) and thematic (e.g. quality, domain, unit of measurement) attributes. Having the necessity to exploit the interoperable access to observations from multiple sites, using heterogeneous sensors, issues to be faced are:

- Heterogeneity: LTER-Europe observational network is heterogeneous; managing authorities are numerous and have different skills, resources and IT expertise. Network nodes technologies are not homogeneous in the collection, frequency and distribution of the measured parameters (e.g. different temporal and spatial resolution, units, identifiers).
- Quality check and harmonization: To allow for a comparison between data coming from sites, quality check of data is a priority. Exclusion of outliers, comparisons among nearby stations, and trend analysis at different temporal granularity are operations that must be carried out at different levels of the data processing workflow; they would allow an effective and meaningful comparison. Another important action is the harmonization of collection and storing practices in order to improve the overall quality of the observations collected from the network.
- Description and history of sensors: Information on sensors used like their description, searching keywords, identification, classification, characterization of physical properties or electrical requirements, capability, contacts of manufacturer, owner or operator, input, output and components of the system, and especially history log to track any changes or calibration, must be collected and made available in order to assess their quality, capacity, features and to compare the sensors and data measured by them.

The pilot created in EnvEurope aimed at testing how distributed repositories and a decentralized data infrastructure can tackle the above issues. By deploying data from heterogeneous, asynchronous sensors connected to the Web, the pilot wishes to prove how OGC services are able to interoperate and to let sharing, visualizing and accessing observations and measurements, without forcing data replication and harvesting towards a centralized caching data centre.

2.1. Sharing LTER observations

In fact, data management within LTER realm is focused on observations from sensors. Therefore, a framework of standards has been proposed and supported by OGC under the common umbrella of SWE (Botts et al, 2008), which includes: SWE Common Data Model, Sensor Model Language (SensorML), Sensor Event Service (SES), Sensor Planning Service (SPS), Sensor Observation Service (SOS) for observations collected by sensors.

In the EnvEurope pilot, the SOS service (Na et al., 2007) has been adopted and tested. SOS has been developed for discovering, binding and querying individual sensors or sensors platforms in real-time (RT), near real-time (NRT) or delay mode (DM) (Bermudez et al, 2009). With SOS, two more specifications work together: SensorML for describing characteristics and capability of the sensors, and Observations and Measurements (O&M) for encoding observations and measurements.

SOS specifies a standard Web service interface for requesting, filtering, and retrieving observations and sensors' information (see Table 1 for the available requests categorized into core, transactional and enhanced, respectively). This interface is the intermediary between a client and an observation repository or near real-time sensor channel. Clients can also access SOS to obtain metadata information that describes the associated sensors, platforms, procedures and other metadata related to observations.

Core Operations	GetCapabilities
	DescribeSensor
	GetObservation
	RegisterSensor
Transactional Operations	InsertObservation
	GetObservationById
	GetResult
Enhanced Operations	GetFeatureOfInterest
	GetFeatureOfInterstTime
	DescribeFeatureType
	DescribeObservationType
	DescribeResultModel

Source: modified by Bermudez et al, (2009). For more information about operation, descriptions see (Na et al, 2007).
Table 1: Requests carried out in SOS service divided by type.

The components of the pilot in EnvEurope are data repositories and OGC services that are both distributed, "… to ensure that geospatial data are stored, made available and maintained at the most appropriate level …" (see Art. 6 – INSPIRE Directive 2007/2/EC) (European Commission, 2007). This aspect is very important in the LTER context, where institutions from all over Europe need to manage and keep the data collected from their equipment.

The EnvEurope pilot provides data collected by sensors, especially physical and chemical parameters listed in Table 2.

Parameter full name	SOS offering	Unit
Air Temperature	AirTemp	°C
Water Temperature	WaterTemp	°C
Total Phosphorus	TP	µg/L
Total Nitrogen	TN	µg/L
Phosphate	P-PO4	µg/L
Ammonia	N-NH4	µg/L
Nitrates	N-NO3	µg/L
Silica	SI	mg/L
Secchi depth Transparency	SDT	m
Salinity	Sal	PSU
Chlorophyll	Chla	µg/L

Source: modified by Bermudez et al, (2009). For more information about operation, descriptions see (Na et al, 2007).
Table 2: List of parameters provided by observations collected in EnvEurope.

The observation flow among different components of the architecture is organized by the standard SOS interface. Observations collected by local, distributed sensors are stored in the respective local repositories by the SOS InsertObservation() request. Also the dialogue between application layer and service/data layer occurs through different standard requests, e.g. GetObservations(), GetFeatureOfInterest(), DescribeSensor(). In this way, a complete decoupling is obtained between the components that store, distribute and deploy observations and the applications that allow end users to search and access them on the Web: in fact, the interoperable dialogue is guaranteed by standard requests, not depending on whichever implementing environment is used. In the EnvEurope pilot, decoupling has been proven by testing observations' access and exploitation by both advanced tools (i.e. RStudio Server and Taverna) and a plain GIS-like user client GeoViewer created in the presentation layer.

2.2. From metadata to geospatial observations of datasets

Linking mechanism between the metadata of dataset and respective associated dataset deployed through available services for observation portrayal (Web Map Service – WMS) and download (SOS). If the metadata of dataset provides all necessary information, which can be used to construct a link, an icon is displayed within the discovery interface (Figure 3). The icon representation depends on a type of data service availability for the dataset described by metadata.

All datasets published by SOS have correspondent metadata stored in the DEIMS and are accessible for authorized users directly from the discovery client. The DEIMS generates a URL defining SOS GetObservation() request, which is posted to the SOS server. An example of SOS GetObservation() URL is constructed as follows:

http://sp7.irea.cnr.it/tomcat/envsos/sos?

SERVICE=SOS&

VERSION=1.0.0&

REQUEST=GetObservation&

OFFERING=AirTemp&

PROCEDURE =urn:lter:object:feature:Sensor LTER_U_IT_009-Lagdei:AirTemp&

OBSERVEDPROPERTY=urn:lter:def:property: OGC:1.0.30:AirTemp&

FEATUREOFINTEREST =LTER_EU_IT_009 -Lagdei&

EVENTTIME=1994-01-01T00 :00:00/2010-12 -31T00:00:00&

RESPONSEFORMAT =text/xml;subtype="om 1.0.0"

Individual parameters of the URL are derived from corresponding metadata fields as follows:

- OFFERING – the value is taken from the dataset keyword part comparing provided keywords with the list of parameters offered by the service – e.g. AirTemp;
- PROCEDURE – the value is taken from the dataset identifier – site name as LTER-Europe site code and station code, than parameter value concatenated with the sampling frequency value – e.g. urn:lter:object:feature:Sensor:LTER_EU_IT_009-Lagdei:AirTempMonthly;

  OBSERVEDPROPERTY – the parameter value from offering section is appended

to the default property URN - urn:ogc:def:property:OGC:1.0.30:AirTemp;

- FEATUREOFINTEREST – the value consists of a LTER-Europe site code derived from the site name in the dataset identifier and the station code - e.g. LTER_EU_IT_009-Lagdei;
- EVENTTIME – the temporal filter is defined by the values provided in the dataset temporal extent metadata section (From and To dates) – e.g. 1994-01-01T00:00:00/2010-12-31T00:00:00.

The response to request represented by this URL is a collection of observations (dataset) encoded in O&M XML data model.

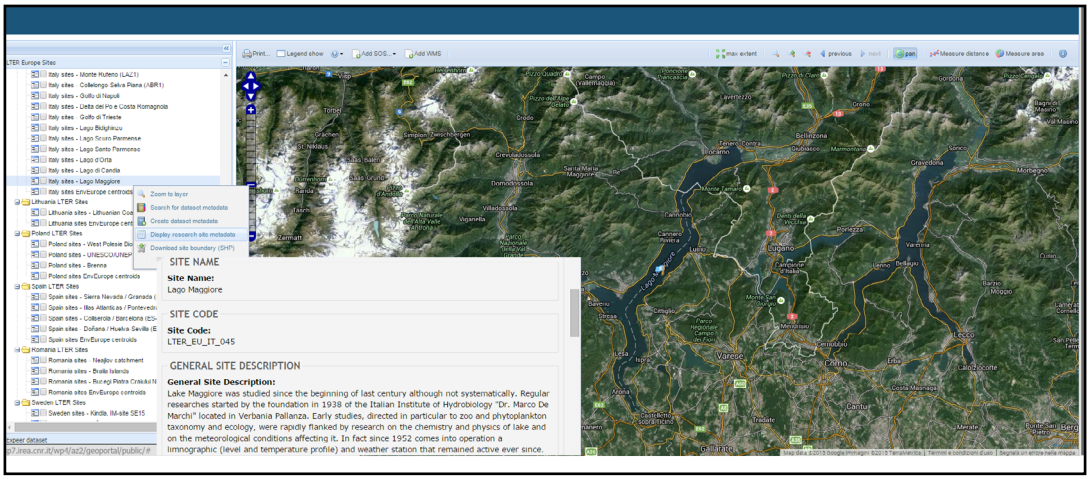
2.3. From metadata to geospatial features of research sites

Geographical representation of datasets is implemented by linkage between DEIMS discovery client and GeoViewer using permalink with parameters latitude (lat) and longitude (lon). The values are defined as averages of the boundaries provided in the metadata section corresponding to the geographic coordinates bounding the dataset and calculated by the DEIMS. The objective of this functionality was to provide users an easy way to navigate from the descriptive representation to geographical location overview. A similar functionality is provided also for the research sites, where WMS GetMap() and WFS GetFeature() requests are constructed with values retrieved from the metadata fields Site Latitude, Site Longitude and Site Code. ESRI Shapefiles of EnvEurope sites were provided and made available to be portrayed by WMS together with the sites' basic information in the GeoViewer (Figure 4). In addition, the sites' geospatial features can be downloaded as shapefile through WFS. On the contrary, reverse links from the site geographic portrayal in the GeoViewer to DEIMS components (metadata editor, dataset search, metadata preview) are provided, in order to drive the user from a site geospatial feature to its metadata as well as linked datasets 'metadata.

3. Monitoring use cases implementation using deployed GDI components

The presentation layer of the pilot contains a client in the form of a GIS-like user interface, called the GeoViewer. It has been created to perform tests in the case when potential non-skilled users are operators involved in daily ecological tasks, such as marine monitoring. Its characteristics are briefly described here in terms of tasks and data, listing services coping with them and the solutions adopted in the pilot. The main testing actions they would perform to assess seawater quality through a network of heterogeneous, distributed stations of sensors may be summarized in the following three use cases:

1. To retrieve and display a description of the station, of sensors available, and of the measurement processes (e.g. calibration, gain, accuracy, offset, etc.) which could include quality control of all sensors of a station;
2. To retrieve and comparatively display observations of one selected parameter (e.g. water temperature, wind direction, wind speed, etc.) collected from multiple, distributed sensors;



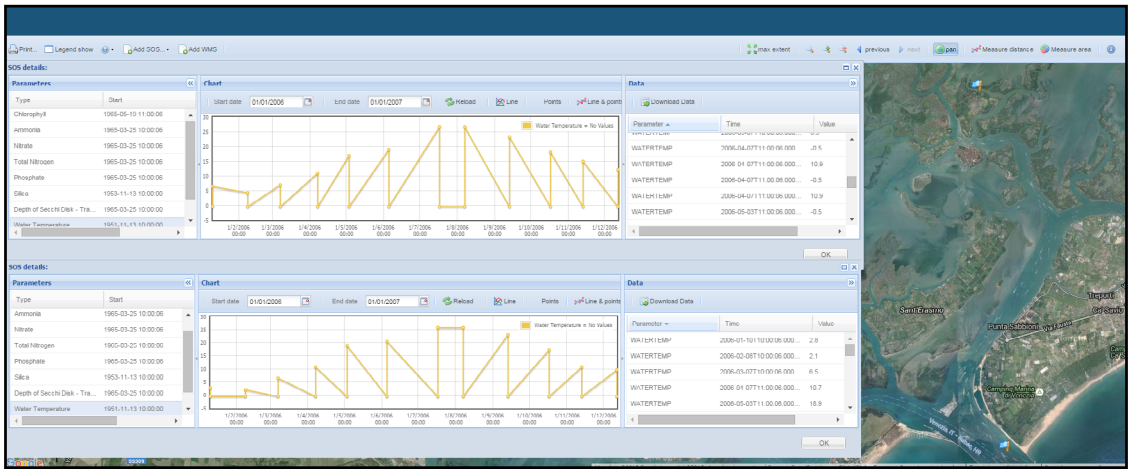
Source: own processing

Figure 4: Research sites geospatial features' map representation and links to metadata and data download services.

3. To retrieve observations of all parameters collected from all sensors from a specific station.

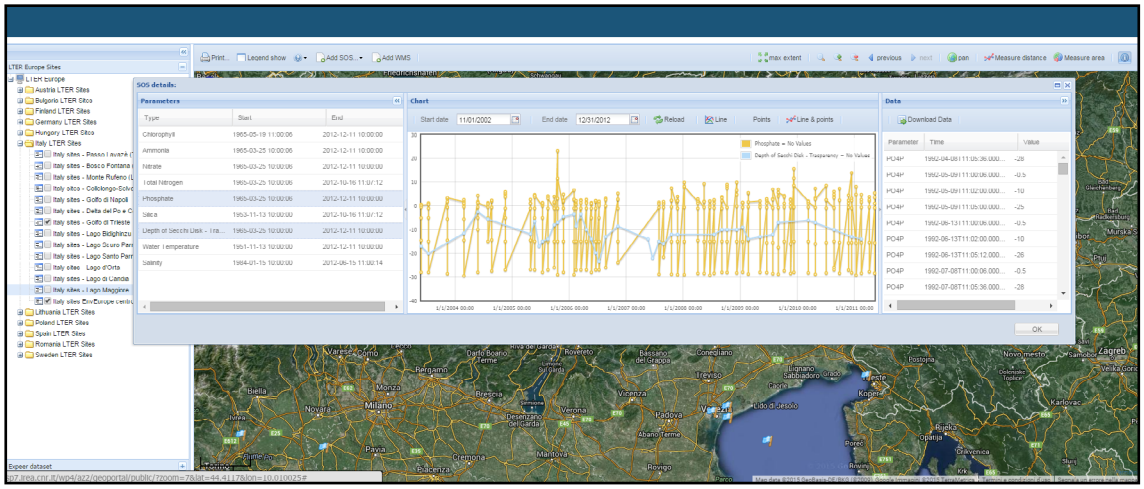
These use cases were tested by real examples as follows:

1. The user may want to know the features of the thermometers of marine stations in LTER. To display on a map the location of different water temperature sensors (thermometers), the pilot system exploits the Enhanced Operation GetFeatureOfInterest() (Table 1) to obtain the coordinates of stations participating in the pilot. The user's selection (by clicking) activates a GetCapabilities() request that produces the parameters each station collects. This way the user can select stations that provide data on water temperature; she/he can then select one of them and, after selection, the client performs a DescribeSensor() request. This allows to display the SensorML description of the water temperature sensor with general description, keywords, identification, classification, characterization of physical properties, electrical requirements, capability, contacts of manufacturer, owner or operator, input, output and components of the system, and moreover its history log to track any changes or calibration.
2. The user in this case may want to retrieve the water temperature in the whole North Adriatic Sea during summer (from 20 of June and 23 of September) 2011, and to know the geographic position of sensors. The pilot system performs a GetCapabilities() request, and shows stations providing data on water temperature and whose observations cover the period requested by the user. In fact, the response to this request contains, among other, information about: parameters measured in each station, period covered by different sensors, and geographic position. The second step is to make graphical representations of the observations through charts. The request GetObservation() with time period filtering can be used to get observations from all stations that satisfy the filter. An example of the results can be seen in the Figure 5.
3. The user in this case may want to retrieve all data collected by all sensors in one station (Figure 6). To this aim the pilot system simply exploits GetCapabilities() and GetObservation() requests to list the parameters and the corresponding values, respectively. The SOS that serves observations from the station selected by the user on the client map can be queried independently and it lists all observed properties present in the response capabilities.



Source: own processing

Figure 5: GeoViewer is able to visualize information distributed by multiple OGC SOSs, such as the related stations' positions and graphic visualizations of parameters trend (water temperature) during a given period.



Source: own processing

Figure 6: GeoViewer is able to comparatively visualize trends of many parameters distributed by an OGC SOS (here phosphate and depth of Secchi's disk) during a given period.

Results and discussion

DEIMS is able to provide a common portal to describe and access the LTER-Europe information resources in terms of research sites, researchers and dataset; DEIMS is an easy tool to collect and discover metadata of these resources. Though DSMM aims to cover all three levels of metadata usage (discovery, evaluation, and synthesis), its primary focus is devoted to the discovery and the evaluation levels. In other words, it focuses on those content areas that will allow the discovery of datasets that would potentially be useful for meta-analysis or other synthetic activities; and to perform a preliminary evaluation of the suitability of the dataset for further analysis or synthesis. Dataset metadata allow to carry out the further step of data download and exchange process, thus to evaluate the fitness for use of the data and finally retrieve information on how to use the data and, if available, how to display, how to access, how to transform, or process, etc. The testing phase of the pilot has brought significant value of the information, collected by means of the DEIMS GUI (Graphic User Interface) available for the researchers, e.g. more than 400 metadata records describing datasets, thus set of observations. Observations are deployed on the Web exploiting an SOS service; they are aggregated into individual datasets described by metadata. The result consists in more than 216 thousand of individual observation instances with a time coverage of more than 60 years (the first observation instance dates to 15/01/1951 and the latest to 16/10/2012) and geospatial coverage in the scope of 27 stations collecting observations within 21 LTER-Europe sites from eight European countries. Additionally, all the observations collected by researchers as aggregated datasets are available to be displayed and used for further analysis from the EnvEurope Data Server through SPARQL queries invoked directly from the DEIMS discovery client, i.e. transparent to the user. Regarding the descriptive information about research sites and individual researchers, 442 metadata records are available for the LTER -Europe research sites and 862 records describing individual researchers. Dataset metadata can be downloaded and exchanged as EML, ISO19139 or RDF files. Another result obtained in the pilot is the GeoViewer designed and implemented in order to make collected observations understandable and visible in a simple way for researchers as an easy web-based interface to provide further ways of representations, e.g. geographical or statistical. It has been tested by means of three use cases depending on the researchers' requirements. Based on the tests performed by researchers, the evaluation of 2 out of 3 proposed use cases can be considered as satisfactory, thus facilitating the research work.

In general, the architecture, components and implementation solutions proposed in the pilot revealed to be able to cope with the requirements of a community of ecology researchers wishing to retrieve and display observations coming from heterogeneous sensors on distributed stations, stored in distributed repositories connected to the Web and delivered via standard OGC Web services in the SWE framework. The multilayer structure and the service approach enable decoupling

of components; in particular, each Institution hosting and maintaining a sensor station is allowed to store observations and to deliver them to multiple independent clients, in a standard, interoperable way, well recognized and accepted at European and global scale. Quality check and harmonization are fostered by the multi-layered approach that allows to include components and tools aimed at those purposes at different level; by example a fast-track quality control can be performed before the storage of observations in the repositories, while a spatially extended cross validation process can be included in the application layer, where values from multiple sites are available.

If we consider the challenges defined in methodology section, the proposed GDI is able to cope with technological heterogeneity of the sites and sensors since it is based on the use of OGC standards, able to describe sites and sensors characteristics but offering a uniform way to communicate among the implementation components. Uniform metadata and shared sensor/observation models are also a way to describe, search and compare quality. However, they are even more useful in facing the need to provide descriptions of sensors and their status, information necessary e.g. to maintain the network and to compare the sensors' performance.

The development of data management and exchange systems, which is being performed in the US LTER network, has chosen a different approach (San Gil et al, 2009). This could have been influenced by several factors: (i) Different approach and understanding in the conceptualization process – metadata models, or content categories developed and being used in the US LTER are simpler, especially the research site model is significantly simplified comparing to the European one; but on the other hand further metadata models are included in the US infrastructure (e.g. Publications, Projects, Variables); (ii) Data access services - data are included in EML encoding, whereas in Europe only metadata are encoded in EML, while the data access services proposed in the pilot is OGC SOS; this results from different legislation requirements as well as ongoing data initiatives (Open Linked Data). The same situation appears also for metadata encoding and services provided by the infrastructure. While the US approach adopts a combination of EML with Metacat as a catalogue, the European approach has taken into account requirements defined by INSPIRE and SEIS and therefore developed a mapping of EML metadata in the ISO 19115/19139 schema encoding, which is the application schema for the INSPIRE metadata (Kliment et al, 2012). Additionally, in order to provide an INSPIRE Discovery Service interface, a catalogue service (CSW) by has been deployed, configured and populated by the metadata collected via DEIMS. Therefore, metadata of dataset collected in the European pilot are compliant with both EML encoding (to allow comparison and integration with the US LTER community) and INSPIRE. It is worth noticing that the dataset included in the pilot are mainly related to abiotic parameters and their description. The inclusion and description of biotic measurements require a further effort that has only been envisaged in EnvEurope.

Conclusion

The current global environmental research scene is highly fragmented, by disciplines or by domains, from oceanography, life sciences and health, to agriculture, space and climate. When it comes to cross-disciplinary activities, the notions of "building blocks" of common data infrastructures and building specific "data bridges" are becoming accepted metaphors for approaching the data complexity and enable data sharing. Data originating from a huge number of research projects, just completed or on-going, realized within the research communities, are becoming more visible due to several positive factors: (i) researchers have understood that publishing their data on the web in de-facto standardized way brings significant added value to their daily work; (ii) Legislation driven initiatives supporting the development of data infrastructures in the public sector, e.g. PSI, INSPIRE, SEIS, GMES have influenced research sector in a positive way, which is resulting in several initiatives and projects in ongoing (e.g. Research Data Alliance) or a proposal phase (e.g. Refer, or Biounify Cost (Co-operation in the field of Scientific and Technical Research) action project proposals) (iii) Links of large datasets from scientific research data in the relationship between Big data and Open data. Big, open data does not come always from governments: More and more scientists are sharing their research in astronomy, genomics, and other areas in a new, collaborative research model. Other researchers are using big data collected from social media – most of which is open to the public – to analyse public opinion and market trends (Gurin, 2014).

This paper tried to offer a contribution to this current debate, by describing the activity performed for the creation of the metadata tool and a pilot component of GDI, exploiting OGC SOS services,

in the framework of LTER-Europe ecology network. DEIMS and the pilot have been implemented and tested within the EnvEurope project; the results obtained are also described in the paper. In particular, DEIMS and the pilot approach (mainly the GeoViewer user interface) have been positively judged in other projects and initiatives dealing with heterogeneous environmental observations such as RITMARE, LifeWatch, or NextData.

The authors do not hide that the job to be done is great: in particular, the technological development of the tools to implement SWE components (and in particular SOS) is still overwhelming for the community of researchers in ecology. The success of the approach is linked to the development and availability of easy to define, ready to use tools, enabling site managers to friendly create their own repositories and services. Cloud providers can also offer a solution to the security issues raised by service distribution in small institutions. The beauty of this user friendly web geoservice-based data management tool, is the possibility of a wide usage and application to different sources; for instance in the determination of abiotic parameters like wind erosion intensity using soil particles (Lackóová et al., 2013), where the data collected in the field can be used as components/ input to create a repositories to be shared with the community. Another perspective is related to syntactic and semantic harmonization of metadata and dataset, which requires intelligent applications that integrate the current technological solutions and standards with knowledge coming from the domain experts. Additionally, the conformance and validation of individual components of the pilot described in the paper will need to be tested against the requirements defined by legislation and related standardization as described in several researches works (Cibulka, 2013; Horák et al., 2011; Kliment et al, 2012; Lopez-Pellicer et al., 2014). The goal is to ensure an appropriate level of interoperability and thus bridge pilot's components with other relevant European and worldwide information infrastructures.

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Factors Influencing Career Success of Employees in Agribusiness

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Anotace

Efektivní řízení lidských zdrojů v agrobyznysu může být zaměřeno na několik oblastí. Náš článek se zaměřuje na faktory kariérního úspěchu v oblasti agrobyznysu, respektive na fundamentální nástroje řízení lidských zdrojů. Při zpracování kariérního systému je nutné navrhnou kariérní koncepce, které vytváří obecný rámec a zároveň determinují alternativy jednotlivých prvků kariérního systému. K tvorbě karierního systému jakožto předpoklad karierního růstu je nutné provést empirický výzkum a potvrdit platnost charakteristik kariérních koncepcí a jejich obsahu pro usnadnění tvorby kariérního systému. Cílem příspěvku je vyhodnotit souvislost mezi velikostí organizace a kariérním úspěchem zaměstnance. Dalším cílem je identifikovat faktory podílející se kariérním úspěchu. Cílevědomou kombinací funkcionálních nástrojů IT se standardními postupy dotazníkového šetření jsme dospěli logickými sekvencemi strategií pro rozhodnutí kariérního systému během návrhu průzkumu v podobě dotazníků a také při syntéze poznatků na konečnou variantu. Výsledky dotazníkových šetření byly analyzovány pomocí popisných a multidimenzionální statistických nástrojů, s využitím programů Statistica 10 a Excel 2010, podporovaných analýzou rozptylu a t-testem pro testování hypotéz. Výsledky potvrzují tři faktory pro kariérní úspěch: první je subjektivní kritérium, a sice spokojenost s kariérou. Další dva jsou objektivní faktory – profesní status a změna příjmů.

Klíčová slova

Informační technologie, simplex návrh, karierní úspěch, informační kompetence, informační využití.

JEL Classification: M120

Abstract

Effective HR management in the agribusiness industry can succeed in many ways. Our paper focuses to career success in the agribusiness, respectively to one of the most important human resource management tools. Applying decision-making methods using best practices in IT is cost-effective in more areas. Processing and sorting quantitative data was done using programs Statistica 10, Excel 2010. Furthermore, concerning the statistical hypothesis testing there were used modules Analysis of variance and t-test. Last but not least, there were used decision-making algorithms and corresponding software tools in support of identifying the types of suitable models of career decision-making processes.

The first part of this article concentrates on the theoretical background. The second part evaluates the results of a quantitative survey carried out for this research.

The research was conducted on a representative sample of agro-business companies, which were categorized according to EU recommendations. Representativeness of respondents' selection was achieved by the randomization of the responder sample. This sample contained information from 226 employees of the agro-business sector.

The main aim of the paper is to evaluate the correlation between organization size and employee career success. A further aim is to identify the factors involved in career success. The outcomes of the questionnaire data were analyzed using descriptive and multidimensional statistical tools, based on Statistica 10 and Excel 2010 programs, supported by analysis of scatter variance and t-test for testing hypotheses. The results confirm three factors for career success: the first is a subjective criterion, namely career satisfaction. The others are objective factors – the occupational status, and income change. With reference to these three factors it was confirmed that the size of a company has an impact on career success. It was shown that, overall, employees are happy to work with their co-workers and that they are interested in their job. They were least satisfied with the leadership.

Purposeful combination of functionalities of IT tools with standard procedures questionnaire survey we came to the logical sequences of strategies for career decisions during the design a survey questionnaire and also in the synthesis of knowledge to the final variant.

The results further confirm that as the size of an organization increase, the number of employees who achieve a higher salary also increases. Thus, it is recommended that large organizations should utilize extrinsic career success factors, which are related to formal career programs and career plans. The next part of the research after the factor analysis (which provided us basic understanding of the significant factors to career success), was to perform more advanced methods such as Simplex Lattice Design (SLD) by adding two information technology factors (C - IT competence, D – Rate of IT utilization) to the current design.

Keywords:

Information technology, simplex lattice design, IT competence, rate of IT utilization, career success.

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Introduction

As the European Union shifts away from agricultural subsidies schemes towards market based approaches, legislators may find agricultural producers to be reluctant to follow fixed environmental policies. The most important condition for the successful implementation of the developed solution is the input of the basic set of relevant data for the system to provide the users with expected information.

But today it is not easy to evaluate cause-effect and impact of technological, economic and social development in order to prove that IT and ICT are the factors of economic increase of efficiency, productivity and growth. Nevertheless, it can be presumed the huge progress in the field of IT and ICT are the main causes of economic changes of both commercial companies and the whole country, and these changes, first of all, are expressed by the growth of labour productivity and career success (Mačiulyté-Šniukiené, Gaile-Sarkane, 2014).

According to Zhen-Wei Qiang, Pitt and Ayers (2003), there are three channels through which ICT can influence labour productivity and economics growth: 1) TFP growth in sector producing ICT; 2) Capital Deeping and 3) TFP growth through reorganization and ICT usage. According authors Zhen-Wei Qiang, Pitt & Ayers (2003), the ICT revolution partly consist of higher productivity growth in industries producing ICT, driven by rapid technological progress. The main characteristic of this revolution is the rapidly increasing computing power of new ICT products. In particular memory chips, as "Moore's law" holds, double their computing power every 18 months.

In the last decades employees are more and more responsible for planning their career. If their career development is limited, they will consider changing to an alternative career. This approach is important because employees have the impression that their career is successful. Thus, they are in charge of their own career. Career success is one of the most important human resource management tools (Arthur et al., 1999). Career success for an individual can be seen either as real or subjectively perceived performance, resulting from the accumulation of work experience (Judge et al., 1995). Career success consists of two parts: extrinsic/objective career success and intrinsic/subjective career success.

Extrinsic/objective career success is considered as objective, extrinsic and measurable in relation to features which are observable and measurable by others (Dries et al., 2011). Extrinsic career success is measured by such factors as "income" and "employee promotion". It is also possible to use other factors such as rise in income, increase in social status, improved promotion prospects, and the number of direct subordinates (Fietze et al., 2011). Baruch (2006) and Arthur et al. (1999) emphasize that the three most common extrinsic factors are salary, number of job changes (promotions) and occupational status. They add to this that income is the most fundamental criterion and is included in almost every research report.

There are several variations. Verbruggen (2012) uses the net monthly income (after tax etc. has been deducted) while Judge et al. (1999) use annual income. Furthermore, occupational status is also used in this type of research. The occupational status is measured by means of the social position index (Hollingshead in Judge et al., 1999). Thus the criterion "number of employee promotions"

is redefined as "number of job position changes" (i.e. job mobility), as used for example by Colakoglu (2011).

According to Chen (2011) the intrinsic part of career success is expressed as the individual employee's subjective reaction to their own career i.e. career satisfaction (Saari & Judge, 2004). The most commonly utilized aspect of career satisfaction or job satisfaction is satisfaction either with income or with development of skills (Heslin, 2005). Judge et al. (1999), when measuring intrinsic career success, use a five-point Likert scale, in which the following 8 statements are evaluated: occupational status; changes in income; number of job position changes; number of promotions; net monthly income; satisfaction with income; satisfaction with degree of interest in the work involved; satisfaction with co-workers; satisfaction with utilization of knowledge; skills and abilities; satisfaction with opportunities to develop ideas on job; satisfaction with management style; satisfaction with respect expressed by others; and satisfaction with job security offered.

Despite the claim by Arthur et al. (2005), Baruch (2004) and Chudzikowski (2012) that individuals manage their own career, Judge et al. (1999) emphasize that nowadays career success depends on the employer and how the employee contributes to the organization. The size of the employing organization affects the career success, because in small companies non-standard tasks may be assigned to broaden the scope of work (Schmidt, 2011). In turn, large employer organizations provide more career paths and opportunities for promotion, with formalized career structure strategies and career plans (Baruch, 2004). The main aim of this article is to identify and assess any correlation between the size of an organization and the career success of employees. A further aim is to identify the factors involved in career success.

Optimal processes for career growth should be based on logical, systematic and strategic decision-making processes. Štůsek's (2008) model of Strategic thinking presents an interesting, but simple look at the application of the decision tree when selecting a gradual strategic options using the weights of individual factors. It also provides guidance on the use of supporting software tools.

Materials and methods

As noted earlier, the first part of this article concentrates on the theoretical background. In the second part the results of a quantitative survey are evaluated. Primary data were collected using a questionnaire survey, which took place in the period from September to November 2012. Questionnaires were distributed electronically to Czech employers using the on-line server "survio.com". The questionnaires were completed by employees over 18 years old, who were not in their first employment and had made a career transition in the previous five years. The reason for the threshold of five years was that the average period in a particular role is usually less than five years (Kvapil, 2011). Indicators of objective extrinsic career success were considered to be one or more of the following: an income change; occupational status; number of job position changes; net monthly income; and number of promotions. Based on Judge et al. (1999) career satisfaction was chosen as an indicator of intrinsic career success.

Outcomes of questionnaire data were analysed using descriptive and multidimensional statistical tools based on Statistica 10 and Excel 2010, supported by analysis of scatter variance and t-test for testing hypotheses Hendl (2006). Factor analysis was used for multidimensional analysis of data methods by Principal Component Analysis (PCA), using Varimax rotation for factor extraction (Hebák et al., 2006).

The next part of the research, after the factor analysis (which provided us basic understanding of the significant factors to career success) was to perform more advanced methods such as Simplex Lattice Design (SLD) by adding two information technology factors (C - IT competence, D – Rate of IT utilization) to the current design.

Results and discussion

A total of 1350 questionnaires were distributed. Altogether 226 employee responses were received, corresponding to a response rate of 16.74 %. 115 employees participated in the first part, of which 38 were men. A total of 111 employees participated in the second part, of which 28 were men. As regards age, 60 employees were 18 – 25 years old, 110 were 26-35, 45 were 36 – 45, 8 were 46 – 55, and 3 employees were 56 – 65 years old. The most highly represented age group was 18 - 35 years old.

The representative sample of respondents was created by employees from the agri-business sector. These employees were from the business of primary production and also from the processing enterprises of agricultural commodities. The companies were categorized

according to EU recommendation, which distinguishes small, medium and large enterprises. 32 respondents were from micro organizations (with up to 10 employees), 48 respondents were from small organizations (with 11-50 employees), 68 respondents were from medium sized organizations (with 51 – 250 employees) and 78 respondents were from large organizations (with over 251 employees). Employee career mobility from one job position to another took place in every direction. All types of career transition were represented by the respondents: 66 employees had been promoted up the structure of the organization; 51 employees had stayed at the same level; 51 employees had stayed in a position related to the one before, but with more responsibilities; and 58 employees had stayed at the same level but not connected to the previous position.

1. Career success factors

The results confirm that there are three criteria for career success. As noted above, one of them was subjective – career satisfaction; the others were objective – occupational status and income change. Factor analysis showed that these three factors had a value higher than 1 (Kaiser-Guttman rule). Factor number 1 can be considered more important, as this factor was the first found and had the strongest variance of all analysed factors - up to two or three times higher in comparison with other factors. The results of the factor analysis (Table 1) represent correlations of variables with individual factors. Factors loadings higher than 0.4 are considered to be significant (Hendl, 2006). The first factor is career satisfaction, which includes all criteria regarding satisfaction.

According to Judge et al. (1999) this proves the validity of the methods for measurement of career satisfaction. Moreover, the results confirm the interconnectedness of the criteria of the authors' survey results. After closer analysis the authors decided to replace the criterion of satisfaction with the use of knowledge, skills and abilities. Thus, this criterion contains high factor loadings for all three factors. The authors Hebák et al. (2005) and Hendl (2006) suggest that a variable should be eliminated when the variable significantly correlates to more factors. Also, the factor 1 (intrinsic career success) consists of seven career satisfaction criteria.

Extrinsic career success criteria form the second and third factors. So, the extrinsic career success factor was divided into two parts: occupational status (factor 2) and salary changes (factor 3). Factor 2 comprises of sub factors, as can be explained by data from other research. These researches are mutually independent from each other and also define objective extrinsic criteria as relatively independent. Individual authors (e.g. Restubog et al., 2011; Verbruggen, 2012) usually test two measurement scales. In addition, salary change and salary are usually independent career success criteria (Chudzikowski, 2012). Thus both extrinsic factors remain separated and are tested as two independent variables.

Factor analysis showed that the number of promotions criterion and the net monthly income criterion were not relevant. The importance of career success criteria influences the target sample because according to our current understanding (Baruch,

Career success criteria	Factor 1	Factor 2	Factor 3
Occupational position category	0.1778	**0.6802**	0.0220
Income change (net monthly)	-0.0338	0.1687	**-0.7899**
Number of job position changes	0.1022	**0.6021**	-0.1393
Number of promotions	0.2348	0.0391	-0.193
Net monthly income	-0.0483	-0.176	0.0329
Satisfaction with income	**0.4850**	0.2334	-0.0350
Satisfaction with degree to which work involves interests	**0.6603**	0.2372	0.2371
Satisfaction with co-workers	**0.6622**	-0.2802	-0.1332
Satisfaction with use of skills and abilities	**0.5556**	0.4336	0.5022
Satisfaction with supervision	**0.7535**	-0.1056	0.0554
Satisfaction with respect that others give to job	**0.6870**	0.2815	0.3574
Satisfaction with ability to develop ideas on job	**0.8260**	0.0160	0.0024
Satisfaction with job security	**0.6659**	0.1038	-0.3725

Source: Authors' survey

Table 1: Factor analysis results for career success.

2004; Arthur et al., 1999) career transitions are moving in different directions with the exception of downward transitions, according to Baruch (2006) and Chudzikowski (2012). Results show that the criteria of promotion and career success are insignificant. In this sample more importance is given to the criterion of number of changes in employment. Thus, this indicates a shift from criteria related to the traditional career (promotion) to criteria related to the present career concept based on the number of job position changes. The results might be influenced by the direction of focus of the target sample, because a part of the research sample participated in promotion as a career transition.

2. Impact of company size on extrinsic career success

The results of the survey confirm that increase in the size of an organization leads to an increase in the number of employees who achieve a higher salary. With respect to change in income; the employees of micro companies and small companies have a similar income to that in their previous position. Medium sized company employees receive an income higher than in their previous position (corresponding to an increase of 200 – 400 EUR). Employees in large companies receive an increase in their income of less than 5000 CZK (EUR 200). However, with the increase in the company´s size, the individual income grows more. In micro companies most of the respondents have had no change in income (37.5 %) or they have had an income change of less than 5000 CZK per month (21.87 %). In small companies in category 3 (i.e. over 5 001 up to 10 000 CZK) the number of respondents fluctuated in all categories between 27 – 29.8% for every category (1, 2, and also 3). The same situation can be observed in medium sized companies where the proportions of respondents fluctuate from 26.5 – 32.4 %. Category 4 is the most highly represented in large companies, where the rise in income is more than 10 001 CZK. In summary, with increased size of company there is an increase in the number of employees who achieve a higher salary.

3. Impact of company size on intrinsic career success

Average values of career success according to size of company illustrate the impact of company size on individual factors and career success determinants. Average values in each given category are shown in the Table 2.

After data analysis of absolute values the authors conclude that in medium sized and larger companies, the bigger the company is, the less were individuals satisfied with the respect expressed towards them. 25 – 30 % of respondents chose a neutral mid-point position (on the Likert scale). This is related to the fact that in small companies the number of jobs is limited so there are one or two individuals in higher specialist-posts, while in larger companies there are several individuals in similar positions (Ng et al., 2005). It is assumed that in small companies power is concentrated in the top management within the organizational structure and this may be the reason for employees to feel relatively well respected in comparison with larger companies, where power is distributed on lower levels (Baruch, 2006).

It is connected to the satisfaction with the job security criterion that a given position offers. The employees of middle sized and large companies were the least satisfied with it. Large company employers usually provide well prepared succession plans and have more jobs. Therefore, an employee has a better chance of transfer to another position (Baruch, 2004). On the other hand, large companies employ more employees. Thus there are more opportunities for substitution (employee replacement) in comparison with smaller companies. Increase in size of company leads to decrease in satisfaction with management style

Company size (number of employees)		I am satisfied with my position as regards					
		Level of interest stimulate	Co-workers	Leadership style	Opportunities to develop my ideas	Respect which is expressed to me	Satisfaction provided by given position
Up to 10		1.594	1.969	2.313	2.188	2.063	2.406
11 - 50		2.081	1.703	2.324	2.432	2.108	2.297
51 - 250		2.103	1.838	2.500	2.559	2.382	2.441
Up 251		2.236	1.989	2.742	2.742	2.449	2.461

Source: Authors' survey

Table 1: Factor analysis results for career success.

as well as lower job interest. So in micro companies 90 % of respondents were satisfied. Geoffroy (2001) adds that specialized positions are more broadly focused in small companies, while increase in company size may lead to more specialized job positions. Small company employees are the most satisfied with their co-workers. The survey shows that satisfaction with co-workers decreases with increase in company size. One of the reasons might be that with increase of number of employees there is a reduction in personal bonds. Respondents employed in micro companies answered neutrally, probably because where there are low numbers of employees they all know each other very well and prefer to give neutral answers, rather than admit that they are dissatisfied.

The next part of the research, after the factor analysis (which provided us basic understanding of the significant factors to career success) was to perform more advanced methods such as Simplex Lattice Design (SLD) by adding two information technology factors (C - IT competence, D – Rate of IT utilization) to the current design.

A class of response surface experiments that investigate products containing several components. It can be used a mixture design to study product characteristics associated with changes in the proportions of the components, process conditions, or the amount of mixture. The theory (Antony, 2003) provides three designs (simplex centroid, simplex lattice, and extreme vertices) and analyses three types of experiments:

- Mixture, where the response is assumed to only depend on the proportions of the components in the mixture. For example, paint colour only depends on the pigments used.
- Mixture-process variable, where the response is assumed to depend on the relative proportions of the components and the process variables, which are factors in an experiment that are not part of the mixture, but may affect the blending properties of the mixture. For example, the adhesive properties of a paint may depend on the temperature at which it is applied.
- Mixture-amount, where the response is assumed to depend on the proportions of the components and the amount of the mixture. For example, the amount applied and the proportions of the ingredients of a fertilizer may affect the growth of a house plant.

According to Kowalski (2011), the Simplex designs are used to study effects of mixture components on the response variables. A (p, m) **simplex lattice design** for p components consists of points defined by the following coordinate settings: the proportions assumed by each component take m+1 equally spaced values from 0 to 1:

$$x_i = 0, \frac{1}{m}, \frac{2}{m}, \ldots, 1 \qquad \text{i = 1,2,…., p} \tag{1}$$

And all possible combinations of the proportions from Equation (1) are used. As an example, let p = 5 and m = 2. Then:

$$x_i = 0, \frac{1}{2}, 1 \qquad \text{i=1,2,3,4,5} \tag{2}$$

And the simplex lattice consists of the following twelve runs:

$$(x_1, x_2, x_3, x_4, x_5) = (1,0,0,0,0), (0,1,0,0,0), (0,0,1,0,0), (0,0,0,1,0), (0,0,0,0,1),$$
$$\left(\frac{1}{2}, \frac{1}{2}, 0,0,0\right), \left(\frac{1}{2}, 0, \frac{1}{2}, 0,0\right), \left(\frac{1}{2}, 0,0, \frac{1}{2}, 0\right), \left(\frac{1}{2}, 0,0,0, \frac{1}{2}\right)$$
$$\left(0, \frac{1}{2}, \frac{1}{2}, 0,0\right), \left(0,0, \frac{1}{2}, \frac{1}{2}, 0\right), \left(0,0,0, \frac{1}{2}, \frac{1}{2}\right), \left(0, \frac{1}{2}, 0, \frac{1}{2}, 0\right),$$
$$\left(0, \frac{1}{2}, 0,0, \frac{1}{2}\right), \left(0,0, \frac{1}{2}, 0, \frac{1}{2}\right) \tag{3}$$

The next phase of the research is to perform more advanced methods such as response surface methodology (RSM) by adding center points and axial points to the current design.

In general (Antony, 2003), the number of points in a (p, m) simplex lattice design is:

$$N = \frac{(p+m-1)!}{m!(p-1)!} \tag{4}$$

Mixture design

Two additional factors - the level of competence of information technology C and degree of use of information technologies D – were used for the Lattice simplex design (see Table 3).

The results of the analysis are shown in Table 4. The calculated effect factor in the coded values (response factor to change from -1 to +1) is in the first column of Table 4. The second column presents the regression coefficient (that is a half effect of each factor).

The results of the analysis of variance are shown in Table 5. The first column presents Degrees of freedom (DF). The DF is the amount of information data provide that can be used to estimate the values of unknown population parameters. and calculate the variability of these estimates. The second very important indicator

StdOrder	RunOrder	PtType	Blocks	A-occup. status	B-salary increase	C - IT competence	D - Utilization IT	Yield – Careersuccess
7	1	2	1	0.0	0.5	0.0	0.5	0.52
6	2	2	1	0.0	0.5	0.5	0.0	0.41
9	3	2	1	0.0	0.0	0.5	0.5	0.27
4	4	2	1	0.5	0.0	0.0	0.5	0.73
10	5	1	1	0.0	0.0	0.0	1.0	0.24
1	6	1	1	1.0	0.0	0.0	0.0	0.39
3	7	2	1	0.5	0.0	0.5	0.0	0.68
5	8	1	1	0.0	1.0	0.0	0.0	0.30
2	9	2	1	0.5	0.5	0.0	0.0	0.87
8	10	1	1	0.0	0.0	1.0	0.0	0.11

Source: own processing

Table 3: List of randomized process parameters for the Lattice simplex experiment.

Term	Coef	SE Coef	T	P	VIF
A-occupational status	0.3900	*	*	*	1.750
B-Salary increase	0.3000	*	*	*	1.750
C - IT competence	0.1100	*	*	*	1.750
D - Utilization rate of IT	0.2400	*	*	*	1.750
A-occupational status* B-Salary increase	2.1000	*	*	*	1.500
A-occupational status* C - IT competence	1.7200	*	*	*	1.500
A-occupational status* D - Utilization rate of IT	1.6600	*	*	*	1.500
B-Salary increase*C - IT competence	0.8200	*	*	*	1.500
B-Salary increase* D - Utilization rate of IT	1.0000	*	*	*	1.500
C - IT competence* D - Utilization rate of IT	0.3800	*	*	*	1.500

Source: own processing

Table 4: Lattice design for estimation of regression coefficients for Yield - Career success (component proportions).

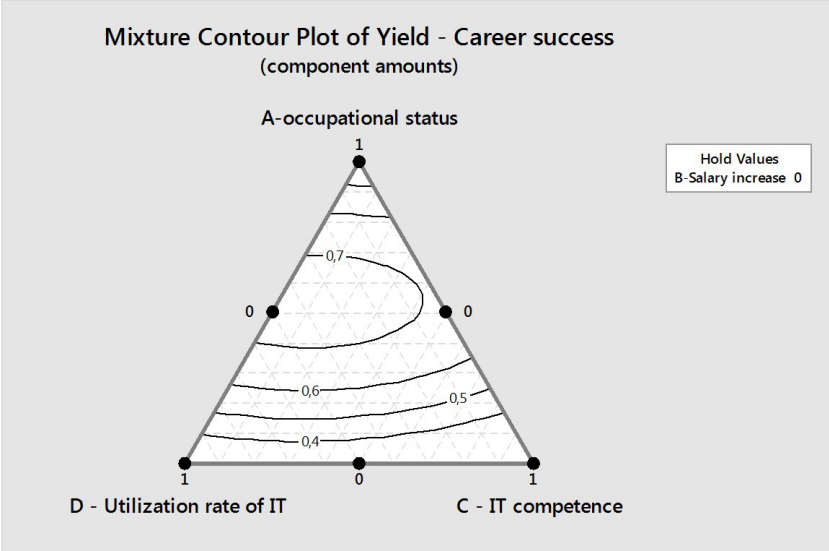
Source	DF	Seq SS	Adj SS	Adj MS	F	P
Regression	9	0.5324	0.5324	0.0592		
Linear	3	0.198267	0.041400	0.013800	*	*
Quadratic	6	0.334093	0.334093	0.055682	*	*
A-occupa*B-Salary	1	0.093130	0.183750	0.183750	*	*
A-occupa*C - IT c	1	0.082477	0.123267	0.123267	*	*
A-occupa*D - Util	1	0.097896	0.114817	0.114817	*	*
B-Salary*C - IT c	1	0.016973	0.028017	0.028017	*	*
B-Salary*D - Util	1	0.037600	0.041667	0.041667	*	*
C - IT c*D - Util	1	0.006017	0.006017	0.006017	*	*
Residual Error	0	*	*	*		
Total	9	0.532360				

Source: own processing

Table 5: Analysis of Variance for Yield - Career success (component proportions).

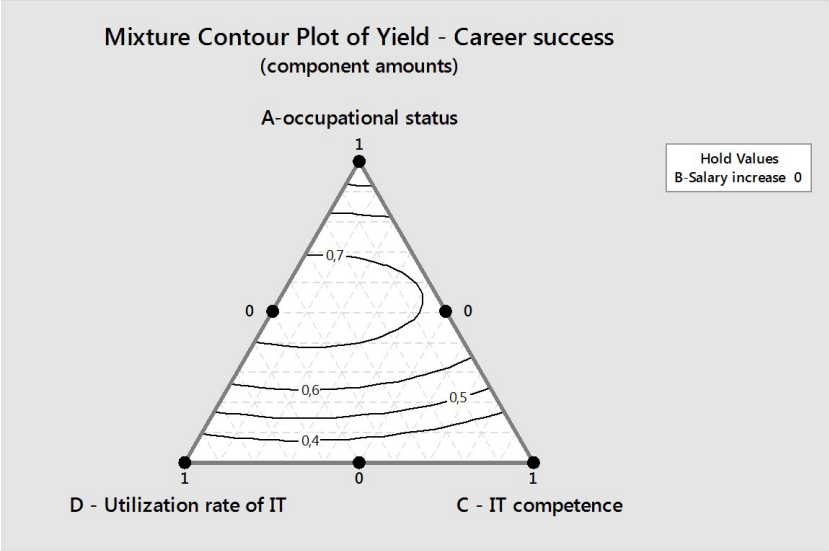
of regression model quality is shown in column two – Sum of squares (Seq SS). This indicator represents a measure of variation or deviation from the mean for individual interactions between factors of the regression model. It is calculated as a summation of the squares of the differences from the mean. The calculation of the total sum of squares considers both the sum of squares from the factors and from random chance or error.

The contour plots in Figure 1 and figure 2 show how a response variable (career success) relates



Source: own processing

Figure 1: Result of the simplex lattice design for career success depending on occupational status. IT utilization and IT competence.



Source: own processing

Figure 2: Result of the simplex lattice design for career success depending on occupational status. salary increase and IT utilization.

to three components (the percentage of components of the modified IT factors. which are A.C.D on Figure 1 and A.B.D on fig. based on a model equation. Points which exhibit the same response are connected to produce the contour lines of constant responses. Because a contour plot only shows three components at a time. whilst holding any other components and process variables at a constant level. contour plots are only valid for fixed levels of the extra variables. If the holding levels are changed. the response surface of the career success changes as well. sometimes drastically.

Conclusion

It is well established that career success is an important construct in career management (Arthur et al.. 1999). As the independence of an individual employee increases in a company there is a shift in significance from extrinsic factors to intrinsic factors relevant to career success. The validity of career success criteria was confirmed in this research sample. On the basis of factor analysis three factors were generated. where career satisfaction was the most significant.

The results support the validity of present thinking on careers and confirm that a career can be multidirectional. Unless an employee is determined to climb the career ladder. As regards three career success factors the size of company was confirmed as having an impact on career success. The results show that as company size increases. so does the number of high earning employees. Employees of micro companies and small companies still achieve the same income after career transition.

It was statistically confirmed that there is a relationship between company size and the other six career satisfaction criteria (except income satisfaction). The growth of large companies leads either to a decrease in satisfaction or to no effect. In large companies. employees were the most satisfied with their co-workers and job interest. compared with smaller companies. On the basis of these results it is possible to recommend that companies develop specialization of their career programs according to company size.

From a methodological point of view. we recommend comparing multiple software tools to support decision-making and evaluation factors in career growth. Supporting IT tools used in the evaluation (Statistica 10 modules and t-test) and qualitative and quantitative analysis (software tools for decision-making tree of strategy career). although relatively simple. also solve the partial aspects (statistical calculations or relationship factor + hypothetical relevance factor => inclusion among the relevant factors => extension of the structure of the questionnaire answering questions => determination of the weights of factors => career options structure relationships). Thus. software tools are either goal-directed used or are used for implementation of specific method(s) of calculation.

The optimum would be to strengthen research in this direction. so that the resulting methodology of career comparison could be suitable for selection or development of new purpose-built software with a reasonable compromise between simplicity. availability. coverage of all key needs methodological procedure. Appropriate form would be a gradual development of tools for the evaluation of these two concepts of career options in the form of cloud services - existing time-proven functionality in the software market could only be used as a plug-in and custom development will primarily focus on implementation of methodological framework. The application would then not be limited to factors such as company size. but all external factors involved in the methodology for which there is enough data. Suggested conclusions "Methodical process of developing a career system" elaborated on the basis of research in agribusinesses are useful in other sectors of the national economy.

While small companies and micro companies may not be able to offer higher income or financial rewards. they can offer more interesting tasks and broader job position specialization to their employees Schmidt (2011). It is recommended for micro and small companies to use intrinsic career success factors. Extrinsic career success factors are more appropriate for large companies. because they are more readily incorporated into formalized career programs and plans. Thus. it is recommended that large companies utilize extrinsic career success factors. which are related to formal career programs and career plans. At the same time they should put emphasis on multidirectional career moves and decentralize responsibility to the lower positions.

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Efficiency of Production Factors and Financial Performance of Agricultural Enterprises

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Anotace

Článek se zabývá rozborem vztahů mezi efektivností využívání výrobních faktorů v zemědělských podnicích a jejich finanční výkonností. Hlavním cílem článku je vymezit společné ekonomické rysy u zemědělských podniků, kterým dlouhodobě roste produktivita práce a současně dlouhodobě zvyšují hodnotu dlouhodobého majetku (investují). Analýza byla zaměřena na 1098 zemědělských podniků rozdělných dle metodiky Evropské komise na mikro, malé a střední. Provedená analýza ukázala, že nadprůměrné zemědělské podniky (s vysokým růstem produktivity práce a dlouhodobého majetku) bez ohledu na velikostní skupinu dosahují vyšší rentabilitu, mají vyšší zadluženost a nižší pohotovou likviditu. Z hlediska analýzy za jednotlivé velikostní kategorie podniků lze vyvodit, že u menších podniků jsou větší rozdíly u nadprůměrných podniků ve srovnání s celkem.

Klíčová slova

Produktivita práce, dlouhodobý majetek, zemědělství, podniky.

Abstract

This article deals with the relationship between efficiency of use of the production factors in agricultural enterprises in Czech Republic and their financial performance. The aim of the article is to define common economic features of agricultural enterprises which labour productivity has been growing for a long time and, at the same time; they have been increasing value of their fixed assets (investing). The analysis was focused on 1098 agricultural enterprises classified according to the European Commission as micro, small and medium enterprises. The analysis showed that above-average agricultural enterprises (high growth of labour productivity and fixed assets), regardless of their size, have higher profitability indicators, higher indebtedness and lower quick ratio. Summarizing the results of the analysis of individual size classes, it can be said that the smaller size class, the bigger difference.

Keywords:

Labour productivity, fixed assets, agriculture, enterprises.

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Introduction

Labour productivity is the basic indicator showing use of human capital in the enterprise. Labour productivity is influenced by many factors, one of them being enterprise´s increase in investment activity. High enterprise investment activity is reflected, primarily, by increasing fixed assets. In economic reality, enterprises with different investment activity dynamics and also labour productivity can be found. The question is whether the enterprises achieving the best results in this area have any common features in performance characteristics and, if so, which. The objective of the article is to define common economic features of agricultural enterprises which labour productivity has been growing for a long time and, at the same time, they have been increasing value of their fixed assets (investing).

The basis for measuring economics efficiency and productivity in agriculture and others branches

is production function. The neoclassical production function takes the form Y(t) = F [K (t), L(t), T(t)] where Y (t) is the flow of output produced at time t. Capital, K (t) represents the durable physical inputs. The second input to the production function is labour, L (t) and it represents the inputs associated with the human body. The third input is the level of knowledge or technology, T (t) (Barro, Sala-i-Martin, 2004). Productivity is called the ratio output and input (Coelli et al., 2005).

The productivity of agricultural enterprises we can measure by indicators of productivity. The most used indicator is labour productivity. Indicator of labour productivity shows the efficiency of utilization labour in enterprises. Labour productivity can be generally defined as volume of output for one unit of input. Labour productivity we can write value added per labour (Oosterhaven, Broersma, 2007). We have other types of productivity as capital productivity or total factor productivity. The capital productivity shows how productively capital is used to generate value added. Total factor productivity measure technological change. Total factor productivity determines labour productivity, not only directly, but also indirectly by determining capital per worker (Prescott, Lawrence, 1998). Labour productivity for agricultural can be characterized by an equation where there is volume of production in numerator and volume of labour in denominator (Brčák, 2009). More appropriate indicators are total costs per labour costs. For definition of enterprise´s or region´s position, graphical illustration of the relationship can be used, for instance, between increase in labour productivity and employment rate (Cuadrado-Roura et al, 1999) or between labour productivity growth and fixed assets growth. Labour productivity in agriculture is influenced by many factors. Ball et al. (2014) told that labour productivity growth was inversely related to specialization. Highly specialized farms were among the productivity leaders but they exhibited slower rates of productivity growth than did less specialized producers. On the other hand, Van den Ban (2011) claims that changing the farming system to increase labour productivity is risky. Farmers have to decide themselves which risks they are able and willing to take. Some farmers have taken managerial decisions, which increased their income a lot, but others regret that they have taken a decision which caused big losses (Van den Ban 2011). Other perspective was offered by Lososová, Zdeněk (2014), stating that farming constitutes a significant factor influencing labour productivity. The enterprises in LFA have higher productivity than those outside of LFA.

The important driver of productivity growth in agriculture is also scientific progress. The reason for the agricultural sector productivity growth in relation to the number of economically active persons in agriculture is the growth of investments especially into machinery and new technologies (in the period 1993–2011) (Svatoš et al., 2014). Similar conclusion was reached by Čechura (2012), stating that the most important factors which determine both technical efficiency and TFP are those connected with institutional and economic changes, in particular a dramatic increase in the imports of meat and increasing. Other authors assume that strong capital flows into the agricultural sector encourage agricultural production levels, (Žídková, et al., 2011).

Factor intensity and efficiency change are found to be sources of labour productivity convergence while technical change is found to be a source of divergence. Policies that encourage investment in capital goods may help to mitigate disparities in labour productivity across the farm sector (Mugera et al., 2012). According to another opinion, hired labour quality is claimed to be an important factor influencing labour productivity. Hired labor are used as the labor inputs. The quality of hired labor is quite different across farms. These labor quality differences are reflected in different wage rates (Kazukauskas et al., 2014)

Materials and methods

The article is aimed at evaluation of agricultural enterprises in Czech Republic with respect to efficiency of the labour production factor in connection with change in fixed assets. Primarily, it was analyzed whether agricultural enterprises that make investments and increase fixed assets value also increase labour productivity. Another question the research should respond to was whether labour productivity growth is also associated with rising financial performance of the enterprise. The analysis was aimed at characterizing the successful class of enterprises and providing specification of common features of these enterprises, based on defined criteria and also considering size classes. The above-average (IA) enterprise was considered the one achieving average increase in its fixed assets and labour productivity more than 1.0 in the reference period.

We used, for the following investigation, the company database called ALBERTINA, which contains accounting data of 1098 farms

(agricultural enterprises) with at least one employee. The observed company data were from the 6 year period (2007-2012) and the set of the 1098 companies was for the whole observation period invariable. The farms were assigned, in every year, according to their size into four categories defined by the European Commission (European Commission Directive (ES) No. 800/2008): micro, small, medium and large sized enterprises. Paper is focused on the analyses of micro, small and medium sized enterprises. Micro enterprises have fewer than 10 employees and their turnover or balance sheet total does not exceed 2 million Euros. Small firms have less than 50 employees and their turnover or balance sheet total does not exceed 10 Million Euros. The Commission further regards an enterprise with fewer than 250 employees, a turnover not exceeding 50 million Euro or a balance sheet total not exceeding 42 Million Euros as a medium-sized enterprise.

Totally, the analysis included 1098 enterprises in the ALBERTINA database. These enterprises had not been changed throughout the period of reference (2007 – 2012) and their activity belongs to section A according to classification made by NACE-CZ. Core data were sourced from financial records (balance sheet, profit and loss account). Performance of agricultural enterprises is largely influenced by external conditions (influence of climatic conditions, price development). At first, the authors attempted to eliminate the influence of price on the indicators used for classification of the enterprises, particularly revenue indictor which was converted using agricultural producer price index; personnel cost index was deflated using consumer index prices. Gross fixed capital formation (GFCF) in sector Agriculture, Forestry and Fishing was selected from the database of annual national accounts for adjustment of prices in the fixed assets indicator. Aggregate value in current prices and prices of previous period prices was used for conversion. At first, year-to-year price indices, i.e. GFCF share in current prices as well as GFCF in prices of previous period in the same year were established, which means use of aggregated price indices. For instance, in 2007.

$$Ip_{2007/2006} = \frac{GFCF_{2007(2007)}}{GFCF_{2007(2006)}} = \frac{\sum p_{2007} q_{2007}}{\sum p_{2006} q_{2007}}$$

Where

$GFCF_{2007(2007)}$ - Gross fixed capital formation in section A in 2007 (q_{2007}) in current prices, i.e. prices of 2007 (p_{2007}),

$GFCF_{2007(2006)}$ - Gross fixed capital formation in section A in 2007(q_{2007}) in prices of previous period, i.e. 2006 7 (p_{2006}).

Resulting price indices were gradually converted to price indices using the relationship between chain and basic indices, with the basis being 2007 (Table 1).

These indices were used for conversion of the indicators above, hence, the values of all indicators are given in prices of 2007.

The enterprises were classified by their size (i.e. micro, small and medium) in accordance with categorization of the European Commission (Commission Regulation No 800/2008). Large enterprises were not included.

Average growth rate of Fixed assets FA indicator (sum of intangible assets and tangible assets) and labour productivity LP (share of revenues and personnel costs) in the relevant interval were used as the criterion of assessment. Based on development of these indicators, four quadrants were defined:

Quadrant I	I FA > 1 and at the same time I LP > 1
Quadrant II	I FA > 1 and at the same time I LP < 1
Quadrant III	I FA < 1 and at the same time I LP < 1
Quadrant IV	I FA < 1 and at the same time I LP >1

In following, the authors focused on Quadrant I,

	2007	2008	2009	2010	2011	2012
GFCF* - A Agriculture, forestry and fishing	1.0000	0.9924	0.9766	0.9891	0.9889	1.0035
Agricultural manufacturer prices	1.0000	1.0881	0.8180	0.8620	1.0262	1.0686
Consumer prices of goods and services (total)	1.0000	1.0636	1.0750	1.0901	1.1110	1.1480

* Gross fixed capital formation

Source: Own calculations based on the data Czech Statistical Office.

Table 1: Price indices (100% = year 2007) of selected indicators.

and particularly the enterprises which performance was above average (Quadrant I– A). Another performance indicators were then investigated in this class of enterprise by their size, namely: Return on Assets – ROA (EBIT (Earning before Interest and Taxes)/ Assets); *Return on Equity* – ROE (Earning after Taxes /Equity); *Debt ratio* (Total Debt/Assets); *Quick Asset Ratio* ((Current Assets – Inventories)/ (Current Liabilities+Short-Term Bank Loans)); *Personnel costs / Total costs; Added Value/Revenues; Other Operating Revenues/ Total Revenues.*

Results and discussion

At first, agricultural enterprises were divided into four quadrants in compliance with selected criteria (with elimination of price influences, see Methodology), considering also the size of the enterprises (Table 2).

Table 2 shows that distribution of agricultural enterprises by their size is comparatively homogenous. The quantity of enterprises categorized "small" and "medium" is roughly the same, with the minimum number of "micro" enterprises. It is obvious that the largest part of enterprises in all size classes belong to Quadrant I, a fact indicating positive trend of monitored values.

In 2007-2012, fixed assets value has been increasing and, at the same time, labour productivity has been growing in approximately 69% of medium enterprises, 55 % of small enterprises and 43% of micro enterprises. To a certain extent, this growth of productivity could also have been influenced by falling numbers of the persons working in agriculture (general trend in this sector), which could result in lower personnel costs and, hence, growth of labour productivity. For the purpose of a more detailed analysis, the enterprises which labour productivity rates and fixed asset values were above average (Quadrant I – A) were also excluded. In small and medium enterprise sector, these enterprises constituted approximately one third of units in Quadrant I and approximately one half in micro. Quadrant II is also significantly represented, where fixed assets value increased, however, reduction of labour productivity could be seen at the same time. Obviously, the investments not increasing efficiency of the labour production factor (approx. one fifth of enterprises in all size classes) prevailed. Quadrant IV showing reduction of fixed assets and, at the same time, growth of labour productivity has comparatively strong presence, particularly in micro (24.9%) and small (15.2%) enterprises. This situation applies to medium enterprises only to a limited extent. These facts suggest that the "smaller" the enterprise, the more difficult renewal of its fixed assets (and perhaps also more demanding, in financial terms) and it can also be concluded that outsourcing of some works is more frequent in these enterprises. In enterprise´s accounting system, outsourcing is reflected by higher share of services, as can be seen in Table 3 with the highest proportion of services in total costs in the enterprises classified in Quadrant IV. Also, it is highly probable that the division into quadrants was largely influenced by the structure of production. The enterprises focusing predominantly on growing of crops will receive more subsidies, thus increasing their yields and, hence, their labour productivity. Table 4 also shows that the enterprises in Quadrant have the highest shares of Other operating revenues in Total revenues. The smallest presence of enterprises is in Quadrant III (the largest part is constituted by micro enterprises, i. e. 12.7%, see Table 3). These enterprises are characterized by reduction of fixed assets and, at the same time, decrease in labour productivity. Supplementary indicators (Table 3) show their minimum share in total yields (approximately 13%), at the same time, their minimum share of services and personnel costs in total costs.

The focus was on Quadrant I, and particularly

	Micro		Small		Medium	
	absolute	relative	absolute	relative	absolute	relative
Quadrant I	78	43.1	250	55.1	314	69.3
Quadrant II	35	19.3	113	24.9	93	20.5
Quadrant III	23	12.7	22	4.8	22	4.9
Quadrant IV	45	24.9	69	15.2	24	5.3
Quadrant I - A	44	24.3	98	21.6	98	21.6
Total	181	100.0	454	100.0	453	100.0

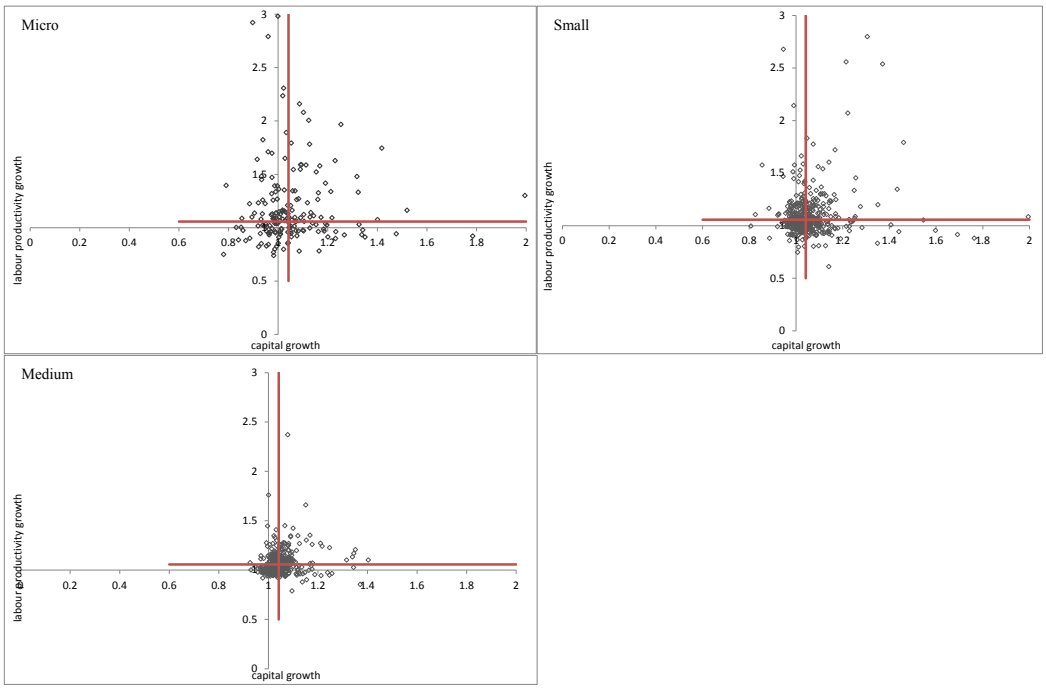
Source: Own calculations based on the data company database Albertina.

Table 2: Absolute and relative numbers of enterprises in individual quadrants.

	Personnel cost/Total cost in CZK	Services / total cost in CZK	Other operating revenues/total revenues in CZK
Quadrant I	0.1989	0.1473	0.1561
Quadrant II	0.1928	0.1425	0.1462
Quadrant III	0.1875	0.1353	0.1342
Quadrant IV	0.1950	0.2017	0.1733

Source: Own calculations based on the data company database Albertina.

Table 3: Results of quadrants.



Source: Own calculations based on the data company database Albertina.

Graph 1: Enterprises distribution by their size.

the enterprises which increase in fixed assets and labour productivity was higher than average growth rate of these indicators in the relevant period. The evaluation was made in each size class. The results in individual classes are shown in graphs (graph 1), average value in each class is highlighted with the red line. All enterprises above this line are considered above average.

Varying distribution of enterprises by their size is obvious in all graphs. Whereas structure of micro enterprises is rather scattered (situation of these enterprises is different as far as the criteria are concerned), that of small and, particularly, medium enterprises is comparatively compact and clustered. This suggests that situation of larger enterprises is more stabilized, as far as selected criteria are concerned.

The enterprises in Quadrant I were analysed in a similar manner, i.e. above-average enterprises (IA), in which additional ratio-based indicators were identified in order to discover links between increasing efficiency of enterprise´s labour production factor and its financial performance. The aim was to investigate characteristics of this class of enterprises in other areas as well as distinct features of successful enterprises in individual size classes.

As illustrated in table 4 showing selected indicators of micro enterprises, the indicators of profitability (ROE, ROA) assume significantly higher values in above-average enterprises, i.e. those with above-average investment activity and efficiency of the labour production factor. ROE values are twice as high, on average. As far as indebtedness is concerned, above-average enterprises (in terms of the criteria as specified hereinabove) have higher leverage indicator. Also, both enterprise classes (i.e. total and IA) are characterized by decreasing indebtedness in 2007-2012, ranging 50-60% in the last relevant

Ratio		2007	2008	2009	2010	2011	2012	Average
ROA in %	IA	12.97	12.13	7.1	6.47	8.89	8.6	9.06
	Total	8.8	7.7	3.18	4.21	6.38	5.65	5.66
ROE in %	IA	35.56	26.91	13.1	10.71	16.02	15.23	17.89
	Total	16.97	13.08	3.18	5.4	9.46	8.52	8.21
Debt ratio v %	IA	70.85	62.46	62.52	59.1	57.12	58.33	61.57
	Total	60.92	57.96	56.54	54.14	52.91	54.76	56.14
Quick Asset ratio	IA	0.817	0.859	0.725	0.699	0.647	0.823	0.758
	Total	0.947	0.995	0.941	0.921	0.911	0.877	0.931
Value added/Total revenues	IA	0.081	0.077	0.022	0.031	0.084	0.093	0.057
	Total	0.083	0.074	0.025	0.05	0.093	0.086	0.063
Other operating revenues/ Total revenues	IA	0.271	0.279	0.305	0.293	0.281	0.279	0.284
	Total	0.2	0.211	0.244	0.232	0.207	0.203	0.216
Personnel cost / Total cost	IA	0.169	0.157	0.154	0.145	0.129	0.12	0.145
	Total	0.129	0.131	0.145	0.149	0.139	0.136	0.138

Source: Own calculations based on the data company database Albertina.

Table 4: Selected ratio-based indicators in 2007-2012 – micro enterprises.

Ratio		2007	2008	2009	2010	2011	2012	Average
ROA in %	IA	9.10	5.58	4.64	7.19	8.62	9.04	7.13
	Total	8.28	5.14	1.85	4.99	7.25	7.03	5.21
ROE in %	IA	14.86	7.69	5.88	10.10	11.58	12.50	9.97
	Total	12.94	6.49	0.70	6.02	9.16	8.71	5.52
Debt ratio v %	IA	48.72	52.94	52.55	49.89	49.62	49.08	50.44
	Total	47.46	48.86	47.35	44.13	42.59	42.13	45.35
Quick Asset ratio	IA	1.209	0.979	1.039	1.017	0.964	0.939	1.021
	Total	1.235	1.030	1.100	1.167	1.220	1.193	1.155
Value added/Total revenues	IA	0.198	0.166	0.100	0.145	0.167	0.172	0.154
	Total	0.191	0.159	0.098	0.150	0.179	0.175	0.155
Other operating revenues/ Total revenues	IA	0.191	0.193	0.219	0.177	0.167	0.142	0.180
	Total	0.183	0.182	0.213	0.193	0.170	0.163	0.183
Personnel cost / Total cost	IA	0.185	0.180	0.166	0.156	0.148	0.129	0.160
	Total	0.190	0.187	0.189	0.190	0.178	0.171	0.184

Source: Own calculations based on the data company database Albertina.

Table 5: Selected ratio-based indicators in 2007-2012 – small enterprises.

year. Quick ratio is higher in enterprises total. Value added-to-revenues ratio does not differ much and other operational costs/revenues ratio was only slightly higher in the enterprises categorized IA.

Table 5 shows selected indicators of "small" agricultural enterprises, in accordance with EU classification. In this class, similar trends can be seen, however, their intensity is different. Again, IA enterprises have higher profitability, however, the difference is not too big. ROE value in enterprises total in 2009 (global economic crisis and adverse conditions for agriculture) comes close to threshold value zero. In above-average enterprises, this indicator was lower, still, it remains satisfactory. Indebtedness is only slightly higher in IA enterprises, remaining almost unchanged within the entire period under consideration. Value added/ Total revenues and Other operating revenues/Total revenues indicators in above-average enterprises and all enterprises do not differ from each other. Small IA enterprises have lower Personnel cost/ Total costs ratio, particularly during global crisis, i.e. starting from 2009.

Similar trends can be seen in medium-sized enterprises (Table 6), yet differing in their levels. Profitability indicators (ROE, ROA) are significantly lower, compared with the preceding classes; on average, they are below 5%. Dramatic

Ratio		2007	2008	2009	2010	2011	2012	Average
ROA in %	IA	5.81	4.85	1.44	3.60	7.58	6.37	4.38
	Total	5.84	3.94	1.05	2.95	5.96	5.43	3.63
ROE in %	IA	7.17	5.43	0.72	4.00	9.43	7.94	4.51
	Total	7.47	4.41	0.17	2.89	6.75	6.17	2.95
Debt ratio v %	IA	37.74	39.84	39.31	40.98	42.53	45.48	40.91
	Total	38.06	39.15	37.43	36.78	37.06	38.03	37.74
Quick Asset ratio	IA	1.482	1.271	1.177	1.070	1.176	1.063	1.199
	Total	1.404	1.205	1.184	1.173	1.167	1.153	1.212
Value added/Total revenues	IA	0.256	0.227	0.168	0.208	0.243	0.239	0.221
	Total	0.238	0.213	0.165	0.202	0.230	0.225	0.210
Other operating revenues/ Total revenues	IA	0.140	0.146	0.175	0.165	0.146	0.127	0.149
	Total	0.135	0.136	0.163	0.157	0.137	0.130	0.143
Personnel cost / Total cost	IA	0.229	0.215	0.211	0.200	0.177	0.169	0.199
	Total	0.212	0.206	0.211	0.208	0.195	0.189	0.203

Source: Own calculations based on the data company database Albertina.

Table 6: Selected ratio-based indicators in 2007-2012 - medium enterprises.

decrease of these indicators can be seen in the period of global crisis, i.e. in 2009. The indebtedness fell slightly in IA enterprises, however, the difference is not significant. In other indicators, the differences between above-average and other medium-sized enterprises are negligible. The same trend of ROA was observed by Střeleček, et al. (2012). Brožova and Vaněk (2013) noted similar trend of ROA and ROE but the absolute values of indicators (ROA, ROE) were different (higher values). These differences could be caused by integrate of large enterprises. Development of values ROA has been slightly different in international comparison (EU 27 – FADN EU farm economics data). The growth rate was lower and its size was about two percentage points lower than in the Czech Republic.

Conclusion

The objective of this article is to provide characteristics of above-average enterprises, considering also their size. Summarising the results of the analysis, it can be said that above-average enterprises, regardless their size, have higher profitability (ROA and ROE), higher debt ratio and slightly lower quick ratio. These facts can be regarded as confirmation of close relationship between indicators of efficiency of labour production factor and those showing financial performance. Labour productivity was very often influenced primarily by reducing the number of workers more than the growth of production (Lososová, Zdeněk, 2014). On the other hand, there are bigger differences between above-average and all enterprises in small enterprise class, compared with other size classes. On average, micro and small enterprises achieve higher profitability than medium-sized enterprises, irrespective of whether they are categorized "above-average" or not. The indebtedness decreases as the size of enterprises diminishes, i.e. the highest indebtedness can be seen in micro enterprises (56% on average), whereas the lowest indebtedness is in medium-sized enterprises (38% on average); at the same time, the indebtedness was higher in above-average enterprises compared with total quantity of enterprises in all size classes. The highest quick ratio was discovered in medium-sized enterprises (approx. 1.2) throughout the relevant period, compared with 0.93 in micro enterprises. It can be said that above-average enterprises had lower quick ratio than all enterprises in all size classes, i.e. the bigger the enterprise, the higher quick ratio. Value added/ total revenues ratio differs mainly with size, i.e. the bigger enterprise, the higher ratio. The subsidy/revenue ratio, as reflected by other operational revenues/total revenues ratio, also differs with size. Obviously, the highest value of this indicator can be seen in micro enterprises (approx. 22%), compared with 14% in medium sized enterprises. This difference is attributable, largely, to patterns of agricultural production. The share of personnel costs in total costs increases with size of the enterprise: micro – approx. 14%, small – approx. 18%, and medium – approx. 20%). It can also be said that this value is lower in above-average enterprises (of all size classes), compared with the value applicable to all enterprises in the relevant class.

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Italian Trade Specialization: Persistence and Change in Regional Agri-Food Production

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Abstract

The Italian agri-food sector has traditionally been one of the strongest in the national socio-economic system. In the last ten years, commercial exchange trends have shown growing openness towards foreign countries and in particular to European Union (EU) countries. Both the primary sector and food industry are strongly influenced by their territorial location so much so that several authors have highlighted territorial specialisation and its effects on that territory's features also considering the contribution of the Italian Regions. The following work will analyse the patterns of agri-food specialisation in the Italian Regions. In particular, the Lafay Index will be used to evaluate competitive advantage at a Regional level.

Keywords

Agricultural trade. Lafay Index. Comparative advantage. Regional specialization.

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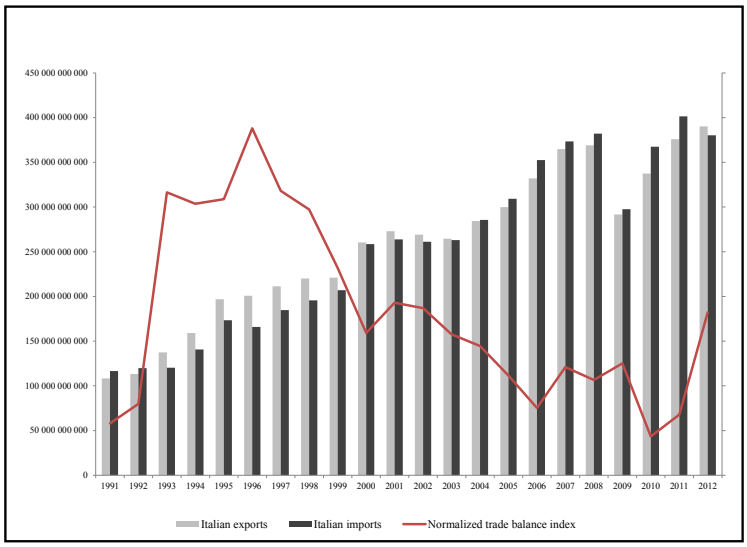
Introduction

Generally, international commerce and exports in particular are among the main motors of a nation's economic growth. This is even more true in Italy where the specialisation model has strongly correlated economic performance in recent years with foreign trade. The debate on the Italian specialisation model has highlighted several characteristics which make it anomalous among the other industrialised nations: strong specialisation in the 'traditional' sector of intense unqualified work, fairly strong in light low-technology mechanical engineering and significant under-specialisation in high-technology sectors (Platania, 2012). These characteristics could according to some observers put the Italian economy in direct competition with emerging nations.

Without its own raw materials, Italy has always had to procure natural resources and this strongly characterises its foreign trade. Furthermore, the foreign component of demand has contributed to sustaining the economy compared with fairly weak internal demand. These characteristics are understandable by considering Italy's international trade from 1991 to 2012 (figure 1). Despite import and export trade flows being substantially static, the overall trend has been toward growth over the 20 years except for the sharp downturn due to the recession in 2009. That growth has more than tripled and after 8 years of deficit, the trade balance in 2012 had returned to being surplus.

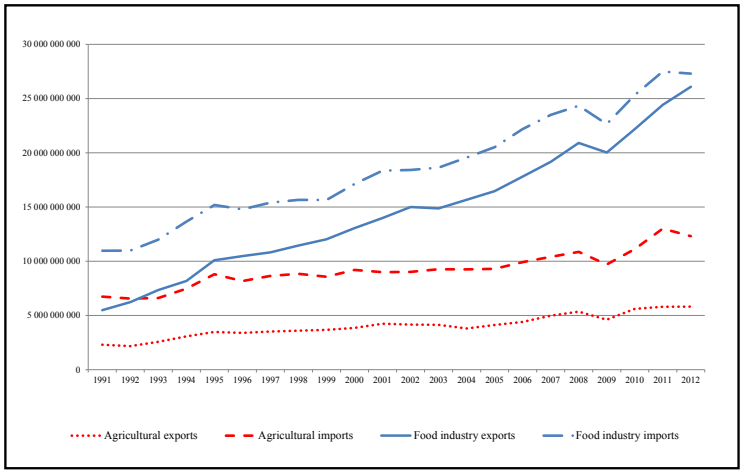
This is even more noticeable by looking at the trade balance which accounts for the overall level of trade exchange (the normalised surplus is given by the ratio percentage between the current trade surplus and the export and import total: it varies between -100 for a country which imports everything to +100 for a country which entirely exports and if imports and exports balance then the normalised surplus is 0). The normalized trade balance curve trend highlights Italy's worsening trade performance as starting in 1997, several years before the economic crisis.

Getting back to a general analysis, the performance trend is influenced by various production sectors each of which contributes variously to the overall trade balance. Among the main contributors, apart from manufacturing – and in particular Machine tools, one of the strong points in International Specialisation of the Italian economy – is Agri-Food both economically and for its effects on the territory making it one of the most important sectors in the Italian trade balance. Italy and its regions possess a rich and varied agricultural and food heritage, due to its wealth of natural resources



Source: our elaboration on Istat data (2014)

Figure 1: Italy: trade balance trend and relative trade surplus - current values.



Source: our elaboration on Istat data (2014)

Figure 2: Italy: trend of the agri-food trade balance (1991-2012).

and variety of pedological and climatic environments, which give to agricultural products a unique taste known in all the world. (Platania, Privitera, 2006; Baraldi et al., 2009; Pilato et al., 2015; Rapisarda et al., 2015).

In 2011 and 2012, total agri-food exports accounted for 8% of the trade balance which had grown from €8Bn for 1991/92 to €31Bn for 2011/12 which exceeded many other manufacturing sectors.

The structural deficit side of the Italian agri-food trade balance is due to two very different internal components: the primary sector which on balance is regularly and structurally negative, and the food industry sector which is in constant growth and represented by those traditional 'Made in Italy' products driving exports in the Italian agri-food sector (figure 2). The dependence on foreign markets is well-known as regards the supply chain to the food derivatives industry which is unable to supply all its own demand from home production (De Devitiis, Maietta, 2013).

If we consider that home food consumption, on a par with other advanced nations, shows a structurally stagnating trend (Alexandratos, 1999; Delgado, 2003), the possibilities of Italian agro-food production development derive from foreign demand, over 80% of which are in this sector, whereas the internal market is the main destination for fresh agri-food (figure 2).

The agri-food component has different dynamics depending on Region which contribute to a national agri-food balance which is quite diversified. To highlight certain structural aspects of Italy's

international trade and the various levels of specialisation and dependence of the Regions, the average import and export figures were examined for 2 biennial periods and the trend of the normalised surplus of the Regions (table 1).

It is interesting how the major quotas of national agri-food exchange is concentrated in 4 large northern Regions (Piemonte, Lombardia, Veneto and Emilia Romagna) which on average in the last biennial period contributed to over 60% of exports and 61% of imports.

The trend of normalised surpluses during the two biennial periods show totally negative values with few exceptions and an improvement in the second biennial period with positive agri-food performances in Piemonte, Valle d'Aosta, Trentino Alto Adige, Umbria, Abruzzo, Campania and Sicilia.

The objective of this study is to analyse the international specialisation patterns of the Italian Regions.

Materials and methods

The imports and exports regionals flows for 1991–2011 by economic activity at the two-digit classification level of ATECO (Classification of Economic Activity) 2007 (table 2) will be analysed using Italian National Institute of Statistics (Istat) data (Vicari et al., 2009).

AA011	non-perennial crops
AA012	perennial crops
AA013	live plants, bulbs, tubers and roots ect.
AA014	live animals and animal products
AA021	products of forestry
AA022	wood in the rough
AA023	products of wild growing non-wood
AA030	products of fishing and aquaculture
CA101	preserved meat and meat products
CA102	processed and preserved fish, crustaceans and molluscs
CA103	processed and preserved fruit vegetables
CA104	vegetable and animal oils and fats
CA105	dairy products
CA106	grain mill products, starches and starch products
CA107	bakery and farinaceous products
CA108	other food products
CA109	prepared animal feeds
CA110	beverages
CA120	tobacco products

Source: ATECO, 2007

Table 2: Italy: trend of the agri-food trade balance (1991-2012).

Regions		Resident population	1991/92		2011/12		NS	
			imports	exports	imports	exports	91/92	11/12
North west	Piemonte	7.30	10.14	14.77	9.17	13.62	-0.21	0.07
	Valle d'Aosta	0.20	0.06	0.05	0.05	0.19	-0.48	0.51
	Lombardia	16.40	24.97	13.58	23.03	15.85	-0.61	-0.30
	Liguria	2.60	5.12	2.94	2.68	2.04	-0.59	-0.26
North East	Trentino-A. Adige	1.70	3.23	5.82	3.56	6.02	-0.10	0.13
	Veneto	8.20	10.69	9.40	13.92	14.96	-0.43	-0.09
	F.-V.Giulia	2.00	2.13	1.69	1.86	2.23	-0.47	-0.03
	Emilia-Romagna	7.30	12.23	18.66	15.30	16.11	-0.18	-0.10
Centre	Toscana	6.20	5.17	4.58	4.85	5.97	-0.43	-0.02
	Umbria	1.50	1.03	1.48	1.04	1.49	-0.21	0.05
	Marche	2.60	1.62	1.14	1.01	0.98	-0.52	-0.14
	Lazio	9.30	7.05	4.00	9.28	2.44	-0.59	-0.66
South	Abruzzo	2.20	1.18	1.09	0.94	1.55	-0.41	0.12
	Molise	0.50	0.13	0.26	0.16	0.18	-0.06	-0.04
	Campania	9.70	5.78	7.91	5.53	8.01	-0.24	0.06
	Puglia	6.80	4.79	7.56	4.00	4.28	-0.17	-0.09
	Basilicata	1.00	0.17	0.29	0.21	0.22	-0.15	-0.09
	Calabria	3.30	0.95	0.54	0.60	0.45	-0.59	-0.27
	Sicilia	8.40	2.62	3.42	2.05	2.95	-0.26	0.05
	Sardegna	2.70	0.93	0.83	0.75	0.46	-0.43	-0.36
		100.00	100.00	100.00	100.00	100.00		

Source: our elaboration on Istat data (2014)

Table 1: Italy: agri-food balance trend: regional imports and exports (val.%) and normalised surplus (NS).

The literature has many indicators of comparative advantage. The Balassa index (1965) of comparative advantage is commonly used and built from the sectorial composition of trade flow for a given period. One of its main drawbacks is that it only relates to exports; degrees of specialization determined from trade flows (exports) alone, may deprive the analysis of significant factors (Boffa et al., 2009). A more comprehensive index with greater explanatory power was proposed by the French economist Lafay (1992). The Lafay index (LFI) is used because of several appealing alternative measures of specialization: it allows for a more precise analysis of the dynamic model descriptors of production specialization (Bugamelli, 2001) than the Balassa index, and can control for intra-industry trade and business cycle variations (Burianova, Belova 2012). Furthermore, in contrast to the Michaely Index (Michaely, 1962) and to the Trade Specialisation Index (Bender and Li, 2002), it can take into account any distortions induced by macro-economic fluctuations (Amable 2000; Caselli, Zaghini, 2005). In this paper, we used a modified version of the LFI taken from Bugamelli (2001). The LFI was compute for the international specialization for the 19 items showed in table 2:

$$LFI_j^i = \left(\frac{x_j^i - m_j^i}{x_j^i + m_j^i} - \frac{\sum_{j=1}^{N}(x_j^i - m_j^i)}{\sum_{j=1}^{N}(x_j^i + m_j^i)} \right) \frac{x_j^i + m_j^i}{\sum_{j=1}^{N}(x_j^i + m_j^i)} * 100$$

where

x_j^i = exports of region *i* of a product in economic sector *j* to the rest of the world;

m_j^i = imports of a product in economic sector *j* from the rest of the world to region *i*;

N = is the number of traded goods

According to the above formula, the comparative advantage for region i in the production of economic sector *j* is the deviation of the product *j* normalized trade balance from the overall normalized balanced trade (the sum of LFI across *j* for any year must by design be equal to zero). Positive values of the LFI imply specialization, and higher values of the LFI imply higher degrees of specialization, with the sector making a bigger contribution to the trade balance. Alternately, negative values imply a reliance on imports (Caselli, Zaghini, 2005; Zaghini, 2005; Alessandrini et al., 2007; Platania, 2014). The index considers trade flows for each sector and for the entire sector. It can then establish whether a country is relatively specialized in a given field (in relation to all other economic sectors), even when the country in question is generally a net importer, provided that the percentage difference between imports and exports is lower than the national difference (Boffa et al., 2009).

Using Lafay Index, we want explore the persistence and change in the patterns of international specialization of the Italian regions and whether their degree of international specialization has increased or decreased. A widely-used methodology in international trade data (Zaghini, 2003; Caselli, Zaghini, 2005; Buturac,Teodorović, 2012; Platania, 2014) has been applied. The first step evaluates whether the Italian regions have increased their level of specialization in the agri-food sector by running the following ordinary least squares regression:

$$LFI_{2011-2012_i} = \alpha + \beta LFI_{1991-1992_i} + \varepsilon_i \qquad i = 1, \ldots.20$$

where LFI 2011-2012 and LFI 1991-1992 are the Lafay indices in the second period (the dependent variable) and first period (the independent variable) of our sample and *i* represents the 20 italian regions considering in the regression. The variables α and β are the standard linear regression parameters and ε is the residual term. The variables on both sides of the equation have a mean of zero, so the estimate of α should also have a zero value. The value of β encompasses the changes over time in the pattern of specialization. If $\beta > 1$, the degree to which the Italian regions have specialised (or not) in certain sectors has increased (or decreased). A coefficient $0 < \beta < 1$ denotes that, on average, specialization has remained the same, even as the Lafay index improved for the items with low initial values and worsened for those with high initial values. If $\beta = 0$, then there is no relationship between the pattern of specialization in the two periods.

To evaluate the change in the dispersion of the comparative advantage distribution a second step is needed in which the following equation is applied:

$$\frac{VAR\sigma^{end}}{VAR\sigma^{start}} = \frac{\beta^2}{R^2};$$

where the numerator and denominator are the variances of the endogenous and exogenous variables, and R^2 is the coefficient of determination (the square of the correlation coefficient). With this ratio, some data can be provided on the changes in the distribution dispersion of comparative advantages. If $\beta = R$, then the distribution dispersion is unchanged. When $\beta > R$, the degree of specialization increases. Finally, if $\beta < R$, the degree of specialization decreases. As in other

studies that have used this ratio, R may be considered as a mobility measure of the products along the distribution. Thus, a high value of *R* indicates that the relative positions of the individual items have remained almost unchanged, and this indicates that they possess low mobility (Caselli, Zaghini, 2005).

Results and discussion

Table 3 shows the shape of the overall distribution of the Lafay index. In particular, it shows

Area	Regions	Lafay Index 1991/92 sector with min and max value	Relative weight of the top 5 items of 1991/92	Lafay Index 2011/12 sector with min and max value	Relative weight of the top 5 items of 2011/12	Spearman's correlation coefficient
North west	Piemonte	AA014	28.69	AA012	29.23	.867**
		CA110		CA110		
	Valle d'Aosta/Vallée d'Aoste	CA110	20.27	CA101	22.00	.003
		AA030		CA110		
	Lombardia	AA014	9.43	AA012	13.94	.867**
		CA110		CA107		
	Liguria	AA012	16.31	CA102	18.53	.886**
		AA011		AA103		
North-East	Trentino-Alto Adige/Südtirol	CA105	34.30	CA108	27.82	.625**
		AA012		AA012		
	Veneto	AA014	21.98	AA014	22.44	.804**
		CA110		CA110		
	Friuli-Venezia Giulia	AA022	21.13	AA012	25.83	.760**
		CA107		CA108		
	Emilia Romagna	CA101	24.24	CA104	15.81	.791**
		AA012		CA107		
Centre	Toscana	CA101	24.24	CA101	28.67	.837**
		CA110		CA110		
	Umbria	AA014	30.78	CA105	18.74	.932**
		AA011		AA011		
	Lazio	CA120	10.77	CA120	13.44	.886**
		CA110		CA108		
	Marche	AA011	14.07	CA102	29.04	.449
		CA104		CA110		
South	Abruzzo	AA014	28.96	CA102	26.84	.616**
		AA012		CA107		
	Molise	CA105	40.13	CA105	44.89	.827**
		CA107		CA107		
	Campania	AA011	31.40	AA012	28.41	.739**
		CA103		CA103		
	Puglia	CA104	29.38	CA104	28.94	.939**
		AA012		AA012		
	Basilicata	AA014	38.97	CA104	36.41	.705**
		AA012		AA012		
	Calabria	AA014	24.18	CA102	29.22	.837**
		CA103		CA103		
	Sicilia	CA101	29.02	CA101	23.96	.700**
		AA012		CA110		
	Sardegna	AA011	35.15	AA011	33.35	.546*
		CA105		CA105		

Note: * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).
Source: own processing

Table 3: Italian regions: value of the Lafay Index and Spearman's rank correlation coefficient, 1991/92-2011/12

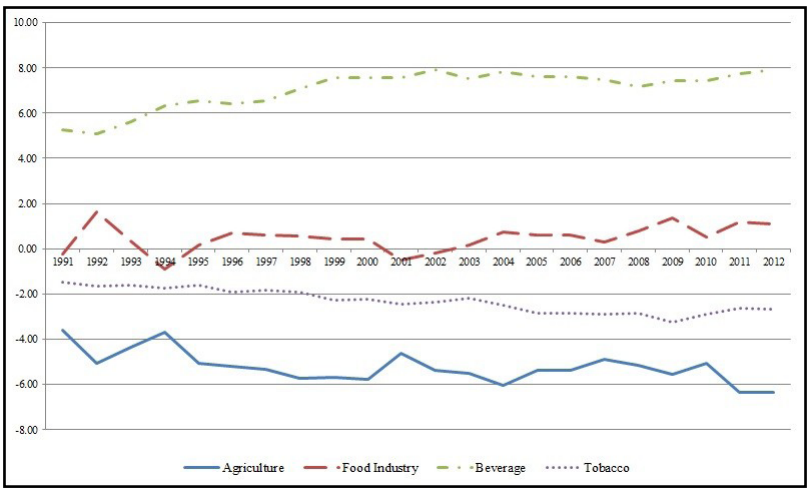
the economic sectors with the maximum and minimum index values in the two periods of observation (1991-92/2011-12), the weight of the first five items (calculated as sum of the LFI of each item) and Spearman's correlation coefficient. From the table, it may be easily deduced how heterogeneous and variously distributed the territorial specialisations are across Italy. If the weight of the first five sectors in the two surveys is considered then they drop in eight Regions (Trentino Alto Adige, Emilia Romagna, Umbria, Abruzzo, Campania, Puglia, Basilicata and Sicilia).

To analyse this data more deeply, let's look at Spearman's correlation coefficient. In this study, it is able to show the degree of change in the LFI during the two surveys. A high correlation indicates that the region's comparative advantages have changed very little, while a low value indicates considerable change. Eleven Regions show much higher values than this coefficient (close or greater than 0.8). Moreover, excluding cases of little statistical significance, the Regions with a significantly lower Spearman's coefficient (lower than 0.8) are those which showed a lower index in the course of the two surveys. It could be hypothesized that there have been changes in those Regions which have brought about a different way of structuring the weight of trade flow within the agri-food sector.

Finally, it's interesting to look at the specificity of the main specialisations – are they agricultural or perhaps linked to one of the six primary sectors (from sectors AA011 to AA030) or can they be re-traced to food industry (the remaining sectors, table 2). In 1991/92, there are 9 Regions with the highest LFI in a primary sector: 2 in the North-West (Valle d'Aosta, Liguria), 2 in the North-East (Trentino Alto Adige e Emilia Romagna), 1 in the centre (Umbria) and 4 in the South (Abruzzo, Puglia Basilicata e Sicilia). During the second survey this scenario changes. Only 5 Regions retain this competitive advantage (Liguria, Trentino Alto Adige, Umbria, Puglia e Basilicata), no other Region being specialised in a primary which is confirmed by obvious restructuring within much of the Italian agricultural industry.

These first results show the role of transformer that Italy is taking in the international food trade. This corresponds to some of the regions examined, to a model of specialization in which there has been a process of purchase of agricultural raw materials and re-export from the food industry. This is possible for those regions where there is a strong integration with foreign markets and where agriculture interacts in a very dynamic way with the rest of the economy, although with lower connection with the territory.

To look more closely at the characteristics of the foreign trade in agri-food, a further calculation of the Lafay Index was carried out. In particular, the 19 business divisions (see table 2) were unified into 4 groups: agriculture, food industry, beverages and tobacco which resemble the traditional sub-divisions of the sector. Figure 3 shows graphically the index trend during the survey. What's evident is how weak the primary sector is, showing significant de-specialisation over the whole survey period. However, the food industry shows a different trend: apart from in 1994 and 2001, its LFI is always positive. For beverages



Source: our elaboration on Istat data (2014)

Figure 3: Lafay index of the Italian Agrofood sector.

too, the Lafay Index remains particularly high and sustained over time.

However, the analysis shown does not provide information on the determinants of a high or low degree of persistence. That is, it does not explain which sectors, in each region, are contributing that persistence or to that change. Therefore, we need further investigation.

The dynamics of international specialization

Joint analysis of the regression and mobility effects (applying the least squares regression formula) shows the changes in distribution of the comparative advantages over time in the Regions. Table 4 shows the two effects which divide the Regions into three groups.

The specialisation model for the Regions of the first group did not change over the survey period: the $\beta > 1$ value shows substantial stability in the specialisation pattern such that growth (or drop) regards sectors in which the Region already showed comparative advantages (or disadvantages), whereas the B/R ratio suggests a growth in the level of specialisation. The four Regions (Lombardia, Toscana, Lazio, Molise) are therefore the only ones to have strengthened their levels of specialisation even without modifying their respective models of comparative advantage.

For the Regions in the second group (Piemonte, Valle d'Aosta, Liguria, Veneto, Friuli V. G., Marche, Abruzzo, Calabria, Sardegna), a catch-up model could be hypothesised – a tendency to modify the comparative advantage model (low R) but by contrast to the first group, with a tendency to grow product specialisation where they were less specialised and to reduce those which were relatively more specialised (low β). These Regions have therefore strengthened their levels of specialisation by modifying their own models of comparative advantage.

Finally, the third group of Regions (Trentino Alto Adige, Emilia Romagna, Umbria, Campania, Puglia, Basilicata, Sicilia) show values of $0 < \beta < 1$ and $\beta < R$ which means that they have modified their comparative advantage model (as did group 2) but in so doing have weakened their own specialisation models.

Conclusions

This study has examined the processes of persistence and change in the patterns of international agri-food trade in the Italian regions. Joint analysis of the coefficients of determination and mobility have highlighted the degree of specialisation of the Italian Regions over the survey period.

These results confirm many of the observations made in previous studies. Above all, Italy shows comparative advantages in the food industry. The analysis highlights how the Lafay Index is positive over time for beverages (including wines) and food industry. Secondly, there is a regional differentiation in agricultural and agri-industrial specialisation. While the northern Regions are more integrated into European and world markets both in buying raw materials and re-exporting food derivatives (Henke, 2006), the southern Regions are still not very integrated into international markets. So, Italy is divided into two as regards the production, transformation and commercialisation of agri-food products.

Notwithstanding the limited data, this study highlights the role of agricultural and food exports which is often overlooked in analysis and foreign trade policy despite their being runner-up to textile exports and stronger than many other Italian manufacturing industries. It is no wonder that despite the notoriety of Italian food products abroad, there is no corresponding penetration of those markets.

Authors´ note:

This paper was carried out in full collaboration of the authors. "Introduction" is written by Marcella Rizzo; "Materials and methods" is written by Marco Platania and "Results and discussion" by Placido Rapisarda. Conclusion are written together.

	$\beta > R$	$\beta < R$	$\beta = 0$
$\beta = 0$	-	-	-
$\beta > 1$	Lombardia*, Toscana*, Lazio*, Molise*		-
$0 < \beta < 1$	Piemonte*, Valle d'Aosta***, Liguria*, Veneto*, Friuli V.G.*, Marche***, Abruzzo**, Calabria*, Sardegna*	Trentino Alto Adige*, Emilia Romagna*, Umbria*, Campania*, Puglia*, Basilicata*, Sicilia*	-

Note: * Significant at the .01 level, ** Significant at the .05 level, *** Significant at the .1 level
Source: own processing

Table 4: Dynamics of international specialization in agro-food sector for Italian regions.

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Evaluation of the Effect of Subsidies on the Production Capability of Land in Selected Regions of the Czech Republic

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Anotace

Pokles produkční schopnosti půd ovlivňuje tvorbu důchodů farmářů, efektivní využití zemědělské půdy, její kvalitativní i kvantitativní degradaci i konkurenceschopnost českého zemědělství. Z výsledků výzkumu UZEI Praha vyplývá, že roční ekonomická ztráta vlivem poklesu kvality půdy v ČR ve sledovaném období let 2009-2012 je přibližně 385 mil. Kč (MZe, 2012a). Cílem článku je zhodnotit souvislosti mezi změnou kvality půdy a vybranými dotacemi, které by měly primárně ovlivňovat efektivní využití zemědělského půdního fondu a trvalou udržitelnost produkční schopnosti. Ve výzkumu byla použita korelační analýza a metoda komparace. Vztah mezi výší vyplácených dotací (SAPS a TOP-UP, AEO, LFA) a změnou produkční schopnosti půd (změna HRRE) nebyl potvrzen. Statisticky významný vztah byl zjištěn pouze u dotací NATURA 2000.

Klíčová slova

Zemědělský půdní fond, BPEJ, degradace půdy, udržitelné zemědělství, Program rozvoje venkova, greening, public goods.

Abstract

A decline in the production capability of land affects the creation of farmers' revenues, the effective utilization of agricultural land, its qualitative and quantitative degradation, as well as the competitiveness of Czech agriculture. The results of the IAEI Prague research show that the annual economic loss due to a decline in the quality of land in the Czech Republic within the analyzed period of the years 2009-2012 is approximately CZK 385 mil. (MoA, 2012a). The aim of the article is to evaluate the potential connections between the change in the quality of land and selected subsidies that should primarily be affecting the effective utilization of agricultural land and the continual sustainability of its production capability. In the research, the methods of correlation and comparison were used. The relationship between the amount of paid subsidies (SAPS+TNA, AEM, LFA) and after changing the production ability of soils (difference GARE) was not confirmed. A statistically significant relationship was found only in the subsidies NATURE 2000.

Keywords:

Agricultural land fund, Bonited Soil-Ecological Units /BSEU/, soil degradation, sustainable agriculture, Rural Development Program, greening, public goods.

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Introduction

1. Historical overview

According to the OECD definition (1996), support is understood to mean every intervention controlled by a public authority that causes a distortion of the market by decreasing the production costs of a given good or service or increasing its price. Support is such intervention from which benefits only arise for a certain group of entities, and not for society as a whole.

Inappropriately provided subsidies into agriculture can affect a decrease in, as well as the quality of agricultural land and thereby also

the competitiveness of agriculture. The state and farmers are still, up to the present time, dealing with the negative effects of agricultural support provided within a centrally planned economy. Subsidies supported an ineffective structure of agricultural production and bad treatment of the highest quality land.

The goal of the centrally planned agricultural policy was maximum self-sufficiency in temperate zone foods (approximately 98%), which led, in view of disposable resources of agricultural land in Czechoslovakia, to: (1) ineffective farming with high intensity of agricultural production, (2) soil degradation, (3) decreases of high quality land for construction investments, etc. Agricultural subsidies drained financial resources away from the state budget in the form of a negative sales tax as part of a "cheap food" policy.

2. Basic overview

Decoupled direct payments linked to land positively affect the amount of the price of land as well as the amount of rent. Subsidies increase income from agricultural production and thereby increase demand for input, including land (Featherstone and Baker, 1988). Economic effectiveness is positively linked with the size of the farm. Studies in Slovenia have led to the conclusion that the expansion of a farm can contribute to an increase in the economic productivity of the agricultural sector. The number of very small farms (less than 1 ha) continues to increase. Their high performance, as far as allocation effectiveness and profitability are concerned, is given advantages through the provision of generous subsidies, primarily on the basis of non-production criteria (Bojnec and Latruffe, 2013). If direct payments are actively used in the production of agricultural cultures, they have a positive impact on tenants of agricultural land as well as landowners, who have the opportunity to participate in the revenues from the support provided to tenants (Ryan et al., 2001, Patton et al., 2008). The index of the dependence of the sector on subsidies is the ratio of costs and revenues without the inclusion of subsidies. It measures the ability of the sector to generate profit from its own resources. A ratio of costs and revenues without the inclusion of other subsidies for production exceeding values of 100% presents a risk of dependence on subsidies. Slovakia and the Czech Republic exceed such a threshold value on a long-term basis. In the EU (15) in the year 2008, the index reached a value of 92.5%, in Germany 100.4%, in Slovakia 108.8%, and in the Czech Republic 117.3%. A greater level of dependence of agriculture on subsidies was seen only in Finland. On the other hand, in Poland, the index only reached 80.1% (CSO, 2010).

Authors Ciaian and Swinnen (2006) point out the positive effect of the policy of decoupling payments on the land market, arising through an increase in formalized relations between parties as far as land ownership is concerned. On the other hand, other authors draw attention to the fact that payments in support of income reduce funds reallocated in the direction of prospering farms and, at the same time, help to maintain the activity of economically weak farms (Viaggi et al., 2010).

The study of Lapka et al. (2011) compares the role of agricultural subsidies in the area of the development of rural areas in the Czech Republic before and after accession to the European Union (EU) in 2004. The results of an empirical case study show positive changes, associated with participation in joint agricultural policy (CAP). Despite an improvement, farmers continue to cite two main deficiencies and limitations – challenging administrative procedures and changes in program rules. Subsidies for the environment in the Horizontal Rural Development Plan 2004-2006 had an effect on the stabilization of the livelihood of the inhabitants of rural areas.

Ecological agriculture is an alternative to intensive agriculture, which substantially affected the character of the countryside primarily in the second half of the 20th century. In the Czech Republic, ecological agriculture has been developing since 1989. Ecological agriculture is such farming that heeds the environment and its individual elements by restricting or banning the use of substances and methods that burden, pollute or contaminate the environment or increase risks of the contamination of the food chain, and which heeds, to an increased extent, the external life manifestations and behavior and welfare of raised farm animals. The basis of ecological farming is healthy soil. The soil nourishes plants and is therefore also a prerequisite for our health (Antoušková and Křístková, 2007, Homolka and Koukolová, 2012). Organic (ecological) agriculture is found both in the United States, as well as in Europe. In the United States, the development of ecological agriculture is driven by the market and depends upon the state and industrial promotion. National policy focuses on the development of standards

for the management of production, processing and labeling of ecologically produced foods with the goal of facilitating the exchange of information on the market (Lohr and Salomonsson, 2000). Lampkin and Padel (1994) studied programs of financial support for a transition from a conventional method of farming to an ecological method in the years of 1987-1992 in Denmark, Sweden, Norway, Finland, Switzerland, Austria and Germany. The majority of direct subsidies were provided for a limited period of time (3 years – during conversion), and required complete transformation of at least a part of the farm. Support of ecological production is justified by the protection of the environment and objectives to decrease the volume of production.

The main merit of organic foods is that they do not contain any foreign chemical substances and residues of pesticides, because their use is forbidden in ecological agriculture. It cannot be claimed with certainty that organic foods are healthier, but it can be claimed that they have a more positive effect on the health of the consumer when compared to conventional foods (Dlouhý and Urban, 2011). Ecological agriculture has more positive effects on the protection of natural elements and on the countryside than conventional agriculture. Biodiversity of flora and fauna on arable land areas, permanent grass growth, edges of fields and in surrounding biotopes is greater in ecological agriculture than in conventional agriculture. The diversity of crops grown is also higher in businesses farming ecologically in comparison to conventional ones (Šarapatka et al., 2006).

The research of Štolbová et al. (2012) analyzes the economic results of small and large farms in LFA within the Czech Republic and evaluates the impact of current measures for disadvantaged areas where the distribution of EU payments is aimed at grass growth, regardless of the size of the agricultural business within the Czech Republic.

Within the new program period of 2014 - 2020 as part of the Rural Development Program, Ecological Agriculture (EA) will be conducted as an independent measure. Further, entry into the measures will be allowed only for farmers without concurrent conventional production, with the exception of cultures that cannot be farmed ecologically according to the law on ecological farming, e.g. a pond. Payments will be provided only to those applicants who fulfill the condition of a so-called "active farmer" (MoA, 2014a). The payment for mountain LFA from the year 2015 in the Czech Republic will not be provided only for grass growth, as was the case until the year 2014 inclusive, but rather, for all agricultural land defined as mountain LFA (MoA, 2014b).

Within the new program period (2014-2020), subsidies for land are provided through the Rural Development Program (6 priorities). The reform of joint agricultural policy for the period of 2014-2020 includes the reduction of support for agriculture. For example, financial resources from the EU for the Rural Development Program will be reduced nearly to a half (from 3.6 billion Euro for the years 2007-2013 to 1.9 billion Euro for the years 2014-2020 (EUROPROJECT, 2014).

A new element of the reformed CAP, which should contribute to a decline in the degradation of agricultural land, is so-called "greening". In the past, we have also seen direct payments that had as a prerequisite the fulfillment of certain conditions (cross-compliance) (MoA, 2014c).

The amendment to Act No. 334/1992 Coll., on the Protection of the Agricultural Land Fund, as amended by Act No. 41/2015 Coll., approved by the Cabinet, has as its main objective to protect agricultural land against its removal from the agricultural land fund /ALF/ and to maintain its production capability. However, decreasing levies for the annexation of agricultural land from agricultural primary production, according to the amendment to such Act, favors the economic aspect over the ecological aspect. Not even a change in the Civil Code (from 1 January 2014) guarantees that the user of agricultural land (tenant farmer) will be a good farmer and will endeavor to maintain the production capability of land.

The effectiveness of subsidies for land can be evaluated according to decreasing land fertility, high decreases of, oftentimes, very high quality agricultural land, which is irretrievably excluded from the agricultural land fund of the Czech Republic – approximately 12 ha per day (MoA, 2012b).

The EU subsidy system should be focusing primarily on: (1) the protection of land against its degradation, (2) the support of the production of quality foods in a sufficient amount and structure, (3) the inspection of their quality, (4) the protection of the environment and the character of the countryside. Other government functions, i.e. non-production functions, are derived from the fundamental

function of agriculture.

Agricultural subsidies should be set up in such a way so that the farmer does not adjust their activity to the subsidies, but rather, to the effective utilization of resources in the specific natural conditions.

The goal of the article is to evaluate the effect of selected subsidies on a change in the quality of land, which should primarily be affecting the effective utilization of agricultural land and impacting upon the continual sustainability of the production capability of land.

Materials and methods

1. Primary data

i. Yearbook of the Agricultural Land Fund, 2007-2011, Czech Office for Surveying, Mapping and Cadastre /COSMC, 2007-2011/

ii. Informations of the State Agricultural Intervention Fund /SAIF, 2008-2011/

iii. Database AGROREGISTER, Czech Statistical Office, /CzSO, 2008-2011/

2. Secondary data

i. Report on the State of Agriculture in the Czech Republic, Ministry of Agriculture, Prague, 2012. /MoA, 2012a/

ii. Situation and Outlook Report for Land, Ministry of Agriculture, Prague 2012. /MoA, 2012b/

iii. Action Plan for Organic Farming 2011-2015, Ministry of Agriculture, Prague 2011.

3. Used relationships, methods and procedures

The basis for evaluating the effect of subsidies on the production capability of land in the Czech Republic are the results of research by IAEI Prague. Such research pertains to the quantification of changes in land quality within individual regions of the Czech Republic (NUTS-3) within the analyzed period of the years 2009-2012 (Voltr, in: MoA, 2012a).

When evaluating changes in the value of the land, updated information was used for Bonited Soil-Ecological Units (BSEU) in the territories, where the complex land adjustment (CLA) was done. It considers disclosure of land, erosion control, water management measures and ecological stability of the territory.

Updating of Bonited Soil- Ecological Units of farmland leads to a reassessment of its production abilities and it is expressed in rent effect (GARE)[1] and official price of BSEU. In these areas there has been a) a change in the structure of the soil, or b) change in the acreage of agricultural land cadastral area by more than 10%.

Updating of soil ecological units is produced in about 1% of agricultural land in the Czech Republic per year. The research, used by the authors (Voltr, 2012), covers 2.81% of the area of the Czech Republic for 2009-2012.

The rent effect is expressed in EUR/hectare of agricultural land. The exchange rate of CZK/EUR used is in accordance with the subsidies paid in the respective years, according to the Official Journal of the European Union (2008: 24.660 CZK/EUR; 2009: 25.164 CZK/EUR; 2010: 24.600 CZK/EUR; 2011: 24.754 CZK / EUR).

In order to fulfill the objective of the article, only those subsidies have been selected which can explicitly affect the continual fertility of land:

a) Agri-environment measures (AEM). Measures targeting the sustainable use of agricultural land (1) economical caring of grassland, (2) organic farming, (3) conversion of arable land, which can alleviate the effects of water erosion and protect water courses from chemical pollution; (4) the cultivation of crops that can reduce water and wind erosion, prevent damage to soil structure by sunlight and enrich the soil with humus (Variable: x_1).

b) Less favored areas (LFA). For the payment of subsidies, farmers must guarantee one regular grazing down of permanent grassland or its cutting twice a year. In these areas stocking density is monitored to ensure sound management of utilized land. It is up to 1.5 LU/ha of subsidized agricultural land, at least 0.2 LU/ha of grassland (Variable: x_2).

c) Nature 2000. Funding of farmland sound management, which will allow the preservation of objects of protection

[1] The rent effect (GARE/ha) = (price of parameterized production - costs of parameterized production) * representation of crop in pricing structure in %. (Voltr et al., Methodology for valuation of land for quality of Bonited Soil-Ecological Units (BSEU), IAEI Prague, October 2012).

(species of plants, animals and habitat types) (Variable: x_3).

d) Direct payments (SAPS), Transitional national aid - land (TNA). Subsidies paid on a blanket basis per hectare of agricultural land. In the model; they are dealt with comprehensively. They are paid to the company and a tool to determine the extent of the amount of cultivated land is the size of the utilized farmland area. It depends on the decision of the company, how the funds received are exploited. In terms of sustainable soil quality, it is necessary to apply in the field of investment projects aimed eg. on: land protecting machines, equipment to perform operations that prevent soil degradation (Variable: x_4).

e) Information on land quality is given by a difference in the GARE/ha (Variable: y); (Voltr, In: MoA, 2012a).

The article was based on up to 2011, since all the necessary data has not been updated by 2015.

Used variables are monitored per hectare of subsidized cultivated agricultural land. The amount of cultivated land was drawn from a database of AGROREGISTER. Its extent is identical with the registration of agricultural land in the LPIS - (Land Parcel Identification System for agricultural land) for which subsidies are paid.

Paid subsidies have been identified for the years 2008-2011. This corresponds to years when updating of Bonited Soil-Ecological Units (BSEU) was finalized within the complex land data editing.

The updated BSEU affects the average official prices for individual cadastral areas, which reflects the value of agricultural land. It is caused by a change of value and by measurement changes of agricultural land in the surveyed cadastral districts of the region. This implies that the degradation of soil occurs because of its fertility reduction and its decrease. The technical data to determine the area of measurement of agricultural land in the region was taken from the primary database The Czech Office for Surveying, Mapping and Cadastre.

The objective of the analysis of relations between the variables (x_1, x_2, x_3, x_4, y) is to ascertain whether there is a connection between the said variables – a relationship (correlation), but also what the strength of such a relation is, how close it is, and what its nature is. In order to prove a correlation between variables x and y, it is necessary for the null hypothesis (there is no relationship) to be disproven and for values within the matrix in the relevant cell (intersection of x-y) to be in correlation on the selected level of significance. For greater transparency, such values are set out in red in the matrix (software: STATISTICA, version 12). Besides correlation, regression among the variables is also important. That follows the shape of the nature of the dependence of one variable on another variable, e.g. for the purposes of prediction. Further, basic research methods are utilized in the article, such as the secondary data collection method, analysis and synthesis, comparison and description of the current state of the agricultural land fund. The issue was assessed from a de lege lata standpoint.

Results and discussion

1. Support for agribusiness versus development of selected indicators in agriculture

As of the accession of the Czech Republic to the EU, support of Czech farmers has increased. That has been reflected in the positive economic result of the sector, despite the fact that, when compared to the volume of subsidies in the "old" EU member states, they were substantially lower. Table 1 (see the: appendix) shows that the economic results of doing business in agriculture (2004-2012) were achieved primarily through an increase in subsidies for agribusiness (by 48%), with a decrease in the size of agriculture (by 41%), a decline in employment (by 39%), in the production of the agricultural sector (by 11%), of sowing areas (by 7%)

The development of selected indicators also shows: an increase in subsidies, with the simultaneous decline in agricultural land of approximately 12 ha per day (MoA, 2012b) and a decrease in the production capability of land (IAEI Prague), and causes primarily an improvement of the economics of businesses, rather than having an effect on the continual sustainability of the fertility of agricultural land. This development is unsustainable on a long-term basis. The competitiveness of Czech agriculture cannot be limited by the growth of subsidies, but rather, by the production capability of the land, its effective utilization and protection against degradation.

2. Quantification of the relationship between subsidies and the quality of agricultural land within the regions of the Czech republic

According to Voltr (MoA, 2012a), "in regard to the evaluation of the economic effect of a change in land quality, it can be assumed that the actualization of inputs at the level of cadastral areas (annexation of agricultural land, re-cultivation of agricultural areas, etc.) affects the growth or decline in the average official price per cadastral area to the same extent and changes in such price are thus caused primarily by degradation processes." On the other hand, however, he acknowledges that some changes in land quality can be brought about by annexations of land, and primarily annexations of quality land. There then remains within the region a lesser extent of land with greater quality.

Information about a change in quality is quantitatively given by the change in the difference of parameterized revenues and costs (GARE). In Table 2 selected subsidies paid in relation to agricultural land are set out and change the production capabilities of soils in the region (expressed GARE).

In order to determine the existence of relationships between variables x_1 to x_4 and y, a correlation matrix was used within the application of basic statistics. A 5% level of testing significance was chosen.

As shown in Table 3, a correlation between variables (SAPS, TNA, LFA, AEN and GARE) was not proven. A relationship between the variables was not ascertained on the further tested level of significance of 10% (further investigation by the authors) either.

Correlation analysis confirmed the relationship between the amount of subsidies paid to Natura 2000 (funded by the Rural Development Programme /RDP/) and the amount of change GARE. The correlation coefficient (-0.7932) is a negative correlation, and the result can be interpreted as follows: in a region where there is a decrease production ability of soils (especially agricultural land management in the vicinity of large cities and growth of the land used for urban infrastructure) funds are invested to care qualitatively about suitable areas of grass and forest vegetation. Correlation describes the behavior of the regions in the use of funds from the RDP so that the natural resources which these regions posses are preserved in the context of sustainable development. The more degraded soils are (loss or decrease in soil fertility

The period of validity of the Decree according to price updates BSEU				Year	
				2009-2012	
Period ended landscaping				2008-2011	
Subsidies paid for the period (annual average)				2008-2011	
	AEM (x_1)	LFA (x_2)	NATURE 2000 (x_3)	SAPS+TNA (x_4)	Value diference GARE (y)
Region	EUR/ha				
Královehradecký	175.945	40.684	27.548	0.008	8.8943
Jihomoravský	173.771	39.533	4.376	0.442	-36.5811
Jihočeský	184.247	61.235	48.448	0.263	1.8573
Karlovarský	181.644	115.846	86.287	0.030	0.142
Liberecký	174.703	93.665	55.073	0.012	12.9452
Moravskoslezský	181.712	65.470	47.644	0.095	9.1601
Olomoucký	183.849	47.124	30.061	0.010	-15.0207
Pardubický	175.171	30.930	22.395	0.013	8.7798
Plzeňský	184.046	52.008	42.227	0.080	2.3344
Středočeský	167.017	108.731	9.248	0.021	-7.8175
Vysočina	183.823	31.349	29.010	0.004	4.4655
Zlínský	173.268	72.241	37.944	0.539	-30.7887
Ústecký	173.108	57.228	27.829	0.032	3.1511

Source: Internal SAIF support database (2008-2011),
Voltr in: MoA (2012a) The exchange rate 2008-2011 the EU Official Journal - see: Methodology.

Table 2: Selected subsidies and the value difference GARE in regions of the Czech Republic in the reporting period (EUR/ha).

Variables	Correlation						
	Marked correlations are significant at the level p<0.5000						
	N=13						
	Averages	st. Deviation	SAPS and TNA	AEN	LFA	NATURE 2000	Difference GARE
SAPS and TNA	177.8696	5.61592	1	-0.284297	0.504468	-0.167716	0.203123
AES	62.7727	27.99334	-0.284297	1	0.522411	-0.070915	0.030424
LFA	36.0068	21.11253	0.504468	0.522411	1	-0.164182	0.345243
NATURE 2000	0.1192	0.18012	-0.167716	-0.070915	-0.164182	1	-0.793237
Difference GARE	-4.3691	15.19639	0.203123	0.030424	0.345243	-0.793237	1

Source: The authors, dates: see Methodology, STATISTICA, version 12

Table 3: Variant 1, The description of relationship between selected subsidies and a production capabilities GARE (EUR/ha).

Variables	Correlation					
	Marked correlations are significant at the level p<0.5000					
	N=13					
	Averages	st. Deviation	SAPS and TNA	AEN	LFA	NATURE 2000
AES	62.91211	28.41785	1	0.548249	-0.098447	0.04695
LFA	36.07946	21.17168	0.548249	1	-0.198255	0.35976
NATURE 2000	0.11832	0.17473	-0.098447	-0.198255	1	-0.794808
Difference GARE	-4.34803	15.12304	0.04695	0.35976	-0.794808	1

Source: The authors, dates: see Methodology, STATISTICA, version 12

Table 4: Variant 2, The description of relationship between selected subsidies without SAPS, TNA and a production capabilities GARE (EUR/ha).

because of agricultural production), the more funds are invested in the protection of ecologically valuable sites.

Regression analysis quantified a relationship: $y = -66 + 3.6052x_3$

Information about regression:

- Significance level $\alpha = 5\%$ (risk measure)
- The coefficient of the variable Natura: $p = 0.001213$
- $R^2 = 0.5955 = 59.55\%$

Table 4, var. 2 shows, that even if pursued subsidies without SAPS + TNA (not paid directly for investments into land), relationships between variables were not detected other statistical correlation than var. no 1. (Table 3).

The influences that must be understood as significant in evaluating land quality are the size of annexations of agricultural land for non-agricultural purposes, the intensity of production, compliance with agro-environmental measures (GAEG), compliance with sowing procedures (improving and deteriorating crop), the extent of erosion sowing crops on inappropriate sites etc

Data characterizing the losses of agricultural land in the regions are arranged in descending order. In the South-Moravian region, which should be a "reservoir" of quality land to ensure food self-sufficiency in the Czech Republic, occurs its degradation (Table 2) and significant decline (Table 5). Soils in poorer natural conditions - Liberec Region have its value improved (Table 2 and 5). Excessive losses of agricultural land of higher quality (Table 5, Figure 1) and soil degradation itself have a significant impact on changes in the land value. Both factors have influence on reduction of land value in the regions of South Moravia.

In view of the dissimilarity of natural conditions within the analyzed regions, we can state that the main effect of subsidies on land is still the compensation of differences in the farming of agricultural businesses within the regions of the Czech Republic.

The monitoring changes in the structure of the agricultural land in terms of transfers to non-agricultural land has not been the purpose of this article. But: It can be stated, that a significant impact on the change in soil quality over farmland

Region	Year		Difference	Difference	Official average farmland price of updating BSEU
	2007	2011	(ha)	(%)	EUR/m^2
Královehradecký	429851	426703	-3148	0.732	0.339
Jihomoravský	195172	193937	-1235	0.633	0.300
Jihočeský	276622	274957	-1665	0.602	0.285
Karlovarský	381770	379930	-1840	0.482	0.168
Liberecký	281089	279763	-1326	0.472	0.272
Moravskoslezský	493354	491150	-2204	0.447	0.157
Olomoucký	411648	409911	-1737	0.422	0.150
Pardubický	279073	277926	-1147	0.411	0.278
Plzeňský	273028	271914	-1114	0.408	0.240
Středočeský	276779	275682	-1097	0.396	0.256
Vysočina	665547	663087	-2460	0.370	0.343
Zlínský	140306	139896	-410	0.292	0.222
Ústecký	124246	124061	-185	0.149	0.124

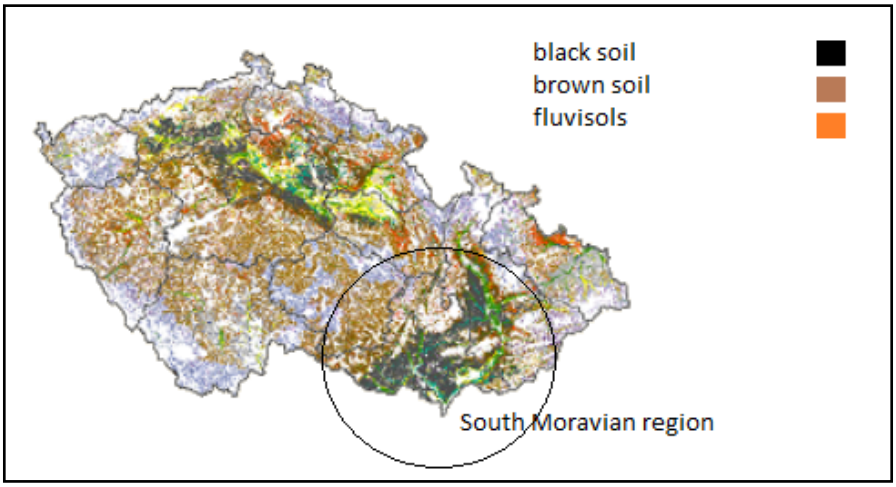
Note:

1) The difference, which relates to the period before updating BSEU farmland (31.12.2007) and after (31.12.2011)

2) The average official price for the concerned cadastral territory after updating BSEU (Price Decree Ministry of Agriculture and Ministry of Finance: 2009-2012). Current exchange rate CZK/EUR: 25.800; used in December 31.12. 2012.

Source: Yearbook of the Agricultural Land Fund (2007-2011), COSMC (2007-2011)
Voltr, In: MoA (2012a)

Table 5: Change in area of agricultural land by region Czech Republic.



Source: VÚMOP, 2015

Figure 1: Main Soil Types in the Czech Republic.

is caused losses higher quality. If there is such land grabs, e.g. in Jihomoravský Region (-0.732% for the period 2007-2011), Olomoucký (-0.472 %) and Zlínský Region (-0.633%), it will be mostly a land of higher quality. There is also greater soil degradation. However, there is no statistical relationship between the amount of decreases of land and the reduction in the production capability of land in the whole file of 13 regions.

The subsidies for pastoral farming (lower soil quality regions: Liberecký, Karlovarský, Jihočeský, Vysočina) affect soil quality positively. There are not explicitly associated with land subsidies, but they cannot be overlooked in the soil assessment.

Primarily the manner of farming on land (e.g. ecological agriculture) has a greater effect on the continual sustainability of the fertility of land than subsidies for land. It is unrealistic, from a long-term standpoint, for negative business income (in production areas) to be compensated

by operating subsidies. Ecological agriculture, as compared to conventional (industrial) agriculture, produces more positive externalities. It should not be an alternative, but rather, it should be, e.g. in multiple variations of the application of such a system, the norm. The effectiveness of subsidies on ecological agriculture would increase through the payment of investment support for the processing and sale of organic foods directly on the farms that produce such products, so that food and energy are not wasted. The time between the production, processing and consumption of organic products would thus be shortened. The costs for transportation, distribution, etc. would be decreased, which would lead to a reduction in their prices. Subsidies would lead to greater economic independence of ecological farms, an increase in the proportion of organic products of Czech origin and the proportion of ecologically farmed agricultural land /the goal of the Czech Republic for the year 2015 is 15% of the total area of agricultural land/ (Action Plan, MoA, 2015).

EU in the new programming period 2014-2020 made major interventions into the CAP. Subsidies will be tied to performance and soil protective ecological farming practices (greening).

Conclusion

i. A correlation between subsidies for land and its production capability was not proven, even at a level of significance of 5% and 10%. That means that a long-term increase in support linked to land (Table 1, 2, and 3) has more of an effect on the economics of agricultural businesses than on the continual fertility of the land, i.e. harmony between agriculture and the environment. The conditions for a change in the current trend (soil erosion, decreases in agricultural land, a relatively low proportion of permanent grassland, a decline in the numbers of farm animals, etc.) are not being created. The decline in the numbers of farm animals does decrease the production of emissions from the agricultural sector, but negatively affects the content of organic matter in the soil. The structure and stability of organic matter, which is an indicator of land quality, is changing.

ii. Although there is no evidence of an effect of AEM subsidies on change of the production capacity of the soil (there was no statistically significant relationship), the authors believe that these subsidies have their purpose and are desirable. The negative result of the research can be explained by the time data base not large enough. Support AEM is paid to new EU countries since their accession to the EU (2004). Implementation of soil conservation plans could not become evident yet.

iii. It is considered to be a positive fact that it confirmed the statistical correlation between subsidies NATURE 2000 and difference GARE (correlation coefficient = -0.79). Regions are aware of the loss of soil quality because of agricultural activity and land occupation for the urbanism development, so they try to rescue valuable forest and grassland habitats.

iv. The author recommends: (1) establish a monitoring technologies of cultivation of agricultural land, particularly in the major producing areas of the Czech Republic and monitor the impact of farming on the environment, threats to soil erosion, lack of available moisture, etc. (2) The issue of degradation of farmland, which also concerns other EU member states, resolved at this level and to promote the adoption of a directive on the protection of agricultural land under the European program for the protection of agricultural land resources.

v. It is worth considering whether it would be appropriate to further research focus on "Subsidies for land consolidation". BSEU updates are handled in territories where they enacted comprehensive landscaping. These include the issue of ownership of land holdings, but also agricultural infrastructure or absence of elements of ecological stability of the landscape (corridors, water tank dikes, ditches catch). All this is undoubtedly beneficial for improving the quality of agricultural land.

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Appendix

	year					index 2004=100
	2004	2006	2008	2010	2012	
Share of agriculture in GVA (%), current prices	2.63	1.94	1.93	1.09	1.55	0.59
Economically active in agriculture (%)	4.3	3.08	2.87	2.64	2.62	0.61
Wage disparity in agriculture/national economy (%)	71.7	76.1	79.1	77.8	78.2	1.09
Agricultural industry output (mil. CZK, constant prices of 2000)	111286	101461	110670	97938	98983	0.89
Net value added (mil. CZK, constant prices of 2000)	27382	19362	25370	17198	17921	0.65
The factor income (mil. CZK, current prices)	30985	34628	40642	35662	47192	1.52
Net operating surplus (mil. CZK)	11825	11003	14586	11678	22364	1.89
Support to the agrarian complex, total (mil. CZK)	28031	35739	37692	44857	41494	1.48
of which Czech Republic	16810	17166	16506	15287	11160	0.66
of which EU	11221	18573	21186	29570	30334	2.70
Net value added / AWU (thous. CZK)	312.9	310.9	374.9	383.0	504.6	1.61
Entrepreneurial income (mil. CZK, current prices)	8558	6835	10143	7645	16444	1.92
Agricultural foreign trade balance (mil.CZK)	-32295.5	-34015.7	-24117.0	-34643.6	-24834.3	0.77
Agricultural land area, 31.12. (ha)	4269227	4259481	4249179	4238975	4229167	0.99
Area of of arable land (ha)	3062019	3047250	3032448	3016858	3000390	0.98
TTP (ha)	970623	973791	977989	982776	989293	1.02
Not sown area, fallow land (thous. ha)	45	44	23	45	33	0.73
Total area under cultivation (thous. ha)	2658	2587	2545	2488	2477	0.93
The area of agricultural land in organic agriculture / total area of farmland (%)	6.16	6.61	8.04	10.55	13.9	2.26
Consumption of mineral fertilizers NPK (kg of pure nutrients / ha of agricultural land)	99.4	98.5	110.6	93.1	117.6	1.18
Livestock (thous. pcs)	1428	1374	1402	1349	1354	0.95

Source:

MaA (2011). Action Plan for Organic Farming 2011-2015, Department of Agriculture, Prague, 2011

MoA (2005-2013). Report on the State of Agriculture v the Czech Republic, Department of Agriculture, Prague

Table 1: Selected indicators of the agricultural sector in the years 2004-2012.

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Value Proposition Canvas: Identification of Pains, Gains and Customer Jobs at Farmers' Markets

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Anotace

Cílem výzkumu je identifikovat faktory business modelu utvářející užitnou hodnotu zákazníků farmářských trhu v oblastech (1) Produkty/služby, (2) Generátory zisků and (3) Řešitele problémů. Zjišťované oblasti faktorů vycházejí z metodiky tvorby plátna užitné hodnoty. Primární data byla získána metodou dotazování, osloveno bylo 217 zákazníků farmářských trhů. Dotazník byl šířen osobně. Nejdůležitější úkoly zákazníka byly identifikovány jako zásobit se čerstvými a zdravými potravinami a mít dobrý pocit z nákupu; nejdůležitější generátory zisků jsou čerstvé a zdravé jídlo a nejdůležitějšími problémy jsou vyšší cena a nevhodná otevírací doba. Výstupem je pět obecných doporučení pro prodejce a organizátory trhů. Bylo také zjištěno, že zákazníci farmářských trhů upřednostňují osobní prospěch ve větší míře než faktory s širší společenskou působností.

Klíčová slova

Business model, plátno užitné hodnoty, užitná hodnota zákazníka, farmářské trhy, čerstvé potraviny, agribusiness.

Abstract

The goal of the research is to identify the factors of business model that form Value Proposition of farmers' market customers in the areas of (1) Products/Services, (2) Gain Creators and (3) Pain Relievers. The examined factor areas are based on the creation of a Value Proposition Canvas. Primary data were acquired through the method of questionnaire survey with 217 customers shopping at the farmer's market. The questionnaire was distributed in person. The most important Customer Jobs are identified as stocking up on fresh and healthy food and feeling good about the purchases; the most important Gain Creators are fresh and healthy food and the most important Pains are higher prices and inconvenient opening hours. Its results are five general recommendations for market sellers and organizers. It was also found that farmers' market customers made personal benefits a greater priority, much more than factors with a wider social scope.

Keywords:

Business model, value proposition canvas, customer's value, farmers' markets, fresh food, agribusiness.

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Introduction

Agricultural production comprises of manufactured goods, generally, food which basically safeguards the physical existence of the population (Vošta, 2014). Within Europe, and EU exactly, the field of food market and problems of food consumption are very important and are highly discussed (Šrédl, Soukup, 2011). The future development of food markets is bound to the consumer trust in the question of quality. As it is stated by Renting et al. (2003) previously, the food purchases were commonly made in the vicinity or even at home. The customer was noticing the food quality mostly based on personal observation and by social networks within his or her

neighbourhood. Previous studies identified that the quality is not just dependent on objective product characteristics. Quality is a complex construct of characteristics that are extended to personal needs, such as the safety of food, impact on the environment, support of local rural communities and other ethical aspects (Migliore et al., 2015). However, quality is not the only factor that influences consumer purchases. Food market must be seen as a dynamic market with trends and fashion. Food consumption is also influenced by different lifestyles, consumers' expectations and image that are projected on the food products (Renting et al., 2003). The channel of distribution used for the food production is also one of the important factors.

The retail chains are used as intermediary between the manufacturers and the end consumers (Vošta, 2014). Characteristically all of the fresh production, such as fresh fruits, fresh vegetables, fresh flowers, and live seafood, are perishable goods and need as short time as it gets to get to its final consumers in the postharvest period (Su et al., 2014). Although the food market is gradually more globalized, there is conversely increased pressure on alternate chains which represents the shortest route from the farmer to the final consumer (Renting et al., 2003). Currently, new forms of food distribution channels has been spread. They are defined as short supply chains or short food supply chains (Renting et al., 2003; Migliore et al., 2015). This concept of supply chains covers all actors that are directly involved in the production, processing, distribution, and consumption of new food products and covers also interrelations between them. The difference between short supply chains and conventional industrial mode of food production bring a shortcut from producer to the consumer but through the direct purchases from producers mediate also the authenticity and trust thanks to personal interaction (Renting et al., 2003). Those face-to-face channels consist of farm shops farmers' markets, roadside sales, pick your own, box schemes and also home deliveries (Renting et al., 2003; Migliore et al., 2015). Migliore et al. (2005) also stated that the popularity of short supply chains is growing according to consumers need of fresh plants and at the same time the personal intention to support local farmers. Farmers' markets and locally grown foods in general contribute to the sustainability of the food system by raising the viability of small and medium-sized farms. To enhance the importance of locally grown product differentiation it is crucial to understand consumers' perceptions of the market attributes and venues (Conner et al., 2010). The consumer is seen as an individual that is spending his own resources in order to gain products and services associated with consumption, therefore it is important to learn about his behaviour and decision-making (Šrédl, Soukup, 2011). Farmer's market can be defined as a place where farmers sell their produce directly to consumers. Items frequently sold through farmers' markets are fruits, vegetables, flowers, baked goods, eggs or dairy products. In recent years, farmers' markets have been rapidly spreading due to their ability of meeting the needs of consumers who matter ethical, responsible or green values (Onianwa et al., 2005). By purchasing fresh, organic and local products at farmers' markets, consumers satisfy their current concerns for nutrition, health, well-being, while also supporting local farmers (Cassia et al., 2012). Most consumers in Ohio purchase locally grown food and thus express support for strengthening the local food system (Smith, 2008). For buyers, when it comes to farmers' markets, the quality of the products, supporting local farmers, the price and the environment are key factors (Conner et al., 2010). In farmers' markets, one can observe a rising demand for goods with a high added value. Customers care more about quality, longer durability or special product characteristics (Turčínková and Stávková, 2009). The study with a nationwide sample found that those who frequently buy fresh produce directly from farmers care about high value of product quality, freshness and safety, as well as organic and locally grown products (Bond et al., 2006). Quality perception depends on personal needs, such as food safety, the way in which food is produced in terms of impact on the environment, ethical content such as animal welfare or the area where production takes place (Brown et al., 2009; Dowd, Burke, 2013). Cassia et al. (2012) tests the impact of a perceived customer-company-territory interaction on shoppers' satisfaction. The perceived value is created through the social-economic interactions among customers, local farms and their territory. They found that customers appreciate the intangible value of the perceived customer-local farmers-local territory interaction, such as the product quality more than they appreciate a low price level. Migliore et al. (2014) in their study identified three types of convention that drives quality perception. Domestic convention refers to direct interaction with the farmer, through which consumers learn about the production system or production traditions. Civic convention is connected with solidarity towards farmers and rural

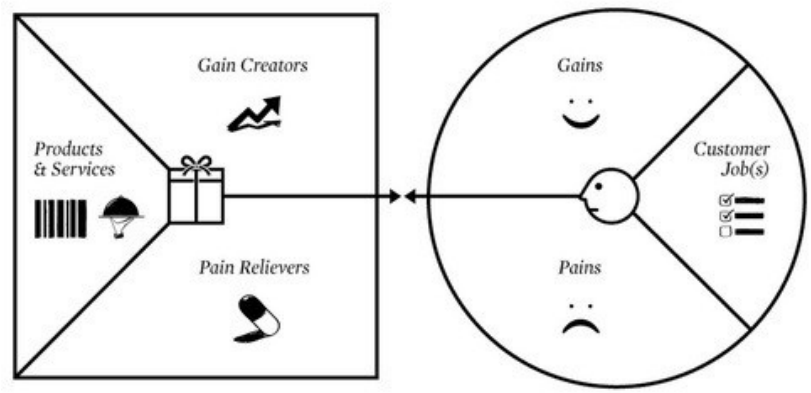
communities, they are inspired by social principles of a higher order, for the public good. Regard convention refer to trust that develops after repeated interactions between farmers and customers.

Agribusiness is an important and major sector of any national economy, but the risks of agribusiness are significantly high. According to Dudin et al. (2015), agriculture and all areas including farmer's market could secure their competitive advantages through forming and regular renewal of Business Model Canvas. Business Model Canvas can be defined as: A business model describes the rationale of how an organization creates, delivers, and captures value (Osterwalder, Pigneur, 2010). With his research, Dubin et al. (2015) identified that management concept of Business Model Canvas is designed for managing the strategic sustainable and competitive development of the enterprise structures in the context of the turbulent and unpredictable changes in the market environment. At the centre of the Business Model Canvas is Value Proposition, which represents the value offered to customers (Clark et al., 2012) and can be seen in figure 1. The Value Proposition Canvas makes explicit how you are creating value for your customers. It helps the company design products and services that their customers want (Osterwalder et al., 2014). The creation of the Value Proposition Canvas is based on creating Value Propositions for (1) Product & Services - what products/services is the value proposition based on (2) Gain Creators - How are they delivering gains? (3) Pain Relievers - How are they killing pains? Using experience in the area of the customer segments of (1) Customer Jobs (2) Gains (3) Pains (Lindič, Silva, 2011).

As it is stated by Šrédl and Soukup (2011), it is important to learn about customer's decision-making. In general, this research is focused on uncovering customers' intentions at the farmer's market as one of the units of the short supply chain. These intentions are used to formulate the Customer's Value Proposition, which is used to design the Business Models of sellers and organizers of farmers' markets. The goal of the research is to identify the factors of business model that form Value Proposition of farmers' market customers in the areas of (1) Products/ Services, (2) Gain Creators and (3) Pain Relievers.

Materials and methods

The primary data are gathered using the questionnaires. The questionnaire is distributed in person and is intended for customers who have experience with shopping at the farmers' markets. The construction of questionnaire is based on the Business Model Canvas, or more specifically the Customer Value Proposition (Osterwalder et al., 2014). The questionnaire is divided into three parts concerning (1) Products/Services, (2) Gain Creators and (3) Pain Relievers. The questionnaire contains 15 core and 3 identifying questions. Core questions are all open. The questionnaire is completed by a total of 217 customers who visited farmer's market at least once a year at the Czech Republic. Primary data were collected in time period of two months, from May to July 2015 at urban farmer's market located in cities with a population greater than 100,000. Selective statistical set of respondents (n = 217) is represented by the gender: female (64 %), male (36 %); by the age: 15 – 29 years (18 %), 30 – 44 years (39 %), 45 – 60 years (23 %), more than 60 years (20 %); by farmer's market shopping regularity: more than once a week (21 %), at least once a month (68 %), at least once a year (11 %). Results (Tables 1 - 3)



Source: Clark et al., 2012

Figure 1: Value Proposition Canvas.

contain only those factors which were repeated by the respondents more than 10 times. Customer jobs and Gains are divided by Osterwalder et al. (2012) who distinguished Social, Emotional, Functional and Basic types of factors. The Customer Jobs functional type represents such factors that fulfil the essence and specific purpose of farmer's market visit, such as purchase or stocking up on food. Basic factors are connected to satisfying basic human needs such as eat, sleep, communicate, etc. Social factors are those that are created through interactions with others or are connected to other people. Emotional factors are those that are connected with feelings and are thus related to one's inner perspective. Gains can also be divided in the same way. Functional factors that represent profit coming purely from functional outcomes, tied to the true goal of the customer's behavior. Social ones are such factors when the benefit can be other people's benefit as well. Emotional factors include the outcomes that are connected to arousing certain emotions and not just satisfying the primary shopping goal (Osterwalder et al., 2014). Customers Pains are divided by the authors to those related to product or shopping convenience.

Results and discussion

In connection to the creation of the Value Proposition Canvas (see Figure 1), the results are grouped into three areas. The tables contain the absolute and relative frequency of the identified factors and the factor type.

The main Customer Jobs in Table 1, which influence the customer while shopping at the farmer's market, belong to the Functional as well as Social and Emotional types. At farmers' markets, they most often stock up on fresh and healthy food (59 %), which belongs to the Functional factors. The second most frequent factor is the good feeling they get from shopping (43 %), which belongs to the Emotional factors. Feeling good is connected to other types of factors, as the respondents stated. They feel good about buying fresh, healthy and high quality food. They perceive the quality of the products primarily in using appropriate ingredients. The third most frequent factor represent eating fresh food (20 %) and it is classified among Basic factors. The fourth factor represents protecting the family and its health by buying fresh and healthy food (20 %) and belongs to the Social factors. Other factors in the Table 1 have a frequency of 10 % or under. Nevertheless, the factor that is one of the least frequent - buying specialty goods (4 %), confirms the conclusions of previous research. Farmer's market produce items were more frequently local and organic, but often tended toward less common or more exotic and heirloom varieties (Lucan et al., 2015).

The main Gains of shopping at farmers' markets are fresh and healthy food (72 % and 62 %, see Table 2). These two factors can be considered as a part of Functional factors, which are directly connected to the food bought at farmers' markets. The other groups that form Gains are Social-Emotional factors, such as sellers' recommendations (the seller's more personal approach), a good feeling from supporting local producers and stylish packaging. Despite their low frequency in the respondents' answers, these factors are very important in terms of the Value Proposition creation, because they have an influence on the overall value that the customer gains from shopping at farmers' markets.

Based on the interviews, 10 factors that respondents connect to negative feelings, risk or unsolicited costs before, during or after shopping at farmers' markets were identified (see Table 3). The most frequently mentioned factor (53 %) is higher prices

Factors	Absolute frequency	Relative frequency	Type of factors
Stocking up on fresh and healthy food	128	59.10 %	Functional
Feeling good about the purchase	94	43.40 %	Emotional
Eating fresh and healthy food	44	20.10 %	Basic, Functional
Protecting family and its health	43	19.79 %	Social
Satisfying curiosity	26	12.13 %	Emotional
Spending free time	15	7.02 %	Emotional
Looking modern/trendy	13	6.06 %	Social
Learning something	11	5.07 %	Functional, Emotional
Buying specialty goods	10	4.47 %	Functional

Source: own calculations based on questionnaire survey, 2015

Table 1: The most frequent Customer Jobs of farmers' markets customers.

Factors	Absolute frequency	Relative frequency	Type of factors
Fresh food	157	72.34 %	Functional
Healthy food	141	64.98 %	Functional
Sellers' recommendations (seller's more personal approach)	79	33.64 %	Social/Emotional
Good feeling about supporting local producers	44	20.28 %	Social
Stylish packaging	12	5.52 %	Social/Emotional/ Functional

Source: own calculations based on questionnaire survey, 2015

Table 2: The most frequent Gains of farmers' market customers.

Factors	Absolute frequency	Relative frequency	Type of factors
Higher prices	167	53,29 %	Product
Inconvenient opening hours	123	39,25 %	Convenience
Not enough information on the source of the goods	92	29,36 %	Product
Anonymity of the farmers	87	27,76 %	Product
No parking	58	18,51 %	Convenience
Queues	43	13,72 %	Convenience
No card payments	40	12,76 %	Convenience
No returns	32	10,21 %	Convenience
No restrooms	23	7,34 %	Convenience
No rest areas	15	4,79 %	Convenience

Source: own calculations based on questionnaire survey, 2015

Table 3: The most frequent Pains of farmers' market customers.

of goods compared to, for example, supermarket prices, which is a factor connected to the product. An important factor is also the inconvenient opening hours (39 %), which is the most important factor in the shopping convenience. Other important factors are insufficient information on the source of the goods (29 %) or the farmer's anonymity (28 %), which are also tied to the product. In contrast, the negative factor that the respondents stated as the least important was the absence of restrooms (7 %) or rest areas (5 %), which, together with other factors, belong to the customer's shopping convenience.

In terms of the Customer Jobs identified in our research, customers focus more on their own benefit and buying high quality goods in the first place. This is in accordance with the growing demand for food with a high added value as stated by Turčínková and Stávková (2009). The customer is focused on his or her own profit and his or her values are mostly connected to Functional factors and those Social and Emotional factors that are linked to the customer as a person or his or her family. Factors from the Gains area can be also aggregated to Functional, Social and Emotional types factors. Functional factors express profit in the form of fresh and healthy food. These factors are considered by the customers as the most important and belong to the main values that will make the customer decide to shop at farmers' markets. The Functional type of the Gain area focuses on fresh and healthy food. This is in accordance with the research (Bond et al., 2006) stating that the high value of high quality product is freshness and safety, as well as organic and locally grown products. In non-functional area, an important factor was also sellers' recommendations, which can be part of the social and emotional type of factors that supports the findings of the research conducted by Renting et al. (2003). Customers often prefer farmers' markets because they can interact directly with the producer/grower, who can give them recommendations or other information. Nevertheless, it must be noted that 20 % of the respondents mentioned the factor of support for local producers. When comparing the research with other current published studies, two significant differences were revealed. The emerged social-emotional factor of stylish packaging signified the farmers' markets customers' desire for a certain social status. Respondents confirm that shopping at farmers' markets is fashionable. The question is, if one of the sellers had purposefully taken advantage of the customers' desire to strengthen

their social status, would that thereby raised both customers' interest and farmer's competitiveness. The main cause of uncomfortable feelings about shopping at farmers' markets is the higher price of the goods. Perceiving the higher prices is confirmed by research (Lucan et al., 2015), showing that farmers' markets were more expensive on average (p values <0.001 for pairwise comparisons to stores) especially when discounts or sales prices were considered. In general, respondents mentioned factors connected to the product, such as the price or the origin, when asked about the source of the bad feeling before, during and after shopping. Factors related to shopping convenience, with the exception of inconvenient opening hours (39 %), were under 20 % (queues, not being able to pay with a card, no returns, etc.). Inconvenient opening hours are related to the fact that farmers' markets were open substantially fewer months, days, and hours than stores (Lucan et al., 2015).

Scholars stated, that customers' values of purchasing goods are more aimed at social issues, such as supporting local farmers, strengthening local food systems or other ethical, responsible or green values (Onianwa et al., 2005; Cassia et al., 2012; Smith, 2008; Conner et al., 2010). However, in this research the lower frequency of such issues was identified in comparison with functional factors and those social factors tied to personal profit. The absence of factors with wider social scope or ethical content, such as animal welfare," that was identified in Central England and Southern France (Brown et al., 2009) and Australia (Dowd, Burke, 2013) is surprising. This factor wasn't even mentioned by any of the 217 respondents, which indicates that, as has been already mentioned, the customers' focus on social and emotional factors connected to their own personal profit, or the profit of their family.

Conclusion

The main purpose of this study was to identify factors that create value for the customer who does the shopping at farmers' markets. Other authors (Conner et al., 2010) primarily analyse the environment of farmers' markets in general, which is in this research in context of the Value Proposition Canvas included in the Customer Jobs and Gains areas in detail. This study mainly contributes to the previous researches with an extension of the Pain area and its factors. In our interviews respondents also related specific constrains that negatively influence them when they shop at farmers' markets and thus decrease the overall value perceived by the customer. The research further discovered that social and emotional factors are directed at the customer's personal profit (feeling good for buying high quality food, protecting one's own family, learning something, spending one's free time, etc.) much more than factors with a wider social scope (welfare, supporting local communities). The research conducted has produced recommendations for individual sellers at farmers' markets as well as for organizers. One can suggest to organizers especially to minimize customers' negative perceptions of the sales environment. Therefore, it can be recommended:

- Communicate the quality of the products especially by emphasizing their freshness and healthiness, i.e. visibly present these qualities to customers on signs.
- Use personal contact to inform the customer, provide extra information on the qualities of the products, the way to use/prepare them, make recommendations and give additional information.
- Provide customers with basic information on the origin of the goods and the farmers, in the case of a local producer it's also advantageous to communicate these facts.
- Respondents mentioned the original and stylish packaging of the farmers' products as a factor that raises customer´s value.
- Organizers should inform customers on parking options in the area or consider possibilities of providing the rest area.

One can distinguish customers' perceptions of farmers' markets by their environment and the product quality. The customers weigh the parameters of the market and the services that the location offers as well as the quality of the products for which they need information. Future research should focus on identifying factors that form the value proposition of shopping at the supermarket and compare those factors to findings of this research focused on farmers' markets.

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EU Quota Sugar Market Concentration – the Main Drivers of EU Sugar Market

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Anotace

Evropský trh s cukrem výrazně mění svůj charakter. V průběhu posledních dvou desetiletí se změnila jeho koncentrace a jednotlivé země a společnosti se začaly připravovat na ukončení systému výrobních kvót na cukr. Úroveň soutěže v rámci trhu s cukrem v EU se zrychluje. Mnoho společností již opustilo trh EU nebo výrazně snížilo své výrobní kapacity. Hlavním cílem tohoto příspěvku je analyzovat trh s cukrem v rámci EU, zejména trh cukru v rámci výrobních kvót a specifikovat současné výrobní struktury v EU. V článku je provedena identifikace klíčových hráčů/subjektů, působících v rámci systému kvótovaného cukru. Záměrem je zjistit úroveň koncentrace trhu s cukrem v EU prostřednictvím Herfindahl-Hirschmanova indexu (HHI). Výsledky, vycházející z analýz poskytují přehled o velmi specifickém charakteru evropského systému výroby cukru v rámci kvót. Ačkoliv se na trhu nachází relativně vysoký počet společností, výrobní kapacity kvótovaného cukru jsou velmi koncentrované. Většina cukrovarů se nachází v Německu, Francii, Polsku a většina cukerních výrobních kvót je ovládána společnostmi se sídlem v Německu, Francii, Nizozemsku a ve Spojeném království. V současné době je systém kvótoveného cukru v Evropské unii provozován/řízen pouze několika velmi silnými subjekty: Südzucker, Nordzucker, Tereos, ABF, Pfeifer & Langen, Royal Cosun a Cristal Union. Článek byl zpracován v rámci IGA (Interní grantové agentury), PEF, ČZU v Praze, číslo 20151031, „Vybrané aspekty ekonomických sankcí a jejich dopad na vzájemný obchod mezi EU a Ruskem“.

Klíčová slova

Výroba cukru, systém cukerních kvót, rozdělení cukerních kvót, trh s cukrem, trh EU.

Abstract

The European sugar market is changing its character. During the last two decades its concentration changed and individual countries and companies have been preparing themselves for the end of sugar production quotas system. The level of competition within the EU sugar market is accelerating. Many companies already left the EU market or significantly reduced their production capacities. The main task of this material is to analyse the EU sugar market and especially sugar quotas character and to specify the current EU sugar production structures existing under the sugar quotas system. The paper is also identifying individual drivers/actors operating under the sugar quota system. The idea is to identify the level of EU sugar market concentration through the Herfindahl-Hirschman Index (HHI). The results coming from the analyses provides the overview of very specific character of the European sugar production quota system. However the market is operated by many companies and alliances, its production capacity are extremely concentrated. The majority of sugar plants are located in Germany, France, Poland and the majority of sugar quotas are controlled by companies headquartered in Germany, France, the Netherlands and the United Kingdom. In nowadays - the sugar quota system in the European Union is operated/controlled by only a few very powerful operators: Südzucker, Nordzucker, Tereos, ABF, Pfeifer & Langen, Royal Cosun and Cristal Union. This paper was supported by the Grant Agency at the Faculty of Economics and Management, Czech University of Life Sciences Prague: The selected aspects of economy sanctions and their impact on mutual trade between EU and Russia [nr. 20151031].

Keywords:

Sugar production, sugar quota system, quota distribution, sugar market, EU market.

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Introduction

The European beet sugar beet quota system has been developing very dynamically in recent years. Reform measures that have been implemented over the last two decades have significantly influenced its present form and structure (Nolte, Grethe, 2012). Abolishing the common market organization, which is expected to be completed in 2017, seems to be the last planned step in reforming the European sugar system. This reform does not mean that the sugar market will be fully liberalized in the European Union. It will remain partly isolated from the rest of the world due to relatively high tariffs (Nolte et al., 2011; Smutka et al., 2012). Quota abolition will lead to an even greater restructuring of the sugar market within the EU-states (Nolte et al., 2012). A long-term process of forming the sugar quota holder system has led to its gradual profiling across the entire European Union. The number of sugar beet growers and sugar producers has been dynamically declining (Nolte, Grethe, 2011). The reforms have contributed to a significant reduction in production capacities in European countries in recent years. Many traditional sugar production regions have completely abandoned the quota system and the production quota was either completely eliminated or significantly redistributed among other states, respectively among companies controlling European sugar production (Smrčka et al., 2012). In addition, sugar production is becoming more concentrated and some countries, respective multinational companies, which operate in the European market have been able to strengthen their position with key producers (Neundoerfer, 2011; Nolte, Grethe, 2011). The European sugar market is very specific, both in the global economy as well as within the European Single Market. While the production of cane sugar is dominating in the world market, European sugar production is based on sugar beets. It is, to some extent, still surviving „Napoleonic paradoxbecause the cultivation of sugar beet had spread at the time of the Napoleonic wars in Europe when Britain blocked continental ports and thus imports of cane sugar. Until 2017, the European sugar market will be protected not only from cane sugar imports, but also to some extent from its own production within the EU. While there are more than one hundred pure beet sugar factories, other sugar producers (i.e. combined sugar factories and cane refineries capable to process imported raw cane sugar) represent over twenty. The market is largely divided among a limited number of players who have been given permission to do business and to who are generating substantial profits. The Single Market is protected by high tariffs levied on cane sugar imports both raw and refined from the main producers as Brazil or Thailand. Developing countries that have signed preferential agreements with the EU can export sugar to the EU duty-free (Gotor, 2009). The EU market is mostly focused on beet sugar for which the Common Market Organisation and related system of production quotas are applied (Gohin, Bureau, 2005). The European sugar quota system is (only in 2006 was a reform) undergoing many changes and reforms. Many players have left the quota holder system, many others have reduced their production capacities. But on the other hand, a group of a specific players have begun dominating the quota holder system (Spettmann, 2008). The formerly competitive quota holder system has become highly concentrated and competition is very limited. A successful producer groupings in the form of cartels has led to increasing quota holder system concentration which creates unfair competition, forms a common price policy and sets the course of the entire sector (Severová, Bendl, 2013). For example, a recent penalty (2014) was imposed by the German Federal Antimonopoly Authority (Bundeskartellamt) to companies Pfeifer & Langen GmbH & Co. KG (Pfeifer & Langen), Südzucker AG Mannheim/Ochsenfurt (Südzucker) and Nordzucker AG Braunschweig (Nordzucker), (Finally the cartel was not proved). Market (quota holder system) concentration can be measured by various methods. It can be assumed that the more concentrated the market (system) is, the greater likelihood that firms are capable to abuse its dominant position. The Herfindahl - Hirschman Index is one of the indicators for measuring market (quota holder system) concentration (Hirschman, 1964). In addition, market (quota holder system) concentration can be measured by the "Four-firm concentration ratio" expressed also as "CR4", eventually by "Five-firm concentration ratio" (DG Comp, 2007). The market (quota holder system) concentration can be perceived from two perspectives. On one hand, the concentration of the sugar market restricts competition. On the other hand, market concentration

within the EU enables it to face other dynamically growing markets outside of the EU (Smutka et al., 2012; Strnadová, 2009). Companies operating in the current sugar quota holder system also have to face other trends such as dynamic research and the development of GM-sugar beet and cane varieties. This increase pressure to cut costs in cultivation (Špička, Janotová, 2013) which becomes an important factor in enhancing labour productivity (Machek, Špička, 2013). Question number one is sustainability of sugar beet growing and beet sugar industry. This sustainability has a fundamental economic aspect regarding competitiveness with cane sugar, and an environmental aspect including mainly the current issue of emissions and foreign chemical substances (Chochola, Pulkrábek, 2012).

Production and trade in sugar are very closely linked with the policies of sustainable development (Smutka, Rumánková, Pulkrábek, Benešová, 2013). The special position of Brazil in relation to global market highlights its influence on the development of world sugar prices (Smutka, 2015).

The main aim of this paper is to analyse the EU sugar market and especially sugar quotas character and to specify the current EU sugar production structures existing under the sugar quotas system.

Materials and methods

The main objective of this material is to analyse the EU sugar market and especially sugar quotas character and to specify the current EU sugar production structures existing under the sugar quotas system. The paper is also identifying individual drivers/actors operating under the sugar quota system. The idea is to identify the level of EU sugar market concentration through the Herfindahl-Hirschman Index (HHI). The current sugar market operating under the quota system is specified through the set of the following tasks:

i) Identification of the various types of sugar factories, their geographical locations in the EU-Member States.
ii) Specification of the main actors/drivers operating under the sugar quota production system.
iii) Specification of the sugar production quota concentration at the level of EU-Members.
iv) Specification of the sugar production quota concentration at the level of the EU as a whole.
v) Specification of the sugar production quota concentration at the level of individual sugar companies/alliances operating within the EU market (both without the respect of their headquarter location and also with respect to their main headquarters location).

The analysed data provides an overview of the situation in the EU-quota holder system during the period 2013/2014. Data coming into the analyses are collected from the following sources databases: ISO organizations (The International Sugar Organization), F.O.Licht: International-sugar-and-sweetener-report (Licht, 2014), CEFS: CEFS SUGAR STATISTICS (CEFS, 2014), European Commission DG Agri: Sugar and isoglucose balance sheets (European Commission, 2014) and Study on price transmission in the sugar sector (European Commission, 2012). Additional data was taken from annual reports published by companies operating in the EU market. This article monitors the quota holder situation from the perspective of the EU-28, but the real production quotas for sugar are only in the following countries: Belgium, Bulgaria, The Czech Republic, Denmark, Croatia, France, Finland, Italy, Lithuania, Hungary, Germany, The Netherlands, Poland, Portugal, Romania, Slovakia, Spain, Sweden and The United Kingdom.

Sugar factories are classified into three categories for analysis purposes: sugar factories processing sugar beet, sugar refineries processing cane sugar and combined beet sugar factories/refineries. Alliances controlling EU-sugar quota production are defined not only by their own production units, but also by their joint venture agreements that they have in relation to other partners.

Quota holder system concentration analysis according to HHI and CRn is applied only on sugar quota (quota R 1308/2013) which is supplying the EU-Single Market with sugar for human consumption. HHI is used to measure quota holder system concentration and to monitor anti-monopoly policies. The index ranges from 0 (no concentration and highly competitive system) to 10,000 (pure monopoly) (Hirschman, 1964). The index is calculated by squaring the quota share of each firm competing in a quota system and summing the resulting numbers:

$$HHI = \sum^{N}_{i=1} s_i^2 = s_1^2 + s_2^2 + \ldots + s_N^2$$

where s_i is the quota share of the firm/alliance "i" in the quota system and N represents the number

of firms / alliances in the market. HHI is also used by offices for the protection of competition; it is used to measure the impact of mergers and acquisitions. Proofing the quota holder system concentration is according to HHI stricter in Europe where the moderate concentration starts at 1,000, whereas 1,500 is considered in the USA. Classification of market (quota system) concentration in Europe and in the USA is presented in the Table 1.

This article uses HHI classification defined by the US Department of Justice. If the HHI is lower than 0.01 (respectively 100), the market (quota system) is highly competitive. HHI ranging from 0.01 and 0.15 (respectively 100 and 1 500) indicates an un-concentrated market (quota system) with significant positions of several companies. The values of the HHI from 0.15 to 0.25 (respectively 1 500 and 2 500) reveals significant market (quota system) concentration (mostly monopolistic competition) and HHI above 0.25 (respectively 2 500) indicates highly concentrated market (mostly oligopoly). HHI close to 1, respectively 10 000 suggests a monopoly. The methodology is used to identify the real power and position of countries and firms operating in the European quota sugar system.

The "Four-firm (Five-firm) concentration ratio" was applied as an additional indicator to the HHI. The indicator is computed as follows:

$$CR_n = \Sigma^{n}_{i=1} s_i = = s_1 + s_2 + \ldots + s_n$$

where S_i is a quota share of a firm i, n represents the number of surveyed subjects within a given sector. The share of firms/alliances was expressed as their partial share in the quota beet sugar production.

Classification of the CR_n index given by the DG Comp (2007) results in three categories:

a) Low concentration (0 – 50%) – from perfect competitiveness to oligopoly
b) Moderate concentration (50 – 80%) – pure oligopoly
c) High concentration (80 – 100%) from oligopoly to monopoly

Results and discusion

The EU sugar market is extremely specific. EU sugar market is operated under the production quota system and it is isolated from the global market through the Common trade and Common agricultural policy. The character of the EU sugar market is also determined by the existence of EU single market and also through the massive subsidy system (Spettmann, 2008;). The European Union is producing about 17 million tonnes of beet sugar and its export capacities have reached about 1.2 million tonnes (European Commission, 2015).

The current EU sugar market is operated by more than one hundred sugar plants – the majority of them are specialized in beet sugar production. Sugar factories are located in 19 EU countries. Their location in EU countries is as follows (the character of individual sugar refineries: sugar beet factories + combined factories + raw sugar/cane factories, source: F. O. Licht Sugar and CEFS): Austria (2+0+0), Belgium (4+0+0), Bulgaria (0+0+6), Croatia (3+0+0), Czech Republic (7+0+0), Denmark (1+1+0), Finland (1+0+1), France (25+0+1), Germany (20+0+0), Greece (1+0+0), Hungary (1+0+0), Italy (2+2+1), Lithuania (2+0+0), the Netherlands (2+0+0), Poland (16+2+0), Portugal (0+1+3), Romania (0+4+3), Slovakia (2+0+0), Spain (3+2+0), Sweden (1+0+1), United Kingdom (3+1+1).

The current state of selected sugar companies in the European sugar market is presented in Table 2. The table shows that approximately fifty companies of various sizes, structures and business strategies currently operate in the EU-market and quota system.

Some of these companies are represented by individual private sugar factories, the others are represented by alliances operating within national markets and quota systems. It is also necessary to highlight the fact that not all companies operating with the EU sugar market are specialized only on sugar production – for some of them sugar production represents only a part of their activities e.g. Südzucker and Tereos.

	High competitive	Unconcentrated	Moderate concentration	High concentration
European Commission	x	x	> 1 000	>2 000
US Departmet of Justice	< 100	< 1 500	> 1 500	>2 500

Source: European Commission, 2010, U.S. Department of Justice and Federal Trade Commission, 2010

Table 1: Market Classification According to HHI Methodology.

ABSugar (8 factories in Spain and the UK)	Povazsky cukor, a.s. (1 factory in Slovakia)
Acor Sociedad Cooperativa (1 factory in Spain)	Raffinerie Tirlemontoise S.A. (3 factories in Belgium)
Agrana Romania S.A. (2 factories in Romania)	RAR Refinarias de Acucar Reunidas, S.A. (1 factory in Portugal)
Agrana Zucker GmbH (2 factories in Austria)	Saint Louis Sucre S.N.C. (4 factories in France)
Burgarski Zaharni zavodi Ltd. (1 factory in Bulgaria)	SC Zaharul Liesti S.A. (1 factory in Romania)
Burgas Zaharen Zavod (1 factory in Bulgaria)	Sermide S.p.A. (1 factory in Italy)
COPROB (2 factories in Italy)	Sfir Raffineria di Brindisi (1 factory in Italy)
Cristal Union/ CristalCo (10 factories in France)	Slovenské Cukrovary s.r.o. (1 factory in Slovakia)
Cukrovar Vrbátky, a.s. (1 factory in the Czech Republic)	Sociedade de Desenvolvimento Agro-Industrial, S.A. DAI (1 factory in Portugal)
Eridania Sadam S.p.A.(1 factory in Italy)	Sociedade de Industrias Agricolas Acorianas, S.A. (1 factory in Portugal)
Fabrica De Zahar Bod SA (1 factory in Romania)	Sucros Oy (1 factories in Finland)
Hanácká potravinářská společnost. s.r.o. (1 factory in the Czech Republic)	Südzucker AG (9 factories in Germany)
Hellenic Sugar Industry S.A. (1 factory in Greece)	Südzucker Polska S.A. (5 factories in Poland)
ISCAL Sugar (1 factory in Belgium)	Suiker Unie/ Royal Cosun (3 factories in Germany and the Netherlands)
Krajowa Spolka Cukrowa S.A. (7 factories in Poland)	Suomen Sokeri Oy / Finnsugar Ltd. (Nordic Sugar, Nordzucker) (1 factory in Finland)
Lesaffre Frčres S.A.S. (1 factory in France)	Tate & Lyle Sugars (1 factory in the UK)
Litex Commerce JSC (3 factories in Bugaria)	Tate & Lyle Açúcares Portugal S.A. (1 factory in Portugal)
Litovelská cukrovarna, a.s. (1 factory in the Czech Republic)	Tereos (9 factories in France)
Magyar Cukor ZRT. (1 factory in Hungary)	Tereos Ludus (1 factory in Romania)
Marr Sugar Romania SRL (1 factory in Romania)	Tereos TTD, a.s. (2 factories in the Czech Republic)
Mimo Trading S.R.L. (1 factory in Romania)	Tvornica Secera Osijek d.o.o. (1 factory in Croatia)
Moravskoslezské cukrovary, a.s. (2 factories in the Czech Republic)	UAB (1 factory in Lithuania)
Nordic Sugar (5 factories in Denmark, Lithuania and Sweden)	VIRO Tvornica secera d.d. (1 factory in Bulgaria)
Nordzucker AG (5 factories in Germany)	Zaharen Kombinat Plovdiv AD (1 factory in Bulgaria)
Nordzucker Polska S.A. (2 factories in Poland)	Zaharni Zavodi (1 factory in Bulgaria)
Ouvré Fils S.A. (1 factory in France)	Zuccherificio del Molise S.p.A. (1 factory in Italy)
Pfeifer & Langen (10 factories in Germany, Poland and Romania)	

Source: Source: Licht (2014), CEFS, 2014

Table 2: Selected Sugar Companies in the EU-Market and Quota System, 2013/2014.

The Group Südzucker reached total sales of € 7,735 million in 2013/14. Of that figure, the sugar sector participated by € 3,961 million, which was 50.8% of total sales. Other market segments were represented by fruit, with a share of 15.15% and energy crops (biofuels) with 9.3% in t total sales.

The Group Tereos (Tereos International) reached total sales of € 4,697 million in 2013/14. Of this sum, sugar beet products (for food and technical use) accounted for € 2,011 million, which was 42.81% of total sales (France € 1,721 million and the Czech Republic and Romania € 290 million). The cereal and starch sectors represented sales of € 1,638 million (34.87% in sales) and cane processing in Brazil, Africa and Indian Ocean area reached € 1,031 million, which represents 21.95% of the company's total annual sales.

However the number of sugar plants located in individual EU countries is still high, their independency is limited. Many companies are operating within the powerful sugar production alliances or their controlled by those alliances through the capital market. The European sugar production quota system and also beet sugar market is controlled by only six powerful players (Table 3): „Nordzucker ", „Südzucker Alliance", „Tereos Group Alliance", „Pfeifer & Langen Alliance", „Associated British Food Alliance" and „Tate & Lyle Sugars Alliance". These alliances represent the main pillars of the European sugar market and control not only their own (parent) production capacities, but also the capacities of subsidiaries, or such companies that have entered into these alliances based on purchase or the exchange of shares, or based on agreements of mutual cooperation. The Nordzucker Alliance, for example, controls (coordinates) the production of the following companies: Nordzucker Germany, Nordzucker Polska, Nordic Sugar (Denmark,

	Alliance/Company	Headquarters	Share of sugar output in the EU-market (%)
1	Südzucker-Gruppe	Germany	24.1
2	Nordzucker AG	Germany	15
3	Tereos	France	10.9
4	Associated British Foods (British Sugar)	United Kingdom	10.8
5	Pfeifer & Langen	Germany	8.0
TOP 5			68.8
6	Suiker Unie/ Royal Cosun	The Netherlands	7
7	Cristal Union/ CristalCo	France	6.9
8	Tate & Lyle Sugars (has no quota)	United Kingdom	5
9	Polski Cukier	Poland	3
10	SFIR (has no quota, only refining)	Italy	2
TOP 10			92.7

Source: CEFS, Licht (2014), own calculation, 2014

Table 3: Producers Controlling the EU-Sugar Market (Sugar Output from Cane and Beet).

Lithuania, Finland and Sweden), Považský cukor (Slovakia). With the exception of the above mentioned capacities owned and managed directly by Nordzucker, Nordzucker has also bought a one-third share in the Cukrovary TTD – however that sugar factory located in the Czech Republic is controlled by Tereos Group.

The „Südzucker Alliance" controls/coordinates: Südzucker AG Germany, Südzucker Polska S.A., Raffinerie Tirlemontoise S.A. (Belgium), Saint Louis Sucre S.N.C. (France), Agrana Zucker GmbH (Austria), Magyar Cukor ZRT (Hungary), Slovenské cukrovary s.r.o. (Slovakia), Moravskoslezské cukrovary a.s. (Czech Republic), Agrana Romania S.A. (Romania). Südzucker AG, through Saint Louis Sucre, owns 44% of the shares of Ouvré Fils S.A. (Souppes) in France.

„Tereos Group Alliance"controls: Tereos (France), Cukrovary TTD (Czech Republic – about 62%) and has an agreement for the refining of raw sugar with Acor (Spain).

„Pfeifer & Langen Alliance" controls: Pfeifer & Langen Germany, Pfeifer & Langen Polska, Pfeifer & Langen Romania and 50 % of Italia Zuccheri (Italy), which markets the beet sugar produced by CoProB and the sugar refined at Minerbio.

„Associated British Food" is active mostly in the United Kingdom and Spain. Currently, the alliance controls: British Sugar (UK) and Azucarera (Spain; ABF/BSG owner of 100%), Billington's (UK; ABF/BSG owner of 100%), Czarnikow Group (UK; ABF owner of 42.5%), Mitra Sugar Ltd (UK) and Silver Spoon (UK).

The above mentioned facts show that the alliances control a much higher market share than apparent when market shares according their parent companies are judged. Sugar companies are interconnected not only by their assets but also by a number of marketing agreements etc.

The ownership structure of sugar companies or alliances is also quite complex, which is presented in the Table 4.

Analysing ownership structures in detail shows additional complications. Because sugar quotas will be abolished in the near future, the European sugar market will become more interesting for investors outside of the EU. For example, the Group ASR (American Sugar Refining, Inc.), headquartered in the USA has already taken over ED&F Man's 50% share in SFIR Raffineria di Brindisi in Italy. ASR Group is also the owner of Tate&Lyle Sugars, which controls 2 refineries in the United Kingdom and Portugal.

The concentration of EU sugar quota production capacities

Sugar production quotas is not distributed equally among individual EU countries: Austria 2.59%, Belgium 5%, Croatia 1.43%, Czech Republic 2.75%, Denmark 2.75, Finland 0.6%, France 22.21%, Germany 21.42%, Greece 1.17%, Hungary 0.78%, Italy 3.76%, Lithuania 0.67%, Netherlands 5.95%, Poland 10.39%, Romania 0.77%, Slovakia 0.83%, Spain 3.68%, Sweden 2.17% and United Kingdom 7.81%). However the production quotas are in theory distributed among individual countries, their owners are not individual governments. Their real owners are individual sugar producing

Südzucker AG Mannheim, Germany	52% shares owned by the cooperative SGVZ* (Alliance of East-German sugar beet producers) 10% shares owned by Zucker Invest GmbH (owner of Agrana) 38% freely traded shares on the Frankfurt Stock Exchange
Nordzucker AG Braunschweig, Germany	84.1 % NGA** Nordzucker Holding AG (joint-stock company) 10.8% Union-Sugar North-Hannover Company (UZS)*** 5.1% other owners – direct interests Shares are not freely traded – the owners are mostly beet suppliers to Nordzucker AG.
Associated British Foods London, United Kingdom	54.5% shares owned by Wittington Investments (79.2% share in Wittington Investments is owned by Garfield Weston Foundation****) 45.5% shares owned by other shareholders (mostly funds, small investors) Shares listed at London Stock Exchange.
Tereos Tereos Union de Cooperatives Agricoles Origny Sainte-Benoite	Tereos is a co-operative owned by 12,000 French sugar beet producers (cooperative union). Tereos' shareholding structure - cooperatives: Union SDA (SDA, CBA, SHP), Union BS (Boiry, Chevrières, Connantre, Escaudoeuvres), SDHF - Sucreries et Distilleries des Hauts de France, CFH and CFVA.
Pfeifer & Langen GmbH & Co. KG Köln, Germany	Quite specific ownership structure (family owned company) in form of a limited partnership. Headquartes is in Cologne, Germany, the company is registered in Belgium.
Royal Cosun (Suiker Unie) Breda, Netherlands	Royal Cosun- cooperative of Dutch sugar beet growers (about 11 000 members)
Cristal Union Paris, France	Cooperative representing about 40 % of sugar beet growers in France.
Polski Cukier - Krajowa Spółka Cukrowa Spółka Akcyjna Toruń, Poland	79.52 % shares in state ownership of Poland 20.48% shares owned by employees and sugar beet growers

Notes: *SGVZ = Süddeutsche Zuckerrübenverwertungs-Genossenschaft eG, **NGA Nordzucker Holding Aktiengesellschaft, *** Union-Zucker Südhannover Gesellschaft mit beschränkter Haftung, **** Garfield Weston Foundation is one of the UK largest grant-making charitable trusts, and the remainder is owned by members of the Weston family.
Source: CEFS, Licht (2014), European Commission, annual reports of sugar companies, 2014

Table 4: Ownership Structure of the most Important Sugar Companies/Alliances in the EU.

companies operating with the EU sugar market. Table 5 gives an overview of the percentage proportion of major European companies on beet sugar quotas (quota R 1308/2013). It is evident that the beet sugar production is in hands of a few subjects (alliances) which de-facto control individual national sugar quotas. On the base of the findings coming from the table below it is evident that the EU quota system is controlled by only five the following operators: Südzucker, Nordzucker, Associated British Foods, Tereos and Pfeifer & Langen. German and French companies are playing the leading role within the quota system.

Table 6 gives an overview of national quota (R 1308/2013) distribution at the level of companies (alliances) headquartered in Germany and France. The following percentage of quota R 1308/2013 beet sugar production quota is controlled by only five alliances in the EU: France (98%), Germany (96%), Poland (61%), Belgium (72%), Italy (79%), Spain (26%), Czech Republic (81%), Denmark (100%), Austria (100%), Sweden (100%), Croatia 37%, Slovakia (100%), Romania (94%), Hungary (100%), Finland (100%) and Lithuania (71%). The EU-quota holder system is dominated mostly by German and French alliances Südzucker-Gruppe, Nordzucker AG, Pfeifer & Langen, Tereos Group a Cristal Union, which control together more than 72% quota R 1308/2013 beet sugar production. The "Five-firm concentration ratio" (additional indicator to the HHI) was calculated and value of the indicator achieved 72.1% (i.e moderate concentration - pure oligopoly).

Table 6 gives an overview of national quota (R 1308/2013) distribution at the level of companies

EU-country*	Südzucker	Nordzucker	Associated British Foods	Tereos	Pfeifer & Langen	Suiker Unie/ Royal Cosun	Cristal Union/ CristalCo	KSC Polski Cukier S.A.	Others
France (without DOM)	20%			41%			37%		2%
Germany	40%	34%			22%	4%			
Poland	25%	9%			26%			39%	
United Kingdom			100%						
The Netherlands						100%			
Belgium	72%								28%
Italy					56%		23%		21%
Spain			74%	26%					
Czech Republic**	25%			56%					19%
Denmark		100%							
Austria	100%								
Sweden		100%							
Croatia					37%				63%
Greece									100%
Slovakia	39%	61%							
Romania	35%			32%	27%				6%
Hungary	100%								
Lithuania		71%							29%
Finland		100%							

Notes: * Azores and French DOM are not included
**The quota is divided among Suedzucker (Agrana)=Moravskoslezské cukrovary a.s., Tereos (+Nordzucker)=Tereos TTD a.s. (Dobrovice) and three other smaller companies in the Czech Republic
Source: CEFS, Licht (2014), EU, DG AGRI, own calculation 2014

Table 5: Shares of Sugar Companies in Quota R 1308/2013 Sugar Production in EU-Member States.

EU-country *	Sum Südzucker + Nordzucker + Pfeifer & Langen	Sum (tonnes) Südzucker + Nordzucker + Pfeifer & Langen	Sum Tereos + Cristal Union/ CristalCo	Sum (tonnes) Tereos + Cristal Union/ CristalCo
France (without DOM)	20%	600 962	78%	2 343 753
Germany	96%	2 782 326	0%	0
Poland	61%	855 508	0%	0
United Kingdom	0%	0	0%	0
The Netherlands	0%	0	0%	0
Belgium	72%	486 889	0%	0
Italy	56%	284 692	23%	116 927
Spain	0%	0	26%	129 605
Czech Republic	25%	93 973	40%	208 716
Denmark	100%	372 383	0%	0
Austria	100%	351 027	0%	0
Sweden	100%	293 186	0%	0
Croatia	37%	71 364	0%	0
Greece	0%	0	0%	0
Slovakia	100%	112 320	0%	0
Romania	62%	65 189	32%	33 396
Hungary	100%	105 420	0%	0
Lithuania	71%	64 200	0%	0
Finland	100%	80 999	0%	0
Total (EU Quota)	50.59%	6 620 905	21.6%	2 832 397

Notes: ** Azores and French DOM are not included
Source: CEFS, Licht (2014), EU, DG AGRI, own calculation 2014

Table 6: Share of biggest German and French Sugar Producers in Quota R 1308/2013: Sugar Beet Quota Production in the EU.

(alliances) headquartered in Germany and France. The following percentage of quota R 1308/2013 beet sugar production quota is controlled by only five alliances in the EU: France (98%), Germany (96%), Poland (61%), Belgium (72%), Italy (79%), Spain (26%), Czech Republic (81%), Denmark (100%), Austria (100%), Sweden (100%), Croatia 37%, Slovakia (100%), Romania (94%), Hungary (100%), Finland (100%) and Lithuania (71%). The EU-quota holder system is dominated mostly by German and French alliances Südzucker -Gruppe, Nordzucker AG, Pfeifer & Langen, Tereos Group a Cristal Union, which control together more than 72% quota R 1308/2013 beet sugar production. The "Five-firm concentration ratio" (additional indicator to the HHI) was calculated and value of the indicator achieved 72.1% (i.e moderate concentration - pure oligopoly).

If we apply the HHI Index we can see that the sugar market operating under the production quota system is concentrated in almost all surveyed Member States (France 3454; Germany 3256; Poland 2938; United kingdom 10000; Netherlands 10000; Belgium 5968; Italy 4106; Spain 6152, Czech republic 2842; Denmark 10000; Austria 10000; Sweden 10000; Croatia 5741; Greece 10000; Slovakia 5242; Romania 3338; Hungary 10000; Lithuania 10000; Finland 10000).

When performing an evaluation of the European quota beet sugar holder system, a paradox appears. While the quota holder system of individual EU-Member States is highly concentrated, the EU-quota holder system as a whole seems to have a relatively low concentration.

When performing the analysis over the last twenty or thirty years, it is evident, that the sugar quota holder system in the EU is becoming more and more concentrated. In regards to the future, it is difficult to predict further development of the EU-market due to expected sugar quota abolition. Nevertheless, it can be stated that the quota abolition, without opening the EU-market to sugar imports from third countries will be exploited by large companies. The quota elimination could lead to the displacement of small and independent producers and would probably strengthen the position of the already big players. One can only guess whether these players will compete with each other or if they will divide the spheres of influence among themselves like the cartel of three German largest alliances have in the past. The EU-antitrust authorities will play an important role in such a case. The next EU-sugar market development may be also influenced by the WTO negotiations, however these are very complicated.

EU country (capacities allocated to concrete states)	Sugar production quota 2013/2014	Share in production	HHI by quota	EU country (capacities controlled by concrete countries through headquartered companies)	Sugar production quota 2013/2014	Share in production	HHI by headquarters
France (without DOM)	3 004 811	23.30%		France (without DOM)	2 799 364	21.71%	
Germany	2 898 256	22.48%		Germany	6 486 110	50.30%	
Poland	1 405 608	10.90%		Poland	548 187	4.25%	
United Kingdom	1 056 474	8.19%		United Kingdom	1 579 966	12.25%	
The Netherlands	804 888	6.24%		The Netherlands	920 818	7.14%	
Belgium	676 235	5.24%		Belgium	189 346	1.47%	
Italy	508 379	3.94%		Italy	106 760	0.83%	
Spain	498 480	3.87%		Spain	0	0.00%	
Czech Republic	372 459	2.89%		Czech Republic	70 767	0.55%	
Denmark	372 383	2.89%	1 364.8	Denmark	0	0.00%	3 225
Austria	351 027	2.72%		Austria	0	0.00%	
Sweden	293 186	2.27%		Sweden	0	0.00%	
Greece	158 702	1.23%		Greece	158 702	1.23%	
Slovakia	112 320	0.87%		Slovakia	0	0.00%	
Romania	104 689	0.81%		Romania	34 547	0.27%	
Hungary	105 420	0.82%		Hungary	0	0.00%	
Lithuania	90 252	0.70%		Lithuania	0	0.00%	
Finland	80 999	0.63%		Finland	0	0.00%	
Total	12 894 568	100.00 %		Total	12 894 568	100.00%	

Notes: *Azores, French DOM and Croatia are not included
Source: CEFS, Licht (2014), EU, DG AGRI, own calculation 2014

Table 7: EU Quota Holder Concentration by Country (by Allocated Disposable Quotas of a Country) and by Production Capacities Controlled by Country (by Allocated Quotas of Companies/Alliances Headquartered in a given Country)

Conclusion

The European sugar production quota system is extremely concentrated and it is becoming more and more dominated by fewer players. The main actors are especially German, French and Dutch sugar producing companies. Dominant role is kept especially by Südzucker, Nordzucker, Tereos and Pfeifer and Langen. These and also other subjects operating on EU sugar market under the sugar quota system are operating under the very comfortable conditions existing within the EU-market. The EU market is not only regulated one, but it is also heavily protected against imports coming from abroad. Imports (including also raw cane sugar) are hindered by high duties (EUR 339 per ton of raw cane sugar and EUR 419 per ton of white sugar). The only significant exception of the EU-sugar market protection is represented by LDCs respectively ACP countries (From 1 October 2009 to 30 September 2015: ACPs have free access to the market, the only restriction being an automatic safeguard clause for non-LDC ACPs. The new trade arrangements are stated in Commission Regulation (EC) No 828/2009. In 2014, ACP exports of sugar to the EU accounted for cc 1.3m tonnes (European Commission, 2015). New subjects have no opportunity to penetrate the market because the beet sugar quota is "sold out". Sugar companies operating in the EU-market are mutually linked by property and contracts. The market is therefore more concentrated than it seems at first glance.

Sugar quota is distributed among 19 EU-Member States. In this regard, the quota is generous, especially in relation to France, Germany, Poland and United Kingdom. A great concentration of disposable quota sugar production capacities is evident at the level of Member States (and companies/alliances operating in Member States) which considerably eliminates a competition there. The quota production is carried out through a very limited number of subjects (alliances) in many Member States, which de-facto control national quota holder systems. An extreme situation can be found in Finland, Lithuania, Hungary, Sweden, Denmark, the Netherlands, Belgium, United Kingdom and Slovakia, where the allocated national quota is controlled by one or two subjects (company, alliance). The capacities (national quotas) in northern countries, i.e. Denmark, Sweden and Finland are fully controlled by the alliance Nordzucker. Contrary, national quotas R 1308/2013 in Austria, Hungary, Slovakia and Belgium are controlled (from 61% to 100%) by the alliance Südzucker.

When assessing the EU as one common quota holder system, the situation seems to be ideal from the perspective of quota and production capacities distribution. In the reality, this state is only apparent, the quota system is concentrated, in hands of a small number of alliances headquartered mostly in three (respectively four) countries. The EU-quota holder system is dominated mostly by German and French alliances Südzucker -Gruppe, Nordzucker AG, Pfeifer & Langen, Tereos Group a Cristal Union, which control together more than 72% quota R 1308/2013 beet sugar production (pure oligopoly) and share about 65% in the total EU-sugar market (including out of quota sugar production).

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Mitigation of Social Exclusion in Regions and Rural Areas – E-learning with Focus on Content Creation and Evaluation

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Anotace

Výukové materiály a vzdělávání obecně se v současnosti posouvá do online prostředí. Tento článek se zabývá celoživotním vzděláváním sociálně znevýhodněných obyvatel. Velkou skupinu zde představují obyvatelé venkovských oblastí. V kombinaci s dalšími faktory, které působí zcela obecně, vniká zásadní disproporce digitální propasti. To je potřeba dále řešit. Jako hlavní cílové skupiny byly zvoleny ženy na mateřské dovolené, senioři a nezaměstnaní absolventi. Jedním z hlavních zaměření příspěvku jsou studijní materiály – jejich vytváření a sdílení. Mezi cílovými skupinami bylo provedeno několik výzkumů, především ve formě polo strukturovaných rozhovorů a dotazníkových šetření. Výsledky ukazují řadu požadavků na e-learningové systémy a materiály. Na základě těchto požadavků byly vytvořeny prototypy aplikací pro web a mobilní zařízení.

Klíčová slova

Celoživotní vzdělávání, vzdělávací materiály, online, LMS, e-learning, WWW, mobilní zařízení, aplikace.

Abstract

Study materials and learning in general is moving online nowadays. The paper deals with lifelong learning of socially disadvantaged people. Inhabitants of rural areas represent a substantial group there. The fundamental disproportion of digital divide emerges in combination with other factors, which impacts generally. The problem requires a solution then. The main target groups selected for the study are women on maternity leave, seniors and unemployed school graduates. One of the main focuses was on educational materials and their creation and sharing. Several researches such as semi-structured interviews and surveys have been made among the groups. The results show several requirements for e-learning systems and materials. Taking the everything into account, prototype e-learning applications have been developed (web and mobile).

Keywords:

Lifelong learning, educational materials, online, LMS, e-learning, WWW, mobile devices, applications.

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Introduction

The importance of lifelong learning is still growing in contemporary society. Rapid technological development calls for changes in working life as well as in retirement and leisure time in general.

Lifelong learning according to European Commission is described as "all learning activities undertaken throughout life with the aim of improving knowledge, skills and competences within a personal, civic, social and / or employment related perspective" (EC, 2001). Lifelong learning paradigm is focused on student-centred, active, autonomous learning (Bryderup et al, 2009) that is demand driven and flexible (Kendall et al, 2004).

According to Çilan et al (2009), there is a significant level of digital divide in the EU. Overcoming digital divide and mitigation of the social exclusion of threatened groups of citizens belong to priority areas of Digital Agenda for Europe 2020.

Elderly, as a group of students, are motivated

to continue learning by different ambitions than job promotion or improved qualifications. Their interest lies in learning to know more and to continue improving as individuals; individuals who should be included in todays changing society (Escuder -Mollon, 2012).

The distant education is focused above all on education of elderly people in regions who cannot participate in lectures in the attendance form in seats of universities for various reasons (distance, health and time reasons, financial costs for transportation and so on). Availability anywhere and in any time is the biggest advantage of the virtual courses (Jarolímek et al., 2010a; Jarolímek et al., 2010b).

Companies tend to re-qualify their older employees (50+) by using distant learning methods. Employees over the age of 50 demonstrate high degree of motivation and interest in further vocational training by means of distance learning methods (Hoenig, Stummer, 2013), willingness to contribute and to learn ICT skills in order to remain active both socially and within their work environment (Lam, Chung, 2010). Growing occurrence of online study material usage puts higher demands on user interface usability on various types of end user devices.

Users of e-learning system can be divided into three main categories. Users who work with the system to study (students), to teach (tutors) and those to create the educational materials (lecturers). The latter two categories being mutually not exclusive, so for the purposes of this study, they are merged into one single group (lectors). For all user groups it is necessary to provide easy to use, intuitive control mechanisms that do not require assistance of system administrator to function. The basic principles of web application usability and accessibility (Benda et al. 2015) are therefore of high importance.

Typical users who fall into the tutor/lecturer category are for instance:

- Teachers from schools and other educational facilities
- HR employees from companies
- Requalification officers from employment departments
- Creators of multimedia content

Based on the initial study of available research materials DAE 2020 and experience obtained at Department of Information Technology while completing other projects, the following socially disadvantaged groups were defined:

- Women returning from parental leave
- Elderly people
- Unemployed aged 50 or more
- School graduates
- Ethnic minorities
- Immigrants

For the primary testing of e-learning educational system and study materials, the following groups were selected:

- Women returning from parental leave
- Unemployed school graduates
- Seniors

Each of the selected groups has different motivation for educations, different initial knowledge and set of skills and different level of ICT literacy.

Education process is divided into five stages:

- Motivation – elements that spark the personal interest in studying
- Exposition – steps providing the initial obtaining of knowledge
- Fixation – occlusion of obtained knowledge
- Diagnostics – feedback by determining the actual level of retained knowledge (usually by testing)
- Application – usage of received knowledge by the student in practice

For each phase, different set of suitable tools is available within the e-learning environment. Partial goal of this study is to determine how useful each tool and component is for particular testing group of students. (Gutierrez-Santiuste, Gallego-Arrufat, 2015).

Education stage	Components and tools within LMS
Motivation	Files, texts, multimedia content, links
Exposition	Files, texts, multimedia content, links
Fixation	Tests, files, texts, multimedia contents (exercises with solution for instance), links, discussion forum, chat, videoconference
Diagnostics	Various tests and polls, file upload, online chat, videoconference
Application	Files, texts, multimedia content, links

Source: own processing

Table 1: Education stages and LMS components.

LMS (Learning Management Systems) allows to create materials that combine sever components using format SCORM (Sharable Content Object Reference Model) and others.

Internet and the World Wide Web environment usage has rapidly spread among the population during past. There are currently around one billion web pages online (Internet Live Stats, 2015). The past decade has brought a rapid departure from classic printed media formats. Newspapers, magazines, books, handbooks and generally any printed publications are now mostly stored digitally and published online (Tewksbury, Riles, 2015). Due to a development of internet technologies, especially Content Management Systems (CMS), even users without knowledge of required technologies (HTML, CSS) can access and manage online content (Brown, 2014). Besides that, the educational content is still stored in a static way (usually PDF format). Usage of software which utilizes SCORM standard is on low level.

A large study of e-learning portal usability brought up design and usability flaws and confirmed an intensive need to design and improve ways of e-learning platform usability evaluation (Granica, Cukusic, 2011). The evaluation of influence of mobile platforms in the learning process is also a current topic. The evaluation of mobile user experience with regard to preferred type of study (Hyman et al., 2014), identification of main interests and requirements of students and teachers, and factors of successful adoption of mobile learning platforms seem to be important perspectives as well.

Educational materials produced by the lectors group needs to be carried out to the student group. The online educational portals and LMSs are the fastest and most flexible way of study. The specified groups of users have special requirements on such portals. The quality of educational materials is one of the crucial aspects in general. The WWW and digital environment offers many opportunities, with the interactivity being one of the main benefits.

Many educational materials are currently produced as PDF or other printable document types. In recent years, this format was most widely used. Based on current trends in society, there is a significant growth in usage of mobile devices such as smartphones and tablets. So, the form of the materials is becoming unsuitable for display on aforementioned devices, thanks to the lack of responsiveness and interactivity.

The educational materials can be stored in the SCORM format. The SCORM is a collection of standards and specifications for web-based electronic educational technology.

There are currently many LMS software solutions, which corresponds with the diversity of needs of various user groups. People of age 50+ needs simplicity while unemployed graduates are familiar with modern devices. The sector of socially disadvantaged groups and rural areas in general needs an open and cheap solution. The focus needs to remain on both user groups - lectors and students. Most existing LMS software solutions do not meet these specific requirements.

Usually, the main part of the content creation utilizes WYSIWYG (What You See Is What You Get) editors. The WYSIWYG editors allow users to work with the content without knowledge of the required technologies the same way text processors do.

Materials and methods

Methodology of the research consists of several investigations and a long-term research done by Department of Information Technologies.

Several semi-structured interviews were done. Members of both user groups (students, lectors) were involved. Two interview guides were designed. The semi-structured approach was chosen because in each group there were various types of users. Moreover, several target groups with specific needs were involved. Each interview can bring new needs, requirements and ideas to light.

The interview guides for both groups include several main topics/questions. The most important are the following:

Learners

- Do you use any LMS? If so, which one?
- In which form your materials are?
- Do you use smartphone, tablet or similar devices?
- Do you prefer to have your materials printed or digital?

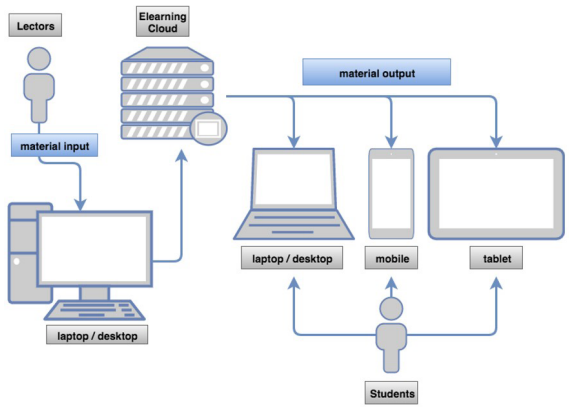
Lectors

- Do you use any LMS? If so, which one?
- In which form your materials are?

- Do you use tablet for content creation?
- Do you have any statistics about learning process?
- How do you get feedback?

The department has made several research surveys among various target groups such as students, farmers in rural areas, seniors, women on parental leave etc. These surveys covered several topics which are important for the research goals. Surveys that were used for the creation process of the prototype were (Figure 1):

- ICT in Agricultural Enterprises in the Czech Republic, held regularly since 2000. This survey focuses mainly on the issue of ICT equipment and usage within agricultural companies in Czech Republic (Vaněk et al., 2010)
- ICT equipment of students at Faculty of Economics and Management – survey is held between several thousand students of the faculty from various regions of Czech Republic. It is focused on usage and availability of ICT equipment
- Survey of ICT knowledge for women on parental leave – respondents of this survey were women involved in the project "Effective return of economically educated women to the job market after parental leave" (2015).

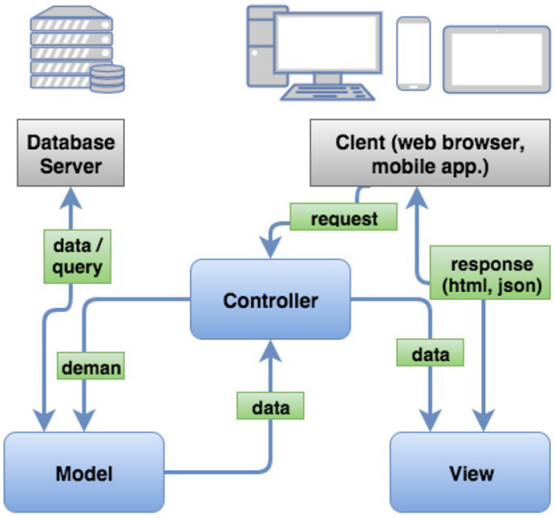


Source: own processing

Figure 1: LMS as cloud service.

Prototype development

Several modern technologies were used to develop a prototype application. Firstly, MVC (Model View Controller) framework Nette (Nette Foundation 2015) for the main development scope (Figure 2).



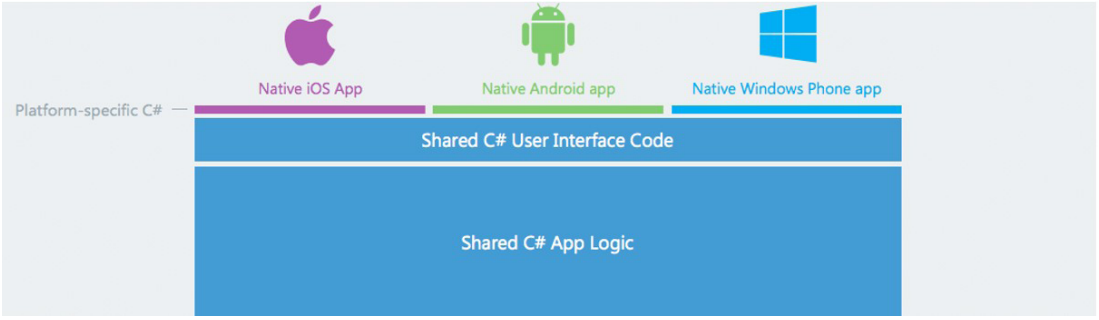
Source: own processing

Figure 2: MVC model.

Backend part (model, controller) uses PHP language. All data is stored in MySQL database. Nette framework consists of several parts working together. Nette\Database is an advanced database layer. It supports caching, simple selections and projections. Development process is supported by Nette\Tracy debugging library. It helps with debugging, performance optimizations and app monitoring.

The frontend part of development is supported by Nette\Latte template engine library. It consists of simple syntax, content-aware escaping and caching system. The template code is translated into pure PHP code and cached for better performance. The main client-side part utilizes HTML5, JavaScript library jQuery and CSS3. Everything is wrapped within the Bootstrap 3 framework. The framework sufficiently supports the modern "mobile-first" approach.

The application for mobile devices was developed using Xamarin platform. It allows to deliver native mobile applications for major operating systems within a single development environment (Figure 3).



Source: https://xamarin.com/platform

Figure 3: Xamarine architecture.

Results and discussion

All the surveys, interviews and other long term researches yielded interesting and valuable observations. As a result, requirements for the software solution have been determined.

Interviews among lectors

When the participants from the lectors group were asked about the LMS, the majority of them were unsatisfied with their current solution. 90% of them commented, they do not have own IT specialists for administration or development. The majority said that they use mostly Microsoft Office Word for educational materials content creation. The materials are distributed in PDF format afterwards. Most of those who were interviewed indicated that tablet device is too uncomfortable for creating materials. On the other side, some of the respondents commented that they use it to manage courses, check test results and statistics.

When asked about the learning process statistics, 90% of the respondents reported that there are many limitations. Talking about this issue, interviewees mostly reported that they miss deeper statistics about usage of educational materials. As one respondent said: "We can get some feedback from our students, but it is always difficult and needs a lot of time".

Several respondents pointed out they would like to have more features than just learning in their LMS. There were some suggestions for feature to organize events such as field trips, workshops etc.

Interviews among students

Majority of student group users does not know which LMS they use. Some of them commented, that they do not care. When talking about materials and devices used for learning, wide range of needs and habits were reported. While people aged 50+ prefer printed materials, many younger participants use tablets, smartphones or just computers. The form of materials can be limiting then. Respondents were asked to give suggestions for future education. Many participants expressed the belief that these modern devices are the future of learning and printed materials will disappear.

Defining requirements for LMS system:

- Online access using a client (e.g. web browser) from different platforms and devices
- Cloud based – no need for own server and LMS management. Current trend is to use application services that do not require installation of any specific software onto the client device. (Figure 1)
- Possibility to access materials offline – since the internet coverage in Czech Republic is not ideal. Some educational materialscan be large and require higher connection speeds to function properly. Users of mobile internet are also limited by their FUP (Fair User Policy). So it is preferred if material can be downloaded (for instance through WIFI) and then used without internet access.
- Accessibility – application should be usable by handicapped people.
- Possibility to print materials – suggested mainly by senior students and women on parental leave.
- Statistics about the learning process – important so that the lecturers receive feedback in form of statistics about the learning process of their students. Based on these, it will be possible to determine quality and usability of various educational materialsin regards to end user

device.

- Social networks integration – especially younger users are used to communicate and share their knowledge through social media. Social networks can be integrated and serve as a communication tool between lecturers and students or even students among themselves.
- Easy management of the course – control and administration should be easy and intuitive in order to allow lecturer to spend most of their time with educational activities rather than system management
- Creating educational materials – one of the key requirements lies in the area of educational materials. Studying has to be possible on various (mobile) devices. The materials should be stored in some standardized, exchangeable and reusable form. The SCORM format have been developed for this purpose. The system should support this format and should be "SCORM compliant". Moreover, the lector does not need to know anything about it. The system should guide him to create the material to fit in the format. On the other side, it still should support the traditional ways of uploading printer-friendly materials. It is necessary for some target groups. The key factor in this area is User eXperience, since the lectors are usually not experienced computer users.
- Progress of studying – statistics of students for students – to help self-evaluation and increase motivation of students
- Simplicity is preferred (over the feature rich solution).

Conclusion

A prototype application was developed to evaluate the obtained results. The Xamarin platform allowed fast development of the mobile application for all major platforms – Android, iOS, Windows Phone, Windows 10. On the other side, the user experience is not on a good level. The development experiences suggest the use of Xamarin platform for simple applications or prototypes. Applications where the User eXperience is a crucial requirement should be developed by native tools.

The study has identified requirements for e-learning of socially disadvantaged groups of people. There is a need to focus on mainly three user groups with different approach to the LMS. The student's group has different needs then the lector's group.

One of the main focus areas was the process of creation and presentation of materials. There was a need to support both creation processes. The traditional one – uploading printer friendly format and the modern way – creation of materials online in digital interactive format. This allows rich evaluation features such as monitoring of learning process, monitoring of certain parts of educational materials and their evaluation, etc.

What is now needed is evaluation of the prototype applications. The feedback from target groups will be collected. A further study could assess the long-term effects of using mobile devices and applications in life-long learning. Internet and the modern devices are changing how the humans brain behaves and learns. There is a need to evaluate educational materialsand their effectiveness in general.

Acknowledgments

The results and knowledge included herein have been obtained owing to support from the following institutional grants. Grant No. 20151007 of the CULS Prague Internal Grant Agency titled „Innovative approaches to the use of ICT in education for mitigation of social exclusion" and Internal grant agency of the Faculty of Economics and Management, Czech University of Life Sciences in Prague, grant no. 20151038, "Methods for creation and update of information content in WWW environment".

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Impact of Hybrid Intelligent Computing in Identifying Constructive Weather Parameters for Modeling Effective Rainfall Prediction

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Abstract

Uncertain atmosphere is a prevalent factor affecting the existing prediction approaches. Rough set and fuzzy set theories as proposed by Pawlak and Zadeh have become an effective tool for handling vagueness and fuzziness in the real world scenarios. This research work describes the impact of Hybrid Intelligent System (HIS) for strategic decision support in meteorology. In this research a novel exhaustive search based Rough set reduct Selection using Genetic Algorithm (RSGA) is introduced to identify the significant input feature subset. The proposed model could identify the most effective weather parameters efficiently than other existing input techniques. In the model evaluation phase two adaptive techniques were constructed and investigated. The proposed Artificial Neural Network based on Back Propagation learning (ANN-BP) and Adaptive Neuro Fuzzy Inference System (ANFIS) was compared with existing Fuzzy Unordered Rule Induction Algorithm (FURIA), Structural Learning Algorithm on Vague Environment (SLAVE) and Particle Swarm OPtimization (PSO). The proposed rainfall prediction models outperformed when trained with the input generated using RSGA. A meticulous comparison of the performance indicates ANN-BP model as a suitable HIS for effective rainfall prediction. The ANN-BP achieved 97.46% accuracy with a nominal misclassification rate of 0.0254 %.

Keywords

Rainfall prediction modeling, hybrid computing; rough set, optimal feature reduction, artificial neural network, fuzzy inference algorithm and accuracy.

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Introduction

Soft computing approaches incorporates efficient computational methodologies stimulated by intrinsic vagueness, intuition and acquaintance of human thinking and real world uncertainty. More ever, the ever growing demand for forecast modeling has led to the emergence of hybrid computing approches. Hybridization of more than one soft computing technique is known as HIS. Usually rough Sets, neural networks; genetic algorithms and fuzzy logic are the widely used for building hybrid architectures to handle uncertanity in real life problems. In this research, rough set based feature selection technique is used for modeling the input data followed by proposed ANN, ANFIS based rainfall models for training the forecast scenario.

Rough set as proposed by Pawlak, has attracted wide range of scientific applications from the time of its introduction. (Pawlak, 1982, 2002, and 2007) stated rough set approach as a suitable model for problem solving in pattern recognition, data mining, machine learning and knowledge representation systems. Rough set based data analysis starts from a data table called as decision table with rows. Attributes of the decision table consists of disjoint groups called condition and decision attributes. Shen and Jensen (2007) have stated rough set as suitable model for handling vaguness and in knowledge discovery for medical and meteorological applications. Yao (2009) reinstated, rough set discernibility matrix based attribute reduction approach as widely adopted reduction approach. Suguna and Thanushkodi (2011) have mentioned that attribute reduction approach based on quick reduct, entropy measure based reduct, hybrid rough set based genetic algorithm, Ant Colony Optimization (ACO) and Particle Swarm Optimization (PSO) are widely adopted

in attribute reduction. Pradhan and Lee (2010) proposed a neural network technique for assessing landslide susceptibility. Sudha and Valarmathi (2013 and 2014) reinstated that rough set based feature reduction using evolutionary computing as suitable model for rainfall prediction.

Srinivasulu and Jain (2006) have reported the behavior of various training methods existing for training Multi Layer Perceptron (MLP) ANNs for rainfall runoff modeling. Raza and Khosravi (2015) assured that forecast accuracy of ANN could be enhanced using better training input data selection method and optimized neural network architecture. Haykin (2009) has stated neural network as parallel computing processor architecture that consists of collection of nodes capable of storing experiential knowledge for future assessments. Flood and Kartam (1994) described artificial neurons as processing elements arranged as layers that are capable of solving complicated real life and scientific problems. ANN has been a preferred technique for modeling rainfall forecast phenomenon. Tokar and Johnson (1999) used for ANN was modeling daily precipitation. The empirical results showed that ANN model perform better than regression and conceptual models.

Kalteh (2008) developed ANN based rainfall prediction model and compared that with the neural interpretation diagram, garson's algorithm and randomization approach. The investigation showed that ANN provides clear understanding on input and output data relationships within the processes (Solaimani, 2009). Combining computational efficiency with input parameters that describe the atmospheric weather variables has enhanced ANN prediction outcome. Machado et al. (2011) proposed back propagation algorithm for training the neural network. The investigation results proved that the trained ANN has gained good predicting potential. Chen et al. (2013) proposed artificial neural network architecture in rainfall runoff modeling. The investigation illustrated ANN as a suitable methodology for large data. The ANN proved to be optimal computational tool for modeling the complex hydrological processes.

Olaiya, and Adeyemo (2012) stated that artificial neural network, decision tree, genetic algorithms, rule induction, nearest neighbor method, memory-based reasoning, logistic regression and discriminant analysis are extensively applied in predictive data analytics. Indicated Artificial Neural Network and tree pruning techniques as appropriate precipitation predictive models. Lee et al. (2007) proposed a novel fusion method for temperature prediction using fuzzy logical relationships and genetic algorithms. Li (2005) proposed a hybrid rough fuzzy neural network model to work out weather forecasting problems. Wong et al. (2003) described fuzzy rule based rainfall prediction and compared the results of the proposed model with an established radial basis function networks. Experimental results revealed that fuzzy rule based approach as suitable technique for prediction. SLAVE is an evolutionary classification approach that implements iterative approach based on genetic algorithm feature selection to learn fuzzy rules (Gonzalez, Perez, 2001).

Zadeh (1983) described that hybrid intelligent systems as suitable mechanism to handle uncertainty, noisy and incomplete dataset. Nikza and Latif (2014) proposed rainfall prediction model based on adaptive neuro fuzzy inference System for Mashhad meteorological station. Bardossy et al. (1995) described about the evaluation and classification of various atmospheric parameter based on fuzzy approach. Witten and Frank (2005) have explained that classification algorithms included in weka can moreover be applied directly to a dataset from its own interface or used in user defined Java code.

Materials and methods

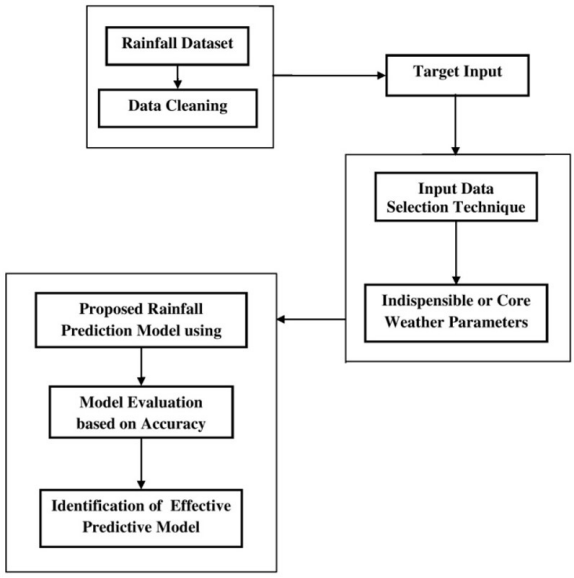
The day by day rainfall data, measured in millimetre (mm), were obtained from Tamil Nadu Agricultural University (TNAU), Coimbatore, India for 29 years from 1984 to 2013. The observatory dataset consisted of eight atmospheric parameters. The outliers in the raw dataset was identified and removed during data pre-processing phase. The eight conditional variables and one decision variable in the target dataset are Maximum temperature (Wp1), Minimum temperature (Wp2), Relative humidity1 (Wp3), Relative humidity2 (Wp4), Wind speed (Wp5), Solar radiation (Wp6), Sunshine (Wp7), Evapotranspiration (Wp8) and Rainfall (RF). The rainfall (RF) is a binary decision variable; (RF = 0) → no rainfall and (RF = 1) → rainfall occurrence. The sample target dataset used as input for the proposed investigation is represented in Table 1.

Wp1 Celsius	Wp2 Celsius	Wp3 %	Wp4 %	Wp5 Km/ hrs	Wp6 KCalories	Wp7 Hrs	Wp8 mm	RF mm
34.5	23.5	82	43	3.8	221.6	8.4	5	0
36	25.5	78	42	7.4	230.4	7.7	7.4	0
35.8	24.8	87	38	7	201.6	6.9	8.2	0
28.5	18	95	42	7.4	200	8.1	4	0
28	18.5	85	46	7.4	213.6	9.6	4.8	0
28.4	23.2	88	85	7.5	200.2	1.9	3.6	1
32.6	21.8	98	48	4.4	277.2	4.4	3.8	1
31.5	21.8	94	88	5.7	202.5	0	3.1	1
30.8	20.5	96	62	5.7	374.2	7.5	4.6	1

Source: TNAU

Table 1: Daily rainfall observatory record (1984-2012).

Proposed HIS for rainfall prediction



Source: own processing

Figure1: Hybrid Intelligent System for Rainfall Prediction-Architecture.

Input data selection methodology

The complete feature reducts is the target input for RSGA.This rough set based feature selection approach is initially used for finding minimal feature subsets. The significant weather parameters are identified from the complete set of reduct, the complete reduct set contains 105 feature reducts generated using Rough Set Exploration System (RSES 2.3). An average optimal reduct selection algorithm is proposed to find the most optimal feature subset for training the prediction system. Generated reduct sets are subject to evaluation based on a fitness function, the set of subsets that satisfy the fitness criteria are selected as a member of new population for further evaluation. Then crossover and rare mutation operation is applied for determining a random optimal subsets. The set of parameters having relative fitness function higher than or equal to the average relative fitness function will constitute the optimal reduct feature vector.

Reduct Selection using Genetic Algorithm (RSGA)

Genetic Algorithm (GA) based feature reduct selection is implemented for identifying the optimal feature reducts for modeling effective rainfall prediction. Every reduct set is represented as a chromosome and encoded in bit string representation format.

A chromosome here represents the reduct set as collection of 1s and 0s, 1 correspond to the inclusion of particular feature and 0 correspond to elimination of that feature. Actually, complete set consists of the entire eight input features {Wp1, Wp2, Wp3, Wp4, Wp5, Wp6, Wp7, and Wp8}. Wherein a reduct set is a possible subset of complete set. For an example a reduct set: {Min, SS} is then encoded to bit string format to represent as a chromosome {0 10 0 0 0 1 0}. Most important factor of GA is the fitness function; a fitness function has to be effective enough to achieve the desired outcomes.

RSGA Algorithm

1. Begin
2. Let {CF-Red} be the complete feature reducts
3. n = (Total no. of reducts in {CF-Red}(n =105)
4. Encode the input reduct dataset in Bit string format
   a. Initialize the Initial population n =105
   b. Calculate the Fitness function F(X) of a reduct set
   c. Estimate the relative Fitness Function RF(x)
   d. If RF(x)>=Avg RF(x) then include the set in to new population
   e. Perform single point crossover
   f. Perform Mutation
   g. Else ignore
   h. n--
5. Repeat 1 to 5 until desired stopping criteria (n =0) is met
6. Return {OF-Red}
7. End

Input: Initial population with complete set of feature reducts

Fitness function $F(x) = C_{n1}/BS_{len}$ (1)

C_{n1} → The number of 1 bit in each chromosome

BS_{len} → Complete chromosome length or Bit string length

Relative Fitness function

$RF(x) = F(x) / Avg\ F(x)$ (2)

Output: Optimal Reducts (Table 2)

ANN for Effective Rainfall Prediction

The ANN prediction models used in hydro meteorological applications are feed forward neural networks, which are trained by back propagation algorithm. The ANN models emerged during the last few years have dissimilar architectures and procedures focused to the problem domain. The proposed ANN model is three layer architecture with input, hidden and output layers as shown in Figure 3. Neurons in the input layer act as a buffer to capture the input to pass to the next layer. The neurons in different layers are connected by means of weights. The activation function is used to transfer the received input to the next layer neurons. Neural networks are employed to detect concealed relations in the input in the training phase. The most commonly used training Algorithm is Back Propagation Neural Network (BP-NN).The most significant problem concerning the artificial neural networks implementation is the network architecture. It is well known fact that an insufficient number of hidden nodes may worsen the learning process. (Santosh, et.al., 2010) stated that ANN model can be adjusted to produce relationships among the data for given source. After the completion of training, the neural network can perform classification or prediction on new data of similar source.

Back propagation training

In this investigation, the standard back propagation algorithm is used in training the proposed ANN as in Figure 2. Most of ANN models employed in the field of hydrology used the back propagation algorithm (Coulibaly et al, 2000). Back propagation is a supervised learning method, and is a generalization of the delta rule. It requires a teacher that knows, or can calculate, the desired output for any input in the training set. It is most useful for feed forward networks. Sigmoid transfer function is used in this proposed ANN model for rainfall prediction. The back propagation learning process involves two stages, a propagation phase followed by weight update.

Wp1	Wp2	Wp3	Wp4	Wp5	Wp6	Wp7	Wp8	F(x)	RF(x)	Positive Region
1	1	1	1	1	0	1	0	0.75	1.25	0.976
1	1	1	0	1	1	1	0	0.75	1.25	0.9942
1	0	1	1	1	1	0	0	0.625	1.04	0.9879
0	1	1	1	1	1	0	0	0.625	1.04	0.981
0	1	1	1	1	0	1	0	0.625	1.04	0.9663
0	0	1	1	1	1	1	0	0.625	1.04	0.9658

Source: own survey

Table 2: Optimal Reduct generated using RSGA.

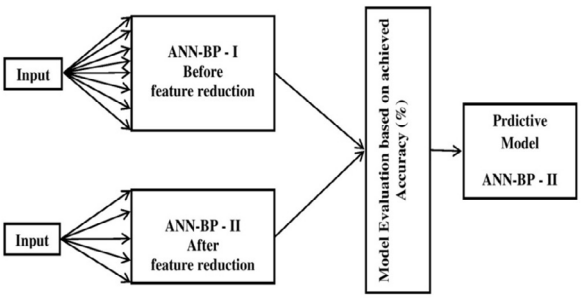
Propagation rule - The propagation rule of a network describes the way the so called net input of a neuron is calculated from several outputs of neighbouring neurons. Typically, this net input is the weighted sum of the inputs to the neuron, i.e. the output of the previous nodes multiplied with the weights in the weight matrix as in equation (3).

$$net(t) = \mathbf{W.o}(t) \quad (3)$$

Activation rule - The activation rule frequently called transfer function determines the new activation value of a neuron based on the net input (and sometimes the previous activation value, in case a memory is used). The function A (F), which takes $\mathbf{a}(t)$ and the vectors **net** for each different type of connection, produces a new state of activation. A**(F)** can vary from a simple identity function, so that $\mathbf{a}(t+1) = \mathbf{net}(t) = \mathbf{W.o}(t)$. Sigmoid functions adopted by the proposed model as in defined in equation (4) below.

$$a(t+1) = F_{bs}\big(Net\ (t)\big) = (1+x)^n = 1 + \frac{1}{1+e^{-\alpha(net(t))}} \quad (4)$$

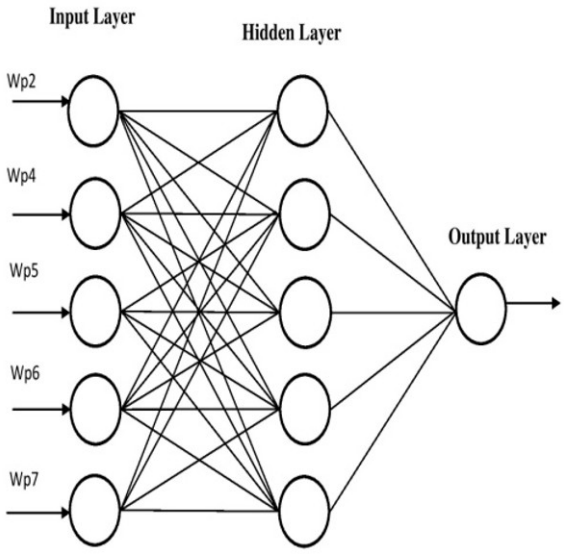
In Weight update, each weight synapse multiply its output delta and input activation to get the gradient of the weight. Bring the weight in the opposite direction of the gradient by subtracting a ratio of it from the weight. This ratio influences the speed and quality of learning; it is called the learning rate.Momentum is applied for reducing problems of instability while increasing the rate of convergence. Repeat phase 1 and 2 until the performance of the network is trained.



Source: own processing

Figure 2: ANN-BP architecture before reduction.

As represented in Figure 2 and 3, the proposed ANN-BP architectures were trained using entire and optimal parameters identified using RSGA. The input to the nodes (n) in input layer will forward this information to all the nodes of the hidden layer. At any hidden node (h), the data received from all the input nodes and the bias mode of the input layer are summed up as $i_1 + i_2 + i_3 + ... i_n$ + bias. A Sigmoid activation function is implemented on neurons. The network is first initialized by setting up all its weights to be small random numbers between –1 and +1. Then in forward pass the input pattern is applied and the desired output is estimated. Then calculate the Error of each neuron: Error = Target – Actual Output. This error is then used mathematically to change the weights in such a way that the error is reduced further. Next, the Output of each neuron is tuned to get closer to its Target in this reverse pass. The process is repeated again and again until the error is nominal.



Source: own processing

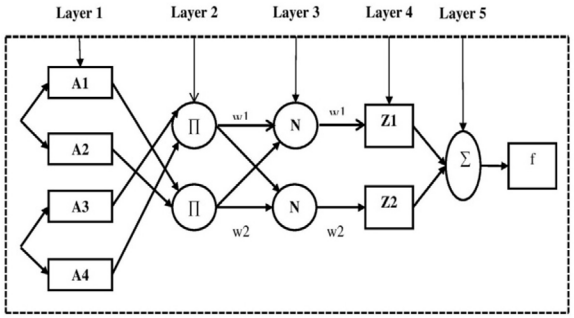
Figure 3: ANN-BP-II architecture.

BP-NN Algorithm

1. Begin
2. Initialize with randomly chosen weights;
3. While Error is above desired threshold, do for each input pattern x_p,
   a. Determine hidden node inputs;
   b. Determine hidden node outputs;
   c. Determine inputs to the output nodes;
   d. Determine the network outputs;
   e. Determine the error between output and desired output;
   f. Adjust the weights between hidden and output nodes;
   g. Adjust the weights between input and hidden nodes;
4. End-for
5. End-while

ANFIS in modeling rainfall prediction

The proposed ANFIS is implemented using Fuzzy Inference Algorithm (FIA) in which fuzzy rules are used to infer a new approximate fuzzy set conclusion while taking a fuzzy set as foundation. Fuzzy inference systems (FIS) are mainly applied to the cases in which the systems are hard to be designed accurately. Hayati et al. (2011) stated that ANFIS is used to map input characteristics to input membership functions (MFs), input MF to a set of if-then rules, rules to a set of output characteristics, output characteristics to output MFs, and the output MFs to a single valued output or a decision associated with the output. ANFIS usually supports only sugeno type systems that exhibit the following properties. The sugeno type systems used must be first or zeroth order sugeno type. It must have a single output, obtained using weighted average defuzzification.



Source: own processing

Figure 4: ANFIS architecture using FIA.

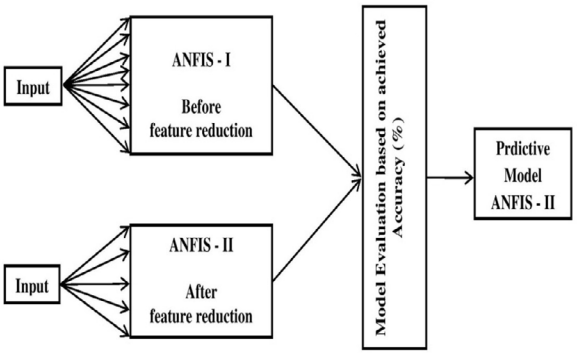
Dissimilar rules cannot share the same output membership functions. It is expected that the number of rules and the number of output membership functions be equal having unity weight for each rule. To investigate which combination of input parameters can produce the best ANFIS results with the highest accuracy, the subsets of the feature set computed using rough set based maximum frequency weighted feature reduction was developed. The proposed ANFIS model as in Figure 4. is observed with three varying set of input parameters.

Rule 1: If x is $A1$ and y is $B1$, then $f1 = p1x + q1y + r1$

Rule 2: If x is $A2$ and y is $B2$, then $f2 = p2x + q2y + r2$

The parameters $p1$, $p2$, $q1$, $q2$, $r1$ and $r2$ are linear, whereas $A1$, $A2$, $B1$ and $B2$ are nonlinear. The ANFIS model as in Figure 5. proposed for rainfall forecast is realized using MATLAb 2012b. The model has five processing layers: fuzzification, production, normalization, defuzzification, and aggregation layer with following input and output relationships for each layer:

ANFIS architecture



Source: own processing

Figure 5: ANFIS architecture for rainfall prediction.

Layer 1 - Fuzzification layer: Let A1, A2, B1 and B2 be the linguistic expressions which are used to distinguish the membership functions (MFs). Each and every node in this fuzzification layer is an adaptive node with a node function. Where x is the input to node i, Ai represents the linguistic label associated with this node function, and Oi^1 denotes the output of the layer 1 and $\mu_{Ai}(x)$ is membership function as given in equation (5) and (6).

$$Oi^1 = \mu_{Ai}(x), \text{ for } i = 1,2 \ldots n \quad (5)$$

$$Oj^1 = \mu_{Bi}(y), \text{ for } i = 1,2 \ldots n \quad (6)$$

The proposed model implements sigmoid membership function with a maximum equal to 1 and a minimum equal to 0 are estimated as in equation (7), f(*x, a, c*) is a mapping on a vector x, and depends on two parameters *a* and *c*.

$$\mu(x) = \frac{1}{1+e^{-a(x-)}} \quad (7)$$

Layer 2 - Production layer - Every node in this layer is a fixed node represented by the symbol ∏. The nodes in this layer2 act as a simple multiplier. The outputs are *w*1 and *w*2, the weight functions of the next layer are product of the weights and O2,i as in equation (8) is the output.

$$O2,i = \omega 1 = \mu Ai\,(x).\ \mu_{Bi}\,(y) \text{ for } i = 1,2 \ldots \quad (8)$$

Layer 3 - Normalization layer - The node labeled as N is an adaptive node. The i^{th} node calculates the ratio of the i^{th} rule's firing strength to the sum

of all rules' firing strengths. The node is marked as **N**, and it is used to normalize the weight functions, The output O3,i as in equation (9) of this layer is a normalized weight functions called as normalized fringing strength.

$$O5,i = \sum \omega i \, 'f_i = \frac{\sum \omega i \, 'fi}{\sum \omega i \, '} \quad (9)$$

Layer 4 - Defuzzification layer - Being an adaptive node of this layer ,ωi' is the output and {*pi, qi, ri*} is the parameter set in this layer. The relationship between input and output is

$$O4,i = \omega i'fi = \omega i'(p_i x+q_i y+r_i) \quad (10)$$

The parameters in this layer-4 are referred as consequent parameters.

Layer 5 - Aggregation layer - The single node in this layer is an output corresponding to the aggregate of all inputs so that the overall output is represented as in equation (11).

$$O5,i = \sum \omega i'fi = (\sum \omega i'fi)/(\sum \omega i') \quad (11)$$

The model must adjust or tune the premise parameters sets (ai, bi, ci) to enable ANFIS output to match the training data.

Results and discussion

The performance of the proposed ANN-BP developed using C# is implemented using .NET environment. The learning rate and momentum are set for some suitable random value and later tuned to obtain the desired output. The proposed ANN rainfall forecast model outperformed when trained with optimal feature subsets using novel RSGA algorithm.For the proposed ANFIS model, MATLab 2012b is used to evaluate the performance of the architecture for both complete and optimal feature vectors.The existing models namely, FURIA (Huhn, Hullermeier, 2009) SLAVE and PSO are trained and tested using Weka (Witten, Frank, 2005) and KEEL (Fdez et.al., 2008).

The exixting prediction algorithms were evaluated for various k-cross fold validation settings. However, 10 cross fold validation outcomes were used for the performance comparison. As all the proposed methodology makes use of minimum of two or more soft computing technique it is hybrid in computing. All the models make use of rough set based input data selection approach followed by training proposed rainfall forecast model using BP-NN and FIA.

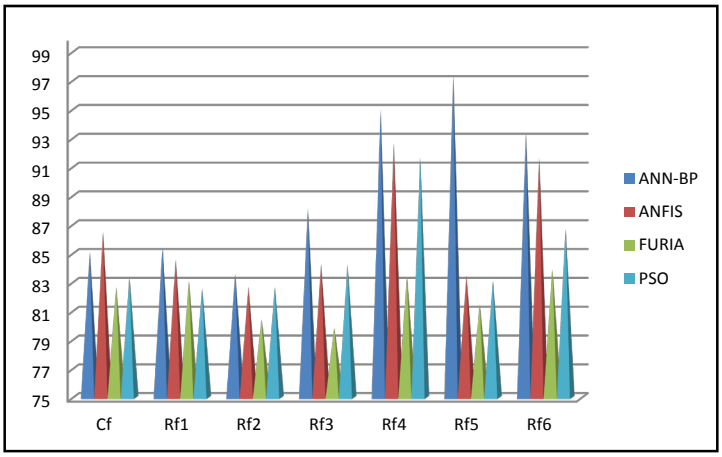
Performance evaluation of proposed HIS's

The HIS's proposed for rainfall forecasting was evaluated under different experimental setups. Although, all the proposed models make use of a common input data selection methodology the improvement in prediction accuracy rate is different for all. Invariably all the architectures have shown some enhancement in prediction rate as shown in Table 3 when trained using the optimal feature vector as input than when trained using the complete feature vector The peak prediction accuracy acquired by ANN-BP model is projected clearly in Graph 1.

Input Data Selection Methodology	**Prediction Accuracy Achieved**				
Complete feature set before RSGA	ANN-BP	ANFIS	FURIA	SLAVE	PSO
Cf -Wp1,Wp2,Wp3,Wp4,Wp5,Wp6,Wp7,Wp8	85.12	86.5	82.66	80.79	83.4
Optimal Feature set after RSGA	ANN-BP	ANFIS	FURIA	SLAVE	PSO
Rf1- Wp1, Wp2, Wp3, Wp4, Wp5, Wp7	85.47	84.59	83.09	82.3	82.6
Rf2 - Wp1, Wp2, Wp3, Wp5, Wp6, Wp7	83.6	82.68	80.44	87.44	82.7
Rf3 - Wp1, Wp3, Wp4, Wp5, Wp6, Wp7	88.16	84.24	79.84	83.69	84.2
Rf4 - Wp2, Wp3, Wp4, Wp5, Wp6	95.04	92.64	83.44	77.45	91.6
Rf5 - Wp2, Wp3, Wp4, Wp5, Wp7	97.46	83.48	81.48	81.06	83.1
Rf6 - Wp3, Wp4, Wp5, Wp6, Wp7	93.4	91.68	83.92	82.39	86.7

Source: own survey

Table 3: Hybrid intelligent systems rainfall forecast accuracy (%).



Source: own survey

Graph 1: Hybrid intelligent systems prediction accuracy achieved.

Relative study existing and proposed models

Input Selection Methods	Input Reducts	Minimal Reducts	Reduct Selection Strategy	Prediction Accuracy Achived
Exhaustive search based attribute selection (Weka)	1	1	Forward Selection	CART 81.07 %
Information Gain based feature selection (Weka)	1	1	Entropy measure	FURIA 83.92%
PSO based subset search approach (Weka)	1	1	Forward selection	ANFIS 89.75%
Feature selection using Genetic Algorithm (RSES)	105	6	Proposed RSGA	ANN-BP 97.46%

Source: own survey

Table 4: Rainfall prediction accuracy of existing and proposed method.

Conclusions

Experimental results revealed that the proposed ANN-BP model as suitable rainfall prediction model. The model outperformed other proposed and existing models when trained using the feature reducts generated using novel RSGA input selection approach. At the same time, the proposed ANFIS model accquired nominal error rate and prediction accuracy close to ANN-BP after feature reduction than for complete feature input. The performance of FURIA, SLAVE and PSO are not satisfactory when compared to ANN-BP and ANFIS. But the all the prediction models have shown substantial improvement in prediction accuracy after feature reduction. This thorough study on rainfall forecast modeling concludes that irrelevant parameters may affect the performance of learning models and may decrease the efficiency. Consequently, identifying effective input parameters for forecast modeling is an essential task. Empirical results revealed {Wp2, Wp3, Wp4, Wp5, Wp7} as optimal feature reduct for designing effective and reliable rainfall prediction model.

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Analysis of Operating Costs of Subsidies in the Field of Agriculture of EU Countries

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Anotace

Článek se zabývá srovnáním zemědělských dotací v členských státech EU v období 2004 – 2012 na základě databáze Farm Accountancy Data Network (FADN). Během sledovaného období byl zjištěn mírný nárůst provozních dotací s tím, že variabilita má klesající trend. Ve struktuře dotací je patrný jasný přechod k platbám odtrženým od produkce s výraznými rozdíly mezi původními a novými členskými státy (NMS). Pomocí shlukové analýzy byly členské státy rozděleny do skupin podle provozních dotací, celkové produkce a nákladů. Pomocí korelační analýzy byly hodnoceny vztahy mezi produkcí, náklady a provozními dotacemi přepočtené na hektar využívané zemědělské půdy. Zvýšení dotací se neprojeví ve vyšší produktivitě nákladů a jen velmi slabě se projeví ve vyšším podílu dotovaných nákladů.

Klíčová slova

Zemědělství, Společná zemědělská politika, provozní dotace, produkce, náklady.

Abstract

The article deals with comparison of agricultural subsidies in the member states of the EU in the period 2004-2012 based on the database Farm Accountancy Data Network (FADN). During the monitored period we found a slight increase of operational subsidies with the fact that variability shows a decreasing trend. In the structure of subsidies we can see a clear transition to payments separated from production with significant differences between original member states and new member states (NMS). With the help of cluster analysis the member states were divided into groups according to their operational subsidies, total production and costs. With the use of correlation analysis we assessed the relationships between production, costs and operational subsidies re-counted per ha of utilised agricultural area. The increase of subsidies will not occur in higher cost productivity and only very slightly will it occur in the higher share of subsidized costs.

Keywords

Agriculture, Common Agricultural Policy, operational subsidies, outputs, inputs.

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Introduction

The support of agricultural production in some form occurs in all world states. The reasons for this are the particularities in agricultural production which form externalities not appreciated by the market. The common agricultural policy (CAP) belongs to the most elaborated policies of the European Community. The common agricultural policy, introduced in 1962, acts as a partnership between the agriculture sector and society, between Europe and its farmers. Its main tasks are:

- to increase the productivity of agriculture so that the consumers have stable supplies of food at acceptable prices,
- to ensure that the EU farmers have an adequate living standard.

At present, fifty years later, further tasks have appeared:

- Securing food supplies – at a world-wide level food production will have to double to provide enough food for the 9 billion

people of the estimated world population in 2050.

- The change of climate and sustainable management of natural resources.
- Landscape conservation in the whole EU and viability preservation of the rural economy.

The common agricultural policy has three dimensions: market support, income support and rural development. These three dimensions are mutually connected and total sustainability of policy depends precisely on how well they complement one another (European Commission, 2014). Regarding the long history of the CAP, it is the policy which has been reformed on many occasions. However, an attempt for its fundamental reconstruction is represented only by reforms started in the 90s and especially the reform of 2003. The main contribution of MacSharry's reform (1992) was the separation of subsidies from the level of production (decoupling), which resulted in the decrease of overproduction. The Community reduced guaranteed prices, which were compensated by way of direct payments determined on the basis of production range. Moreover, some compensations were paid out only on the basis of leaving a part of land to lie fallow.

Fischler's reform in 2003 introduced a single payment per farm. Therefore, farmers only get one payment instead of several. The paying out of direct payments is conditioned by keeping a set of legislative norms, the so called cross-compliance (19 rules for environmental protection, food safety and animal health). In 2008, the so called Health check was introduced In other words, a check-up of the CAP health state in 2008. Through a packet of four legislative documents, partial adjustments and smaller interventions into some CAP mechanisms were approved: direct payments and a modulation system, separating subsidies from production, changes in the field of common milk and dairy products market including the gradual elimination of the so called milk quotas. In 2013 the last change appeared, whose key principles are the change of the political paradigm (recognition of common provision of private and public goods), more effective and integrated structure of supportand bigger flexibility in fulfilling the aims of the common agricultural policy.

The four basic EU regulations of the new Common Agricultural Policy are published in the Official Journal of 20 December 2013. These four legislative texts reflect the political agreement between the European Commission, EU Member States Agriculture Ministers (in the Council) and the European Parliament. With these new rules, the vast majority of CAP legislation will be defined under four consecutive Regulations – a significant simplification - covering:

- Rural Development: Regulation 1305/2013
- "Horizontal" issues such as funding and controls: Regulation 306/2013
- Direct payments for farmers: Regulation 1307/2013
- Market measures: Regulation 1308/2013

To ensure a smooth transition, Regulation 1310/2013 lays down certain transitional provisions as regards the application of the four basic regulations in the year 2014 (European Commission, 2013).

CAP is a common policy for all EU member states. It is run by the EU and is also financed from its budget. For the last 50 years the Common Agricultural Policy has been the European Union's most important common policy. This explains why traditionally it has taken a large part of the EU's budget, although the percentage has steadily declined over recent years. The CAP is financed by two funds which form part of the EU's general budget:

1. EAGF (The European Agricultural Guarantee Fund) primarily finances direct payments to farmers and measures regulating or supporting agricultural markets.
2. EAFRD (The European Agricultural Fund for Rural Development) finances the EU's contribution to rural development programmes (http://ec.europa.eu/agriculture/cap-funding/index_en.htm).

CAP represents approximately 40 % of the EU budget. This implies that this policy is one of a few fields in which the common policy is financed predominantly by the EU. Therefore, it is necessary to put the CAP budget into connection with total public expenses in the EU. In this case the given budget seems to be small – it represents only 1% of all public expenses in the EU. In 2014 it amounted to 58 billion euros. Furthermore, we need to point out that the share of the CAP's budget in the EU budget in the last 30 years has decreased considerably, from not quite 75 % to approximately 40 % (European Commission, 2014).

Problems regarding agricultural subsidies and predictions of their impacts on international markets and the EU are the topic of many studies, e.g. Fárek and Foltýn (2004), Donaldson et al. (1995), Beard and Swinbank (2001), Benjamin et al. (2006), Latruffe and Davidova (2007). Most

foreign studies are directed at the impacts caused by the enlargement of the EU (Ciaian et al. 2007). An analyses of the impacts of the CAP on the new member states was carried out by e.g. Pokrivčák, Svinnen and Gorter (2003). Impacts of the CAP on the results of management of agricultural enterprises together with the reference to disparity of results according to the types of companies, natural conditions of management and economic prosperity were studied by Szabo and Grznár (2002).

Svatoš (1999) defines subsidies as the evaluation of the public sector, influencing the prices of products and services and prices of factors of production. Bečvářová et al. (2008) defines subsidies as transfers reflecting changes in the division of income which are not connected with the flow of goods and services. Grega (2005) defines them as an interference into the allocation powers of the price mechanism. Subsidies evoke discussions whether to subsidize agriculture or not. According to the opponents of subsidies, the problems with the economic situation are caused by bad management and subsidies into the agrarian sector are very high from the point of view of a taxpayer. Van Beers and Van den Bergh (2001) say that subsidies are introduced to support certain aims, changing in the course of time, and the impacts of subsidies are unpredictable. Subsidies lead to prices that convey fundamentally incorrect information about real costs relating to production, extraction or resource scarcity. Subsidies run the risk of favouring less profitable over more profitable firms, where profitability includes social costs. Therefore, subsidies should never be structural, but merely serve to guide transition periods.

The defenders of subsidies stress the particularity of the agrarian sector and the formation of social, environmental, consumer and other negative impacts on the dissolution of a higher number of agricultural companies. To which extent the removal of direct payments could influence the dynamics of land exploitation in Europe including impacts on structural changes and environment is discussed by e.g. Uthes et al. (2011), Acs et al. (2010), Offermann et al. (2009).

Reforms of the CAP are rather complicated and emerge in historical and political contexts and in the interaction of several institutional mechanisms, thus their results are not fully predictable (Moyer and Josling, 2002; Garzon, 2006; Swinnen, 2010). Erjavec and Erjavec (2015) detected that in the process of CAP reform decision-making, European institutions justified the CAP with a transformation of key discourses (productivist, multi-functional and neo-liberal) by emphasising the hugely popular environmental element while, at the same time, employing a strong productivist discourse at the level of measures and the budgetary distribution between the EU member states and farmers' groups. The prediction of impacts of changes in the CAP after 2013 is dealt with by Ciaian et al. (2014). They presume the strengthening of competition on the estate market and higher estate values, especially in the countries where subsidies will be balanced.

The aim of the article is the analysis of the policy of subsidies in the field of operational subsidies in the EU countries in years 2004 to 2012, which represents its comparison based on selected economic indicators. The objective was to find suitable connections and links among these indicators and operational subsidies.

Materials and methods

In the article we use calculations based on the database of selective research; The Farm Accountancy Data Network (FADN) in the EU. Standard output FADN is a set of indicators - the results of agricultural companies published officially per particular company types within FADN systems. The purpose of EU methodology is to enable the evaluation and comparison of economic results of agricultural companies in individual EU countries according to a single methodology, which is not influenced by divergences of tax accounting records (http://ec.europa.eu/agriculture/ricaprod/).

From many recorded indicators we have chosen those which are relevant for the given points at issue and are linked to operational subsidies. The indicators were:

- Total Utilised Agricultural Area in ha (SE 025).
- Total output (SE 131) – i.e. total output crop, livestock.
- Total Inputs (SE 270) – i.e. specific (direct) costs, overheads (e.g. energy, maintenance, repairs, fuel, etc.), depreciation and external factors (wages, rent, interest).
- Operational subsidies (SE 605).

FADN EU methodology within operational subsidies contains more types of subsidies. More detailed structure of operational subsidies was determined at the level of following groups:

- Total subsidies on crops (Compensatory payments, Set aside premiums, Other crops subsidies)
- Total subsidies on livestock (Subsidies dairying, Subsidies other cattle, Subsidies sheep/goats, Other livestock subsidies)
- Environmental subsidies
- LFA subsidies
- Decoupled payment (Single Farm payment, Single Area payment, Additional aid)
- Others subsidies (Other RD subsidies, Subsidies on intermediate, consumption, Subsidies on external factors).

The draft of calculation of the basic indicators of economic activity results according to FADN EU methodology, which draws on the principle of creation and VAT difference, is illustrated by the following scheme (Fig. 1).

Considering the fact that the system of most paid out subsidies is directly dependent on the farm size, the indicators of total output, total costs and total operational subsidies were calculated per ha of Utilised agricultural area. Thus, the size of individual farms of given states is taken into consideration.

Based on these figures a cluster analysis could be carried out; a multi-variation statistic method which brings about a division of a big monitored group into smaller and more homogeneous ones. A similar method can be applied on the classification of EU member states according to the economic output of farms (Giannakis and Bruggeman, 2015). The process of clustering can be roughly divided into three categories: hierarchic, non-hierarchic and two-stage. Ward´s method was used in this work. Ward's method joins two clusters A and B that minimize the increase in the sum of squares of error within a cluster, I_{AB} (Rencher (2002), Řezanková, Húsek and Snášel (2009)),

$$I_{AB} = \frac{n_A n_B}{n_A + n_B}\left(\bar{\mathbf{y}}_A - \bar{\mathbf{y}}_B\right)^T\left(\bar{\mathbf{y}}_A - \bar{\mathbf{y}}_B\right)$$

where n_A, n_B are the numbers of units in *A, B*; are centroids of *A*, and *B*, respectively. As distance function is used Eucliean distance between two vectors $x = (x_1, x_2, ..., x_p)^T$ and $y = (y_1, y_2, ..., y_p)^T$, defined as (Rencher, 2002)

$$d(\mathbf{x},\mathbf{y}) = \sqrt{(\mathbf{x}-\mathbf{y})^T(\mathbf{x}-\mathbf{y})}.$$

The aim of its assessment is the division of EU states into groups which enabled their clearer assessment. The commentary of these groups further contains basic descriptive statistical characteristics.

In another part, the links between defined indicators are described with the help of correlation and regressive analysis. Indicators related to utilized area value from FADN EU were further completed by relative indicators (total output/ operational subsidies, Operational subsidies/total costs, total output/total costs).

Results and discussion

Comparison of selected FADN EU indicators in EU countries

Before total assessment, it is suitable to point out how the EU enlarged with newly joining states

<table>
<tr><td colspan="3">Total output</td><td rowspan="2">Balance current subsidies & taxes</td></tr>
<tr><td>Output crops & crop products</td><td>Output livestock & livestock products</td><td>Other output</td></tr>
<tr><td colspan="2">Intermediate consumption</td><td rowspan="2">Gross farm income</td><td rowspan="2"></td></tr>
<tr><td>Specific costs</td><td>Farming overheads</td></tr>
<tr><td colspan="2"></td><td>Depreciation</td><td>Farm Net Value Added</td><td>Balance subsidies & taxes on investment</td></tr>
<tr><td colspan="3"></td><td>External factors</td><td rowspan="2">Family Farm Income</td></tr>
<tr><td colspan="3"></td><td>Wages | Rent | Interest</td></tr>
</table>

Source: FADN

Figure 1: Derivation of indicators of economic results according to FADN EU methodology.

in the monitored period. 2004 was determined as the starting year of monitoring, i.e. the biggest EU enlargement by 10 new member states (NMS). During the monitored period Bulgaria and Romania also became members in 2007.

According to the utilized area value, the biggest EU farms are in Slovakia and the CR. Other countries with average sized farms over 100 ha are in Great Britain, Estonia and Sweden. Slovakia and the CR at the same time belong to countries with the biggest share of tenured land (table 1), i.e. landowners usually do not cultivate the land, but they rent it. In most East-Central European countries land was privatized by restitution. Land was given back to former owners or their successors within certain limits of size. In Czech Republic the restitution resulted in a severe fragmentation of ownership, sharply contrasting with the extreme land use concentration (Lososová, Zdeněk and Kopta, 2013).

The land rent growth, along with the growth in land prices, affects the majority of the Czech farms due to the high percentage of rented land. Despite the fact that these farms are trying to acquire the rented land, farmers fear that the land rent costs may negatively affect their farm plans in the near future. The land rent growth rate significantly exceeds the growth rate of profit, revenues and subsidies (Zdeněk, Lososová and Kopta, 2014). Regarding the average growth rate, it is possible to assume that land rent of the NMS is supposed to match the EU-15 (Lososová, Zdeněk and Kopta, 2013).

Viewing the development from 2004 it is obvious that the area value of an average company increased by more than 10% in most member states, and in the newly added Baltic countries and Poland. The biggest growth of the area value of an average company were in Lithuania, Greece, Denmark and Belgium. On the contrary, the decrease of the area value of an average company is apparent in Slovakia, Cyprus, Hungary, Malta and the CR. On comparison of the division of EU countries in 2004 and in 2012 (table 2 and 3), according to the extent of operational subsidies per ha

Share of tenured land	Countries
Up to 25 %	Ireland (19.3)
25 – 50 %	Denmark (29.0); Spain (36.8); Italy (43.1); Latvia (47.7); Netherlands (41.3); Austria (28.1); Poland (26.6); Portugal (26.5); Finland (33.9); Slovenia (35.0); United Kingdom (43.6)
50 – 75 %	Belgium (72.6); Cyprus (67.4); Germany (67.3); Greece (51.6); Estonia (62.2); Hungary (62.4); Lithuania (53.7); Luxembourg (52.6); Romania (56.5); Sweden (54.1); **EU (54.2)**
More than 75 %	Bulgaria (89.3); Czech Republic (82.6); France (87.7); Malta (82.1); Slovakia (95.0)

Source: FADN, own results

Table 1: Division of countries according to the share of tenured land in 2012 (in %).

Subsidy	Country
Up to 200 €/ha	Estonia (95); Slovakia (98); Lithuania (117); Latvia (122); Poland (129); Czech Republic (154); Hungary (176);
200 - 400	Spain (209); Portugal (225); United Kingdom (281); **EU (305)**; Sweden (324); Netherlands (333); France (351); Italy (363); Denmark (367); Ireland (381); Germany (388); Belgium (396)
400 - 600	Slovenia (461); Luxembourg (504); Cyprus (514)
More than 600	Austria (610); Greece (658); Finland (889); Malta (2 289)

Source: FADN, own results

Table 2: Division of EU countries according to the extent of operational subsidy in €/ha in 2004.

Subsidy	Country
Up to 200 €/ha	Lithuania (183); Latvia (190); Bulgaria (191); Romania(194); Estonia (196)
200 – 400	Spain (244); United Kingdom (263); Slovakia (272); Portugal (281); Poland (299); Hungary (328); **EU (341)**; France (361); Czech Republic (364); Denmark (383); Sweden (385)
400 – 600	Germany (409); Italy (420); Ireland (427); Belgium (515); Cyprus (537); Austria (574); Netherlands (578)
More than 600	Luxembourg (613); Slovenia (626); Greece (710); Finland (921); Malta (1 102)

Source: FADN, own results

Table 3: Division of EU countries according to the extent of operational subsidy in €/ha in 2012.

of Utilised agricultural area, the shift of the CR from the position where subsidies reached only 50% of EU average to subsidies 7% higher than the average, is apparent. The biggest increase of operational subsidies in the monitored period happened in Slovakia, the CR and Poland. These countries gained more than double the subsidies per ha of Utilised agricultural area in 2012 than in 2004, although neither Slovakia nor Poland have reached the EU average so far. In 2004 subsidies exceeded the EU average only in Slovenia (from the newly added countries). Contrary to 2004, a decrease of subsidies per ha occurred only in Malta, Austria and Great Britain.

However, a substantial problem is also the structure of individual subsidies (table 4). Years 2004 and 2012 are presented here again to get a basic comparison. Unambiguously, this implies a diversion from the support of particular crops or animals (vegetable or animal production), whose share (in total operational subsidies) decreased in average from about 63% in 2004 to not quite 8% in 2012, to the so-called decoupling, where the proportion is in fact the opposite, i.e. from about 9% in 2004 to about 60% in 2012. The other types of subsidies can be considered as relatively stable – environmental subsidies 10.4% and 13%, LFA subsidies 10.5% with a slight drop to 8.8% and other subsidies 69% and 10%.

The starting amount of subsidies of vegetable and animal production were in the competence of given states with their political decisions respecting the particularities of their countries and determined priorities.

The starting extent of direct payments (subsidies

State	Total subsidies on crops		Total subsidies on livestock		Environmental subsidies		LFA subsidies		Decoupled payments		Other subsidies	
	2004	2012	2004	2012	2004	2012	2004	2012	2004	2012	2004	2012
Belgium	27.5	0.5	51.5	14.8	4.7	7.6	1.8	1.9	0.0	63.7	14.5	11.6
Bulgaria	-	3.7	-	7.5	-	5.3	-	3.9	-	65.6	-	14.0
Cyprus	54.6	0.0	32.7	9.0	0.0	22.1	0.0	8.6	12.7	53.5	0.0	6.8
Czech Republic	21.4	0.2	8.1	2.5	6.8	14.5	14.9	9.1	35.5	58.3	13.3	15.3
Denmark	74.3	0.1	18.8	1.3	3.9	2.1	0.1	0.1	0.0	90.3	2.9	6.0
Germany	56.2	0.4	18.8	0.3	10.6	9.1	5.4	4.0	0.0	77.1	9.1	9.1
Greece	72.1	9.1	18.2	1.3	0.1	1.5	7.9	6.7	0.0	73.6	1.6	7.7
Spain	65.5	6.9	27.0	8.0	1.3	5.7	2.8	3.8	0.0	73.3	3.4	2.3
Estonia	17.4	0.0	13.2	2.5	31.3	27.8	9.0	4.8	25.5	47.6	3.5	17.3
France	59.0	3.9	26.2	9.5	6.1	4.4	4.8	5.5	0.0	72.2	3.9	4.5
Hungary	32.8	4.3	9.2	5.0	0.1	17.2	0.2	0.8	35.7	62.3	22.0	10.4
Ireland	7.8	0.0	62.1	1.4	14.0	14.5	13.5	9.6	0.0	72.1	2.6	2.5
Italy	74.7	2.6	14.9	1.4	5.6	10.3	2.2	5.1	0.0	76.3	2.6	4.3
Lithuania	22.3	0.0	11.0	4.1	0.0	1.8	27.3	9.6	27.4	63.8	12.0	20.7
Luxembourg	17.7	0.0	29.6	0.1	20.5	20.2	25.7	20.2	0.0	44.3	6.4	15.2
Latvia	28.3	0.2	19.2	13.1	8.0	15.8	19.6	13.1	14.1	37.6	10.8	20.2
Malta	10.1	9.9	58.1	0.0	1.9	8.6	9.3	20.6	0.0	60.2	20.6	0.6
Netherlands	38.7	0.0	43.4	0.7	13.8	9.4	0.0	0.4	0.0	77.8	4.1	11.7
Austria	23.1	2.4	18.5	4.0	40.7	34.6	13.8	14.5	0.0	36.6	4.0	8.0
Poland	54.8	1.5	0.1	0.9	0.2	7.4	1.1	7.0	35.9	58.6	7.9	24.6
Portugal	34.6	8.8	35.8	19.2	13.6	10.1	12.8	15.1	0.0	42.6	3.1	4.2
Romania	-	0.7	-	5.2	-	3.1	-	1.3	-	61.4	-	28.3
Finland	23.1	6.0	33.5	20.1	19.5	21.9	21.2	26.3	0.0	22.9	2.8	2.8
Sweden	41.8	0.0	27.7	4.3	21.4	25.8	5.5	8.5	0.0	60.0	3.7	1.4
Slovakia	11.4	0.0	3.4	3.0	0.0	10.1	36.4	18.4	43.3	62.8	5.4	5.6
Slovenia	14.0	0.2	27.0	3.9	28.9	23.1	22.1	15.3	0.0	44.5	8.0	13.1
United Kingdom	36.3	0.0	45.2	0.8	7.5	17.2	6.1	3.2	0.0	77.3	5.0	1.5
Average	36.8	2.3	26.1	5.3	10.4	13.0	10.5	8.8	9.2	60.6	6.9	10.0

Source: FADN, own results

Table 4: Structure of operational subsidies in EU countries (in %)

on crops, subsidies on livestock, decoupled payments) for NMS was determined at 25 % in 2004 with 5% growth up to 2007 (40 %) and further 10% annual growth with the possibility of paying off from national resources right to 30%. Table 5 illustrates a gradual start of direct payments on the example of the CR and a real share of direct payments per ha of Utilised agricultural area towards the EU average (including NMS) and towards Germany´s average. Direct payments in NMS (except Malta and Cyprus) reached the EU average in the monitored period only in Slovenia.

Average operational subsidies per ha of Utilised agricultural area in the EU from 2004 make 333 €/ha and the trend is slightly growing. The median shows an average growth rate of 1% annually, it grew from 351 €/ha in 2004 to 383 €/ha in 2012. Variability of subsidies is the lowest in comparison with output and costs and shows a decreasing trend. The highest variation coefficient was 112% in 2008 and the lowest in 2011 and 2012, when its value was 53%. The range of subsidies has a dropping trend in time, values of minimum and maximum draw near each other during the monitored period.

According to operational subsidies per ha the EU, states can be also divided into 6 groups (figure 2):

Group 1 (Belgium, Holland, Luxembourg, Cyprus, Austria, Slovenia) operational subsidies per ha are above average - 540 €/ha, which is 162% of the EU average. The output (222 %) and costs (234 %) are above average too.

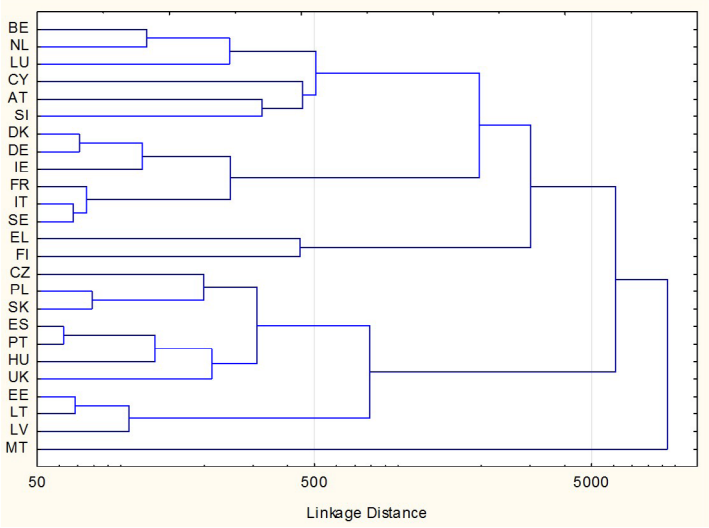
Group 2 (France, Sweden, Italy, Denmark, Germany, Ireland) is characterized by slightly above-average operational subsidies per ha of utilised agricultural area. Subsidies reach 116 % of the EU average and are 386 €/ha. The output is 121 % and costs are 140 % of the EU average.

Group 3 (Greece, Finland) has significantly above-average subsidies - 884 €/ha, which is 266 %

Year	2004	2005	2006	2007	2008	2009	2010
Share of direct payments from the EU	25%	30%	35%	40%	50%	60%	70%
Maximum top up from national resources (Top-up)	30%	30%	30%	30%	30%	30%	30%
Totally	55%	60%	65%	70%	80%	90%	100%
Real share of direct payments in the CR towards the EU average	41%	55%	63%	41%	53%	59%	69%
Real share of direct payments in the CR towards the DE average	34%	46%	49%	30%	38%	43%	52%

Source: FADN, own results

Table 5: Conditions for gradual start of direct payments NMS.



Source: FADN, own results

Figure 2: Dendrogram of EU states according to operational subsidies per ha of utilised agricultural area.

of the EU average, but the output is below average (87 %) and costs are 118 % of the EU average.

Group 4 (Spain, Slovakia, Poland, Portugal, Hungary, the UK, the CR) subsidies reach only 254 €/ha, which is 76 % of the EU average. The output is 1 025 €/ha, which is 55 % of the EU and costs are 1 188 €/ha (72 %).

Group 5 (Baltic republics – Estonia, Lithuania, Latvia) In this group subsidies reach an average 50 % of the EU subsidies are 167 €/ha. Also, the output and costs are significantly below average only 35 % (output) a 40 % (costs) of the EU average.

Group 6 (Malta) In most indicators Malta significantly differs from the EU average. Operational subsidies reach 1976 €/ha (594 %), output 12 799 €/ha and costs 10 734 €/ha.

The average output in the EU in the monitored period is 1 873 €/ha and shows an increasing trend. The median shows the average growth rate of 4% annually. It grew from 1358 €/ha in 2004 to 1915 €/ha in 2012 with a 17% slump in 2009. Output variability was the highest in 2004 (120). It gradually shows a decreasing trend, the lowest being in 2011 (107). The range does not change in time significantly.

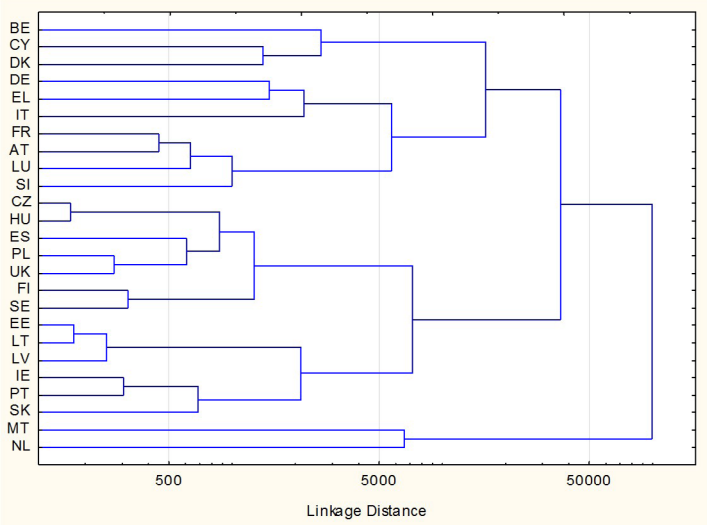
In the monitored period the average costs per ha in the EU is 1661 €/ha and as well as the output they show an increasing trend in particular years. The median has been growing by 3% on average since 2004, from 1541 €/ha in 2004 to1938 €/ha in 2012. The costs variability is lower than in the output and in particular years it oscillates around 108. The range shows a slightly increasing trend over time. According to the output and costs in particular years of the monitored period, the states can be divided into 6 groups (figure 3 and 4):

Group 1 (Malta, Holland) shows a high output and costs per ha and high operational subsidies per ha of Utilised agricultural area. The average output for the whole monitored period is 1 873 €/ha in the EU, this group reaches 11 273 €/ha = 6x higher. Average costs are 1 661 €/ha in the EU, this group reaches 10 285 €/ha = 6.2x more. The EU average operational subsidies per ha since 2004 are 333 €/ha, but they are 621 €/ha in this group = 1.9x more.

Group 2 (Belgium, Cyprus, Denmark) is characterized by above-average ha output (4 006 €/ha) as well as costs (3 935 €/ha) and above-average operational subsidies per ha of Utilised agricultural area. The average output in the monitored period is 2.1x higher contrary to the EU and average costs are 2.4x higher. Average operational subsidies are 432 €/ha = 1.3x higher than the EU average.

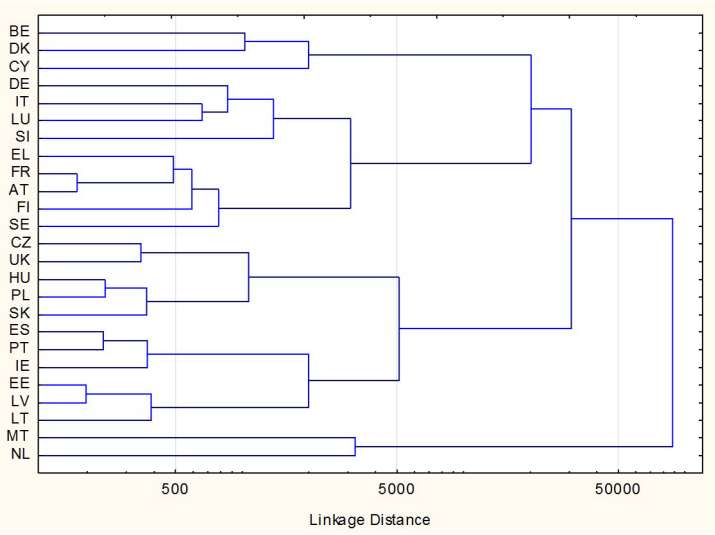
Group 3 (Germany, Greece, Italy) the output, costs and subsidies are slightly above the EU average. The output makes 2 576 €/ha (1.4x more than the EU average), costs 2 328 €/ha (1.4x more than the EU average) and operational subsidies 434 €/ha (1.3x more than the EU average).

Group 4 (France, Austria, Luxembourg a Slovenia) the output and costs oscillate around the EU



Source: FADN, own results

Figure 3: Dendrogram of EU states according to output per ha of utilised agricultural.



Source: FADN, own results

Figure 4: Dendrogram of EU states according to total costs per ha of utilised agricultural area.

average. The average output makes 1 990 €/ha (1.1 of the EU average), costs 1 991 €/ha (121 of the EU average), operational subsidies are 480 €/ha = 1.4x more than the EU average.

Group 5 (the CR, Hungary, Spain; Poland; the UK, Sweden, Finland) the output and costs are below the EU average. Operational subsidies are in average. The average output here is 1314 €/ ha (70 % of the EU average), costs 1416 €/ha (85 % of the EU average) and operational subsidies 343 €/ha, i.e. 103% of the EU average.

Group 6 (Estonia, Lithuania, Latvia, Ireland, Portugal, Slovakia) seems significantly below average as to the extent of output, costs and subsidies. The output reaches only 42% of the EU average (793 €/ha), costs 59 % (978 €/ha) and subsidies 68 % (227 €/ha).

The relationship of operational subsidies and other derived indices

Table 6 contains correlation coefficients of the relation of operational subsidies and other derived indices. These indices are in the relation:

$$\frac{\text{Total outputs}}{\text{Operational subsidies}} \times \frac{\text{Operational subsidies}}{\text{Total inputs}} = \frac{\text{Total outputs}}{\text{Total inputs}}$$

Based on the results of the correlation matrix (table 6) the following conclusions can be drawn:

- neither the share of output on subsidies (r = -0.004) nor cost productivity(r = 0.06) depend on the extent of operational subsidies
- higher subsidies per ha will occur only very slightly in a higher share of subsidized costs (r = 0.17)
- the share of output on subsidies influences the cost productivity very slightly (r = 0.24)
- the share of subsidized costs is in a very slight correlation relation with the cost productivity (r = -0.06)
- the share of output on subsidies is in a strong negative dependence on the share of subsidized costs (r = -0.72)

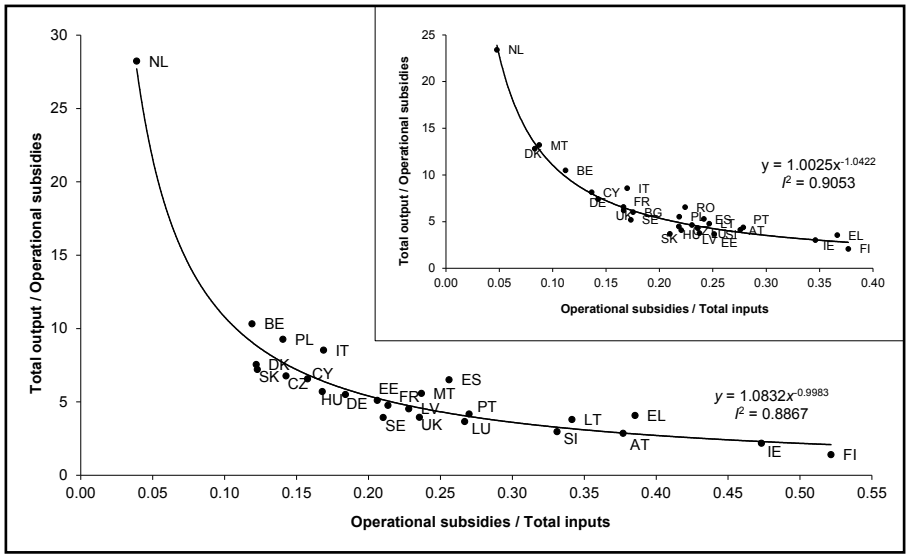
Considering the decomposition of above mentioned model, it can be expected multi-collinearity of indicators. The relationship between the share of subsidized costs and output towards subsidies explains non-linear power function (figure 5), where in 2012 the determination index was I^2 = 0.91. The highest share of subsidized costs in 2012 shows Finland (0.38) and Greece (0.37; figure 2 group 3), where the output of 2.08 EUR (Finland, or 3.56 Greece) falls on 1 EUR of accepted operational subsidies. Another group is formed by states roughly corresponding with clusters 4 and 5 (figure 2). Here the share of subsidized costs is lower and the output falling on subsidies higher, e.g. the CR´s subsidized costs make 22% and the share of output in subsidies makes 4.09. A lower share of subsidized costs with their higher effectivity is characteristic for states contained in clusters 1 and 2. Parameters of relationship between the share of the subsidized cost and production subsidies remain unchanged in the observed period.

Variable	Operational subsidies	Total output/ Operational subsidies	Operational subsidies / Total costs	Total output/ Total costs
Operational subsidies	1	-0.004	0.17	0.06
Total output / Operational subsidies	-0.004	1	-0.72	0.24
Operational subsidies / Total costs	0.17	-0.72	1	-0.06
Total output / Total costs	0.06	0.24	-0.06	1

* red marked correlations are significant at $p < 0,05$, N=237

Source: FADN, own results

Table 6: Correlation matrix of monitored indices.



Source: FADN, own results

Figure 5: The relationship between the share of subsidized costs and production in subsidy in 2004 (inserted graph 2012).

Conclusion

The aim of the article was to analyse operational subsidies in the EU countries. Together with investment subsidies and other possible measures, they are the basis of CAP, which is financed from the EU budget. Although its share in the budget has decreased lately to approx. 40%, it still represents the key EU policy. Using standard output of FADN EU figures in 2004 – 2012 enabled us to draw particular conclusions. The linkage of paid out operational subsidies related to area value of Utilised agricultural area is obvious – the co called decoupling occurs (i.e. breaking away of subsidies from output). It unambiguously implies the diversion from particular crop or animal support (vegetable or animal production), whose share in total operational subsidies dropped on average from about 63% in 2004 to not quite 8% in 2012, in fact the share is converse here, i.e. from about 9% in 2004 to about 60% in 2012.

Comparing the development from 2004, we can see that the area value of an average company increased by more than 10% in most original member states, in the Baltic countries and Poland (from NMS). A drop of area value of an average company happened in Slovakia, Cyprus, Hungary, Malta, and the CR, and Slovakia and the CR are countries with the biggest area value of an average farm and also with the biggest share of rented land.

The average extent of subsidy in the EU shifted from 305 €/ha in 2004 to 341 €/ha in 2012. Significant differences exist within the EU-27 countries. The median shows an average growth rate of 1% annually and the variability of subsidies compared to production and costs is the lowest and proves a dropping trend. The subsidy range has a dropping trend over time and the values of minimum and maximum draw near each other during the monitored period. Naturally, in the first years of the EU enlargement new member

states had a lower starting value, which caught up gradually. Among the least subsidized states both at the beginning and the end of monitoring we can rank Lithuania, Latvia, and Estonia. On the other hand, Malta, Finland, and Greece traditionally rank among the most subsidized states. The biggest growth of operational subsidies in the monitored period happened in Slovakia, the CR, and Poland, yet still neither Slovakia nor Poland reached the EU average. Contrary to 2004, there was a drop in subsidies per ha only in Malta, Austria and the UK. Boháčková and Hrabánková (2011) deal in this context with a question of incomes according to their origin – agricultural incomes, incomes from non-agricultural activities, subsidy means. They state that the representation of subsidies in net entrepreneurial income is very high in some countries (Germany, Austria). A relatively low representation of subsidies is shown in Greece and Spain. The new member countries do not achieve in the net entrepreneurial income such a high percent of subsidies as countries of the former EU-15. A situation in the Czech Republic is characterized by how strong dependence of incomes of agricultural branch on subsidy means is.

Using the cluster analysis, the EU states were divided into several groups. The first group (Belgium, Holland, Luxembourg, Cyprus, Austria and Slovenia) reached the subsidy of 162% of the EU average. Also the output (222 %) and costs (234 %) are significantly above average. On the contrary, Baltic states (Estonia, Lithuania, Latvia) reach operational subsidies of 50% average of the EU subsidies. Also, the output and costs are significantly below average – at 40% of the EU average. The only state surpassing the EU average is Malta with subsidies at 594% of the EU average as well as the output and costs (600 – 700%). This is caused by the higher prices of inputs and outputs and the particularities of agricultural production, e.g. the lowest utilised area value per farm, orientation of production and natural conditions.

The correlation analysis implies that neither the share of subsidies in production nor the productivity defined as the share of costs in production depends on the extent of operational subsidies. Increasing subsidies per ha of Utilised agricultural area will not occur in a higher productivity of costs and only very slightly it will occur in a higher share of subsidized costs. The share of output in subsidies influences the productivity of costs very slightly and the share of production in subsidies is in a strong negative dependence on the share of subsidized costs. The highest share of subsidized costs in 2012 shows Finland and Greece, another group is formed by states Spain, Slovakia, Poland, Portugal, Hungary, the UK, the CR and Baltic republics. Here the share of subsidized costs is lower and the output falling on subsidies higher. A lower share of subsidized costs with their higher effectivity is characteristic for states Belgium, Holland, Luxembourg, Cyprus, Austria, Slovenia, France, Sweden, Italy, Denmark, Germany and Ireland. Similar results appear in article Giannakis and Bruggeman (2015). They say that high performing countries are mainly located in the Northern-Central part of the EU, while the continental peripheries make up the low performing cluster. Their results indicate that there is a statistically significant relationship between the high performing countries and the direct CAP payments per farm holding. This wide variation of support levels deteriorates further the performance of farm sectors with chronic structural weaknesses. The redistribution of direct payments between old and new member states after 2013 aims to close by one third the gap between current level and 90% of EU average by 2020. This evolution will put new pressures on countries receiving direct per hectare payments significantly over the EU average.

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The Efficiency Improvement of Central European Corporate Milk Processors in 2008 - 2013

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Anotace

Cílem článku je vyhodnotit vývoj technické efektivnosti českých, polských a slovenských zpracovatelů mléka v období 2008 – 2013 se záměrem identifikovat potenciální zdroje nízké konkurenceschopnosti českých a slovenských zpracovatelů mléka. Analýza byla založena na individuálních datech 130 zpracovatelů mléka (NACE 10.51). Soubor zahrnuje střední a velké zpracovatele. Deflovaná data o tržbách, materiálových nákladech, osobních nákladech a odpisech byla použita jako výstupy, resp. vstupy pro výpočet technické efektivnosti a technického pokroku. K výpočtu technické efektivnosti byla zvolena metoda DEA, Malmquistův index byl použit k odhadu změny v čase. Hypotézy byly testovány pomocí dvouvýběrového t-testu, analýzy rozptylu a Scheffeho testu. Výsledky ukazují, že čeští a slovenští zpracovatelé dosáhli nižšího tempa technického pokroku než polští zpracovatelé. Investiční aktivita významně neovlivnila změnu v efektivnosti. Doporučením je, aby čeští a slovenští zpracovatelé mléka efektivně využívali investiční dotace z Programu rozvoje venkova v letech 2014 – 2020 ke zvýšení technické efektivnosti, protože polští zpracovatelé mléka v období 2007 – 2013 české a slovenské zpracovatele v technické efektivnosti předčili.

Klíčová slova

Konkurenceschopnost, DEA, finanční poměrové ukazatele, Malmquistův index.

Abstract

The aim of the article is to evaluate the technical efficiency improvement of the Czech, Polish and Slovak corporate milk processors in the period 2008 – 2013 to identify the possible source of low competitiveness of the Czech and Slovak milk processors towards Poland. The analysis was based on individual data of 130 milk processors (NACE 10.51). The sample covers medium-sized and large companies only. Deflated data on sales, material and energy costs, staff costs and depreciation were used as output and inputs for efficiency calculation. The DEA method was used for calculation of technical efficiency, Malmquist index estimated the efficiency change in time. Two-sample t-test and the analysis of variance enhanced by Sheffe's test verified the statistical hypotheses. The results proved that the Czech and Slovak milk processors had lower efficiency improvement than Polish companies. Investment activity did not significantly affect the efficiency improvement. The Czech and Slovak milk processors should effectively use quite big amount of public subsidies from the Rural Development Programme in the period 2014 – 2020 to improve the efficiency since the Polish companies outstripped the Czech and Slovak companies in the period 2007 - 2013.

Keywords:

Competitiveness, DEA, financial ratios, Malmquist index.

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Introduction

Milk and milk products are the essentials of human nutrition. The Central Europe is a region with long tradition of production and consumption of milk and milk products. There is quite strong competition between production capacities in the Central Europe. Competitiveness of companies influences the competitiveness on national economy. Economy is competitive when producing goods and services which can withstand the test of international competition, i. e. generate a relatively high income and relatively high level of employment under the conditions

of open economy (Nečadová, 2015). The balance of foreign trade is a good indicator of international competitiveness. According to the External Trade Database of the Czech Statistical Office, the foreign trade balance of the milk and milk products (codes 0401 - 0406 of Harmonized System 4-digits code) is positive between the Czech Republic and Slovakia (it raised from 948.9 mil. CZK to 2 386.4 mil. CZK in the period 2008 – 2014) and negative between the Czech Republic and Poland (it decreased from -1 992.1 mil. CZK to -2 523.9 mil. CZK). The comparative advantage of dairy products has been reduced. It indicates that the Czech Republic is not able to compete to the Polish milk processors whereas it is more competitive than Slovak companies. One of the possible reasons are low technical efficiency and low efficiency improvement.

The question of the technical efficiency and the efficiency improvement in agribusiness in the Central Europe was occupied by many authors. Most papers have dealt with the technical efficiency of agricultural companies in recent years (Čechura, 2012; Bojnec et al., 2014; Nowak, Kijek, Domańska, 2015; Špička, Machek, 2015; Baráth, Ferto, 2015; Maxová, Žáková Kroupová, 2015). Unfortunately, only a few authors focused on food processing industry (Forsund, Hjalmarsson, 1979; Ferrier, Porter 1991; Daňková, Bosáková, 2005, Nastasenko, 2010; Čechura, Hockman, 2010). Čechura and Malá (2014) analyzed the differences in the technology and the technical efficiency of Czech and Slovak processing companies in the period 2003–2012. They compared oils, dairy, milling and other sectors (not specifically the meat processing industry). They found significant differences in technology between the Czech and Slovak dairy industries. This especially concerns the productivity parameter, technological change and the cost share of materials. All the estimated country-specific effects are negative for Slovak dairy companies. An analysis of the development of technical efficiency indicates that the best Czech firms in the dairy sector have a strong market position, and companies with low efficiency have lost their position in the market for dairy products. In the Slovak Republic, an increase in the competitiveness of dairy companies is evident. Moreover, Slovak milk processors have the highest variability in technical efficiency.

So, it is very topical to evaluate a technical efficiency and efficiency improvement in the milk processing industry. The problem of negative foreign trade balance between the Czech Republic and Poland is a good reason to make the analysis. The aim of the paper is to evaluate the technical efficiency improvement of the Czech, Slovak and Polish corporate milk processors in the period 2008 – 2013. The analysis covers medium-sized and large companies only since they have a potential for foreign trade rather than small processors. The article also deals with the differences in financial indicators between companies with high and low efficiency improvement and among Czech, Slovak and Polish companies.

Methodology

As Špička and Machek (2015) introduced, efficiency measurement is often carried out from two perspectives: total factor productivity (TFP) which takes into account all possible inputs and outputs of an industry (firm, process), multifactor productivity (MFP) which deals with the relationship between output and multiple input factors, and partial factor productivity (PFP) which deals with the productivities of individual inputs. The article deals with multifactor productivity (MFP) which deals with the relationship between output and multiple input factors. MFP and Malmquist index to quantify change in a company's efficiency over a period of time.

A producer can be defined as an economic agent transforming a set of inputs $x = (x_1, x_2, \ldots, x_n)$ into a set of outputs $y = (y_1, y_2, \ldots, y_m)$. Generally, we consider the components of these vectors to be strictly positive. In order to define the Malmquist index of productivity (Caves et al., 1982), consider a period during which the production has changed from (x_t, y_t) to (x_{t+1}, y_{t+1}). Let's suppose the output-maximizing approach which means the lesser the distance from a production frontier, the better the efficiency score. The Malmquist index of productivity for period t, respectively for period $t + 1$, would be the ratios.

$$M_t(\mathbf{x}_t, \mathbf{y}_t, \mathbf{x}_{t+1}, \mathbf{y}_{t+1}) = \frac{D_t(\mathbf{x}_{t+1}, \mathbf{y}_{t+1})}{D_t(\mathbf{x}_t, \mathbf{y}_t)}$$
$$M_{t+1}(\mathbf{x}_t, \mathbf{y}_t, \mathbf{x}_{t+1}, \mathbf{y}_{t+1}) = \frac{D_{t+1}(\mathbf{x}_{t+1}, \mathbf{y}_{t+1})}{D_{t+1}(\mathbf{x}_t, \mathbf{y}_t)}; \quad (1)$$

where D_t denotes the value of the distance function in period t. If the technology has changed during the period, these two indexes would result in different values. Therefore, it is common to employ the geometric mean of the two indexes and specify the Malmquist index of productivity as

$$M(\mathbf{x}_t, \mathbf{y}_t, \mathbf{x}_{t+1}, \mathbf{y}_{t+1}) = \sqrt{\frac{D_t(\mathbf{x}_{t+1}, \mathbf{y}_{t+1})}{D_t(\mathbf{x}_t, \mathbf{y}_t)} \times \frac{D_{t+1}(\mathbf{x}_{t+1}, \mathbf{y}_{t+1})}{D_{t+1}(\mathbf{x}_t, \mathbf{y}_t)}} \quad (2)$$

The index can be further decomposed in the product of two terms (Färe et al., 1992):

$$M(\mathbf{x}_t,\mathbf{y}_t\mathbf{x}_{t+1},\mathbf{y}_{t+1}) = \sqrt{\frac{D_t(\mathbf{x}_{t+1},\mathbf{y}_{t+1})}{D_t(\mathbf{x}_t,\mathbf{y}_t)} \times \frac{D_{t+1}(\mathbf{x}_{t+1},\mathbf{y}_{t+1})}{D_{t+1}(\mathbf{x}_t,\mathbf{y}_t)}} =$$

$$= \sqrt{\frac{D_{t+1}(\mathbf{x}_{t+1},\mathbf{y}_{t+1})}{D_t(\mathbf{x}_t,\mathbf{y}_t)} \times \frac{D_{t+1}(\mathbf{x}_{t+1},\mathbf{y}_{t+1})}{D_t(\mathbf{x}_t,\mathbf{y}_t)} \times \frac{D_t(\mathbf{x}_t,\mathbf{y}_t)}{D_{t+1}(\mathbf{x}_{t+1},\mathbf{y}_{t+1})} \times \frac{D_t(\mathbf{x}_{t+1},\mathbf{y}_{t+1})}{D_{t+1}(\mathbf{x}_t,\mathbf{y}_t)}} =$$

$$= \frac{D_{t+1}(\mathbf{x}_{t+1},\mathbf{y}_{t+1})}{D_t(\mathbf{x}_t,\mathbf{y}_t)} \times \sqrt{\frac{D_t(\mathbf{x}_t,\mathbf{y}_t)}{D_{t+1}(\mathbf{x}_t,\mathbf{y}_t)} \times \frac{D_t(\mathbf{x}_{t+1},\mathbf{y}_{t+1})}{D_{t+1}(\mathbf{x}_{t+1},\mathbf{y}_{t+1})}} =$$

$$\Delta TE(\mathbf{x}_t,\mathbf{y}_t\mathbf{x}_{t+1},\mathbf{y}_{t+1}) \times \Delta T(\mathbf{x}_t,\mathbf{y}_t\mathbf{x}_{t+1},\mathbf{y}_{t+1}) \quad (3)$$

The first term ΔTE reflects the impact of changes in technical efficiency which means that $\Delta TE > 1$ as technical efficiency improves and $\Delta TE < 1$ as technical efficiency deteriorates. The second term ΔT captures the changes in technology (technical change) which can be expressed by the ability of a firm to produce more (or less) with a given level of inputs in t related to the levels feasible in $t + 1$. ΔT is the geometric mean of two term, when the first term compares the two periods in terms of period t data, and the second term the two periods in terms of period $t + 1$ data. $\Delta T > 1$ as technical progress occurred between periods, while $\Delta T < 0$ as technical regress occurred between the two periods.

The input-oriented Data Envelopment Analysis model assumes the variable returns to scale (DEAVRS method[1]). The issue of the returns to scale concerns what happens to units' outputs when they change the amount of inputs that they are using to produce their outputs. Under the assumption of the variable returns to scale a unit found to be inefficient has its efficiency measured relative to other units in the data-set of a similar scale size only.

Three inputs and one output per company were used for efficiency calculation.

- Output = Sales, i.e. the financial value of production sold to the customers excluding the Value Added Tax.
- Input 1 = Materials and Energy, i.e. the financial value of material and energy consumption.
- Input 2 = Staff costs, i.e. the financial value of wages including all payments of employees and employers.
- Input 3 = Depreciation and amortization, i.e. the financial value of consumption of the long-term assets within each year.

In order to remove the influence of price development, outputs and three inputs (expressed in monetary units) were deflated using output and input price indices. The indices were taken from the Eurostat database of price indices. The variables are deflated in each country as follows:

- Sales: Eurostat - Producer prices in industry, total - Processing of milk and milk products (EU-27, 2010 = 100).
- Material and energy: Eurostat - Price indices of agricultural products, output - Milk (CZ, PL, SK, 2010 = 100). Milk is the main input in the milk processing industry.
- Staff costs: Eurostat - Labor input in industry, total – Manufacture of food products - Gross wages and salaries (CZ, PL, SK, 2010 = 100).
- Capital consumption (depreciation): Eurostat - Producer prices in industry, total - Capital goods (CZ, PL, SK, 2010 = 100).

1. **Detection of outliers.** Outliers in the original sample were detected through the Rosner's ESD many-outliers test for Labor productivity, Material and energy productivity and Capital productivity (Rosner, 2011).
   - Labor productivity = Sales / Staff costs
   - Material and energy productivity = Sales/ Materials
   - Capital productivity = Sales/Depreciation and amortization

Total 16 of 146 companies were removed as outliers, i.e. 130 companies remained as the final sample for efficiency analysis.

2. **Calculation of Malmquist index and input-oriented technical efficiency** (Caves et al., 1982). The method is described at the beginning of this chapter. The DEA method and Malmquist index was applied through Banxia Frontier Analyst 4.

3. **Economic indicators of the individual companies in the sample.** The following economic ratios and indicators were calculated.
   A. Investment Activity (%) = (Fixed assets$_t$ - Fixed assets$_{t-1}$ + Depreciation $_t$)/Fixed assets $_{t-1}$ * 100
   B. Profitability ratios
      - ROCE using P/L before tax (%) = (Profit before tax + Interest paid)/ (Shareholders funds + Non-current liabilities) * 100
      - ROA using P/ L before tax (%) = (Profit before tax /Total assets) * 100

[1] BCC (Banker-Charnes-Cooper) model.

- Profit margin (%) = (Profit before tax/ Operating revenue) * 100

C. Turnover ratios
- Net assets turnover (x) = Operating revenue/(Shareholders funds + Non-current liabilities)
- Stock turnover (x) = Operating revenue/ Stocks

D. Payment balance
- Credit period (days) = (Creditors/ Operating revenue) * 360
- Collection period (days) = (Debtors/ Operating revenue) * 360

E. Liquidity and solvency ratios
- Liquidity ratio (x) = (Current assets – Stocks) / Current liabilities
- Solvency ratio (asset based, %) = (Shareholders funds / Total assets) * 100

F. Capital structure
- Current liabilities / Total assets (%)
- Loans / Total assets (%)

4. **Comparison of differences between progressive and other milk processors.** The two-sample t-test compare the distribution between the two equal-sized groups - progressive companies with higher values of mean Malmquist index (group A) and other companies with low values of mean Malmquist index (group B) in the period 2008 - 2013. The two-sided test of hypotheses is applied. H0: There is no statistical difference between the distributions A and B. HA: There is a statistical difference between the distributions A and B. The statistical analysis is processed automatically by software NCSS 10.

5. **Comparison of multiple differences in the sample (a country view).** The statistical analysis is processed automatically by software NCSS 10. The one-way analysis of variance compares the means of two or more groups to determine if at least one group mean is different from the others. It is important to notice that the assumption of simple random samples is not complied since the sample contains only companies with complete financial statements in the period 2008 – 2013. However, if we analyze medium and large corporate milk processors only, we can assume the sample as representative and random. To verify the rejection or acceptation of the null hypothesis, the F-test is used. Decisions are made by comparing the maximum first type error (the p-value), based on our data, and errors of the first type of alpha, which we have set before testing. Following hypotheses were tested: H0: All group data distributions are the same; HA: At least one group has observations that tend to be greater than those of the other groups.

6. **Multiple Comparison Procedure.** Given that the analysis of variance test finds a significant difference among treatment means, the next task is to determine which treatments are different. We chose Scheffe's test. It can be used to examine all possible comparisons among k means or just to look at all pairs as done here. It controls the overall or experimentwise error rate.

Data

The analysis used data from the Amadeus database that provides comparable financial information for public and private companies across Europe. The companies with specialization in the branch 10.51 Operation of dairies and cheese making in the Czech Republic, Poland and Slovakia were in focus. The analysis covered the period 2008 – 2013 that represents the "old" programming period of the Rural Development Programme (RDP). The article focused on the medium and large corporations since they have produced most value of processed milk in both countries. Moreover, small companies do not usually export the products. Not all companies generated by Amadeus database released complete balance sheet and income statement in the period 2008 – 2013. So, 30 Czech companies, 98 Polish companies and 18 Slovak companies had complete financial statements in that period (i.e. 146 companies in total). Afterwards, the Rosner's ESD many-outliers test detected 16 outliers. So, the final sample of 130 companies entered into the analysis. The table 1 contains the number and turnover (operating revenues) of the companies in the sample and in the population according to the official statistics by Eurostat and the Czech Statistical Office.

The three largest milk processors (turnover in 2013, majority owner) in the sample are:

- Czech Republic: Mlékárna Pragolaktos, a. s. (201.43 mil. EUR, Sachsenmilk Leppersdorf GmbH, Germany), MADETA a. s. (194.98 mil. EUR, Faltha Investment, SA, British Virgin Islands), OLMA, a. s. (124.29 mil.

	Sample	Population	Sample / Population (%)
Number of enterprises (CZ)	27	35	77.1
Number of enterprises (PL)	87	145	60
Number of enterprises (SK)	16	16	100
Number of enterprises (Total)	130	196	66.3
Turnover (CZ), th. EUR	1 076 370.2	1 534 956.3	70.1
Turnover (PL), th. EUR	3 533 638.5	6 254 600.0	56.5
Turnover (SK), th. EUR	489 685.0	489 685.0	100.0
Turnover (Total), th. EUR	5 099 693.7	8 279 241.3	61.6

Source: Eurostat, Czech Statistical Office, Amadeus, author's calculation

Table 1: The comparison of the sample and the population (2012) – 50 and more employees.

Indicator	Total assets (EUR)	Turnover (EUR)	EBITDA (EUR)
Mean	20 001 899.30	39 228 412.56	1 918 081.58
Median	6 143 890.07	15 880 977.76	552 157.28
Standard Deviation	64 106 993.78	84 707 849.92	4 775 907.42
Standard Error	5 622 555.30	7 429 369.91	418 874.79
Minimum	14 896.50	43 773.00	-57 551.37
Maximum	655 945 237.32	626 338 062.56	43 007 411.25
95% LCL	8 877 535.93	24 529 222.24	1 089 327.54
95% UCL	31 126 262.66	53 927 602.87	2 746 835.61

Source: author's calculation

Table 2. Descriptive statistics of the sample (mean of the 2008 – 2013)

EUR, Agrofert, a.s., Czech Republic)

- Poland: Spółdzielnia Mleczarska Mlekovita (804.91 mil. EUR, Spółdzielnia Mleczarska Mlekovita, Poland), Mlekpol Spółdzielnia Mleczarska (782.97 mil. EUR, Mlekpol Spoldzielnia Mleczarska, Poland), Danone Sp. z o. o. (349.69 mil. EUR, Danone, France).
- Slovakia: Rajo, a. s. (160.06 mil. EUR, Meggle AG, Germany), Syráreň Bel Slovensko, a. s. (77.70 mil. EUR, Fromageries Bel, SA, France), Tatranská Mliekareň, a. s. (74.73 mil. EUR, Ing. Mikuláš Bobák Slovakia).

There is a big difference in size between the biggest milk processors in Poland, the Czech Republic and Slovakia. Polish milk processors are bigger than Czech and Slovak companies. Morevover, the biggest Polish milk processors are cooperatives unlike Czech and Slovak companies which are owned by one major national or foreign investor.

The table 2 informs about basic descriptive statistics of the sample. The book value of total assets, turnover (operating revenues) and EBITDA (Earnings before Taxes, Depreciation and Amortization) are key indicators of firm size.

Descriptive statistics reveal quite wide range of the sample. It contains both profitable and loss-making companies. Eight companies in the sample were in loss in the period 2008 – 2013. However, the loss is not so deep to make bankruptcy.

Results and discussion

The results describe differences between two equal-size groups according to the value of the mean Malmquist index (2x27 companies). The difference in the Malmquist index was tested both between two equal-size groups (A, B) and between Czech and Polish companies. Moreover, development of the technical efficiency over time is described in the Czech Republic, Poland and Slovakia through the analysis of variance. A description of Malmquist index and investment activity (tables 3, 4) is followed by the comparison of technical efficiency development (Fig. 1 and 2). Afterwards, the development of partial productivity is discussed.

The companies in the group A with mean Malmquist index 1.074 experienced more dynamic growth of the efficiency than companies in the group B with mean Malmquist index 0.992. The difference is significant at $\alpha = 0.01$. The analysis of variance revealed the significantly higher technical improvement of Polish milk processors

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Malmquist index	Mean	1.074	0.992	13.7093	0.0000
	SD	0.036	0.032		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Malmquist index	Mean	0.996	1.056	0.974	
	SD	0.065	0.035	0.023	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	0.138	0.069	38.8173	0.0000
Scheffe	DF = 127 MSE = 0.001772458			CZ-PL, SK-PL	

Source: author's calculation

Table 3. Statistics of the Malmquist index.

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Investment activity	Mean	16.865	19.390	-0.7557	0.4512
	SD	16.982	20.907		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Investment activity	Mean	24.894	16.439	15.890	
	SD	26.357	17.004	11.962	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country	2	1564.514	782.257	2.2041	0.11456
Scheffe	DF = 127 MSE = 354.9117			No differences at $\alpha = 0.05$.	

Source: author's calculation

Table 4: Statistics of the investment activity.

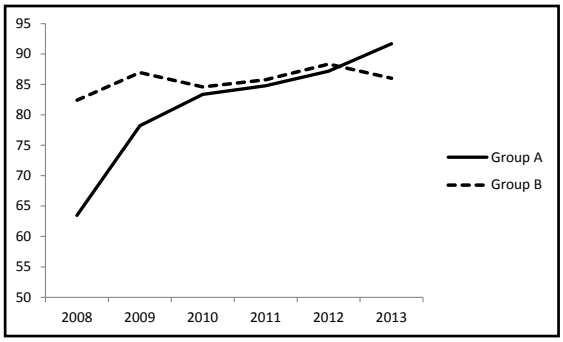
(MI = 1.056). Alternatively, there is no significant difference between Czech and Slovak Malmquist index. This is important finding that could partly explain the negative and worsen trade balance between CZ-SK and Poland. One of the possible reasons of the higher technical improvement of Polish milk processors could be an investment activity. Nevertheless, table 2 did not establish any statistically significant difference between the two groups and countries. So, it could imply that the investment expenditures are differently efficient, probably more in Poland. Other possible reason of more dynamic technical efficiency in Poland could be a quality of management. However, such conclusion requires qualitative research.

Figures 1 and 2 show a development of the technical efficiency in each year of the period 2008 - 2013.

Figures demonstrate that companies in the group A had strongly lower technical efficiency than group B in 2008 - 2009. Both groups improved the technical efficiency at the beginning of the "old" RDP programming period after their investments launched. Then, group A and B improved the technical efficiency in the same direction and kept their technical efficiency at the similar level between 83 % and 88 % in the period 2010 - 2012. In 2013, the technical efficiency of the companies in the group B slowly decreased at 86 % whereas the technical efficiency of the group A reached 91.7 %. Regarding international comparison (fig. 2), the development of the technical efficiency of the Polish companies is different from Czech and Slovak. Polish companies have continuously increased the technical efficiency from 66.6 % (2008) to 90.9 % (2013). The technical efficiency of Czech and Slovak milk processors has varied without any significant trend. Thus, Polish milk processors can be considered as very successful in technical efficiency improvement. The fig. 2 clearly shows that there are some problems with technical efficiency of milk processors in the Czech Republic and Slovakia.

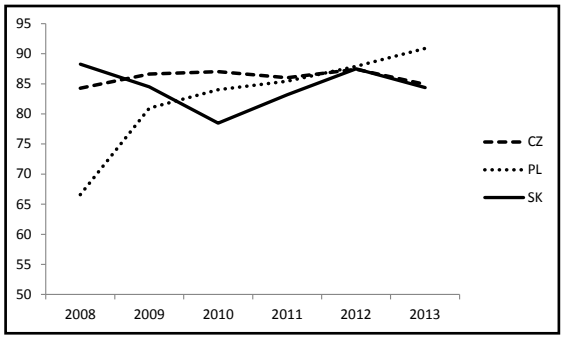
Tables 5a, 5b and 5c disaggregate the technical efficiency into the partial efficiency of thee inputs – materials (material and energy), staff costs and capital consumption (depreciation).

There are significant differences of sales to materials ratio between group A and B (at $\alpha = 0.1$)



Source: author's calculation

Figure 1: Differences in the technical efficiency score between Group A and B.



Source: author's calculation

Figure 2: Differences in the technical efficiency score in CZ, PL and SK.

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Materials and energy productivity	Mean	1.232	1.355	-2.8875	0.0046
	SD	0.100	0.330		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Materials and energy productivity	Mean	1.426	1.254	1.289	
	SD	0.481	0.120	0.117	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	0.609	0.305	5.1821	0.0069
Scheffe	DF = 127 MSE = 0.05879883			CZ-PL	

Source: author's calculation

Table 5a: Statistics of the partial productivity – materials and energy.

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Labour productivity	Mean	17.801	14.874	1.5477	0.1242
	SD	13.050	7.879		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Labour productivity	Mean	14.883	17.445	12.767	
	SD	10.638	11.404	6.612	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	367.823	183.911	1.5801	0.2099
Scheffe	DF = 127 MSE=116.3952			No differences at α = 0.05	

Source: author's calculation

Table 5b. Statistics of the partial productivity – labour productivity.

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Capital productivity	Mean	50.253	44.445	1.4437	0.1513
	SD	23.641	22.202		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Capital productivity	Mean	49.624	49.811	30.122	
	SD	27.495	21.881	12.025	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	5415.331	2707.665	5.4585	0.0053
Scheffe	DF = 127 MSE = 496.0486			CZ-SK, PL-SK	

Source: author's calculation

Table 5c: Statistics of the partial productivity – productivity of capital consumption (depreciation).

and between Czech and Polish companies. The Czech companies have significantly higher productivity of material and energy than Polish milk processors. The companies in the group A had lower material productivity than the group B. However, the group A had higher labour productivity and higher capital productivity but not significantly. It could indicate some substitution between material and labour (human and machine). Slovak companies had significantly lower capital productivity than Czech and Polish milk processors. The main reason of dynamic technical improvement of Polish companies was growing capital productivity, especially in 2012 and 2013.

Next tables show differences in financial ratios between the two groups and three countries. The section starts with three profitability indicators – ROCE, ROA and Profit Margin.

ROCE is the important indicator because it expresses how much profit before taxes and interests the company generate from one unit of long-term capital of shareholders and creditors. Table 6 establishes significant differences in ROCE between Czech, Polish and Slovak companies. The Czech companies had significantly higher ROCE than milk processors in other countries. Another indicator of profitability, ROA, measures profit per total assets including current assets. There is no significant difference between the two groups A and B. However, the Czech companies had

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
ROCE (%)	Mean	4.616	7.369	-0.7902	0.4310
	SD	22.494	15.192		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
ROCE (%)	Mean	15.905	4.370	-1.674	
	SD	18.613	18.527	18.134	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	3551.124	1775.562	5.1887	0.0069
Scheffe	DF = 127 MSE = 342.196			CZ-PL, CZ-SK	

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
ROA (%)	Mean	2.833	3.032	-0.1351	0.8927
	SD	7.993	8.825		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
ROA (%)	Mean	6.078	2.831	-1.821	
	SD	6.978	8.384	8.696	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	629.592	314.796	4.7341	0.0104
Scheffe	DF = 127 MSE = 66.49523			CZ-SK	

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Profit Margin	Mean	0.778	0.747	0.0385	0.9694
	SD	3.118	5.631		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Profit Margin	Mean	2.222	0.630	-0.979	
	SD	4.335	4.629	3.764	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	107.564	53.782	2.6849	0.07210
Scheffe	DF = 127 MSE = 20.03167			No differences at $\alpha = 0.05$	

Source: author's calculation

Table 6: Statistics of the profitability indicators.

significantly higher ROA than Slovak companies.

The results of technical efficiency and profitability confirm that productivity (efficiency) and financial performance do not necessarily move in the same direction (Machek, 2014) since there is a different methodology of financial ratios and construction of productivity indices.

The ROA can be divided into profit margin and turnover ratios. Profit margin does not differ between the group A and B. Moreover, there are no significant differences between countries at $\alpha = 0.05$.

Statistics of turnover ratios – net assets turnover and stock turnover – are described in the table 7. Stock turnover is very important indicator of business activity in the field of material and product utilization in the manufacturing industry.

There are no significant differences in turnover ratios between group A and B. The Czech companies had the highest net assets turnover but not significantly at $\alpha = 0.05$. Stock turnover is higher in the group A. Slovak milk processors had the highest stock turnover. Despite no significant differences in turnover ratios, there are some indications of profitability determinants between countries. The Czech Republic had the highest profitability (ROA, ROCE). It was caused by higher profit margin. It means that Czech milk processors get more profit from one EUR of selling price than companies in Poland and Slovakia. Alternatively, the lowest profitability had Slovak milk processors which were in loss in the period 2008 – 2013. They prefer quick stock turnover at the expense of profit margin. This is a specific strategy which could lead to problems with competitiveness. It seems that Polish milk processors had balanced marketing strategy.

Next tables present differences in quality of financial management through indicators of debt management and solvency. Table 8 informs about credit period and collection period.

The credit period is the time frame between when a producer purchases inputs and when the producer's payment is due. The companies in the group B had significantly longer credit period than companies in the group A. In other words, group A had better payment morale than group B. When comparing countries, the credit period in Poland was shorter than in the Czech Republic and significantly lower than in Slovakia. It seems that Polish milk processor had different debt strategy from the Czech and Slovak companies.

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Net Assets Turnover (x)	Mean	5.996	5.693	0.3179	0.7511
	SD	5.137	5.701		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Net Assets Turnover (x)	Mean	7.612	5.212	6.304	
	SD	8.930	2.867	7.612	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	122.562	61.281	2.1327	0.12274
Scheffe	DF = 127 MSE = 28.73414			No differences at $\alpha = 0.05$	

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Stock Turnover (x)	Mean	37.459	29.516	0.7958	0.4276
	SD	54.683	59.041		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Stock Turnover (x)	Mean	18.873	35.708	46.076	
	SD	8.496	48.262	117.074	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	8731.277	4365.639	1.3596	0.26047
Scheffe	DF = 127 MSE = 3210.915			No differences at $\alpha = 0.05$	

Source: author's calculation

Table 7: Statistics of the turnover ratios.

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Credit Period (days)	Mean	29.934	44.311	-3.3343	0.0011
	SD	14.268	31.702		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Credit Period (days)	Mean	45.782	32.665	46.749	
	SD	29.083	21.053	35.331	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	5236.261	2618.130	4.2179	0.0168
Scheffe	DF = 127 MSE = 620.7208			PL-SK	

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Collection Period (days)	Mean	34.542	43.038	-3.3623	0.0010
	SD	10.661	17.360		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Collection Period (days)	Mean	40.514	37.036	45.415	
	SD	18.421	13.719	13.782	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	1050.124	525.062	2.3937	0.0954
Scheffe	DF = 127 MSE = 219.3512			No differences at α = 0.05	

Source: author's calculation

Table 8. Indicators of debt management.

It should be explained by cooperative character of Polish milk processing companies which are more closely related to farmers – milk producers.

The collection period measures the time between when a producer sells outputs and when producer receive the payment from its customers. The companies in the group A have significantly shorter collection period than the group B. It means that they manage their receivables better. There are no significant differences in the collection period between countries but Polish companies had the collection period shorter than 40 days. So, Polish milk processors had better debt management than Czech and Slovak companies.

Table 9 evaluates the financial management through indicators of solvency and liquidity. It clearly shows that there weren't any significant differences in liquidity and solvency. So, the financial management seems to be similar in both groups and countries. The capital structure is described in table 10.

The share of current liabilities to total assets did not significantly differ between the groups and countries. It means that management used similar share of current liabilities as the source of funding. The current liabilities include short-term loans and short-term trade liabilities. The share of loans to total assets was significantly lower in group A but it did not significantly differ between countries. Thus, the companies with dynamic efficiency improvement (A) used less external finance resources. Such strategy is very beneficial in times of crisis when many companies could have problems with settlement of debt service costs.

Finally, the analysis distinguishes between national and foreign ownership of milk processors. There should be a hypothesis that technical efficiency, technical improvement and profitability are higher in the companies owned by strong foreign capital than in the family-owned firms or companies with national equity. The main argument for the hypothesis is that the parent foreign company put more emphasize on optimization of production process and financial management of the subsidiary company. Moreover, the parent foreign company should manage investments in subsidiary company more efficiently. The table 11 shows results of Welch's modification of t-test with unequal variances.

The comparison reveals the significant differences between technical efficiency between the two groups. Companies with majority of foreign capital had significantly higher technical efficiency than

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Liquidity Ratio (x)	Mean	1.365	1.072	0.9861	0.3259
	SD	2.242	0.829		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Liquidity Ratio (x)	Mean	1.108	1.315	0.880	
	SD	0.686	2.000	0.797	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	2.968	1.484	0.5155	0.59844
Scheffe	DF = 127 MSE = 2.878802			No differences at α = 0.05.	

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Solvency Ratio (%)	Mean	46.598	42.145	1.1212	0.2643
	SD	22.204	23.075		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Solvency Ratio (%)	Mean	40.725	47.166	35.328	
	SD	23.272	21.380	26.503	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	2346.831	1173.416	2.3312	0.10133
Scheffe	DF = 127 MSE = 503.3601			No differences at α = 0.05	

Source: author's calculation

Table 9: Statistics of liquidity and solvency.

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Current liabilities / Total assets (%)	Mean	42.075	48.301	-1.4550	0.1481
	SD	16.909	30.072		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Current liabilities / Total assets (%)	Mean	48.334	42.795	52.893	
	SD	22.008	25.219	23.707	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	1715.349	857.675	1.4385	0.24111
Scheffe	DF = 127 MSE = 596.2081			No differences at α = 0.05	

Groups	Statistics	Group A (N = 65)	Group B (N = 65)	t-statistic	p-value
Loans / Total Assets (%)	Mean	4.346	11.030	-3.0006	0.0032
	SD	6.807	16.619		
Countries		CZ (N = 27)	PL (N = 87)	SK (N = 16)	
Loans / Total Assets (%)	Mean	8.913	6.554	11.784	
	SD	9.336	14.338	10.735	
ANOVA	DF	Sum of Sq.	Mean Sq.	F-Ratio	p-value
Between (Country)	2	420.853	210.426	1.2330	0.29488
Scheffe	DF = 127 MSE = 170.6631			No differences at α = 0.05	

Source: author's calculation

Table 10: Statistics of the capital structure.

Indicator	Statistics	Foreign (N = 15)	National (N = 115)	t-statistic	p-value
ROA (%)	Mean	3.821	2.817	0.5103	0.6152
	SD	6.967	8.575		
TE (%)	Mean	89.974	82.723	2.8356	0.0112
	SD	9.416	8.497		
Malmquist index	Mean	1.014	1.036	-1.0142	0.3261
	SD	0.082	0.048		

Source: author's calculation

Table 11: Comparison of milk processors with national and foreign ownership (2008 - 2013).

milk processors with national ownership. However, there were no significant differences in ROA and Malmquist index.

The limitation of the research is that the analysis does not comprise milk products sold under private labels in large grocery retailers (hypermarkets), such as Tesco (Tesco Stores ČR a.s., Tesco Polska Sp z.o.o., Tesco Stores SR a.s.), and discounters (Lidl Česká republika v.o.s., Lidl Polska Sklepy Spozywcze Sp z.o.o. Spk, Lidl Slovenská republika, v.o.s.; Kaufland Ceska republika v.o.s., Kaufland Polska Markety Sp z.o.o. Spk, Kaufland Slovenská republika v.o.s.). The trade flows within the vertical of milk products in the large multinational grocery retailers enable to produce even cheaper than in conventional customer-supplier vertical.

Conclusion

The aim of the article was to evaluate the efficiency improvement of the Czech, Polish and Slovak milk processors through DEA and Malmquist index. The analysis of 130 medium and large corporate milk processors in the NACE 10.51 covered the period 2008 – 2013 as the major part of the "old" programming period of the RDP. The analysis of the technical efficiency was completed by the financial analysis.

The results clearly proved that Polish milk processors had significantly more dynamic technical improvement than Czech and Slovak companies. An important finding was that the investment activity did not significantly affect the efficiency improvement. Unlike Czech and Slovak companies, Polish milk processors have continuously increased the technical efficiency from 66.6 % (2008) to 90.9 % (2013). Thus, Polish milk processors can be considered as very successful in technical efficiency improvement. The partial productivity revealed the significant role of high capital productivity in Poland in 2012 and 2013. So, capital productivity is one of the main determinants of technical efficiency and improvement. The success of Polish milk processors could even deepen the future negative trade balance of milk products in the Czech Republic and Slovakia.

The statistical comparison indicates different strategy of financial management and marketing. The Czech milk processors had high profitability and profit margin and quite low stock turnover. Alternatively, Slovak milk processors had very low profit margin (loss) and quick stock turnover. Polish milk processors had balanced profit margin and stock turnover. However, differences in stock turnover between countries were not statistically significant.

Indicators of debt management proved significant differences in collection period and credit period between the group A and B. The group A had better payment morale than group B and was able to get receivables quicker. Polish milk processor had different debt strategy from the Czech and Slovak companies. It should be explained by cooperative character of Polish milk processing companies which are more closely related to farmers – owners of milk processing capacities.

The group A used significantly less loans to finance total assets than the group B. It means that higher technical improvement was achieved by less use of bank loans. It is interesting conclusion that is partially influenced by the crisis period in 2008 - 2013 as the companies with lower debt were more viable than indebted ones.

An important finding is that companies with majority of foreign capital had higher technical efficiency than companies owned by national investor. However, there were no differences in technical progress. So, government should consider more the criterion of ownership independence in order to support national family and non-family companies which are not financed by foreign capital.

The results establish arguments to the Ministry of Agriculture to support investments towards technology of milk processing. For example, the Czech Rural Development Programme in the period 2014 – 2020 offers 98 mil. EUR of public support for investments in processing/ marketing and/or development of agricultural products and 70.88 mil. EUR of public support for pilot projects/the development of new products, practices, processes and technologies in processing of agricultural products. The same suggestion should be targeted at Slovak Ministry.

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Landmark Finding Algorithms for Indoor Autonomous Mobile Robot Localization

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Abstract

This contribution is oriented to ways of computer vision algorithms for mobile robot localization in internal and external agricultural environment. The main aim of this work was to design, create, verify and evaluate speed and functionality of computer vision localization algorithm. An input colour camera data and depth data were captured by MS® Kinect sensor that was mounted on 6-wheel-drive mobile robot chassis. The design of the localization algorithm was focused to the most significant blobs and points (landmarks) on the colour picture. Actual coordinates of autonomous mobile robot were calculated out from measured distances (depth sensor) and calculated angles (RGB camera) with respect to landmark points. Time measurement script was used to compare the speed of landmark finding algorithm for localization in case of one and more landmarks on picture. The main source code was written in MS Visual studio C# programming language with Microsoft.Kinect.1.7.dll on Windows based PC. Algorithms described in this article were created for a future development of an autonomous agronomical mobile robot localization and control.

Keywords:

Computer vision, localization, MS® Kinect, algorithm, agronomical mobile robot.

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Introduction

In this era there are many available solutions for indoor and outdoor navigation systems. Usually these navigation systems are based on odometria or global positioning system (GPS). Human obtain the most of information by vision. Designs of an autonomous mobile robots and inputs control algorithms are built by using conventional integrated sensors. Only a tiny sphere of research teams are working on a camera sensing and processing multidimensional scenes. Nowadays, satisfactory results are not achieved in the field of navigation yet; where the inputs for control algorithm are obtained from complex camera systems.

Duchoň (2012) says that localization represents a set of tasks that are guide to determinate object's place or position in an environment. A localization system is a technology that estimates current location to run an autonomous navigation systems safely and consistently (Abdel Hafez et al., 2008; Son et al, 2015; Royer et al., 2007; Wang et al., 2006). Object's position can be assigned relatively, with respects to another object's position in environment, or absolutely, with respects to beforehand defined coordinate system. The mobile robot is not able to make useful activity, without knowing about, where in environment it is. It seems, that the answer to the most important question: "Where am I?" doesn't exist, and any universal solution doesn't exist in robotics either. Especially, the reason is the measurement's uncertainty of used sensors for the mobile robot localization. Therefore, mixed robot localizing methods are applied in the mobile robot applications, where each one of method has some pro-and-con. For this reason, application is very individual. Conventionally, sensor based vision localization systems have three inherent limitations: sensitivity to illumination variations, viewpoint variations, and high computational complexity (Son, J. et al., 2015).

Practically proved methods like triangulation, trilateration, modern methods like inertial navigation methods, but also difficult mathematic probability and statistical methods are used in sphere of mobile robot localization. Many authors (Son, J. et al., 2015; Kim, H. et al., 2015;

Hu, G. et al., 2012; Davison, A. J. et al., 2007; Eade, E. et.al., 2006; Wolf, J. et.al., 2002; Ohya, A. et al., 1998) see big potential in computer vision as a very useful tool for autonomous robot localization system (SLAM).

Materials and methods

Environment property extraction based localization is a specific localization where an application needs sufficient precise sensors, e.g. laser range finders. Trilateration and trilateration localization methods belong to this group. The triangulation methods are applied for detected natural environment marks like edge of door or edge caused by colour difference. If these environment marks are detected exactly, then this information may be used as the input for triangulation method and it can help to determine the absolute position of the mobile robot. But the reactive movement is determined between two positions of the mobile robot more frequently (Duchoň, 2012).

Vision-based localization system, frequently called as vision odometry, is a relative localization method based on obtained information from visual system. The visual systems are usually mounted on mobile robots in mobile robotics sphere and sense three dimensional environments in one plain.

To determine the relative position of the mobile robot, the third dimension of the reconstructed image is needed. To reconstruct the third dimension of a space is necessary to compare two consecutive images from the sequence of images. The motion vector of the mobile robot is indicated by two compared corresponding frames (two successive positions) that consequently localize the mobile robot relatively in environment. It is necessary to pair the significant characteristics of the environment in images, to determine the motion vector. If these significant marks (characteristics) match in pairing, vectors are created between these significant marks. After that vectors characterise the position change of the mobile robot among two images (frames) that were captured by the visual system (Duchoň et al., 2014). This methodology is also called as optical flow localization (Figure 1).

If the robot is described by a translation vector T_v and by rotation vector R_v and vector L_i^a describes the significant points of the first image and L_i^b describes the second image (Duchoň et al., 2012), then we can apply (1):

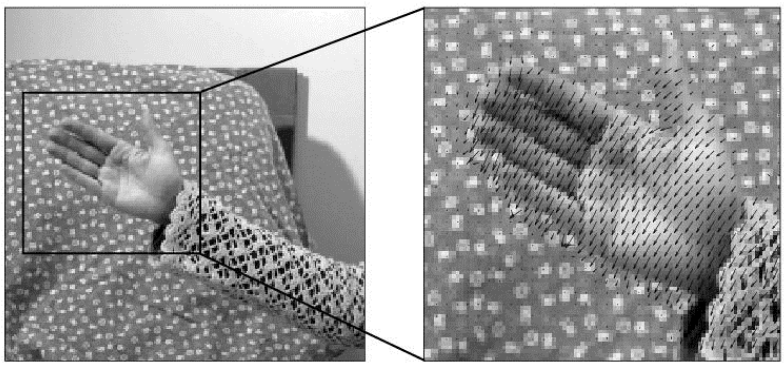
$$L_i^b = R_v.L_i^a + T_v + e_i \quad (1)$$

where e_i is error in the position estimation.

Error e_i should be the minimum for matching pairs of significant points of the two images, which responds to error minimizing with method of least squares (2):

$$e^2 = \frac{1}{N}\sum_{i=1}^{N}\left\|L_i^b - (R_v.L_i^a + T_v)\right\| \quad (2)$$

The biggest source of visual odometry errors are dynamic objects in the environment. It is necessary to decide, whether the movement significant environment marks was caused by the movement of the mobile robot, or the movement of objects in the environment. The solution to this problem is to use visual odometry for prediction of an expected movement. This will provide by certain value characterizing the eventually maximum distance between the pair and the corresponding significant marks. The implementation and the application of this filter can help to remove cases when probably there has been captured a motion of a dynamic objects (Duchoň et al., 2014).



Source: http://www.math.ntnu.no/~anstahl/Images/Hand.jpg

Figure 1: Variational optical flow estimation.

Multiple methods and procedures can be selected for a digital image processing and for purpose of obtaining some information that will be served to the mobile robot localization system. The environment has the biggest impact wherever the mobile robot will move. Under this condition, the image processing algorithms should be chosen carefully. In addition, a fast image processing is required with correct output information. The environment and objects in the environment are containing characteristic features that are possible to use as landmarks, e.g. edges, different colours or surface topography and shadows.

The Canny edge detector is useful at first step of the image processing. In principle, Canny edge detector is composed by several elements that are used at image analysis. These include, for example: noise suppression, application of a convolution operator with a mask, calculate the direction and the intensity of edges and others. Multiple steps combined can be considered as an advantage of this detector, although more time is required to perform operations. Minor drawback may be the sensitivity; unwanted edges can be obtained on the output image in addition to the necessary edges. This could be eliminated by threshold intensity. The Hough transformation is a standard method for shape recognition in digital images (Yuen, 1990). It was firstly applied to the recognition of straight lines and later extended to circles and ellipses (Duda, 1972). The Hough transformation has more advantages: robustness to noise, robustness to shape distortions and to occlusions or missing parts of an object. Its main disadvantage is the fact that computational and storage requirements of the algorithm are increased as the power of the dimensionality of the curve (Ioannou, 1999).

The above description is the summary of methods that can be changed and controlled by an appropriate control algorithm. One of the ways is using fuzzy control algorithm to decide, which method is relatively better for localization in the concrete situation. Hrubý (2007) says that fuzzy control is qualitative control based on qualitative description of real systems. We do not need to know the exact equation of control system. One of main benefits of fuzzy control system is intuitiveness of design, that allows control system designing too, where isn't available a mathematical model of the system (environment) or it is hardly determinable (Hrubý et al., 2007).

Results and discussion

The both, the colour camera and the depth sensor of the MS® Kinect capture images in resolution 640x480pixels at 30fps. The colour and the depth sensor capture angle are not the same, the depth camera has smaller capture angle. Different vertical and horizontal capture angles of both sensors cause difference between captured images of the scene, so an image calibration process is needed. The colour image sequence captured by the colour camera was calibrated manually i.e. the original width and height of the colour images were reduced (deleted) in relation to image captured by the depth sensor. The image calibration is described next; a rectangle calibration object was moved in front of the depth camera, from one side of depth image to another side. When the calibration object on the depth image touched the border of the depth image, the colour image pixel lines are deleted from that side up to the border of calibration object appeared on the colour image. These steps are repeated on each side of the colour image. Then a new colour image was created with new width and height, so the size of the final colour image will be smaller.

After the calibration process, the algorithm calculated the ratios between depth image and new colour image width and height. Definition of ratios is needed, because the new colour image size was reduced and the depth image was not. The colour and the depth image do not need to have the same resolution, but they need to have the same aspect ratio. The calculation of the ratio for each dimension is shown next in formula (3) for width and for height formula (4):

$$R_x = \frac{x_{org}}{x_{calib}} \tag{3}$$

$$R_y = \frac{y_{org}}{y_{calib}} \tag{4}$$

where:

R_x – calibration ratio for width (x line);

R_y – calibration ratio for height (y line);

x_{org} , y_{org} – width and height of the depth image;

x_{calib} , y_{calib} – width and height of the new calibrated colour image from VGA camera.

These calibration ratios were used for determining the distance at pixel on the depth image.

Landmark finding algorithm should be able to find shining colour objects, edges, circles, lines or rectangles by using of RGB camera. For example tree stumps, wine grapes stems, poles, ground

and grass colour contrast and even static shadows indoor and outdoor in agrarian sector. The main landmark finding algorithm should memorize constantly set vicinity of these objects on images. The landmark finding algorithm should these object notice on a new image anytime. Therefore, Khan et.al. (2012) image processing algorithm, upper mentioned Duchoň's (2014) optical flow algorithm or colour comparing histogram based method could be applied. However MS® Kinect colour camera colour sensing and our algorithm are dependent from ambient illuminance (light) level, for monitoring this variable, our mobile robot NUC (fig. 11a) was supplemented by an external light-dependent resistor monitor. The value of measured ambient illuminance level compensatesthe RGB colour offset. The colour histogram (that was calculated by found landmark) can characterise the memorised landmarks. Individual colours classifying can be reached in accordance to the ambient light levels by fuzzy control system. The advantage of fuzzy control versus conventional methods is the ability to synchronous control of multiple independent physical variables (Cviklovič, 2011). Landmark finding algorithm can find landmarks like flat objects with depth sensor help too. Found landmarks are presented by one pixel i.e. by centre of rectangular frame drawn around colour blob of landmark.

Remembered landmarks searching algorithm speed will be the dominant factor at algorithm choice (fuzzy control). If the image processing speed decreases or the response time increases, captured image size (resolution) will be decreased on RGB camera device.

Information about the key point's (landmark's) distance is allocated at xfinal, yfinal co ordinates of the depth image pixel. The x_{final}, y_{final} co ordinates are necessary to calculate (5) and (6) for correct pixel identification in the depth picture:

$$x_{final} = R_x * x_{landmark} \quad (5)$$

$$y_{final} = R_y * y_{landmark} \quad (6)$$

where:

x_{final}, y_{final} – corrected x and y co-ordinate of the landmark centre pixel on depth image;

R_x , R_y – calibration ratio for width and height (x, y co-ordinate ratio);

x_{land}, y_{land} – x and y co-ordinate of the recognized landmark centre;

The result of the final pixel's co-ordinate calculation must be integer value, so these values will be rounded and converted to data type Int32. The space (distance) between the camera and the landmark is directly characterized in millimetres by pixel's depth information. Practically, the algorithm creates a three dimensional array with structure [X coordinate, Y coordinate, Depth] for each final colour pixel, i.e. for each landmark centre pixel.

Only two landmarks (point A and B on Figure 2) are enough to determine the relative position of the mobile robot in the environment. But it is necessary to find another one landmark for reserve, just in case, if one landmark drops off from two.

At the beginning of mobile robot localization, the algorithm found landmark points (method was descripted upper). Each of this point was found at different distance, but the colour camera represents these points as points in one plain (Figure 2). The next step was to calculate the sizes of angles α_A and α_B by counting horizontal pixels from the centre of the colour frame to the landmark points. These angles helped to determine perpendicular distances dV_A (9) and dV_B (10).

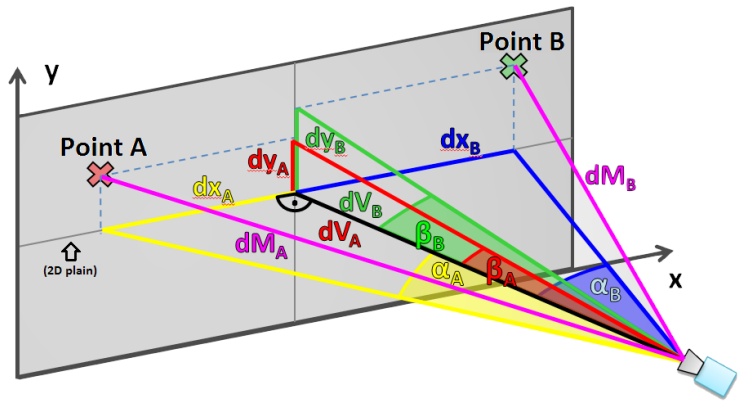


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Figure 2: Illustration of calculated angles and distances on 2D frame.

Next formulas (7) (8) helped to calculate perpendicular distance dx_A between the A point and perpendicular distance dx_B between the B point and the axis of the colour camera (figure 2). There was needed to measure not only angle, but also the distances dM_A and dM_B by MS® Kinect depth sensor.

$$dx_A = dM_A \,.\, sin\alpha_A \tag{7}$$

$$dx_B = dM_B \,.\, sin\alpha_B \tag{8}$$

Parameters dV_A (9) and dV_B (10) represented the perpendicular distances of each one landmark point from the colour camera sight.

$$dV_B = dM_B \,.\, cos\alpha_B \tag{9}$$

$$dV_A = dM_A \,.\, cos\alpha A \tag{10}$$

Furthermore, if some application needs the elevation of landmark points in the environment, parameters dy_A (11) and dy_B (12) characterise these values.

$$dy_A = dV_A \,.\, tg\beta_A \tag{11}$$

$$dy_B = dV_B \,.\, tg\beta_B \tag{12}$$

Sum of dx_A and dx_B did not give real distance between A and B landmark, caused by plain of 2D colour camera frame (Figure 3). For this reason, the real distance of two landmarks A and B are calculated by next formula (13):

$$AB = \sqrt{(dx_A + dx_B)^2 + (dV_A - dV_B)^2} \tag{13}$$

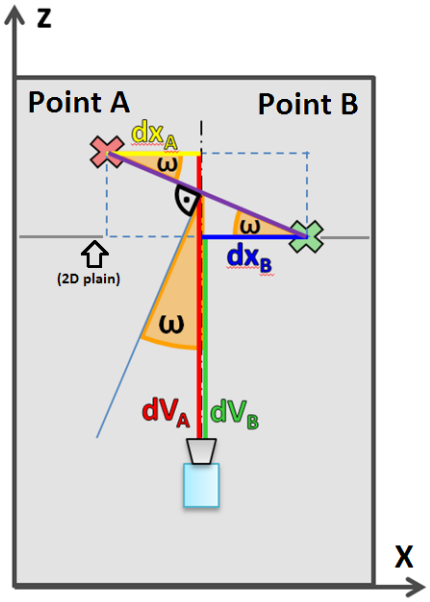

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Figure 3: Typified real situation of camera, depth sensor and landmark points from above.

Also it was possible to enumerate the angle of shift ω of MS® Kinect sensor system plain and vertical line to the AB abscissa (14). This angle represented the real angle of shift of the mobile robot (camera) to landmarks. The turn direction of the AB abscissa from the camera plan is possible to sense by the result of the formula 15. If the result is negative number (the A landmark is far away), the mobile robot is on the right side of the perpendicular axis of the AB abscissa and vice-versa.

$$\omega = \text{atg}\left(\frac{(|dV_A - dV_B|)}{(dx_A + dx_B)}\right) \tag{14}$$

$$\text{Dir}_{(L+R-)} = \text{dV}_\text{A} - \text{dV}_\text{B} \tag{15}$$

The main algorithm remembers all of calculated parameters for each of found landmark (point), and consequently the algorithm applicate these parameters to localize the mobile robot. If the mobile robot moves to another position, algorithm determines distances and angles to remembered landmarks (points) again.

Finally, the difference of remembered values and last measured (actual) values gives the relative position of the mobile robot in the environment (Figure 4) with reference to landmark points. Vector ε represents the trajectory of the mobile robot (16):

$$\varepsilon = \sqrt{\varepsilon_x^2 + \varepsilon_y^2} \tag{16}$$

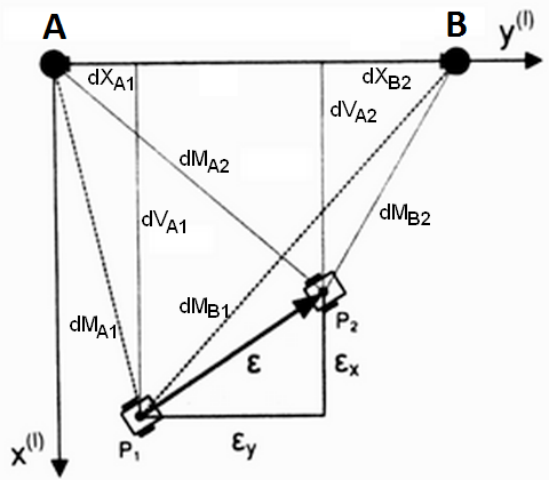

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Figure 4: Determination of the mobile robot's relative position between two points P_1 and P_2

Results of the landmark finding algorithm for indoor localization are showed in stages: MS® Kinect colour camera output (Figure 5), landmark finding algorithm output (Figure 6), calibration algorithm output (Figure 7), depth sensor output (Figure 8), depth measurement correction - error filtration algorithm output (Figure 9) and landmark points-angles finding algorithm output (Figure 10).

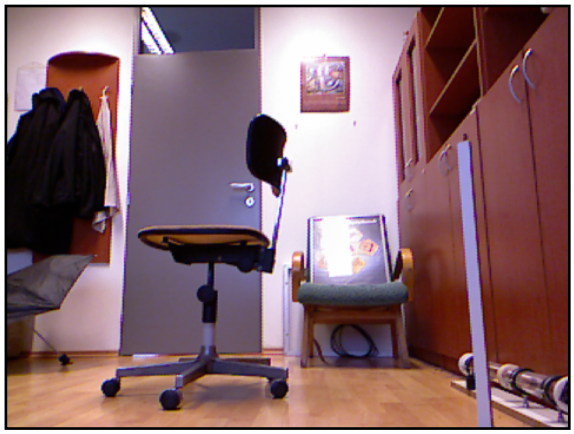

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Figure 5: Output from MS® Kinect RGB camera (original frame).

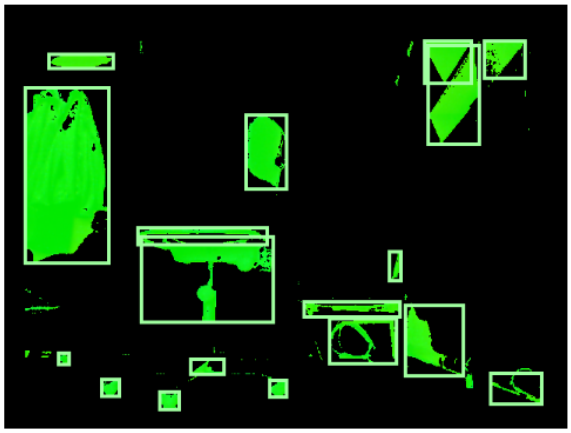

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Figure 6: Landmark finding algorithm (from RGB camera frame)

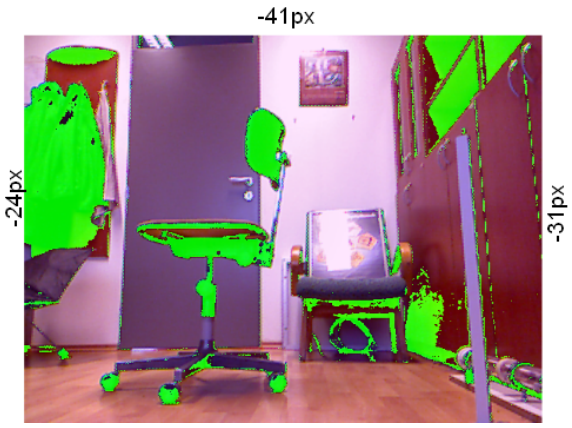

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Figure 7: Result of RGB camera and depth sensor calibration algorithm and landmarks.

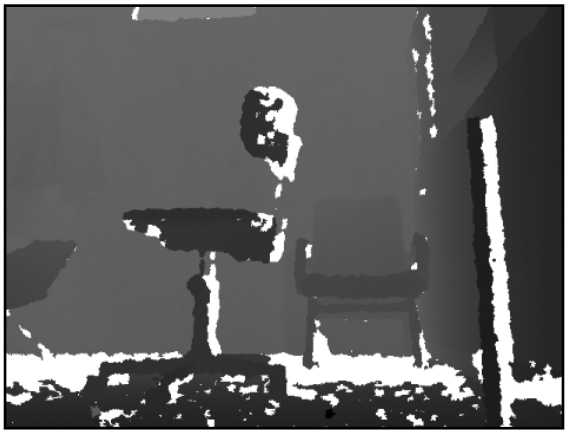

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Figure 8: Output from MS® Kinect Depth sensor (original frame).

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Figure 9: Depth measurement correction - error filtration algorithm (corrected frame).

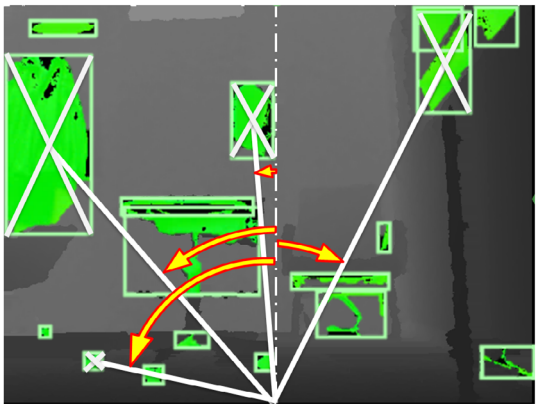

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Figure 10: Landmark point angles finding algorithm (join of RGB calibrated frame, found landmarks data, and corrected depth frame information).

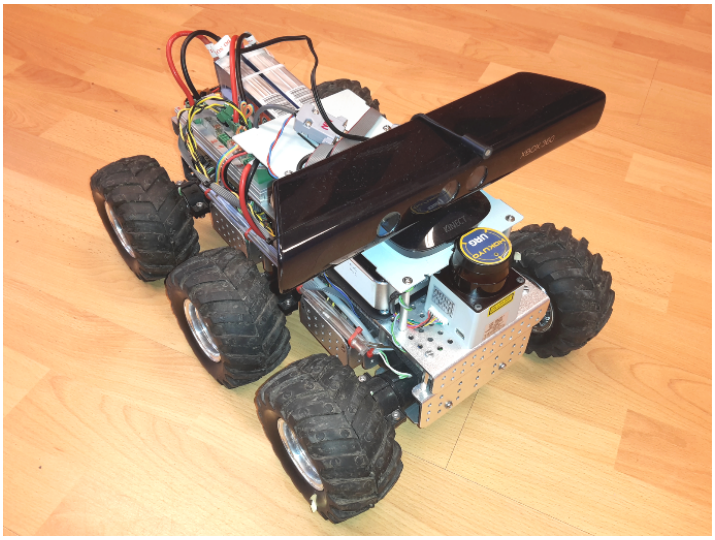

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Figure 11: Created six wheel drive mobile robot prototype NUC v1.1 with MS® Kinect, Laser rangefinder and light sensor.

The algorithms were tested on our six wheel drive mobile robot prototype NUC v1.1 with MS® Kinect, light intensity sensor and Hokuyo URG LX-04 2D laser rangefinder indoor (Figure 11). All algorithms were run on Intel NUC mini PC with integrated Intel i5 CPU and integrated Intel GPU on motherboard with 8GB RAM.

Finally, a simple framerate measuring algorithm was created for evaluation of achieved colour image processing speed by the landmark finding algorithm and the achieved framerate of the mobile robot localization in the environment. After the landmark finding algorithm function test the framerate of image processing (landmark finding) and localization was at more structured environment 2 fps (laboratory) and at less structured environment 4fps (hallway).

Conclusion

The paper describes the knowledge of the mobile robot relative localization by using landmark finding algorithms and some algorithms for input information correction (error filtration) in an indoor environment or in a dark external agriculture environment. The main aim of this project was to create and design the basic landmarks finding algorithms, for mobile robot localization. This algorithm is applicable only on moving object, because, it is necessary to change the position to localize the robot.

The total error of localization mainly depends on resolution of the colour camera, because angles are calculated from reckoned frame pixels. Error can occur, in case when landmarks start moving. Some error situation can occur, when sensors cannot measure distances precisely due to shining materials like mirror, glazed surface or glass. Thereby, some additional distance measuring sensors are needed to be supplemented in future that are based on measuring another physical quantity. For this purpose it is possible to use ultrasound sensors with tight flaring angle or additional laser rangefinder. Also an additional odometry based algorithm may be used to localize the mobile robot in the next movements. However we want to increase the accuracy of localization, it is able to use feedback from MS® Kinect's three axis accelerometers. In case of information feedback from the localization process, it is possible to use the advantages of inertial navigation, because the information about the position could be obtained through the acceleration and gyro data from accelerometers and gyroscopes (Cviklovič et al., 2011). If the concrete application needs the precise mobile robot information about direction, an additional gyroscopic sensor can be used with the Cviklovič's (2013) method of calibration to achieve tolerance of ±0.5 degree.

The framerate of landmark finding algorithm depended on environment structure, so 2 to 4fps was reached that is enough to localize mobile robot only up to speed 0,3 $m.s^{-1}$. Vaz, M. (2015) has described a faster localization algorithm that using a particle filter fusing the odometry with a novel observation model reflecting the quality of the match between the ground edges and the nearest obstacles for localization.

These algorithms are primarily created for actual indoor autonomous mobile robot NUC and for future development of an autonomous agronomical mobile robot control in the agrarian sector. In regard of an external agricultural environment, sunlight is the limiting factor for depth camera sensor. The depth camera sensor works on constantly defined wavelength laser beams projected to the environment. The sunlight interference with these beams and thereby depth sensor cannot acquire the distances. The solution is the usage of the MS® Kinect at night with its enabled colour camera night vision function. Especially, application of this landmark finding algorithm for localization is suitable for small agricultural devices that are moving in agrarian sector between i.e. maize rows, vine yards or cornfield only at night. These localization algorithms are ideal for lawn movers too that are mowing the grass in the home gardens at cloudy weather.

One of the most suitable tasks for this landmark finding algorithm is spraying with the airblast sprayer between fruit trees or wine grapes. In this case, the main benefit of this algorithm is increasing the health and safety at workspace, because workers do not need to drive the sprayer tractor and meanwhile breathe the pesticides. The whole sprayer system could work autonomously with appropriate electro-mechanical actuating devices installed on agricultural machine.

Advantages of landmark finding algorithm for localization could be used in conjunction with precise fertilization research works too, where every single plant obtains only necessary amount of soil conditioner in dependence on plant nutrient index. Every coordinate of fertilized plants or places in row could be remembered and used to build a precise agrarian nutrient map.

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Agri-Environmental Performance of EU Member states

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Abstract

Agriculture as the primary sector has gained increased attention in terms of its environmental implications. Based on the reform of Common Agricultural Policy, there is a link of direct payments to requirements that farmers maintain land in good agricultural and environmental condition and obey the relevant environment legislation since 2003. The aim of our work is the evaluation of agri-environmental performance of 27 European Union member states (we do not consider Croatia as it is the newest member state and there are missing data). We employ data envelopment analysis to calculate environmental efficiency, and Malmquist index for quantification of productivity change with respect of environmental performance. The results show that in terms of agri-environmental efficiency scores Hungary, Malta, Luxembourg and Netherland are the only efficient countries over the whole observed period (2008-2012). The average output-oriented environmental efficiency is found to be 2.4 over the five observed years. The resulting productivity change is an average decrease of TFP (9%) over the period 2008-2012.

Keywords:

Agri-environmental performance, DEA, efficiency, desirable output, undesirable output.

JEL: Q01, Q53, Q57, C38

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Introduction

Environmental performance has been lately one of the major global issues. There have been great efforts concentrated on the climate change over the last decades. More recently, agricultural sector and fisheries have gained importance on the global policy agenda in terms of environmental sustainability. Countries are constantly asked to explain their environmental performance on a range of pollution control and natural resource management with reference to quantitative metrics. The aggregated measurement of environmental performance is provided by environmental performance index (EPI), which gives the integrated information for analysts and decision makers dealing with energy and environmental related issues (Esty et al., 2006).The move towards a more data-driven empirical approach to environmental protection enables policymakers to spot problems, track trends, highlight policy successes and failures, identify best practices, and optimize the gains from investments in environmental protection (Emerson et al., 2012). EPI is tool serving to evaluate environmental sustainability. The index considers several policy categories related to environmental public health and ecosystem sustainability. Under the framework of environmental performance evaluation, ecosystem vitality is the objective affected by air pollution, water, biodiversity, forestry, fisheries, agriculture and climate change (Emerson et al., 2012). European agriculture is lately characterized by continuous decrease in the number of farms, while in terms of farm there is a tendency towards larger holdings. It appears that from point of performance efficient countries have big farms and high expenditures for agriculture per agricultural holding and per hectare typical for Netherlands or Denmark or many small family owned farms typical for Mediterranean countries (Svetlanská, Záhorský 2015).

The objective of our work is the evaluation of agri-environmental performance of 27 European Union (EU) member states as there is a lack of studies evaluating agricultural sustainability at regional or national level (Vlontzos et al., 2014). Agri-environmental performance measures on the member states level serves as a tool for evaluating the sustainable development of agriculture in EU. The EU directly supports

the pro-environmental activities beyond the mandatory measures. Environmental objectives are also included in the new programming period. Therefore, we have built the question of recent development of environmental performance of agriculture in member states. Unlike the EPI, which is the aggregated index, we try to develop an agri-environmental index indicating the environmental performance of European agriculture. We employ greenhouse gas emissions (GGE) from agriculture, labour, arable land, total output of agriculture and fertilizers consumption in evaluation of agri-environmental performance. This paper applies data envelopment analysis (DEA) to calculate the environmental efficiency of member states. This method is used to compare the performance of individual states for its explanatory power. DEA can be applied for the efficiency evaluation of any decision-making unit (DMU) that utilizes inputs to produce outputs. The great advantage of DEA is that it allows multiple inputs and outputs enter the model and efficient frontiers of DEA are not defined in functional forms. Furthermore we use Malmquist index to compare the productivity and utilization of factors involved in production over the observed period 2008-2012.

The paper is organized in several chapters. Firstly we briefly depict the theoretical background consisting of literature review related to issue. In the second section we describe the methods and data. Third section is devoted to results and brief conclusion summarizes main findings.

1. Theoretical background

Around 40% of EU land is considered as arable land. Therefore agriculture has a significant influence on the natural environment. Farming and its practices have a significant impact on natural resources, as pollution of soil, water and air, fragmentation of habitats, and a loss of wildlife.

1.1. Environmental policy in EU – agri-environmental measures

EU has taken initiative in protecting common environment through the Environment Action Programmes since 1973 (Jordan, 2012). Since 1992, the application of agri-environment programmes and measures have been implemented in all EU states under the framework of their rural development plans (European Commission, 2015). Agri-environmental measures (AEM) became mandatory for all member states after the Agenda 2000, reform of common agricultural policy (CAP) in 1999 (Uthes and Matzdorf, 2013). Based on the reform of CAP there has been a link of direct payments to requirements that farmers maintain land in good agricultural and environmental condition and comply with relevant environment legislation since 2003 (European Commission, 2014). The AEM are integrated in the groups of indicators and proposed by several organizations. Beside the EU and the European Environment Agency (EEA), it is also the Food and Agriculture Organization of the United Nations (FAO), the Organisation for Economic Cooperation and Development (OECD) and the World Commission on Environment and Development (WCED) (Hřebíček et al., 2013).The indicators can be divided into environmental (greenhouse gas emissions from agriculture, water withdrawals, environmental protection expenditures etc.), social (training and education expenditures, health and safety of costumers, etc.), corporate governance (compliance with legal norms, etc.), economic (value added, profitability etc.).

1.2. Environmental performance

Environment performance evaluation, EPI, for the most of the countries in the world was introduced in 2006. The EPI is the integrated index which ranks how well countries perform on environmental issues from point of human health and ecosystem (Emerson et al., 2012). Agri-ecosystem is defined according to Swift as "(natural) ecosystems that have been deliberately simplified by people for purpose of the production of specific goods of value to humans"(Swift et al., 2004).

There have been a large collection of wide-ranging environmental indicators constructed and applied by different organizations aimed to calculate environmental performance (Tyteca, 1996, Olsthoom et al., 2001). In order to compose the index there is often used multiple criteria decision making considered as an indirect method (Diaz-Balteiro and Romero, 2004). In case of indirect method there is a need to normalize indicators in a first stage of constructing the indicator. The direct approach incorporates the pollutants as undesirable output in the productive efficiency of agriculture. Productive efficiency measurement was pioneered by Pittman (1983), who extended the CCD multilateral productivity index (Caves et al., 1982) and took undesirable outputs into consideration. One limitation of Pittman's work is that it requires the prices of pollutants which are difficult to measure (Zhou et al. 2006).

Another measure is based on Coelli´s et al. (2007)

environmental efficiency. The environmental efficiency incorporates material balance condition into production models (Turčeková et al., 2015). Material balance condition can be explained by the balance of nutrients and thus the difference between nutrients in inputs and nutrients in outputs. Popular method recently used to measure environmental performance is the data envelopment analysis (DEA), which only requires the observed quantities of inputs and outputs. DEA is widely used to calculate technical efficiency of energy industry (Boyd and Pang, 2000; Ramanathan, 2000) and ecological efficiency (Dyckhoff and Allen, 2001; Korhonen and Luptacik, 2004, Hassan, 2014). Sustainability efficiency of agriculture of OECD countries was estimated by Hoang and Rao (2010).

The application of DEA aimed to measure environmental performance is built upon the fact that outputs are divided into desirable and undesirable outputs (Scheel, 2001). Traditional DEA models mainly handle desirable outputs that have the property of 'the more the better', while the undesirable outputs have the property 'the less the better'.

The use of DEA in environmental efficiency evaluation has been steadily increasing after 2000. There are different extensions of DEA models taking into account the undesirable outputs of the production process (Vlontzos et al., 2014). Based on the efficiency measures we distinguish radial and non-radial DEA. In the radial type of efficiency measures inputs and outputs are adjusted proportionally, while in non-radial the adjustments can be non-proportional (Sueyoushi and Goto, 2012). Wang et al. (2013) decomposed efficiency of agricultural production in 29 Chinese regions to three basic elements: technical efficiency, economical efficiency and environmental efficiency, using DEA window analysis.

Materials and methods

In the paper we apply radial output-oriented DEA to measure environmental efficiency. Then, based on the efficiency results we compute Malmquist indices to measure the change in total factor productivity. For the efficiency measurement we use R software 3.1.0. Additional computations are done in Microsoft Office Excel.

1. Data

Model works with one desirable output – total agricultural output (TAO) in million EUR (EUROSTAT, 2015a) adjusted by Harmonised Index of Consumer Prices (HICP) basis of year 2012(EUROSTAT, 2015b).In this paper the panel data is used. Therefore the variables expressed in currency units are adjusted. Firstly TAO inflation adjustment to the prices of the year 2012 is done through HICP. Consequently, the adjusted TAO is adapted by Purchasing Power Parity (PPP) for the year 2012 so that EU28 = 1 (EUROSTAT, 2015c). HICP unifies the time aspect to 2012 basis and consequently purchasing power across the countries are adapted to the EU average for each year on the basis of 2012.

We include one undesirable output – greenhouse gas emissions (GGE) in 1 000 tonnes of CO_2 equivalent (EUROSTAT, 2015d). These outputs are produced as a result of set of inputs. We consider arable land in hectares (AREA)(EUROSTAT, 2015e), labour force (LAB) in 1 000 annual work units (EUROSTAT, 2015f), fertilizers consumption in tonnes (NFERT – nitrogenous fertilizers, PFERT - potassium fertilizers) (EUROSTAT, 2015g) and agricultural subsidies (SUB) in million EUR (EUROSTAT, 2015h). Subsidies were adjusted in the same way as TAO (using HICP and subsequently by PPP) (Table 1).

2. Data envelopment analysis

The employment of DEA models enable to measure efficiency involving multiple inputs and outputs. It is based on seminal work of Farrell (1957) and it is a non-parametric approach toward efficiency measurement using linear programming, accounting for multiple outputs and inputs. These models can be constructed either as output oriented (maximization) or input oriented (minimization). We employ output-oriented model which answer the question by how much can output quantities be proportionally expanded without altering the input quantities (Coelli, 2005).We calculate the radial DEA, which is based on proportional reduction of undesirable output. The advantage of using the radial DEA is in its explanatory power and enables clear interpretation of efficiency scores. Use of input or output oriented model provide similar values under constant return to scale (CRS) but are unequal when variable return to scale (VRS) is assumed.

In the case of environmental efficiency we employ output-oriented model with CRS in form:

$$\max_{\varphi,\lambda)\ \varphi}, \qquad (1)$$

$$\text{st-}\varphi y_i + Y\lambda \geq 0$$
$$x_i - X\lambda \geq 0$$
$$\lambda \geq 0$$

Year	Variable	Mean	Std. Dev.	Min	Max
2008	TAO	10920.29	16464.46	30.05	58367.76
	GGE	78.93	23.54	1.00	96.84
	SUB	1683.96	2469.96	4.12	8626.72
	NFERT	399003.70	579507.70	300.00	2425200.00
	PFERT	44733.33	67626.89	100.00	282400.00
	LAB	425.39	606.18	3.70	2299.30
	AREA	4042293.00	4795399.00	8000.00	18300000.00
2009	TAO	9658.58	14761.72	22.03	53083.61
	GGE	79.36	22.85	4.42	96.85
	SUB	1644.04	2389.20	4.86	8468.53
	NFERT	367629.60	511292.00	400.00	2098800.00
	PFERT	32596.30	45939.84	0.00	163900.00
	LAB	414.03	591.49	3.60	2213.80
	AREA	4035084.00	4781721.00	8000.00	18300000.00
2010	TAO	10470.85	15902.43	23.53	57839.56
	GGE	79.45	22.66	5.24	96.85
	SUB	1708.65	2473.03	5.94	8742.59
	NFERT	381103.70	513359.10	400.00	2080000.00
	PFERT	38170.37	51480.38	0.00	177000.00
	LAB	375.56	504.63	3.70	1914.80
	AREA	3979176.00	4695259.00	9000.00	18400000.00
2011	TAO	11587.70	17420.15	31.07	62947.06
	GGE	79.42	22.94	4.05	96.86
	SUB	1730.63	2489.59	6.56	8806.72
	NFERT	392759.30	568736.80	0.00	2332400.00
	PFERT	40851.85	60350.72	0.00	218400.00
	LAB	365.74	489.57	3.70	1914.80
	AREA	3979880.00	4695029.00	9000.00	18400000.00
2012	TAO	12425.06	18702.11	31.23	68555.20
	GGE	79.63	22.37	7.66	96.86
	SUB	1805.15	2556.13	7.28	9044.98
	NFERT	376555.60	514572.80	0.00	2024700.00
	PFERT	39074.07	54823.03	0.00	189600.00
	LAB	363.65	490.33	3.80	1914.90
	AREA	3980343.00	4665489.00	9000.00	18300000.00

Source: own processing based on EUROSTAT data

Table 1: Descriptive statistics of data.

where φ is efficiency rate for each decision-making unit (DMU, EU member states in this case), λ refer to linear combination of inputs and outputs, Y is vector of outputs and X vector of inputs. The condition $\lambda \geq 0$ indicates CRS. In case of environmental efficiency it is essential to classify inputs and outputs into desirable and undesirable. The aim is to reduce undesirable outputs and maximize desirable outputs.

Efficiency measures obtained from the output oriented DEA imply that the output of the given DMU (country in this case) should be multiply by the efficiency measure in order for the unit to become efficient. Given that the inputs of the unit remain stable. When the undesirable output (such as greenhouse gas emission) is present, it needs to be adjusted. Procedure applied in this paper is as follows:

$$Adjusted\ value = [Max\ (GGE) + 1] - Actual\ GGE\ (country/year) \quad (2)$$

We have chosen the maximum of the GGE for the whole studied period in order to capture the possible change for the country with maximum of the GGE. If the maximum for the given year would be chosen, there could be a situation in which the particular country would have maximum for every year and no change in the amount of the GGE would be observable for this country.

3. Malmquist index, distance functions

Malmquist index is used to compare the development of environmental performance over the time periods 2008-2012. It is the measure of total factor productivity (TFP) change and it decomposes this productivity change into technical change and technical efficiency change (Coelli, 2005).Malmquist index is the geometric mean of 2 production function involving technical efficiency change (TECH) and technological change (TCH).

Malmquist index is a geometric mean of two production functions based on the distance functions. The distance function based approach for measuring the TFP seeks to separate TFP into two components. This is done using an output distance function that measures the distance of DMU from its production function. In principle, this technique enables a change in TFP to be decomposed into changes resulting from a movement towards the production frontier and shifts in the frontier. The output distance function measures how close a particular output vector is to the production frontier given a particular input vector (Mawson, 2003).

$$M_o(y_{t+1}, x_{t+1}, y_{t,} x_t) = \left[\frac{d_0^t\,(y_{t+1},x_{t+1})}{d_0^t\,(y_t,x_t)} \times \frac{d_0^{t+1}(y_{t+1},x_{t+1})}{d_0^{t+1}(y_t,x_t)}\right]^{1/2} \quad (3)$$

which can be further adjusted to:

$$M_o(y_{t+1}, x_{t+1}, y_{t,} x_t) = \frac{d_0^{t+1}\,(y_{t+1},x_{t+1})}{d_0^t\,(y_t,x_t)} \times \left[\frac{d_0^t\,(y_{t+1},x_{t+1})}{d_0^{t+1}\,(y_{t+1},x_{t+1})} \times \frac{d_0^t(y_t,x_t)}{d_0^{t+1}(y_t,x_t)}\right]^{1/2} \quad (4)$$

where y_t, x_t are output and input in the basic period, $y_{(t+1)}$, $x_{(t+1)}$ are output and input in the next period. Notation d_0^t and $d_0^{(t+1)}$ represents distance of the DMU in the basic and next period. The resulting product of Malmquist index (M_o) is change in productivity. It includes change of technical efficiency (TECH) and technological change (TCH). Whenever the $M_o > 1$ it signalizes the enhanced productivity. TECH>1 indicates the enhanced TE, while TCH>1 represents technological progress.

Results and discussion

1. Environmental efficiency

The radial DEA is applied to calculate environmental efficiency of 27 countries of EU from 2008 to 2012. As in this case the environmental efficiency has the same properties as technical efficiency the effective states lie on the production possibility frontier and have the value of one (Table 2). From the table it is clear that Hungary, Luxembourg, Malta and Netherlands are efficient over the observed period. In case of Hungary there are low GGE over whole observed period ($\overline{8.79}$/1000 t of CO_2 eq). In general, considered the amount of arable agricultural land (4491000 ha in average) and the share of agriculture on GDP (4.08%), Hungary belongs to leading group in terms of agri-environmental performance. On the other hand Netherlands has lower amount of arable land (1048916.67 ha in average) but has higher GGE ($\overline{16.48}$/1000 t of CO_2eq). However we can observe lower consumption of fertilizers, labour and higher support in form of subsidies. The Netherlands signals some positive outcomes from environmental policies under which the nitrogen and phosphorous surpluses exceeding certain limits were subject to levies (Hoang, 2010). In terms of TAO, Netherlands had the highest output over the observed period. Luxembourg has among the observed states one of the least number of agricultural holdings, thus agriculture accounts for only a small percentage of GDP (0.3%). It can be therefore assumed that the sector of agriculture is not the major producer of pollution in Luxembourg which is also proved by low GGE ($\overline{0.68}$/1000 t of CO_2 eq). Malta as an island state is one of the smallest countries of EU yet sector of agriculture is quite diverse. The share of agriculture on GDP (1.7%) together with low consumption of fertilizers and labour lead to low GGE ($\overline{0.09}$/1000 t of CO_2 eq).

The countries, with efficiency scores higher than one, should either expand their desirable output (TAO) or reduce the undesirable output (GGE). With the mean efficiency 2.4 over the five observed years, an average EU member state should augment the TAO and reduce GGE approximately two and half time given the current inputs. Vlontzos et al. (2014) applied DEA approach for agricultural environmental efficiency of EU countries for period 2001-2008. Conclusions suggested that countries

Country/Year	eff_2008	eff_2009	eff_2010	eff_2011	eff_2012	mean_eff
Austria	2.59	2.35	2.75	3.24	3.42	2.55
Belgium	1.38	1.37	1.52	1.00	1.00	1.38
Bulgaria	3.71	3.55	4.28	4.01	4.66	4.04
Cyprus	1.03	1.27	1.20	1.38	1.47	1.17
Czech Republic	1.42	2.55	2.85	2.82	2.93	2.52
Denmark	2.03	2.17	2.08	1.99	1.85	2.02
Estonia	3.03	3.95	3.34	2.91	2.76	3.20
Finland	3.76	3.64	4.08	3.64	3.55	3.73
France	1.91	1.90	2.27	2.12	2.10	2.06
Germany	1.67	1.78	2.16	1.82	1.89	1.86
Greece	2.53	2.98	2.97	3.81	4.28	2.85
Hungary	1.00	1.00	1.00	1.00	1.00	1.00
Ireland	3.79	4.32	5.02	4.64	4.82	4.52
Italy	1.78	1.92	2.05	2.37	2.49	1.95
Latvia	5.66	4.77	5.16	5.19	4.74	5.11
Lithuania	3.84	4.88	5.50	4.91	4.91	4.81
Luxembourg	1.00	1.00	1.00	1.00	1.00	1.00
Malta	1.00	1.00	1.00	1.00	1.00	1.00
Netherlands	1.00	1.00	1.00	1.00	1.00	1.00
Poland	3.55	4.13	4.44	4.61	5.13	4.37
Portugal	2.19	2.45	2.36	2.59	3.03	2.36
Romania	2.12	3.11	3.15	3.02	4.42	3.16
Slovakia	3.93	4.74	3.97	3.53	3.59	3.95
Slovenia	2.63	3.23	3.31	2.96	3.46	3.09
Spain	2.17	2.34	2.89	3.36	3.44	2.55
Sweden	2.47	3.45	3.19	3.01	2.83	2.99
United Kingdom	1.53	1.63	1.98	1.68	1.61	1.68

Notes: eff denotes the efficiency scores, mean_eff denotes average efficiency scores for the period 2008-2012
Source: own processing based on EUROSTAT data

Table 2: Environmental efficiency scores.

like Germany, Sweden, or Austria, with strong environmental protection standards, appear to be less environmentally efficient in the field of primary sector. Calculated environmental efficiencies over the period 2008-2012 confirm these results as well as the conclusion that a series of eastern European countries achieve low efficiency scores. Slovakia, the Czech Republic and Poland are among the countries with highest efficiency scores (what indicate a low efficiency in case of output-oriented model), due to low level of technology used in agriculture. The low environmental performance in eastern European countries also suggests extensive use of fertilizers as the remaining of intensive agricultural practises. On the other hand there are differences on the efficient states. Hungary, Malta, Luxembourg and Netherlands (in case of Vlontzos et al. work it is Belgium, Bulgaria, Denmark, Italy, Netherlands and Spain) are efficient over whole observed period of 2008-2012. This is due to low GGE levels – undesirable output - decreasing over the observed period. Another key factors playing role are CAP subsidies that can increase TE or environmental efficiency if they provide an incentive to innovate or switch to new technologies (Harris and Trainor, 2005) confirmed by the example of Hungary, where the high subsidies, low emissions and favourable conditions assign it to the most efficient member states. The fact that the environmental performance of agriculture over the compared period 2001-2008 (Vlontzos et al., 2014) and presented results for the period 2008-2012 did not change significantly indicates that new subsidy management scheme has not motivated further improvement of environmental efficiency, despite the fact that this was one of the most important goals of the CAP.

Among the survey of environmental and sustainable efficiency in 29 OECD countries the Netherlands, Luxembourg and Denmark were found as the most sustainable systems in work of Hoang and Rao (2010). They decomposed the sustainable efficiency into technical efficiency and exergy allocative efficiency, using non-parametric DEA. However, based on obtained results Denmark in order to be more environmentally efficient, should increase output with respect of given inputs, which are characterized by relatively high consumption of fertilizers. In this case the GGE are relatively low ($\overline{9.72}$/1000 t of CO_2 eq).

2. Total factor productivity change

Table 3 shows the results of total factor productivity (TFP) change - Mamlquist index, representing the increase or decrease in productivity. Values greater than 1 indicate better use of inputs resulting in increase of TAO or reduction of GGE (as undesirable output). The average value over the observed period is 0.91 implying decrease in productivity. On average, EU countries experienced aTFP decrease in rate of 9%. This decrease was caused by the technological regress (index 0.93). The technical efficiency scores representing the environmental performance of EU states did not change in average over the observed period (average index 1.00).

Nine European countries experienced the improved technical efficiency (TE) over the observed period (Table 3) in average growth rate of 14%, namely Bulgaria, Denmark, France, Greece, Ireland, Latvia, Portugal, Romania and Spain. TE of the rest of the countries declined or stayed unchanged (in case of Austria, Germany, Luxembourg, Malta, the Netherlands and Slovenia). Table 3 also shows the decomposition of TFP (Malmquist index) into technical efficiency change (TECH) and technological change (TCH). On average, there was a technological regress over the observed period of 7% in terms of environmental performance among the EU states. However, after year 2010 there was a technological progress in almost all countries (except of the Czech Republic, Hungary and Sweden). Technological progress result into decrease of GGE.

Domanska et al. (2014) studied the TFP of agriculture in EU states over the period of 2007-2011, finding the small increase (2.4%) mainly caused by TE improvements. When we consider the environmental indicators and GGE, TE improvements of agriculture are neglected, due to the environmental pressure. Farming businesses in EU countries could improve their environmental performance by changing the use of inputs and changing the structure of farming management practices (Hoang, 2010). All of these findings support the demand for comprehensive evaluations of the implementation of the agro-environmental policies.

Country/Indicator	TECH	TCH	TFP	Country/Indicator	TECH	TCH	TFP
Austria	1.00	1.06	1.06	Latvia	1.36	0.72	0.98
Belgium	0.98	1.06	1.03	Lithuania	0.99	1.00	0.99
Bulgaria	1.36	0.62	0.85	Luxembourg	1.00	1.01	1.01
Cyprus	0.90	0.94	0.84	Malta	1.00	0.79	0.79
Czech Republic	0.69	0.65	0.45	Netherlands	1.00	1.16	1.16
Denmark	1.13	0.69	0.78	Poland	0.86	0.82	0.71
Estonia	0.93	0.98	0.91	Portugal	1.02	1.05	1.08
Finland	0.96	1.06	1.02	Romania	1.35	0.52	0.71
France	1.01	1.07	1.08	Slovakia	0.94	1.04	0.97
Germany	1.00	1.07	1.08	Slovenia	1.00	1.02	1.02
Greece	1.02	1.06	1.08	Spain	1.02	1.06	1.08
Hungary	0.75	0.70	0.52	Sweden	0.82	0.86	0.71
Ireland	1.04	1.06	1.10	United Kingdom	0.98	1.07	1.05
Italy	0.97	1.05	1.02	EU- 27	1.00	0.93	0.91

Notes: TECH, TCH, TFP – geometric mean over the period 2008-2012
Source: own processing

Table 3: Decomposition of TFP.

Conclusion

The aim of this paper was to evaluate the environmental performance of agriculture in 27 EU member states (we do not consider Croatia as it is the newest member state and there are missing data). We employed radial output-oriented DEA model to calculate environmental efficiency. The model enabled to involve desirable output of TAO which was maximized and undesirable output of GGE which was minimized. We can conclude that only four countries (Hungary, Luxembourg, Malta and Netherlands) reached the value of one, thus were efficient over the whole observed period of 2008-2012. The average environmental efficiency of 2.4 over the five observed years suggests that an average EU member state should augment the TAO and reduce GGE two and half time given the current inputs. Efficiency is greatly influenced by consumption of inputs. Extensive use of fertilizers led to higher GGE, but it is vital to take arable land into account as extensive utilised agriculture area requires higher input of fertilizers and labour. It can be also concluded that subsidy management has not motivated further improvement of environmental efficiency, thus there is a need to increase the effectiveness of agro-environmental policies. The Malmquist index was used to measure the change of TFP over the observed period in EU member states. The average decrease of TFP (9%) was observed over 2008-2012. This decrease was caused by the average technological regress. However after the year 2010 almost all countries improved technology. Improved technology in case of environmental performance evaluation indicates decrease in GGE.

The empirical results showed that agriculture is the sector with largest remaining environmental mitigation potential with respect to its resources. Environmental adaptation of European agriculture depends on the capacities of farming businesses across the Europe to manage the use of input mixes in sustainable and environmental friendly way.

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Concept of Horticulture Ambient Intelligence System

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Anotace

V souvislosti se změnami klimatu se setkáváme s prognózami o nedostatku srážek a vody k uspokojení potřeb obyvatel a zemědělců. O udržitelnosti těchto zdrojů rozhoduje hospodárnost při zemědělských a zahradních činnostech. Mezi tyto činnosti patří zavlažování a zalévání. Zde je prostor pro aplikaci inteligentních systémů pro udržitelné hospodaření s vodními zdroji.

Klíčová slova

Voda, srážky, závlaha, hospodaření s vodními zdroji, udržitelnost, zahradnictví.

Abstract

In the context of climate changes, there are predictions about the lack of rainfall and water to satisfy the needs of population and farmers. The sustainability of these resources determines watering efficiency in agricultural and horticultural activities. These activities include irrigation and watering. There is scope for the application of intelligent systems for the sustainable management of water resources.

Keywords:

Water, rainfall, irrigation, water resource management, sustainable, horticulture.

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Introduction

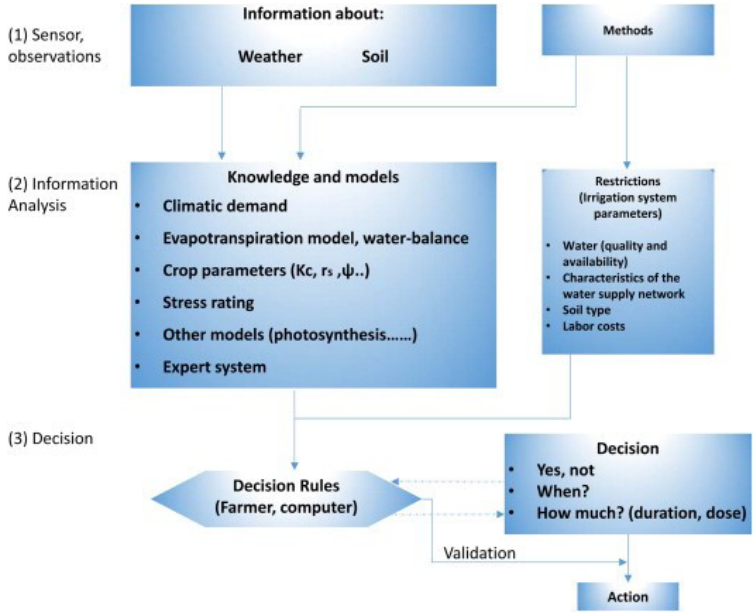
There is a big pressure on water consumption (Hayashi, et al., 2012) and there is a need to ensure similar level of production with decrease of water spending (Pereira, 1999). Three questions about irrigation are such as following:

- The first question (when?) implies the determination of the irrigation period, i.e. time between two irrigations.
- The second question (how much?) requires to define the dose (volume, height, or type of application) of water.
- Will be there some rain in a close time? For how long? If the rain comes in few hours, it is wasteful to start irrigation.

To perform a successful irrigation scheduling, some basic data and knowledge (sometimes formalized in "models") must be taken into account (see Figure 1). Either the farmer or the automatic irrigation system (computer or embedded controller with watering algorithms) will determine the dose and irrigation and frequency using a set of decision rules (Vera-Repullo, et al., 2015).

Another question is about methods of watering – where should be watering points placed. There are two possible options – both are opposite to each other. First is above the soil and second is under the soil. Upper watering has advantage in easy construction and in soil watered in whole profile – from the surface to below. When watering pipe is located under surface, then it must be in proper depth (Cancela, et al., 2015).

In this context, there is a need for smart but simple tool for optimising water consumption on horticulture. Almost all horticultures use only eyes and experience to make decision - how much water is needed for watering the flower bed. If there is a possibility to optimize this process to lower water consumption without any negative effect on plants. This can be considered as „sustainable horticulture".



Source: (Vera-Repullo, et al., 2015)

Figure 1: Stages and agents involved in the irrigation decision process.

There are plenty of automatic watering systems. The simplest systems are based on pure time management. Water valves are open every certain time and preset amount of water is released. Smarter systems can measure or calculate level of soil humidity and turn on watering when soil humidity is below defined level. Those systems can be bought in stores and hobby markets.

More advanced systems can be intelligent by using for example Penman method to calculate amount of evaporation water (Yu, et al., 2010). Those systems are based on prediction – there is known amount of water in soil and current meteorological data. So system can predict when humidity in soil is getting below critical value.

This system shows significant parts of Ambient Intelligence. AmI is growing fast as multidisciplinary area which can allow many areas of research and applications to have a real beneficial influence and a performance added value. The basic idea behind is that by enriching an environment with technology (sensors and devices interconnected through networks), a supporting system embedded in the environment can be built such that based on the real-time information gathered and the historical data accumulated, important and proactive decisions can be done by the system in order to support the horticulturist activities in that environment (Augusto, J. C., 2010), (Augusto, J. C., et al., 2010), (Cook, D. J., et al., 2009), (Cook, D. J., et al., 2007).

Sustainable horticulture need more information from different data sources. So there can be applied parts of business intelligence processes that enables intelligent systems to know more than ever before. This system can be named Horticulture Ambient Intelligence (HAmI).

Horticulture is small part of agriculture. In comparison with agriculture, the most of decisions in horticulture is based only on horticulturist experience or estimation. There is a possibility to apply some procedures from agriculture to horticulture. The research is about integration of open data and local sensors data to improve watering and make horticulture more sustainable. The paper is a part of research at Department of Information technology at Czech University of Life Sciences in Prague. If principles of Horticulture Ambient Intelligence will be confirmed, than HAmI can be used in larger fields in agriculture business.

Materials and methods

Most systems are focused on only one part of water treatment, which is an issue. They use one of the following options:

- Time management for periodical watering
- Sensor for measuring humidity level
- Method to calculate evaporation from soil and plants
- Near IR imaging to check plants health

But only a few systems can combine those data

as a synthesized data source. The explanation can be done on a common situation. There are few hot days and no rainfall. So, due to evaporation from plants and soil the water level is getting down. All our systems decide that there is a need for water, which is a proper decision – all marks are in the conformity. System is starting to irrigate, but in a short time after watering, heavy rain comes.

Therefore, a massive watering is a waste of water. So system can use weather forecast to make real proper decisions in short-term lookout. Even in a situation when plants are in water shortage for few hours. Even advanced systems calculate only with current situation based on local measurement predictions (Giusti & Marsili-Libelli, 2015).

All decisions have to be made in a fully informed state. This is key advantage of proposed concept „HAmI" that offers a complex data synthesis where farmer can optimize water consumption. HAmI can help all because in a rainless time. HAmI can make our plant production sustainable and friendly to water resources.

Data requirements

Every plant has specific water supply needs – different amount in different time and in different soil depth (O`Shaughnessy, et al., 2012), (Yavuz, et al., 2015). Next variable in the decision process is soil – there is a need to consider all soil characteristics (Romero, et al., 2012) because of different water leakage and evaporation levels. The third part is information about meteorological data – forecast data to provide at least 24 hours prediction.

To design such a tool, there is necessary to specify data requirements. One part of those data is everywhere worldwide. It is the nature itself. Intelligent system must only have proper devices to measure it and analyse it. This allows decision support system to make imminent view of situation, and also provide look into past – system can pick up data to rate our decisions and interventions on the garden. Perhaps Penman Method can be used to water evaporation calculation (Yu, et al., 2010).

The second part of data is also important because it depends on weather forecast. Our system should be capable to offer some predictions. Minimal information needed is about weather for at least next 24 hours. One day is minimal time to prepare garden work plan. The second important function is prediction likelihood of diseases and pests. If there is current information and system can compare the information with weather forecast then it can enable to make our gardening smarter, friendly to water resources and also predict plants diseases.

Low or near zero cost is required in small business. There is a chance to design the system by using free data, free software and low cost computer components (but with reasonable value for money ratio). Very good price to performance ratio is crucial.

To provide necessary information, specific set of sensors is needed:

- Temperature
- Humidity
- Light intensity
- Rainfall

First two sensors will be located in different level. Correct level of measurement is needed to obtain proper data for all plants. Each crop has special demand. For basic measurement, there can be only one sensor set for each patch. If the patch is big or has different conditions – for example due to partial tree shade, it is recommended to use multiple sensor set.

Meteorological data

External forecast data and current weather information is crucial for a proper data analysis. Currently, it is very difficult to obtain the data in the Czech Republic. The Czech Hydrometeorological Institute (CHI) provides data on the Internet under the Creative Common licence – mark author, non-commercional use and no changes. The licence is quite suitable and sufficient enough to conduct proposed tests.

However, like other European National Meteorological and Hydrological Services, CHI operates on cost recovery model and sells some raw data (Pettifer, Primet, 2009). Moreover, data provided by CHI are represented as image or HTML code, which definitely makes data hard for machine reading – especially images. There are tools that can extract required information even from an image, but a less difficult option is needed to realize the proposed system. The system will be hosted at a small computer board with no CPU power to spare.

Fortunately an alternative open data resource is available in Norway at the web address http://yr.no. Norwegian meteorological service is very popular in the Czech Republic due to highly accurate forecasts. Provided data are available under an open licence for free use, even for commercial purposes. Second data source will be http://openweathermap.

org/ – an open meteorological data service with API. Data are easy to access due to machine-readable formats. Supported data formats are such as XML, JSON or HTML format. The data set contains current data and prediction for next five days. The university meteorological station – http://meteostanice.agrobiologie.cz - can be used as a reference point. There are current and past data available for analysis.

Due to decision-making based on weather forecast for a certain precise location, complex data processing combining data from multiple sources with different time attributes must be designed to achieve the best possible results.

A key part of proposed data processing is the evaluation. Every forecast service uses its own algorithm. Data sources provide distinct weather forecast data. This must be kept in mind due to analytic process design. The second problem is in the area size. Small field requires information about very specific area but not about entire city or region. The best estimation will be obtained for few hundreds of square meters.

Suggested data sources are such as:

- Local current weather – sensors array and nearest weather station as a reference point
- Local past weather – sensor data from the past
- Larger area current weather – weather situation in the entire city
- Larger area past weather – data from weather forecast service for entire city
- Larger area future forecast – weather forecast for entire city or region

Every data from other source has to be compared with our measuring. For exact estimation, system have to calculate variance. More values can be obtained by analysing variance changes in time. Forecast data providers rarely change their algorithm – variance can differ during time.

Weights of every single data source can be assigned by variance analysis, which makes the analysis more accurate after certain time. As an example, used sensors can measure temperature with ±0,5°C every single second. For our purpose, it is ideal to save every minute average data. The first data source provides an exact look at temperature curve at the monitored field. The second data source comes from local weather station. As an example, the weather station at CULS provides different data amount every 10, 15 and 60 minutes. For the purpose of temperature variances determination in the location, comparison of temperatures from professional tools and also verification of correct sensor data provision are done. The third part is made of data from countrywide measurements. A precise weather forecast based on multiple meteorological data sources is needed, enabling simultaneous data analysis. A forecast evaluation is made possible by comparison of external data and system local data and, consequently, it enables to prepare a scaled irrigation decision system. Synthesis of multiple forecasts helps to specify forecast for decision-making at certain location.

Forecasts evaluation

Due to a limited size of the article, following example of yr.no data can be shown:

<time from="2015-08-14T14:00:00" to="2015-08-14T15:00:00">

<!-- Valid from 2015-08-14T14:00:00 to 2015-08-14T15:00:00-->

<symbol number="1" numberEx="1" name="Clear sky" var="01d"/>

<precipitation value="0"/>

<!-- Valid at 2015-08-14T14:00:00 -->

<windDirection deg="144.0" code="SE" name="Southeast"/>

<windSpeed mps="3.7" name="Gentle breeze"/>

<temperature unit="celsius" value="23"/>

<pressure unit="hPa" value="1018.2"/>

</time>

There is a forecast for every next hour and every record has a valid time. So, if it can store every record from every hour forecast, those data can be compared and decision can be made about evaluation value. Once having enough evaluations available, the system can decide how accurate the record was. Then it is possible not even to rate entire meteorological service but also to rate certain months or weeks.

Accordingly to (Verzijlbergh, et al., 2015) those methods can be used:

- Forecast error – $\epsilon_{t+k|t} = y_{t+k} - \hat{y}_{t+k|t}$

In this notation, $\hat{y}_{t+k|t}$ denotes a forecast of variable y issued at time t valid for time $t+k$ and y_{t+k} is the observed value of the variable. In this context, k (not to be confused with the previously introduced clear sky index kt) is often referred to as

the forecast lead time.

- Bias – bias(k) = $\frac{1}{T}\sum_{t=1}^{T} \in_{t+k|t}$

where *T* denotes the length of the evaluation period (i. e. the number of forecasts evaluated). The bias thus represents the mean of the forecast error.

- Root mean square error

$$– RMSE(k) = \sqrt{\frac{1}{T}\sum_{t=1}^{T}(\in_{t+k|t})^2}$$

- Relative root mean square error

$$– rRMSE(k) = \frac{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(\in_{t+k|t})^2}}{\frac{1}{T}\sum_{t=1}^{T} y_t} = \frac{RMSE(k)}{\bar{y}}$$

where $\bar{y}$ denotes the average of all observations. To compute the average irradiance, observations can be discarded during the night when the irradiance is zero.

Results and discussion

Case study

A simple case study is focused on strawberry bed irrigation. In general, similar methods can be used on any crops in horticulture or agriculture. The first basic information is the crop water, temperature and sunlight demands. Secondly, sensor set is proposed as a hollow rod. In the rod, all sensors and necessary cabling are placed. Thirdly, pivot table for data analysis is designed.

Sensor rod

Basic sensor rod can have three levels of sensors. Each sensor level monitors specific values provided for a qualified irrigation decision-making. The three levels are such as:

- + 20cm – for light intensity sensor, air humidity and temperature
- + 5cm – for air temperature
- - 10cm – for soil humidity and soil temperature

Data stated above provide enough information for basic decision-making. There is a lack of information about amount of local rainwater. This can be fixed by adding rainfall measurement device. With rainwater information can be used Penman method to calculate evaporation and predict the length of time period before the water level drops below a comfort level.

Prototype of sensor set is prepared. Core of sensor set is micro computation board Arduino Nano, with communication unit nRF24L01. Main computation part is based on Raspberry Pi computer. Sensor set is composed from:

- BH1750 – light sensor – output in lux
- DHT22 or DHT11 – for air temperature and air humidity
- 18B20 – for soil temperature
- SHT10 – for soil humidity
- BMP180 – as barometric measurement

Sensor set is powered by small solar panel and energy is stored in rechargeable batteries. Energy consumption optimization has become the main part of testing. In the same manner, all chosen sensors are tested for measurement precision.

Source: own processing

Figure 2: RaspberryPi board.

Wireless communication is available for larger areas (Nesa Sudha, et al., 2011). RaspberryPi conducts all data processing and downloads open data on site. RaspberryPi can be powered by AA batteries or by car accumulator, which leads to significant energy savings. A power transformation module BattBorg is able to handle electric current between 7 V and 36 V. If there is power connection RaspberryPi can be powered by regular micro USB power source including mobile power banks. The same power sources can be used to power portable modem. When no power network is there combination of solar panels with a battery pack can be used (Deveci et al., 2015).

To provide correct data processing exact weather forecast is needed. This is probably the most difficult part of the system. Weather forecasts are very fuzzy with hourly updates and changes. Current forecast systems are able to predict exact situation for next 24 hours. When more hours are predicted, there is more uncertainty in the forecast. The level of uncertainty can be reduced by using more data sources. Data sources can be evaluated

and selected with better prediction results by data source combinations and by time evaluation.

There are no historical data at the beginning of measurement. So, the system has to learn in time. The system provides summarized information about soil environment to the horticulturist, which is an added value. There are two ways of information provision:

- Periodical updates to the server – can be used also as data backup;
- Direct information sharing via secured Wi-Fi connection to a mobile application.

Sensors enhancement

Sensors rod can be enhanced when they are is placed as a part of array with multiple sensors. The first optional sensor is near infrared camera to watch one segment of plants. The camera will record image in visual light or near infra-red spectrum. A proper colour model and mathematical model are needed for image evaluation to set precise soil to plants ratio. According to (García-Mateos, et al., 2015) a* in L*a*b* is the best channel with an optimal election and an accuracy of 99.2% by itself.

Next possibility is to add another sensor for extra information. It can be a laser sensor for checking plants health status. Through laser detection HAmI system can make estimation about plant condition (Li., et al., 2015).

System architecture

HAmI system is planned as three layer architecture. The first layer is described in the article. It is a sensor part providing data feed for decision subsystem of Horticulture Ambient Intelligence. In the first layer, there is also data mining subsystem that obtains information from open data sources, especially, meteorological data.

The second layer is composed from business intelligence processes. Those processes will be optimized for horticulture specific needs and for low computing power of low consumption computer board. This layer will provide data for correct decisions in accordance between local data, weather open data and specific needs of a crop.

The third layer is designed as decision support subsystem of HAmI. The layer accepts basic principles of ambient intelligence systems. Those system are designed to make decision as a reaction to external data in accordance with quick changing conditions.

Conclusion

The proposed project is ambitious. But, there are some facts that must be taken into account. Climate changes are continuous due Earth history. Weather has been changing since the time when first gases were released and created atmosphere around the Earth. Therefore horticulture as part of agriculture business has to be ready for next changes and must accept idea of sustainable and economical farming. Horticulture follows the above mentioned concept. The proposed concept is a part of the research plan of the Department of Information Technologies at the Faculty of Economics and Management, CULS Prague.

What is the status of HAmI? There is an early prototype of measuring system where some sensors are tested for accuracy and durability. On the other hand, there is also the first version of weather skill measuring system based on Data Cube principles. At the moment, Data Cube is implemented in Microsoft Excel with Power Pivot add-on. There is a continuous evaluation of forecasts from two sources for the first stage of implementation.

Making a cloud application for collection of those skill measurements and synthesizing data into one simple user's outcome is found as very difficult and challenging. In 2016, first measuring device will be launched on a real garden to test its operating characteristics.

The proposed system is capable to save large amounts of water without significant affection to the plant production. Every gallon of water that is saved at gardens or at larger fields is ready to be used for another purpose. HAmI system can be extended as a cloud solution with shared measurements that will lead to higher accuracy of weather forecasts for an end point application. Currently, there are three parallel developments in process. First prototype test should be ready in one year.

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