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## **Editorial office**

AGRIS on-line Papers in Economics and Informatics  
Information and Consulting Center of FEM CULS Prague  
Kamýcká 129, 165 21 Praha 6 – Suchdol  
Czech Republic  
Phone: +420 224 382 050  
E-mail: agrisonline(at)pef.czu.cz

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## **An analysis of the Peruvian jungle cocoa farmers: Acopagro cooperative vs. intermediaries – a case of study**

A. Higuchi<sup>1</sup>, M. Moritaka<sup>2</sup> S. Fukuda<sup>2</sup>

<sup>1</sup>Graduate School of Bio-resource and Bio-environmental Science, Kyushu University, Fukuoka

<sup>2</sup>Faculty of Agriculture, Kyushu University, Fukuoka

### **Abstract**

In the Peruvian jungle, there are two main cocoa marketing channels: the intermediaries and the cooperative. The Acopagro Cooperative, a Peruvian organization, for example, has contributed to the shift from illegal crops like coca to an alternative crop like cocoa which gives small scale farmers a sustainable welfare. A survey of 243 farmers in Juanjui, San Martin-which is the main cocoa production area in Peru-was carried out between December 2009-January 2010. This study analyzes Peruvian cocoa farmers' socio-economic characteristics as these attributes affect their decision-making process in the cocoa commercialization for their self-improvement and evaluates if the farmers' participation in Acopagro or not influences the increment of the cocoa production. Policy makers and farmers' organizations should consider these results in order to contribute to improve the competitiveness of the farmers' marketing channels not only towards the development of these organizations' but also to that of their communities as a whole.

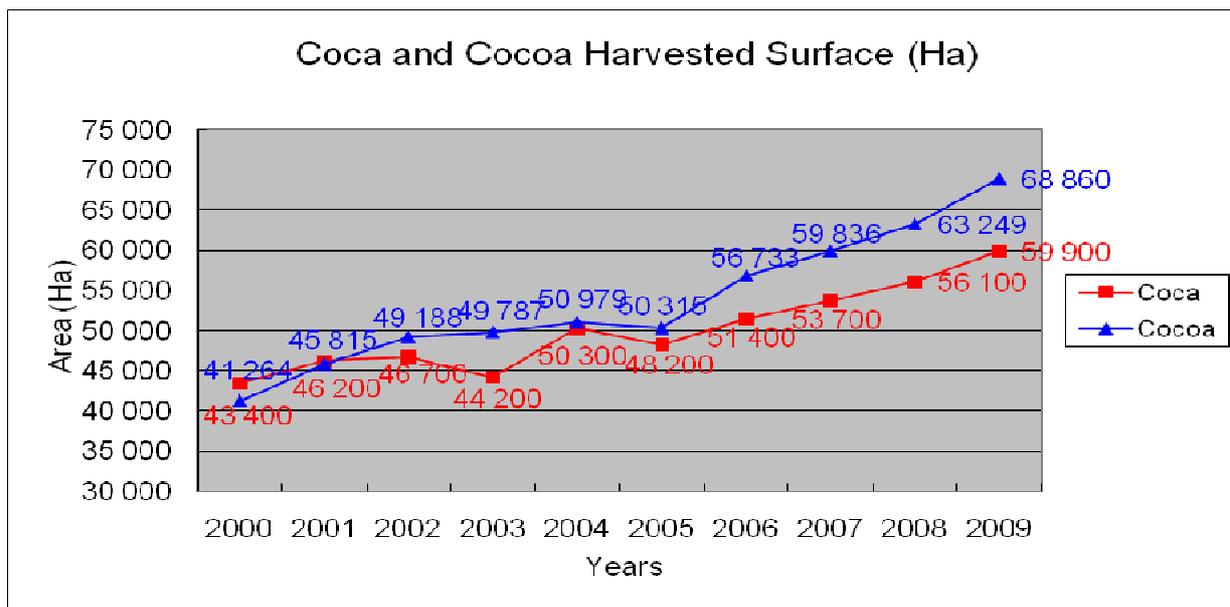
### **Key words**

Cooperative, socio-economic characteristics, logistic model, multiple regression function, cocoa production, marketing channel, farmers' organization.

### **Introduction**

The value of agricultural cooperatives can be very significant because they can assist small farm producers to effectively access new niche markets for their products, offering a promising option for rural poverty reduction (Donovan, J., 2006). Participatory cooperatives are very helpful in overcoming access barriers to assets, information, services and the markets within which small-holders wish to sell high-value items (Holloway, G. et al., 2000). In the Peruvian jungle, there are two main marketing channels. First, there are the intermediaries who just focus on the high prices without concern about the quality of the beans. Then there are the cooperatives who pay attention to cocoa beans differentiation due to their participation in the international market. These cooperatives provide benefits, such as, credits and technical assistance, as well as international prices information to members (M. Wollni, M. Zeller, 2007).

Since 1972, the Peruvian jungle was a perfect terrain for cultivating cocoa, which was the most profitable crop in remote areas. As a consequence of terrorism and drug trafficking, farmers were abandoned in the free market without financial or technical support. Consequently, the cocoa crop became an alternative to coca leaves (Ruiz, R., 2007). Nowadays, Peru is the second world cocoa leaves producer with 59,900 hectares, being 92% used for drugs usage (ONUDD, 2009). Acopagro cooperative, a Peruvian organization created in 1992 with United Nations support, for example, has contributed to the shift from illegal crops like coca to an alternative crop like cocoa. This shift helps small scale farmers in the Peruvian jungle to increase and diversify their income in a legal and sustainable way, preserving the environment at the same time. Due to this effort, the production of



Graph 1.

cocoa beans has increased immensely in the past years. This can be seen when comparing previous years to the present.

Measuring farmers' perceptions as well as studying the socio-economic characteristics and information-seeking behavior that influence those perceptions should be the preliminary steps towards the development of extension programs to promote sustainability among farmers and rural population (Fusun Tathdil, F. et al., 2009). Therefore, it is necessary to understand the socio-economic characteristics for making judgments about the effects of different policies on economic welfare (Glewwe, P., 1991). Participation in an institution like the cooperative involves the adoption of quality standards and specific production techniques for exporting the product (M. Wollni, M. Zeller, 2007). Consequently, mainly having access to extension services which help farmers to increase the quality of their cocoa is presumed to have a positive influence on their participation in Acopagro. On the other hand, farmers who commercialize through the intermediaries just focus on the cocoa for the national market, which pays a higher price without caring about the drying and fermentation of the beans. (IICA, 2009).

It is expected that having a higher education level can influence the probability of participating in the cooperative positively. This is because naturally,

farmers are more able to adopt new technologies; understand price and market information; and have more access to credit and other forms of capital (Norton, G. W., et. al, 2006). Experience in cocoa cultivation is also expected to be positively associated with participation in the cooperative as farmers can demonstrate a greater capacity to bear the risk involved in adoption of innovations (M. Wollni, M. Zeller, 2007). Another characteristic like being older is also positively related to participation due to intergenerational differences in cooperative values. In addition, many of the cooperatives have launched projects intended to strengthen the role of women (Murray, D. L. et al., 2006). Therefore, female membership is also positively related as gender equity improves their process of economic development (M. Wollni, M. Zeller, 2007).

Many tropical and subtropical crops as cocoa display the tendency to produce low yields after years of large yields (Florkowski, W. J. and Sarmiento, C., 2005). Moreover, small cocoa producers do not possess high technology equipment. As a result, most of them are not able to produce in scale economy. However, access to institutional support services plays a significant role in enhancing smallholder intensity of input use, crop productivity and market orientation,

Variable	Description	Total (n=243)		Coop member (n=103)		Non coop member (n=140)	
		Mean	SD	Mean	SD	Mean	SD
Coopmemb	Dummy variable which takes the value of 1 if the farmer participates in Acopagro; 0= not a member	0.42	0.03	1.00	0.00	0.00	0.00
Experience	Experience in cocoa cultivation (years)	6.31	0.20	7.77	3.29	5.24	2.43
Livestock	Land for livestock (ha)	0.51	0.14	0.82	2.65	0.28	1.81
Othercrop	Land for other crops except cocoa (ha)	0.91	0.08	1.16	1.43	0.73	1.17
Maleadult	Number of male farm workers (>18 years old)	1.50	0.05	1.27	0.73	1.66	0.66
Parttime	Number of workers hired as part time labor	1.17	0.11	1.51	2.05	0.91	1.41
N.intcha-1	No. of institutions that gave technical assistance discarding the cooperative (No. Institutions – 1)	0.53	0.73	0.89	0.78	0.26	0.57
Cocoa	Cocoa cultivation before (1= yes, 0= no)	0.48	0.03	0.64	0.48	0.36	0.48
Distance	Distance to gathering center > 2 km (0= yes, 1= no)	0.65	0.03	0.31	0.47	0.90	0.30
Sex	Sex (1= male, 0= female)	0.96	0.01	0.93	0.25	0.99	0.12
Age	Farmer's age (years)	45.35	0.76	49.22	12.27	42.50	10.82
Education	Farmer's education (years)	8.78	0.23	7.66	3.50	9.58	3.42
Married	Farmer's civil status (1= married, 0= other)	0.57	0.04	0.52	0.50	0.56	0.50
Occupation	Farmer's main occupation (Agriculture=1, Other=0)	0.91	0.02	0.98	0.14	0.86	0.35
Cocoaproduct	Cocoa production (tons)	1.72	0.78	1.81	1.21	1.65	1.23
Cocoalnd	Cocoa land (ha)	2.31	1.27	2.44	1.10	2.20	1.38
Proptitle	Have a property title (Yes=1, No=0)	0.61	0.49	0.58	0.50	0.64	0.48
Machine	Have a machine for cultivating cocoa (Yes=1, No=0)	0.30	0.46	0.17	0.38	0.39	0.49
Fertilizer	Total amount of fertilizer (soles/year)	134.89	290.60	49.64	155.34	197.61	346.40

Table 1: Summary Statistics.

controlling other factors (Gebremedhin, B., et. al., 2009). Consequently, it is expected that the cooperative, which provides technical assistance and training, influences the farmers' cocoa production volume.

Two objectives are anticipated to be reached in this paper: First, to identify and analyze the socio-economic characteristics that influence membership in the Acopagro cooperative by comparing cooperative members to cocoa farmers who distribute their product through intermediaries. The second objective is to measure whether being

member of Acopagro or not impact the current cocoa production volume.

## Materials and methods

A survey of the cocoa producers was carried out in December 2009-January 2010 in Juanjui, San Martin (which is the largest cocoa producer region in Peru). Primary data was gathered by using a structured questionnaire at the study site with cooperative support, covering topics as the socio-economic characteristics of households and marketing information. As a result, a total sample of 243 farmers was collected. Personal interviews

with the general manager as well as one farmer community leader were also conducted for qualitative description purposes.

Socio-economic variables are commonly used by many researchers to compare or study the influence of different factors on some behaviors of a specific group of people (Fusun Tathdil, F. et. al., 2009). To identify the factors that make farmers choose which marketing channel they would like to use in order to commercialize their cocoa, a bivariate logistic regression was used to analyze and examine the effect of each explanatory variable on the dichotomous dependent variable. In this case study, the dichotomous dependent variable is the membership in Acopagro or distribution of their products through intermediaries.

The logistic regression equation is based on the principle which uses logarithmic terms to express the multiple linear regression equation. Thus, the problem of violating the assumption of linearity is overcome. For interpretation purposes, the odds ratio is reported as this proportionate change in odds. Moreover, it can be interpreted as a multiplier of the odds of being a member or not of the cooperative. If the value is greater than 1, then it indicates that as the predictor increases, the odds of cooperative membership increase. Conversely, a value less than 1 indicates that as the predictor increases, the odds of cooperative membership decrease (Field, A., 2009).

$$P(Y) = \frac{1}{1 + e^{-(b_0 + b_1 X_1 + b_2 X_2 + \dots + b_i X_i + \dots + b_n X_n + \mu)}} \quad (1)$$

Using the Binary logistic regression model equation (1) for the model purposes, Y is the marketing channel that the farmer chooses (if Y=1, the farmer belongs to Acopagro cooperative, otherwise if Y=0, the farmer chose the intermediaries). P(Y) is the probability of participation in a marketing channel;

$b^0$  is the intercept;  $b_i$  ( $i= 1\sim n$ ) are the estimated model coefficients;  $x_i$  ( $i= 1\sim n$ ) are the independent variables and finally,  $\mu$  is a random error term. Summary statistics for the variables included in the logistic model are given in Table 1.

Growth in output per worker in agriculture is generally recognized a necessary condition for economic development. Institutions as a cooperative supplies technical inputs to their

farmers and provides them with the knowledge and skills to make a productive use of the new inputs (Hayami, Y. and Ruttan, Vernon W., 1985) in order to produce more volume of a product. It is expected to find an important influence in the cocoa production volume, given the quality and consistency requirements of the dedicated cooperative members. A multiple regression model was used to explain the variability in the cocoa production volume and estimate the effect of being member of Acopagro or not among other various factors.

$$y_i = a + b_1 x_1 + b_2 x_2 + \dots + b_i x_i + \dots + b_n x_n + \mu \quad (2)$$

Where  $y_i$  is the cocoa production volume (tons),  $a$  is the intercept;  $b_i$  ( $i= 1\sim n$ ) are the estimated model coefficients;  $x_i$  ( $i= 1\sim n$ ) are the independent variables and finally,  $\mu$  is a random error term. Summary statistics for the variables included in the multiple regression model are also given in Table 1.

## Results and discussion

Table 2 shows the results of the logistic regression model, previously testing the presence of multi-collinearity between the explanatory variables used in this model. The aftermath confirms the positive effect of receiving technical assistance for participating as a member in the Acopagro cooperative. Particularly in this case, bias was controlled by not considering Acopagro as an institution that gives technical assistance to the farmers (N.instcha-1). This was because if cocoa farmers belong to the Acopagro cooperative, they would then have free access to technical assistance- an advantage for members over non members. This factor would then become a potential source of partiality in this model. As the number of institutions that give technical assistance to the farmers increased by a unit, the change in the odds of membership to Acopagro is 2.53. In other words, farmers who belong to Acopagro are concerned about learning competitive sustainable techniques based on high export standards. This knowledge acquisition then translates into high income for them.

Although former studies conducted by Boz and Akbay (2005), M. Wollni, M. Zeller (2007), Fusun Tathdil, F. et. al. (2009) showed education as a significant variable for a positive effect on

cooperative values, the results in this case demonstrated the opposite. Namely, most of the farmers who are Acopagro members have only an elementary school level and agriculture is their main income source. Thus, the theory that mainly the education level can influence the probability of becoming a member in the cooperative positively is rejected as it did not have a significant impact on participation. Instead, the farmers who commercialize on their own have higher level of education than the ones who chose Acopagro.

As it was expected, being older than 40 years old and the experience of cultivating cocoa have a positive effect on the odds of cooperative membership (1.06 and 1.33 respectively). Also, the number of male household members has a significant but negative effect (decreasing 0.32,  $p < 0.05$ ). This is because farmers who belong to Acopagro prefer to send their young people to study at school instead of having them help out on the farm. Consequently, part time labor, used by the farmers, is a positive variable and significant in this model (1.31). In 2007, Acopagro increased their female members to 12% in 2007 (Ruiz, R., 2007). It is confirmed in this paper's model that the odds of a woman entering a cooperative as a member is nine times more likely than her commercializing through

intermediaries. The longer the distance to distribute the product and the larger cocoa production (significant at 1 and 5% respectively), the more positive the effect for commercializing through intermediaries.

Table 3 shows the final selection of the variables and the parameter estimation results for the multiple regression equation. Although quantitative variables were few, the model proved to be a useful tool for analyzing relationships between individual factors in their effect on the cocoa production volume.

$R^2$  is the proportion of cocoa production volume variation explained by the model and its value of 0.73 which means that explanatory variables included in the model explained 73% of the cocoa production volume variation. In other words, the model explains 73% of the variation in the dependent variable.

Many studies as the one conducted by Aspiazu, J. (2010), pointed out that an association generates greater production tradable volumes. Nonetheless, regression findings show that participation in Acopagro is not significant and even the effect in the cocoa production volume is negative. Part of

Variable	$\beta$ (SE)	95% confidence intervals for odds ratio		
		Lower	Odds ratio	Upper
Intercept	0.53(2.12)			
Experience	0.29(0.09)***	1.12	1.33	1.56
Livestock	0.07(0.11)	0.87	1.08	1.33
Other crops	0.12(0.17)	0.81	1.13	1.57
Male adult	-1.13(0.30)***	0.18	0.32	0.58
Part time	0.27(0.14)**	1.01	1.31	1.71
N.instcha-1	0.93(0.32)***	1.36	2.53	4.72
Cocoa	0.40(0.44)	0.63	1.49	3.53
Distance	-3.25(0.48)***	0.02	0.04	0.10
Sex	-2.23(1.33)*	0.01	0.11	1.44
Age	0.06(0.02)***	1.01	1.06	1.11
Education	-0.03(0.07)	0.86	0.98	1.11
Married	-0.21 (0.47)	0.33	0.81	2.02
Occupation	0.53(1.10)	0.20	1.71	14.65
Cocoa prod	-0.50(0.21)**	0.40	0.61	0.92

Note: [a]  $R^2 = 0.52$  (Cox & Snell), 0.70 (Nagelkerke), 0.26 (H&L goodness of fit), \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

[b] B are the estimated coefficients. Standard errors are in parenthesis (SE).

[c] SPSS version 15.0 was used for estimating the binary logistic model.

Table 2: Results from binary logistic regression analysis of Acopagro membership.

Variable	$\beta$ (SE)	T-value	P-value
Intercept	-0.70(0.18)***	-3.98	9.34E-05
Coopmb	-0.11(0.10)	-1.05	0.29
Cocoalnd	0.68(0.04)***	16.14	7.11E-40
Proptitle	0.18(0.09)**	2.07	0.04
Part time	0.07(0.02)***	0.03	2.69
Machine	0.11(0.10)	1.07	0.29
Experience	0.06(0.02)***	4.17	4.31E-05
Education	0.02(0.01)	1.29	0.20
Fertilizer	0.00(0.00)*	1.74	0.08

Note: [a] R<sup>2</sup>= 0.73, adjusted R<sup>2</sup>= 0.72, standard error= 0.64, \*p<0.10, \*\*p<0.05, \*\*\*p<0.01.

[b] B are the estimated coefficients. Standard errors are in parenthesis (SE).

[c] Excel 2003 was used for estimating the multiple regression model.

Table3: Results from the multiple regression analysis.

this reason is that the intermediaries collect raw material quantity, not classifying the cocoa using quality standards while Acopagro cooperative cares about the drying and good fermentation of the cocoa. This is the main reason why the Acopagro cooperative distributed cocoa quantity is low.

Cocoa land represents a form of internal capital accumulation. Therefore, as it increases, the product volume also increases. If the cocoa area increases by one unit holding other factors fixed, then the total cocoa production volume is predicted to change by about 0.68 metric tons. Experience is also another important factor that contributes to the cocoa volume (0.06). As years pass, farmers gain better skills for cultivating the crop. In perennial crops this fact is even more accentuated, because the more years that the tree has, the more and the better is the production. Nevertheless, the production is not sensitive to the education factor, as it appears as a non significant variable.

Peru was endowed with a favorable land-labor ratio (Hayami, Y. and Ruttan, Vernon W., 1985) and this can be appreciated specially in the jungle that there is no pressure regarding to the limitation of the land resources. Therefore, as the part time labor increases, the total volume of cocoa production also increases (0.07). In addition, having a property title, contributes also to the cocoa volume production (0.18). As the jungle is a vast region, farmers tend to get a piece of land without having a property title and this affect the production as it is not really owned by the farmer. Finally, biological improvements as fertilizers are associated with higher levels of yield (0.00031).

## Conclusions

Acopagro cooperative offers a promising option for rural poverty reduction, providing benefits that influence the participation of the cocoa farmers in this institution. Numerical results confronted with personal interviews made by the author, illustrate that farmers who join the cooperative possess strong willingness to learn through technical assistance. This is because they can learn more techniques to improve their welfare. They can also improve their cocoa production to yield higher revenues that can provide stability to their families. Although earlier works mentioned education as a significant variable, this research's outcomes show that farmers who belong to Acopagro have just an elementary school level of education. Thus, this is not a significant factor for their joining the cooperative.

Lack of access to main cities due to the wide geography of the jungle made it difficult for cocoa farmers to receive a good education and have access to health services. Consequently, they found in Acopagro a way to overcome poverty by cooperating with farmers who belong to their communities. In this way, they try to pursue long term prosperity, for example, by sending their children to the school.

Results also demonstrated that farmers who possess the following attributes were more likely to participate in the Acopagro cooperative: 1) older than 40 years old 2) cultivation of cocoa experience 3) less family male members on the farm 4) hired part time labor and 5) female. Alternatively, farmers who commercialize through intermediaries have more cocoa production and go further to

gather their crops in order to receive higher prices for their raw material.

The multiple regression function outcomes show a non significant and even negative relationship between the cocoa volume production and the participation in Acopagro cooperative. Acopagro cooperative takes care about the quality of the cocoa as it is one of the main requirements for exporting, obtaining as a result less quantity of raw material. Findings that influence in higher cocoa production volume are: 1) cocoa land 2) cultivation of cocoa experience 3) labor 4) have a property title and 5) use of fertilizer.

In a nutshell, farmers who belong to Acopagro depend on the Cooperative for commercializing their cocoa due to their basic education and their willingness to learn more techniques. This gives

them a means to compete more effectively against farmers who sell through intermediaries. The farmers who rely on intermediaries sell their cocoa to those who care about the quantity not the quality, because the raw material is mainly destined for the national market.

Development programs over the medium to long run will need to take into account the changing nature of farm-level investments thus implied (Hernandez, R. et al., 2007). The Peruvian Government should consider these socio-economic facets when constructing bridges for connecting districts; improving the roads as well as building good schools and hospitals for the enhancement of these farmers' communities. Conversely, contemplating these factors are important for the development of farmers organizations as well as the long term improvement of the region as a whole.

*Corresponding author:*

*Angie Higuchi*

*Kyushu University*

*Fukuoka-shi, Higashi-ku, Hakozaki 1-12-30 Shurain Hakozaki 702, postal code: 812-0053*

*Phone: +81-80-6411-7142*

*email: angiehiguchi@gmail.com*

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## Valuing Socioeconomic Factors of Farmers' Households and Economic Effects of Agroforestry System

J. Kalabisová, Z. Křístková

Faculty of Economics and Management, Czech University of Life Sciences Prague

### Abstract

The paper contains results of research realized in the rural area of Ucayali region in Peru, situated in the tropical zone in the Central East of the country. With the use of data acquired from agroforestry research on the demonstration plots and questionnaire survey on farmers' households, the objective is to assess the economic effects of designed agroforestry multi-strata system by means of ex-ante approach. It was found out, that unfavorable financial results in first two years of the system, long production cycle of timber trees and low price of timber represent the principal challenges for adoption of agroforestry systems. The results drawn from the LP modeling described in this paper provided useful insight into the household's economy which is based on agroforestry production system. The results were elaborated within the research intention IVZ MSM 6046070906.

### Key words

Agroforestry System; Linear Programming Model; Ucayali.

### Anotace

Tento článek obsahuje výsledky výzkumu realizovaného v rurální části regionu Ucayali v Peru, který je situován v tropické zóně v centrální části země. Data byla získána z demonstračních parcel z agrolesnického výzkumu a provedeného terénního šetření u zemědělských domácností. Hlavním cílem tohoto příspěvku je zhodnotit ekonomické efekty navrženého agrolesnického systému zvaného multi-strata a to pomocí ex-ante přístupu.

Bylo zjištěno, že finanční ztráta v prvních dvou letech systému, dlouhý produkční cyklus dřevin a nízké ceny dřeva představují hlavní překážky pro přijetí agrolesnických systémův oblasti. Výsledky modelu lineárního programování popsaných v tomto článku poskytnou detailnější pohled na ekonomiku zemědělských domácností, která je založena na agrolesnickém produkčním cyklu. Poznatky prezentované v článku jsou výsledkem řešení IVZ MSM 6046070906.

### Klíčová slova

Agrolesnický system, Model lineárního programování, Ucayali.

### Introduction

Traditional slash-and-burn<sup>1</sup> (or shifting cultivation) systems<sup>1</sup> with prolonged fallow periods are no longer feasible in most parts of the tropics, due to excessive growth of population placing greater demands on soil and forest resources (Fujisaka and White, 1998; pp.1). Farming systems, that imitate the structure and processes of natural forest vegetation, such as agroforestry systems, have high potential to increase the productivity of farming systems and sustain continuous crop production

(Stark, 2000; Fagerström, 2000; cit. in Lojka, 2005; pp.3).

Leakey (1997; pp.5-7) defines agroforestry as “a dynamic, ecologically based, natural resources management system that, through the integration of trees in farmland and rangeland, diversifies and sustains production for increased social, economic and environmental benefits”.

It is now generally acknowledged that practices which can be qualified as agroforestry are common among many Amazonian tribal and non-tribal

farmers (Padoch and de Jong, 1995; pp. 226-237). Indigenous systems are found to provide subsistence and cash income while conserving soil, water and forest resources. For these reasons, indigenous agroforestry systems are being promoted as alternate models for rural development (Coomes and Burt, 1997; pp.27).

Agroforestry can improve productivity by increased output of tree products, improved yields of associated crops, reduction of cropping system inputs, and increasing labor efficiency (Nair, 1993; cit. in Lojka, 2005; pp.13). However, positive effects of agroforestry systems refer mainly to humid tropical conditions, and optimum conditions for fast decomposition are found under high average temperatures and continuous water supply. Tree biomass accumulation and nutritional contribution is generally less pronounced in arid, semi-arid and highland areas and available data are scarce (Anthofer et al., 1998, pp. 1). On the other hand, with increase in density of trees, their size, and/or ability to capture resources, they can exert strong competition for light, water and nutrients, and reduce annual crop yields beyond the interests of farmers if improperly selected and managed (García-Barrios and Ong, 2004, pp. 222).

Sustainability is achieved by conserving the production potential of the resource base, mainly through the beneficial effects of woody perennials on soils. However, the improved or new agroforestry technologies that are introduced into new areas should also conform to local farming practices. According to the research focused on feedback from farmers regarding their perceptions of technology it was found out that the benefits of sustainability are not always perceived by farmers. Especially resource-poor farmers may make sustainability a secondary consideration and thus may be more reluctant to adopt agroforestry technologies (Loker, Verab and Reitegui, 1997; pp.405).

Concern over adoption rates of agroforestry systems has highlighted importance of integrating socioeconomic elements into traditional biophysical agroforestry research (Nair, 1998; cit. in Alavalapati and Mercer; 2004, pp.1). The socioeconomic research<sup>2</sup> carried out by Thangata and Alavalapati (2003; pp. 68) find out that younger farmers are more likely to adopt

agroforestry. They also state, that farmers with larger families are more likely to adopt agroforestry technology when compare to farmers with smaller families. For resource poor farmers, who cannot afford to apply fertilizers in their farming, agroforestry practices are thought to provide best alternatives. As the findings confirm, "better off households can afford to use high cost fertilizers. As such there is less necessity for them to adopt this technology.

Various research studies focused on the sustainability of production systems in the region of Ucayali have been carried out (e.g. Fujisaka and White, 1998; Fujisaka, Escobar and Veneklass, 2000; Loker, Verab and Reitegui, 1997; Kobayashi, 2004; Fujisaka et al., 1999; Smith et al., 1999).

Fujisaka and White (1998; pp. 1-15) analyze the role of agroforestry as a land use option in region Ucayali. It is suggested that analyzing the adoption of agroforestry systems the attention should be paid also to the conditions and trends in demand. Due to limited land and closeness to the urban market, the designed agroforestry systems developed in the Ucayali region should contribute to intensification and diversification of crop production including the establishment of perennial crops.

The need for proper agroforestry systems is supported in research made by Fujisaka, Escobar and Veneklass (2000). The findings show that the slash-and-burn agriculture reduces diversity of forest plants and increase weeds that lead farmers to more forest clearing. Reduced biodiversity in Pucallpa is due to disappearance of genuine primary forest, expansion of pasture area and pressure to hard wood trees as substitute to cocoa production. The research on land use systems and dynamics (Fujisaka et al., 1999; pp. 23) revealed that most of the farmers using slash-and-burn agriculture techniques arrived to the region Ucayali within 1990-1995. Migratory agriculture in Pucallpa leads to the fact that a high proportion of farmers' lands is under fallow or secondary regrowth. Thus, the need to work with farmers on new agroforestry technologies such as multi-strata<sup>3</sup> systems is supported.

Based on this evidence, agroforestry dissemination is the main topic of the official development project of Ministry of Agriculture of the Czech Republic carried out by Institute of Tropics and Subtropics of

the Czech University of Life Sciences from 2003. One of the main objectives of this project is development of agroforestry systems and technologies for improvement of soil quality of agricultural plots and design of sustainable production systems of agricultural households in the region Ucayali. Since 2004, demonstration plots where multi-strata systems are implemented have been established.

The paper deals with economic assessment of the designed multi-strata systems in the region Ucayali. Ex-post assessment of agroforestry adoption after the technology has been disseminated is useful to evaluate how the resources were used to extend the technologies. However, in this case, the demonstration plots with implemented multi-strata systems do not provide with economic results yet. Therefore, the assessment is based on ex-ante approach which assesses possible adoption before the technologies are disseminated (Mudhara and Hildebrand; cit. in Alavalapati, 2004; pp. 202). On basis of ex-ante assessment, this paper presents the use of dynamic linear programming (LP) model for simulating different situations of farmers' households adopting multi-strata agroforestry system in the agricultural area of region Ucayali, Peru. The objective is to assess the economic effects of designed agroforestry multi-strata system and to evaluate socioeconomic factors of farmer households with the use of data acquired from agroforestry research on the demonstration plots and questionnaire survey on farmers' households. The results will provide better understanding of household's economy in relation to agroforestry production cycle and thus will contribute to the process of agroforestry implementation, leading to greater sustainability of the production systems in the region Ucayali.

### **Characterization of research site**

The Ucayali region is situated in the central part of Peru and forms a part of the Amazon River basin. It borders with the Loreto Department on the North, with Cusco and Madres de Dios on the South, with Brazil on the East and with Huanuco, Pasco and Junín Department on the West. Its surface is 102 410.55 km<sup>2</sup> corresponding to 7.97 % of total national territory. Almost the whole region is covered by forests and by extravagant vegetation with the altitudes varying between 150 and 450 meters above sea-level. The predominant climate is

warm and humid and the precipitations are abundant (in average 2,344 mm annually) but do not exceed the precipitation of the cloud forest reaching 4,000 mm per year. The temperature fluctuates between 19°C and 30.6°C with the annual average of 26.7°C (Gobierno Regional, 2004; pp. 1).

The population of the Ucayali region is estimated to 460,557 inhabitants in 2003 what is 1.7% of the country's population (Instituto nacional de estadística e informática, 2003) and is represented mostly by the immigrants from the coast and mountain parts of the central Peru and Amazon Basin that colonized especially the neighboring areas on the main road between the capital of the region - Pucallpa and Lima (Gobierno Regional, 2004; pp. 31).

The poverty rate of the Ucayali region is 70.5% and the level of population living in extreme poverty reached 44.9% that places this region to the ninth place of the poorest regions of Peru. The Human Development Index (HDI) of the Ucayali region was 0.55 that corresponds to the average level, reaching the lowest value for the forest parts. The value of HDI reflects differences in the indicators of GDP per capita and the distribution of income (Gobierno Regional, 2004, pp. 32).

In 2001, the Ucayali region contributed to the national GDP with US \$ 462 millions that represented 0.85% while GDP per capita was US \$ 1,026. The main production activities of the Ucayali region are: agriculture (farming) and forestry, manufacture industry, commerce, restaurants and hotels, fishery and mining (Křístková and Kalabisová, 2006; pp.1).

The region is divided into four provincials Coronel Portillo, Atalaya, Padre Abad and Purús. A study was carried out in the villages of Pimental, Antonio Raimondi and Nueva Belén. All the villages are situated nearby the capital of Pucallpa in the province of Coronel Portillo.

Nueva Belén, a hamlet of approximately 250 inhabitants with a bad access to the main road Federico Basadre especially during the rainy season, is situated 15 km from Pucallpa. The main activity of the farmers is recollection of the widely grown crop-plant and timber. The bad access to Pucallpa's market is a cause of under-developed

agriculture. The principal crops are cassava, rice and pineapple. The productive land is in general poor and the main problem is excessive expansion of weed *Imperata*<sup>4</sup>.

Antonio Raimondi lies 19 km from Pucallpa with the population of 300 inhabitants. This solitary village is surrounded by the terrain with the majority of pasture of bad quality caused by the weed of *Imperata*. Although the village disposes of suitable terrains for the pasture, beef-raising is not very well developed. The principal crops are cassava, raise, corn, citruses and other fruits. Nowadays a majority of the farmers desire to dedicate to the cultivation of sugar cane hoping to get good results.

Pimental is the most developed village of the entire research area with the total population reaching approximately 500 inhabitants and is situated 35 km from the capital of Pucallpa. In the near history, most of the inhabitants dedicated to the cultivation of pepper that was supported by the state subventions. Nevertheless due to the significant decrease of the pepper prices during last few years, the pepper production is not more profitable. Soils are in general poor and beside pepper, that still remains one of the most important crop, the most cultivated crops are citruses, rise and cassava (Lojka and Lojková, 2003).

## **Data sources**

For the construction of linear programming (LP) model, two data sources have been used. Data dealing with designed agroforestry system were provided from demonstration plots and were related to labor requirements, material inputs, yields, producer prices and rotation of crops within a period of 10 years.

A questionnaire with mostly open-ended questions was developed to collect required information of households' families. This questionnaire was pre-tested on two households and the output was used to make minor modifications in the questionnaire. 34 questions in the final version were divided into three groups, namely the information about:

- Agriculture related activities of the farmer;
- Age, education and occupation of all household members; and

- Detailed financial flows of the household including all sources of incomes and expenditures.

A total of 60 households (farmers' families) were interviewed from 10th July to 8th September 2006. Most of the questionnaires – 43 were obtained in the biggest village, Pimental. The rest, 10 questionnaires were obtained in Nueva Belén and 7 in Antonio Raimondi. The average age of the interviewed farmers was 48 years. Farmers spent in average 8 years at school, corresponding to second year of secondary school (primary education is six years). The average size of farmers' families was 5 members (considering only permanent members of the household).

In the research area, the crop production predominates; 29 of the interviewed households noticed as main activity crop production, 10 households claimed as main activity animal production and 13 households obtained their incomes from other activities. Regarding farmers' revenues, crop production reached in average 50% of total farmers' revenues while animal production represented only 22%. The rest 28% of revenues originated from other activities such as recollection of the widely grown crop-plant and timber, commerce, hired labor and financial support from other family members.

Rice, cassava and maize represent main source of income from crop production (29% of the total income) followed by citruses with 20% and other fruits with 14%. Total average area of farmers' plots was 23.8 ha; however the farmers cultivated only minor part reaching 3.7 ha, the rest of the land were pastures and fallows. With respect to the land ownership, 42 farmers claimed themselves as the registered owners, 14 as unregistered owners and only 4 claimed that lived on a hired land. More than 50% of households were producing on their land less than 20 years, whereof 9 farmers lived in the respective area less than 5 years. It was found out that 24 farmers included in the questionnaire survey were involved in the agroforestry project of Institute of Tropics and Subtropics by planting demonstration plots.

In the research area there is limited access to state support and microfinancing tools are not employed in a large extent; only 16 households of all research sample derived benefits from micro credits. Due to

insufficient financial capital, the crop production is carried out with low inputs of fertilizers, seeds and machinery. Most farmers claimed that in case of having sufficient financial capital, they would invest to cattle production that is perceived as more stable and profitable.

Pucallpa represents the principal trade outlet for the farmers. Despite of its closeness, the undeveloped infrastructure and non-existing sales cooperatives make the commercialization of agricultural commodities difficult. To assess the economic effects of designed agroforestry multi-strata system, a representative farm household was chosen on basis of following criteria:

- farmer main activity is crop production,
- both the farmer's income and profit meet the average value of the sample, calculated on basis of percentile mean (Hendl, 2006, pp.103).

The characteristics of the selected farmer are given in Table 1.

### **Description of Agroforestry System**

Agroforestry system was designed with respect to the experience gained from the research carried out in demonstration plots. For modeling purposes, the agroforestry system was simplified to final form with the total of five planting activities: cassava, pineapple, Inga edulis<sup>5</sup>(Guaba), fruit trees (Annona muricata – Guanabana) and timber tree Bolaina (Guazuma crinita – Bolaina blanca) that represent major crops in the research area.

A dynamic 10-year LP model was chosen to reflect the rotation of the crops taking into account the long production cycle of Bolaina. The designed agroforestry system during a 10-year production cycle on one plot of land is demonstrated in Table 2.

The rotation of crops follows the multi-strata principle of agroforestry system. In the first year, the main cash and food crop (C) that is cassava, is planted on one plot of land together with guaba and

other tree species (guanabana and bolaina). In the following year, cassava is grown again on the plot but due to the higher competition with the tree species, the cassava yields are lower. Since cassava cannot be planted more because of the insufficient light and nutrient competition with trees, in the third year it is replaced by pineapple (P). The competition between cassava and tree is also mentioned in work of Agbo et al. (1997). The pineapple is shade tolerant crop and is cultivated until the sixth year, when the tree cultivation prevails. Guaba (IE) is grown on the plot between the first and fifth year of the cycle. It is periodically pruned and thinned to minimize light and nutrient competition. Since the third year, fruit can be harvested. Last four years, only timber trees of bolaina (B) and fruit trees of guanabana (FT) are cultivated on the given unit of land. Guanabana fruit can be harvested since the third year and the trees has to be thinned to the final density of 150 trees of guanabana and 150 trees of bolaina per hectare in the fifth and seventh year. After ten years, the agroforestry cycle is finished, the timber is harvested and the rotation can start again following the described agroforestry practice on the same unit of land.

In the paper, the representative farmer applies designed agroforestry system on five units of land that represents total cultivated agricultural area of the farmer. Within the ten-year cycle, the agroforestry plots are gradually occupied in two years-period. In the last two years, the whole agricultural area is occupied by agroforestry plots. In order to meet farmer auto-consumption requirements, on the unoccupied parts of total agriculture area, the additional cassava monocultivation was introduced into the model. Due to the fact, that the additional cassava monoculture is planted without tree species, there is no competition problem and thus the yields do not decrease in the following year. Scheme of the agroforestry system of all the units of total agricultural land within ten-year period is demonstrated in Figure 1.

	Representative Farmer	Sample mean
Age	49	48.15
Education (years)	8	7.9
Number of family members	9	4.6
Total Annual Income [Soles*]	17.620	17.899
Total Annual Profit [Soles]	7.496	6.759

Notes: \* US \$ 1= 3.1853 Soles (as of March 13, 2007)

Table 1: The representative farmer.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
ALK	c	c	p	p	p					
	IE	IE	IE	IE	IE	IE				
	FT									
	B	B	B	B	B	B	B	B	B	B

Notes: ALK- Agroforestry plot, C-cassava, P-pineapple, IE- Inga Edulis, FT-fruit trees, B- Bolaina.

Table 2: Agroforestry production cycle.

### Household LP Model

Linear programming is a mathematical technique for determining the most desirable or most profitable course of action for situation where a number of variable are involved, where many possible courses of action are available, and where the problem can be expressed in linear terms. Thus, linear programming is another optimizing technique, however, which is applicable to many types of decision problems (Howel and Teichroew, 1963; pp.103).

Before the presentation of general form of the LP model it is necessarily to specify the specific assumptions, limitations and household behavioral characteristics that determine the design of the model. These assumptions are as follows:

- [1] aim of the farmer's agricultural activity is especially to assure own auto consumption,
- [2] decision making is presented by whole farmer's household,
- [3] there are two kinds of decision processes: strategic ones with long term effects and operational ones with short term effects,
- [4] auto consumption is partly provided by monoculture cassava and partly by purchasing local product on the market.

The general form of the LP model is represented by following description:

Maximize  $z = cx$

Subject to  $Ax \leq b$

$x \geq 0$

where  $z$  are revenues of the farmers at the end of the agroforestry cycle using their constrained resources (land and labor).  $C$  is row vector of revenues of each activity per hectare and  $x$  is a column vector of each activity.  $A$  is matrix of technical coefficients driven from demonstration plots and  $b$  is a column vector of farm resource endowments represented by household's labor, cash surplus and cassava auto-consumption requirements

(including initial capital in the first year of the cycle). The model was processed by means of LP modeling application Linkosa.

The LP model is designed for a ten-year period.

The objectives are:

- Determine optimal size of each five agroforestry plots.
- Find out additional area of cassava mono-cultivation to meet the auto-consumption needs of the farmers' households.
- Maximize revenues from sales of the cultivated agroforestry crops at the end of tenth year of the cycle.

The optimal size of agroforestry plots and cassava mono-cultivation is determined by constraints as follows:

- available annual family labor sources (calculated on the base of number of household members that are dedicated to crop production, taking into account the age of the members),
- initial available capital (assuming that all annual profit of the farmer at the beginning is invested into the model activities),
- cash surplus  $t = \text{annual sales } t-1 - \text{annual fixed costs}^6$  (the sales in one-year period is transferred to following period to meet the future expenses),
- annual auto-consumption requirements (assuming cassava as the principal source of alimentation and considering only the family members permanently living in the farmer's household with respect to their age),
- available agriculture land,
- tree area limit (maintaining the same size of each agroforestry plot within the whole cycle),
- rotation of cassava monoculture (cassava can not be cultivated more than two consequent years on the same unit of land and simultaneously less than two years before the beginning of cultivation of agroforestry crops on the respective unit of land – as described in Figure 1).

In the LP model, the only investment that is carried out from the cash surplus is used to pay for the hired labor that enables to cultivate more crops within the limited household's available land.

Matrix of technical coefficients is formed by variable costs per hectare. In the case of agroforestry plot, variable costs per hectare are defined as sum of labor costs, expenditures on seed and tree plants and transport costs per hectare. According to the crop rotation, the amount of variable costs changes within the agroforestry cycle. In case of cassava monoculture, variable costs comprise labor and transport costs per hectare.

### **Analysis of LP model results**

The described dynamic LP model was applied on example of the selected representative household family in two scenarios:

**Scenario 1** (Model 1) assumes that there are no land and auto-consumption constraints. The results are interesting since they uncover the optimum structure of farmers' agricultural activities (cultivation of agroforestry crops and cassava monoculture) on basis of available labor source and initial amount of capital. The results indicate optimal sizes of each plot within ten-year period.

**Scenario 2** (Model 2) takes into account land and auto-consumption constraints and thus this scenario corresponds to the real situation of the selected farmer.

The results of the two scenarios processed in Linkosa are expressed in the Table 3. In the Table 3 it is evident that agroforestry crops are not cultivated in Model 1 during the first six years of the cycle. Only in the seventh year, the agroforestry plot enters to the cycle (ALK 4). All the activities are focused on production of cassava monoculture, which in the first period occupies 11.3 ha, in the second period 19.5 ha and in the third period 34.8 ha. The tenth year, total area of agroforestry crop reaches 28.1 ha and the area of cassava monoculture 65.6 ha.

Considering Model 2, the results are completely different. Due to the auto-consumption constraint, all agroforestry plots are cultivated within the whole cycle to meet the basic consumption needs of cassava. Total cultivated area (15 ha) corresponds

to the household's available agriculture land. Financial flows originating from the results of the two models are expressed in the Figure 2 and 3.

Comparing two agroforestry models, it is apparent that the model with no constraints reaches more profit in the last year of the cycle achieving 104,259 Soles. On contrary to the second model, in the first three periods, the revenues flow only from cassava mono-cultivation. This is due to the fact that in the initial period, the cultivation of agroforestry plot brings the household into the loss. As the revenues from cassava monoculture grow, the farmer is able to cultivate up to 28 ha agroforestry crops in the seventh year that will bring considerable increase of revenues between the ninth and tenth year of the cycle (the fruit trees start to produce).

The problem with exclusion of agroforestry plot in the first periods is due to insufficient revenues from fruit and timber trees. Sensitivity analysis of cost coefficients shows that if the amount of revenues per hectare in the tenth year increased from 4,950 Soles to 6,928 Soles, the agroforestry plots would be included in the cycle from the beginning.

The amount of financial flows in case of Model 2 gradually rises. At the beginning, the farmer is facing a loss that will be recovered in the second period. The peaks in the graph correspond to the increase of revenues when the plots produce in the fourth period of the cycle (the fruit trees start to produce).

### **Impact of production factors on household's revenues**

This chapter deals with the impact of land, capital and labor on revenues in the tenth year of the production cycle. The representative household has fixed amount of available production sources. The designed LP model enables to find out optimal level of revenues with one variable production factor maintaining the other two constant. Estimating the relation between production factor and output is useful to objective finding of the effectiveness of employed factors comparing real yields with their theoretical values (Tvrdoň, 2000; pp.65).

The paper assumes that the farmer employs three production factors: land, labor and capital. With respect to the land, the farmer disposes with limited

Variable	<i>ALK1</i>	<i>ALK2</i>	<i>ALK3</i>	<i>ALK4</i>	<i>ALK5</i>	<i>CM31</i>	<i>CM41</i>	<i>CM42</i>	<i>CM51</i>	<i>CM52</i>	<i>CM53</i>
Model 1	x	x	x	27.8	0.3	11.3	x	19.5	x	x	34.8
Model 2	5.8	1.1	0.4	7.5	0.1	x	x	x	x	x	x

Notes: "x" – variable is not cultivated in the respective year and plot, all variables are expressed in [ha].

Table 3: Comparison of two scenarios.

available agricultural land. Figure 4 demonstrates dependence of farmers' revenues on variable amount of available agricultural land. As shown in the Figure 4, the revenues increase substantially up to 40 ha of employed land. Afterwards, marginal revenues decrease. The saturation point of revenues is reached at the level of 165,248 Soles that corresponds to 93.6 ha of cultivated land. The regression curve that best estimates the dependency between these two variables is logarithmic regression function (as shown in the Figure 3). The coefficient of determination is close to one that corresponds to high rate of dependency of the respective regression function. In accordance to the economic theory, the estimated relation is of degressive type indicating declining marginal production expressed in Soles. According to the Figure 3, the selected farmer is situated in the first part of the curve, indicating the amount of revenues that could be reached with extending household's agriculture land.

Following production factor that was analyzed was the initial capital. Analogically to the previous case, the relation between revenues and capital was estimated taking into account fixed amount of agriculture land. The results of the analysis are demonstrated in the Figure 5. As shown in this figure, the relation between initial capital and the output, expressed in Soles, can be best estimated by means of quadratic production function with degressive character and a satisfactory high rate of dependence. On basis of the regression function it is possible to conclude that the productivity of initial capital is decreasing within the considered interval.

Situation of the respective farmer, as expressed in the Figure 5, indicates that the farmer's maximum potential revenue reached with a constant amount of employed land is 81,884 Soles, i.e. only 2,318 Soles less than farmers' actual revenues. It is evident, that increasing of farmer's initial capital would not contribute substantially to growth of revenues. Based on the analysis of RHS (Right-Hand-Side), the maximum value of initial capital

would have to be 11,945.78 Soles to cause additional increase of revenues.

In the last case, relation between labor and revenues was analyzed taking into account only available household labor. The results of regression analysis are expressed in Figure 6. Maximum value of revenues that can be achieved with constant amount of initial capital and available land is reached when the household's labor costs are between 44,000 to 47,000 Soles that corresponds to 25 - 27 members of household. At this point, maximum sales would be 86,630 Soles, which does not represent a big increase in comparison with the actual level. As in case of initial capital, the additional increase of family size does not cause any substantial growth in revenues. The highest productivity of household labor is noticed at the beginning of the respective curve and it declines within the observed interval. From a certain point, with additional amount of household labor, the revenues start to fall down due to excessive cassava auto-consumption that leads to decrease of revenues originating from cassava production.

This analysis showed interesting findings regarding the effectiveness of production factors employed in the agroforestry production system. Comparing the real data of the respective household with the values from regression function it is evident, that having unlimited access to land, the revenues could be increased by 108% to achieve its maximum value. On the other hand, in case of initial capital, the actual value would be increased only by 3% and in case of household's labor only by 7% to reach the maximum revenues. This indicates that the amount of initial capital and household labor does not play essential role for the increase of household's production since the representative farmer employs these production factors in sufficient level. On the other hand it is evident, that the amount of land is limiting factor for production possibilities of the region.

## **Discussion**

It was showed that the designed LP model represents a useful instrument to assess economic effects of multi-strata agroforestry system. However, there are some limitations that should be considered in further modeling stage. A remarkable limitation that is essential to the distribution of model activities is the maximization function that should be extended to include results from all the ten-year period and not only in the tenth year of the cycle.

In order to improve the results of agroforestry plots, it would be useful to extend the model to two agroforestry cycles (i.e. from 10 to 20 years period). The positive effects of agroforestry system are noticed only in the second cycle such as saving of the labor connected with the preparation of the plot and possibility to sell timber every year from the tenth year of the cycle.

Other considerations that would be useful to take into account are the positive effects of agroforestry systems such as improving of soil quality due to increase of nitrogen quantity by cultivation of *Inga edulis* and mitigation of the problem with weed extension by agroforestry tree species included in the system.

The designed model is a simplified version of the reality including various farmers' activities and range of commodities. Usually, the farmers are involved in many different activities, not only in crop production but also in animal production, recollection of widely grown plant and timber, commerce and so on. However, the model takes into account the real amount of the labor that the householder uses for crop cultivation. With respect to structure of commodities, in reality the crop production is more diversified and besides cassava and fruit trees include especially citrus, rice and maize.

It was found out, that in the first two years of the agroforestry cycle; the householder faces financial loss due to elevated labor costs and requirements of initial capital. This is the principal challenge for adoption of the agroforestry systems since the farmers are discouraged by negative financial results at the beginning of the cycle. As described by Mercer, an agroforestry system is likely to take three to six years before benefits begin to be fully

realized compared to the few months needed to harvest and evaluate a new annual crop or method (Franzel and Scherr 2002). These characteristics can enhance opportunities for adoption by allowing more farmer experimentation and adaptation but can also complicate analysis of who adopts, what they adopt, and how they modify the system adopted (Vosti et al. 1998). The additional uncertainty inherent in these new input-output mixes is also an important reason for slower adoption rates and suggests that agroforestry projects will require longer time periods before becoming self-sustaining and self-diffusing than the earlier Green Revolution innovations (Amacher et al. 1993).

Another problem represents long production cycle of timber trees, where the benefits originating from selling of the timber are derived after ten years of cultivation (in case of Bolaina). Other timber trees have even longer production period and if included in the agroforestry systems, the agroforestry cycle would be extended. Furthermore, the prices of timber are unfavorable for the farmers and therefore the attractiveness of agroforestry systems is low. The main challenge for the future of the multi-strata agroforestry systems is to improve the commercialization of timber. It was found out that the price of processed timber tree is much higher than of the unprocessed tree.

An important remark is the investment activity of the farmers. The model assumes that the entire cash surplus is used for hiring of the labor and there are no savings incentives. In the reality, the cash-surplus might be spent in other activities such as cattle production, purchase of vehicle or other items increasing the living standard.

The results of the model would be slightly different, if discount factor was included. However, for this purpose of the paper, the discount factor was not considered relevant since the objective was to assess the optimal structure of agroforestry plots.

With respect to the effectiveness of production factors, it is necessary to realize, that the conclusions based on the regression analysis are only derived from the model and not from the real data. It should be taken into account, that the impact of labor might be different in reality because productivity of labor is lower than the model assumes (the real farmers' yields might be lower

then estimated). Also, the analysis does not consider the impact of hired labor on revenues by the reasons of model form that does not enable such analysis. Regarding the land effectiveness, most of the interviewed farmers cultivate in average only 16% of total available land (corresponding to 3.7 ha).

## **Conclusion**

The paper was elaborated with the use of ex-ante approach. Ex-ante approach is a useful instrument of economic evaluation because it saves time and funds resources both of the farmers' households and the researchers. In addition, ex-ante approach is very helpful especially in case of agroforestry systems evaluation where the results of ex-post analysis are usually derived after a long time period due to prolonged production cycles. However, once the ex-post analysis is made, it can be compared with the results of ex-ante analysis too.

By means of LP model, optimal sizes of agroforestry plots were determined under the maximization criteria and consequently the results were used for evaluation of production factors effectiveness. The designed LP model was found to be proper tool for assessing the economic effects of multi-strata agroforestry systems. In the same light, the constructed model can be utilized for further analysis. Furthermore, the general character of the model enables to be used for agroforestry systems evaluation in different regions of the world. The results drawn from the LP modeling described in this paper provided useful insight to the household economy which is based on agroforestry production system and will serve for the realization of the development project of Institute of Tropics and Subtropics in the Ucayali region. Furthermore, the aim is to introduce the results of the paper to the households' families.

## **Footnotes**

1 Slash-and-burn agriculture or swidden/fallow system refers to farming or agricultural systems in which land under natural vegetation is cleared, cropped with agricultural crops for a few years, and then left untended while the natural vegetation regenerates (Lojka, 2005; pp. 13)

2 The socioeconomic research is based on exploring the differences between adopters and non-adopters in terms of their age, gender and other socioeconomic variables.

3 Multi-strata system is a combination of annual crops (e.g. maize and cassava), perennial crops and tree species (local fruit and timber species). Farmers begin to cultivate annual crops in combination with tree species at first. Annual crops are gradually replaced by perennial species and within few years tree species prevail in this system (Areaviva, 2007).

4 Imperata is a pandemic genus, found throughout the tropics. It is a rhizomatous perennial grass, with a spreading habit (Menz et al., 1998; pp. 2).

5 Inga edulis, a large genus of leguminous trees native to the American humid tropics, is popular with agroforesters for its rapid growth, tolerance of acid soils and high production of leafy biomass to control weeds and erosion (FACT Net, 2007).

6 Annual fixed costs are formed by living expenditures of the family: consumption goods, health, education, services and transport.

*Corresponding author:*

*Jana Kalabisová*

*Faculty of Economics and Management, Czech University of Life Sciences Prague*

*Kamycká 129, Prague- Suchdol, Czech Republic*

*e-mail: kalabisova@pef.czu.cz*

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## Limits of the applicability of the social structural model in Czech rural areas

R. Kopřiva

Faculty of Economics and Management, Czech University of Life Sciences Prague, Czech Republic

### Abstract

This article focuses on the voting behaviour of citizens in rural areas of the Czech Republic. Within the theoretical embodiment of the relationships between the individual in a social structure and voting behaviour, a so-called social-structural model for voting behaviour is often mentioned. However, when explaining the behaviour of the voting behaviour of citizens living under the conditions of the Czech Republic the applicability of this model is of course disputable. Due to the predominant inconsistencies of the social status of citizens of rural areas, it is not at all possible to determine the hypothesis of the applicability of a social-structural model of voting behaviour for citizens living in the conditions of the Czech rural countryside. The aim of this article is, through a case study of Zatec region, to prove the predominant (in)consistency of the social status of the given population.

### Key words

Social structural model, voting behaviour, class identification, rural areas, social status, status (in)consistencies, left-wing right-wing continuum.

### Anotace

Článek se zabývá oblastí volebního chování obyvatel venkovského prostoru ČR. V rámci teoretického zakotvení vztahu mezi postavením jedince v sociální struktuře a volebním chováním je často zmiňován tzv. sociálně-strukturální model volebního chování. Uplatnitelnost tohoto modelu je ovšem při vysvětlení volebního chování obyvatel v podmínkách České republiky sporná. Při převládající inkonsistenci sociálního statusu obyvatel venkovských oblastí nelze hypotézu o aplikovatelnosti sociálně-strukturálního modelu volebního chování v podmínkách českého venkova vůbec stanovit. Cílem článku je prostřednictvím případové studie žatecké oblasti prokázat převládající (in)konzistenci sociálního statusu dané populace.

### Klíčová slova

Sociálně strukturální model, volební chování, třídní identifikace, venkov, sociální status, statusová (in)konsistence, kontinuum levice-pravice.

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### Abbreviations

ČSSD = Czech Social Democratic Party, KDU-ČSL = Christian and Democratic Union – Czechoslovak People's Party, KSČM = Communist Party of Bohemia and Moravia, ODS = Civic Democratic Party, SPOZ = Party of Civic Rights – Zemanovci, SUV = Sovereignty, SZ = The Green Party, VV = Public Affairs

## **Introduction and aids**

The specific interests of the value-based positions of residents of rural areas and the differences of society in rural areas compared to society in cities are the main subjects of interest of the sociology of rural areas. In relation to this, the contemporaneity of the sociology of rural areas asks how interests in rural areas are formed, and what determining factors are behind the differences in rural and urban areas. The research is, for example, focused on the results of integration and independence of the small municipalities in the context of citizen participation in public life or the local identity (e.g. [13]), marginalized groups of citizens in rural areas e.g. in relation to unemployment and social-economic effects (e.g. [4]), etc.

The existence of differing interests and value attitudes of citizens of rural areas was repeatedly proven not only throughout the world, but also in the Czech environment. Compared to those in cities, the residents of rural areas differ from the view of demographic and social structure. Radim Perlín characterizes rural areas from a number of viewpoints. From the social viewpoint, he perceives rural areas as spaces with close social contacts, the existence of long-time informal social control and participation [23]. Citizens of rural areas are defined by a lower level of education which, among other things, demonstrates a more-limited cultural progress when compared to cities. Lower level of education is tied to the limited possibilities to assert oneself on the job market, a lower level of material security, etc. From the view of Czech social class structure, a lower level of education plays a significant role. Eric Wright, author of one of the most significant works on social structure, considers education to be the decisive determinant in class identification [30]. It arises from this that the portion of the population in rural areas represented in lower social classes is greater than in cities. The differing characteristics create from rural areas a specific status space [23].

Diverse interests also form the diverse nature of rural areas. The ability of their articulation, assertion and political representation also understandably garners the interest of sociologists. Rural areas are viewed as original areas with their own determinants (in the Czech environment, e.g.

[5]). The investigation into the voting behaviour of the residents of rural areas closely ties into the dilemma of the representation of their interests. Voting behaviour is one of the main themes of political science. This is also an area that in countries with long-time democratic traditions can be considered as sufficiently investigated. A number of works have also arisen with regard to the theme of value attitudes and factors that are the basis for the decisions of voters in the Czech political environment. Even though the research into voting behaviour is limited by the relatively low time span during which free elections have been organized, the applicability of some explanatory theoretical concepts was proven in the Czech Republic, and some general conclusions have been implied. The investigation into voting behaviour was primarily focused on the entire population of Czech voters in elections into the nation representative bodies, e.g. European parliament. The conclusions of these works prove the relationship between the social class structure and voting behaviour (e.g. [22] or [17]), the existence of long-term affective relationships between voters and the political parties they traditionally prefer (e.g. [28] or [18]). The influence of the voting system on voting behaviour (e.g. [17]) or the influence of voting participation on acquiring votes for political parties was also analysed [17]. In the case of municipal elections, mainly the size of the municipality is the monitored variable from the view of voting behaviour. Diverse voting behaviour of citizens of small municipalities with significant support of independent candidates was repeatedly proven to be different from citizens of large cities (for the largest cities in the Czech Republic) who fundamentally do not differ in their voting decision-making during elections into national parliament [6]. Regional differences in voting behaviour were also investigated. These are mainly the works of voting geographers, who proved the existence of regional voting heterogeneity in the Czech Republic. The results of these works proved that relevant political parties enjoy various levels of political support from the view of regional support (e.g. [24]). From the view of investigating the voting behaviour of the residents of rural areas, these works are significant mainly from the view that they provide elementary data material on the basis of which partial conclusions can be made on the differences in the voting behaviour of citizens in purely rural areas and urban regions. It can also be

stated that scientific works oriented this way are practically the only ones that deal with the question of voting behaviour in rural areas in the Czech Republic.

It is evident from the aforementioned investigations that the projection of value positions, or social compositional characteristic of citizens of rural areas in voting behaviour differ in the context of an entire region. A number of questions arise in relation to this, and answers for them will continue to be sought-out in the future. One of these questions is the relationship between social structure and voting behaviour. With regard to the prospects of research into the voting behaviour of citizens of rural areas, the fundamental information regards whether a given class polarization of citizens resides in the background of voting results, or if political conflict is based more on status that is reflected in the form of diverse interests. The picture of the influence of social structure on voting behaviour can be drawn on the basis of investigating the voting behaviour of social classes. This may subsequently lead to the argument whether someone's vote is a consequence of the social structural composition of the population, or the articulation of joint political interests. We can, however, not ignore the premise that the voting choices of the populations of rural areas directly relate to other factors that have not yet been considered.

The development of interest in social conduct influenced by value attitudes began in the second half of the 20th century. This period also brought increased interest in voting behaviour. However, the majority of works oriented this way arise from the much older works of H. Tingsten, which were publicized under the title of *Political Behaviour: Studies in Election Statistics* [26]. In this relation, a common (but not the only) approach became the search for the relationship between the nature of social structure and voting behaviour (e.g. [2], and currently e.g. [8], [27] 2010 or [3]).

Social structure influences, and also has historically influenced the forming of political ideologies such as the group of theoretical concepts, value attitudes or ideas. These are then the basis for the functioning of political parties. When party systems formed in democratic countries during the course of the 20th century, decisive significance belonged to

the ideologies of liberalism, conservatism and socialism, which contributed to establishing liberal, conservative and social-democratic, or communist parties in the party systems. The social structural model explains voting behaviour on the basis of relationships between membership in a social class and election support of a political party that is a representative of the value attitudes of a respective social class. In this relation, a hypothesis is set that the lower social classes (e.g. the workforce) usually identify with left-wing political parties (social-democratic or communist). Adversely, those of middle and upper social classes tend to vote right-wing (conservative or liberal-conservative) [17].

The existence of this relationship was proven among others by the research of British voters from 1964 to 1987 [11]. The variable that differentiated social groups was (among others) the employment of respondents. People doing manual labour (labourers) tended to prefer left-wing values. People not doing manual labour whose jobs are of a routine nature tend to be inclined toward values that represent political entities in the centre of the political continuum. People who have professional jobs identify with right-wing parties, and those who are self-employed are even more inclined toward right-wing values. Other variables that are often taken into consideration when differentiating social groups are education and religion (e.g. [11] or [10]). The age and gender of voters are also decisive factors [10].

Value attitudes and their roles in voting decision-making and the relation between the standing of an individual in a social structure and voting behaviour was also researched in the Czech environment. The works of Petr Matějů and Klára Vlachová are most certainly worth mentioning with regard to this. They are occupied with the social structure in the Czech Republic, its development and variables in the 1990's, and value attitudes that are formed on the basis of belonging to a social group [22].

Their work showed that during the course of the period from the beginning of the 1990's to 1996, when elections took place to the Chamber of Deputies, voting behaviour was stabilized, and voting became more of a custom than always a newly considered decision. The feeling of identity with a socioeconomic group also demonstrably played its role here. At the beginning of the 1990's,

the differences in the likeliness of election support of left-wing parties between members of individual social classes<sup>1</sup> were statistically insignificant. However, during the election in 1996, voting from the view of the main social groups was already significantly different [22].

In the investigation of voting behaviour, the social structural model had its firm place mainly in the period up to the 1970's and 1980's. The situation changed with the growth of regional differences in voting behaviour [16]. The decrease in the significance of the model is also put into relation with unnatural voting behaviour in the context of presumed class interests of voters [1]. These were often explained in accordance with the Michigan school through the effect of so-called party identification [7]. Currently, unnatural voting behaviour is also interpreted as a consequence of the transformation of cultural interests [1]. The greatest influence on the transformation of voting behaviour of social groups is the swing of a part of the middle class to the support of left-wing parties. These are mainly state employees that are directly interested in higher state redistribution and the significance of the state in social regulation [15].

The investigation into the relationship between the positions of voters in social structure and voting behaviour has a purpose only when society is truly fragmented into internally-homogeneous groups, and voters are able to give preference to political entities that are suitable representatives of their group interests.

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*1 The concept of the "social class" is used by Řeháková and Matějů for differentiating the four main social economically active groups of the population. This is a group of professionals with university education and other non-manual workers, the independent (small business owners and businessmen), and tradesmen. The analysis also included a category for pensioners. The other economically non-active were excluded from the analysis. Other variables that entered into the analysis of the relationship between position in a social structure and voting behaviour were gender, age groups and region [29].*

Society is characterized by a structured imbalance of its fractional parts – the so-called social classes. The concept of the social class is usually understood as a relatively homogeneous socioeconomic group with consistent socially-significant attributes that differentiate it from the other social layers. This is also a group of persons interconnected through a feeling of solidarity that forms a strong internal relationship between individual members. Social sciences characterize the nature of social structure of society on the basis of different criteria. The most frequent of these are the shares in the consumption of articles, which are rare in society (e.g. profession, belongings), and a share of power or form of lifestyle relating to economic security [25]. The standing of the individual in class structure relates to his social status. This social status is often understood as a group of rights and obligations that relate to the role that a person had in society. In theory, attributed and acquired social status usually tends to be divided. Attributed status is given from birth and is independent of will. As a rule, it is very difficult to change it. This status includes things such as position of power, family wealth, as well as age, nationality or gender. Achieved status then relates to the individuality of a person. Education, employment, etc. are often taken into consideration for this status.

The utilization of the social structural model of voting behaviour can only be considered under the conditions of Czech rural areas when its population is socially structured with solid internal ties within social groups. There is no question about the existence of social class structure in rural areas in the Czech environment. We are, however, still faced with the question of whether individual social classes are internally homogeneous, or in other words, if the prevailing part of the population has a consistent social status in its individual dimensions.

For contemporaneous sociology, it is typical that it approaches social status as a multidimensional characteristic. This means that individual parts of statuses that form the collective social status of the individual are independently studied. The main problem is that the existence consistency or inconsistency of social status is investigated in relation to this. If the individual parts of a status are in a close mutual relationship, then these are known as consistent social status. In this case, the

individual is a member of more social groups in which he has a similar social status. The opposite is true for an inconsistent social status. This means that the position of a person in various social groups embodies various levels. In other words, this means that a person embodies various levels of social status in its partial sections [9]. When investigating the applicability of the social structural model for explaining voting behaviour, it is necessary to take into consideration that in this case, the prevailing status consistency is an explicit presumption. As described above, the social structural model presumes the relationship between social structure and voting behaviour. If an inconsistent social status prevails for the majority of members of a researched population, this theoretical concept cannot be applied at all. A prevailing inconsistent social status in society disables the operational relationship between social structure and voting in that that it does not allow for the classification of independent, internally homogenous social classes.

## **Materials and methods**

For the needs of this article, social structure will present a stable system of mutual social relationships as a whole, social groups and individuals in such a way that social structure is understood by, for example Machonin [20] in its fundamental conception. Social groups within the monitored population will be identified on the basis of demographic and economic criteria (education, income, employment). Additional criteria will then be the joint knowledge of belonging to a social group. For such determined social groups, we will use the “social class” concept that routinely uses the theory of social stratification. The theoretical difficulties that relate to this concept will not be further taken into consideration. The monitored population will be the residents of rural areas. This will be determined as a social group on the basis of economic, demographic and geographic criteria.

Rural areas in the Czech Republic have been specified in a number of theoretical works (e.g. [29] 2009 or [21]). Radim Perlín defines rural areas as continually-defined spaces. He thus understands them as areas that show similar characteristics. From a social standpoint, these are areas with a lower intensity of social economic contacts, a lower density of relationships between individual entities, and also with the existence of long-term, informal social controls and participation. From an economic viewpoint, these are areas where the significant

activity is agriculture and the main type of production is food, and where a significant part of economically active persons goes out to seek employment. Along with this, rural areas can be defined through population density, or the number of people related to an area unit. Within the EU, rural areas are usually defined through population density to 100 residents per 1 km<sup>2</sup> [23]. On the basis of the Strategy of Regional Development for the Czech Republic for the period of 2007-2013, rural areas are tied to poor education and age structure.

The citizens of the Žatec region are the subject of the investigation that complies with the mentioned characteristics of rural areas. For the needs of this article, the concept of the “Žatec region” means the region and municipalities of the county of the city of Žatec, which is authorized to perform the transferred competency granted to the municipality with extended competency. The Žatec region displays a number of rural area attributes from the view of cultural, social and business relations of the population, a large portion of agricultural land, the distinct agricultural nature of the region, but also from the view of the permanent stagnation of the development of incomes and employment behind the Czech Republic average. The definition of the Žatec region as a rural area is also supported by its population density and a deficit in the area of the migration of young and professionally-qualified, etc. (specifically [14]).

This data was acquired through standardized discussions with voters during the election into the Chamber of Deputies in 2006 and 2010 in the city of Žatec and the other five municipalities in this area. During the election into the Chamber of Deputies in 2006, data was collected through an exit-poll<sup>2</sup>. In 2010, the data was acquired through discussions with voters during the first ten days

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*2A discussion is held with the voter as soon as they leave the voting room. A two-step, random selection was decided on. During the first step, a random selection of ten voting precincts was used. In the second step, every third voter leaving the voting room was addressed.*

after the election<sup>1</sup>. The scope of the selected group is in both 2006 and 2010 N=400 of completed discussions.

The aim of the work is to describe through the Žatec-region case study the predominant status (in)consistency of the citizens of this region, and thereby contribute to the discussion on the possible applicability of the social-structural model of voting behaviour under the conditions of rural regions in the Czech Republic. The intensity of the relationship between social structure and voting behaviour can be measured only under the premise that society is distinguished by a prevailing consistency of social status. In practice, this means that the majority of members of the population have a similar social status in the various social groups in which individuals participate. The prevailing (in)consistency will be analysed through the relationship between the basic socioeconomic characteristics (education, income, employment and subjective status). The utilized analytical method will be an analysis of dependence.

## **Results and discussion**

On the basis of the research performed to this point, it has been shown that in social, economic and politically stable societies exists a close mutual relationship between individual parts of statuses. A consistent status applies to the majority of members of these societies. However, in societies that undergo transformation processes with significant (positive or negative) social consequences, this fact may not apply. In relation to this, a problem arises in the possibility to utilize the social structural model to explain the voting behaviour of citizens in the Žatec region. As previously mentioned, this is a region with number of negative social

consequences that are due to the political-economic transformation that mainly occurred in the 1990's. The basis for the analysis of the relationship between social class identification and voting behaviour is the analysis of the (in)consistency of socioeconomic status.

The difficulty of the operationalization of the concepts of status consistencies and inconsistencies is the determining of individual variable socioeconomic statuses. The aforementioned work of authors Matějů and Vlachova, which is probably the most comprehensive in the Czech environment, considers the problem of social imbalance as a variable of voting behaviour, and uses the criteria of education, employment and income for measuring status consistency [22]. As mentioned at the beginning of this article, education is considered to be the decisive indicator of social class. Employment positions and income amounts are determined by this variable to a significant level. It is possible to determine a simple presumption that a higher education allows for the acquisition of better employment with a higher wage. Matějů and Vlachová include another variable called subjective social status. This variable is measured through the declared standing of the individual in social structure. The subjective evaluation of actual standing is an important indicator, as well as factor of (in)consistency. As demonstrated in the past, (e.g. [19]), erroneous evaluation is a consequence of status inconsistency. However, the opposite may also be true. If, for example, an individual with an objectively-high status in the dimension of education (e.g. university educated person) evaluates their social standing on a low level, then this individual is willing to accept employment that as a rule is performed by people with a lower education level. In such a case, the person is often also willing to accept a lower wage.

The status (in)consistency of voters in the Žatec region was evaluated on the basis of four variables (education, employment, income and subjective status). It was not possible to include all of the respondents in the analysis. Along with the questioned individuals who did not answer some of the questions relating to the variables of social status, these are also the economically inactive, i.e. the unemployed, pensioners, students and trainees. Achieved education was evaluated according to the commonly-used six-point classification (e.g. [22]).

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*<sup>1</sup>Voters were selected thorough a two-step selection process. In the first step, the number of discussions with respondents from the municipalities of Žatec (360), Libořice (10) and Měcholupy (30) were determined. In the second step, every third citizen was addressed in areas of high frequency of movement of citizens. Discussions were not completed with the citizens of municipalities who are not a part of the Žatec region and respondents who did not vote.*

	Distribution of education (in %)		Distribution of incomes (in %)		Distribution of jobs (in %)			
	2006	2010	2006	2010	2006	2010		
Basic + no further education	6,42	9,86	Up to 10 thousand CZK	10,57	14,08	Labourer	42,64	26,76
Apprenticeship without leaving examination	30,19	28,87	10,001-15 thousand CZK	24,91	21,48	Independent	17,74	32,39
Apprenticeship with leaving examination	14,34	12,32	15,001-20 thousand CZK	20,75	21,13	Routine non-manual	24,91	17,96
High school with leaving examination	36,6	30,99	20,001-25 thousand CZK	24,15	21,83	Professional	8,3	13,03
College, unfinished university	2,64	5,63	25,001-30 thousand CZK	13,58	11,97	Other	6,41	9,86
University	9,81	12,32	over 30 thousand CZK	6,04	9,51			
Total	100	100	Total	100	100	Total	100	100
N	265	284	N	265	284	N	265	284

Source: Examination of elections to the Chamber of Deputies in 2006 and 2010 in the Žatec region

Table 1. Distribution of education and incomes (column percentage)

The six-point classification was also selected in cases where income was measured. Individual categories were construed while taking into consideration the amount of the average gross monthly income in the Czech Republic and in Ústí nad Labem region<sup>4</sup>. The shown employment was classified through the international index of social-economic status of authors Ganzeboom, De Graaf and Treiman<sup>5</sup>. The advantage of the ISEI is the large number of employment categories<sup>6</sup>. Respondents were further divided

according to employment using a five-point classification. Table 1 shows the distribution of education, incomes and employment between respondents of the investigation.

The methodology of Matějů and Vlachová [22] was used to measure subjective positions in social structure. Respondents declared their positions on a ten-point scale<sup>7</sup>. The highest number (10) represents the highest social position and the lowest (1) shows the lowest social position. The average value of subjective social status on the basis of the 2006 examination was 4.58, and it reached an average value of 4.56 in 2010. Table 2 shows the average

<sup>4</sup> The average gross monthly income was 20,158 CZK in 2006, and in the first quarter of 2010, it was 22,748 CZK.

<sup>5</sup> The values of the social-economic status of jobs were derived by the iterative method of optimal scaling on the basis of international research of job prestige. It is an index of the social-economic positions of individuals who work in the respective job. For individual jobs, the values of the index move in the range from 10 (assistant cook) to 90 (judge).

<sup>6</sup> Classification of jobs is based on the ISCO method which registers 217 categories.

<sup>7</sup> The task given to the respondent is: "There are groups in our society which are assigned high social positions and, on the contrary, groups with low social positions. If you think of yourself, where would you place yourself in comparison with other people in his country on the following scale whose highest number (10) represents the highest social position and the lowest (1) then represents the lowest social position?"

	Average rate according to education		Average rate according to income		Average rate according to job			
	2006	2010	2006	2010	2006	2010		
Basic + no further education	2,53	2,39	Up to 10 thousand CZK	2,89	2,65	Labourer	3,69	3,21
Apprenticeship without leaving examination	3,09	2,94	10,001-15 thousand CZK	3,21	3,21	Independent	4,6	4,92
Apprenticeship with leaving examination	3,89	3,83	15,001-20 thousand CZK	4,07	4,43	Routine non-manual	5,55	5,45
High school with leaving examination	5,31	5,43	20,001-25 thousand CZK	5,33	5,48	Professional	6,81	5,97
College, unfinished university	6,86	6,69	25,001-30 thousand CZK	6,58	5,84	Other	3,88	3,57
University	8,23	7,69	over 30 thousand CZK	8	6,93			

Source: Exit-poll examination of the 2006 and 2010 elections to the Chamber of Deputies

Table 2: Average values of subjective status according to education, income and job.

	2006				2010			
	Education	Job	Income	Subjective status	Education	Job	Income	Subjective status
Education	1				1			
Job	0,56	1			0,55	1		
Income	0,8	0,4	1		0,7	0,4	1	
Subjective status	0,83	0,5	0,74	1	0,84	0,46	0,66	1

Source: Examination of elections to the Chamber of Deputies in 2006 and 2010 in the Žatec region

Table 3: Correlation matrices.

values of subjective status according to education and income categories.

When we use regressive analysis, it is possible to arrive at the conclusion that a linear relationship exists between individual selected variables, both in 2006, and in 2010. Thanks to this fact, it is possible to use the Pearson's' correlation coefficient to measure mutual dependence. Table 3 shows correlation matrices.

## Conclusion

On the basis of the current research done in the Czech Republic, it is demonstrated that the position of an individual in the social structure has been playing one of the important roles in the voting

behaviour of the electorate since the election to the Chamber of Deputies in 1996. The research focused on the possibility to apply this sociological concept from the viewpoint of the relationship between class identification and voting behaviour in the Žatec region, which, for many reasons, can be considered a rural area of the Czech Republic.

From the viewpoint of research prospects, the deliberations on the relationship of class identification and voting behaviour meet partial problem from which then methodological problems arise. The social structural determination of the voting decision-making is measurable only under the assumption of the prevailing consistency of the

social status in society, not only from the viewpoint of its individual objective dimensions but also from the viewpoint of subjective perception of the social status. In societies that have undergone fundamental economic, political and other changes in the past with negative social consequences, it is possible to expect a loosened social stratification with a prevailing inconsistency of the social status. Similar problems are also characteristic for the Žatec region. In this relation, the research had to deal with the question whether the Žatec region has already been established from a social viewpoint, with a crystallized consistency of the social status. The research of the (in)consistency of social status was resolved from the methodological standpoint by the dependence analysis which demonstrated a close relationship between individual social-economic variables of the status (education, job, income) and, at the same time, between the objectively measured social status and its subjective perception by the respondents.

The finding on the crystallized social structure warrants the determining of partial hypotheses on the diverse voting behaviour of citizens of individual social-economic groups under the conditions of the Žatec region. From this view, social structure, as a factor of voting behaviour, can be considered mainly in its objective form. The position of the individual in a social structure thus influences the nature of voting behaviour. It is possible to assume that the voting decision-making of the residents of Žatec is not at variance with the classic thesis of voting behaviour. This means that the citizens of a social-economic group who are situated on the lower levels of the social structure are more inclined toward left wing political values and they vote for left wing political parties. Adversely, the political orientation of members of

higher social classes tends to have more of a right wing nature. This of course is also demonstrated in the support of the right wing political parties. This is, however, only a hypothesis which is necessary to empirically verify. Understandably, the results of this study cannot be used generalize the rural areas of the Czech Republic, but they can serve as one of the indicia when investigating the voting behaviour of the citizens of rural areas. The voting behaviour of the residents of rural areas is not a consistently explored field in the Czech environment. The interest of sociologists mainly focuses on the entire political space without the internal electorate or geographical fragmentation. Therefore, from the viewpoint of the voting behaviour of residents, a number of often quite elementary questions remain unanswered. The most basic question is whether it is possible to seek in the Czech environment any important differences in election results if we compare the urban and rural areas. Based on several voting-geographical studies so far published in the Czech environment, differences really can be identified. However, their background is unclear. Are they a consequence of different value attitudes? If so, are the value attitudes of rural population essentially influenced by a different form of the social structure? In the social structure context, a question emerges whether, in accordance with the deliberations on rural areas as an independent social space, it is possible to take the rural population as an internally homogenous political group (i.e. a group of specific status)? If so, can this group relevantly represent its own political interests? These and other questions show the depth of the problem of voting behaviour of the residents of rural areas. It is absolutely necessary to answer them to understand the rural areas as a socially-specific space of the Czech Republic.

*Corresponding author:*

*Ing. Radek Kopriva, Ph.D*

*Czech University of Life Sciences Prague, Department of Humanities*

*Kamýcká 129, Prague – Suchbátka, Czech Republic*

*e-mail: kopriva@pef.czu.cz*

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## **Analysis of the Relationship between State Budget and Trade Balance of Libyan Economy (Period: 2000 – 2008)**

M. Maitah, A. der Ali

Czech University of Life Sciences Prague, Faculty of Economics and Management

### **Abstract**

The subject of the relationship between state budget and trade balance is important as economic subject, not only at the level of developing countries, but also at of advanced ones, too. Such importance emerged clearly when 1980s witnessed in United States of America a deficit in both state budget and trade balance, which was called at that time as the twin or dual deficit. We can say that the analysis of relationship between state budget and trade balance states the extent of mutual effect between financial and trade policies of any economy, namely; any change in the outcome of either one may affect the other in the same degree. To put in other words, the instruments of financial policy represented by total incomes and total expenditures can affect the trade balance through the movement of exports and imports and vice-versa. One tracing properties and features of Libyan economy may remark its dependence greatly on the public sector in financing developmental projects and making development generally, as well as its dependence on incomes to supply consumer and investment goods. Further, it depends in collecting its incomes of foreign currency on exports of chief source which is crude oil. So, study and analysis of relationship between state budget and trade balance of Libyan economy means to study and analyze relationship of public sector through the state budget, with the external sector expressed as the external trade through trade balance. The paper was processed within the framework of the Research Project of MSM 6046070906 "The economics of Czech agricultural resources and their effective use within the framework of multifunctional agri-food systems".

### **Key words**

State budget, trade balance, Libya, trade policy, fiscal policy.

### **Anotace**

Vztah mezi státním rozpočtem a obchodní bilancí je mimořádně důležitý, a to nejen pro rozvojové země, ale též pro ty vyspělé. Významost takového vztahu se jednoznačně ukázala během 80. let, ve Spojených státech amerických, kde byly v deficitu jak státní rozpočet, tak obchodní bilance. Lze říci, že analýza vztahu mezi státním rozpočtem a obchodní bilancí, popisuje vzájemné působení mezi fiskální a obchodní politikou každého hospodářství. Jakákoli změna ve fiskální politice ovlivňuje obchodní bilanci, stejně tak změna obchodní politiky má přímý dopad na státní rozpočet. Nástroje fiskální politiky, zastoupené celkovými příjmy a výdaji, mají mimořádný vliv na obchodní bilanci, a to prostřednictvím změny množství vývozu a dovozu, kde též pozice obchodní bilance ovlivňuje stav veřejných financí. Analýza charakteristik libyjské ekonomiky, jednoznačně ukazuje závislost jejího vývoje a růstu na veřejný sektor. Zároveň je evidentní závislost dovozu spotřebního i investičního zboží na veřejných příjmech státního rozpočtu. Tato ekonomika je též velmi závislá na vývozu ropy, jako na jediném zdroji příjmu cizích měn, tolik potřebných pro dovoz potravin. V této práci se zabýváme vztahem mezi státním rozpočtem a obchodní bilancí, jinými slovy vztahem mezi veřejnými financemi a vnějším sektorem libyjské ekonomiky.

Poznatky prezentované v článku jsou výsledkem řešení grantu MSM 6046070906 "Ekonomika zdrojů českého zemědělství a jejich efektivní využívání v rámci multifunkčních zemědělskopotravinářských systémů".

### **Klíčová slova**

Státní rozpočet, obchodní bilance, Libye, obchodní politika, fiskální politika.

## **Introduction**

Libyan Economy is characterized with dependence on crude oil revenues in financing economic activity whether through operating expenses or expenses of transformation (investment), and supplying imports of consumer and productive goods. As a result, the instruments of financial and trade policy play fundamental part in the process of economic development of Libyan economy. Recently, it has been noticed that there was unprecedented increase of total incomes accompanied with increase of averages of public expense especially the one of transformation, for the sake of commencing in improving and performance of different developmental projects aiming at achieving economic and social growth, and considerable development have occurred in the sector of external trade through increase in value of both exports and imports, which led to maximization of vulnerability of Libyan economy towards abroad, especially under non-existence of restrictions on imports and foreign spending. Such remarkable changes undergone by Libyan economy require study and analysis of relationship between its state budget and trade balance.

## **Aims and Methodology**

It aims to analyze the relationship between the state budget and trade balance in the period: 2000 – 2008, for the sake of measuring mutual effects between fiscal and trade policies. Importance of this research lies in dealing with an important economic matter, which is relationship of state budget with trade budget, so as to contribute to set fiscal and trade policy sufficient to generate growth and improve performance and development of national economy.

Through the content of the problem of the research and aims of the research, the hypotheses of the research can be stated as follows:

Libyan economy depends on the sector of oil in providing revenues of foreign currency. Therefore; any promotion occurs to prices of crude oil in global market leads to increase of public revenues, then to increase in public expenditure. Libyan economy depends essentially on imports of consumption and investment goods, and any change in averages of public expenditure results in change in size and content of imports in the same trend. There is an obvious relation between state budget and

trade balance, but it is directly affected by changes occurring in global prices of oil.

To achieve the aim of the research and study its hypotheses, the analytic plan has been adopted through available data on state budget and trade balance of Libyan economy within 2000 – 2008.

## **Framework of the Research**

- theoretical framework of relationship between state budget and trade balance
- analysis of extent of economic vulnerability of Libyan economy during 2000 – 2008
- analysis of status of state budget of Libyan economy during 2000 – 2008
- analysis of status of trade balance of Libyan economy during 2000 – 2008
- analysis of mutual effect between state budget and items of trade balance during 2000 – 2008
- trends of rate of both net of state budget and trade balance to nominal national outcome during 2000 – 2008

### **1 - Theoretical Framework of Relationship Between State Budget and Trade Balance**

Some economic concepts<sup>(1)</sup> refer that it is possible to use shrinking or expansive fiscal policy. As for deficit in trade balance, it is possible that state follows shrinking financial policy represented in raising levels of taxes, reduction of public expenditure or both. Such matter may lead to minimizing economic activity which would extend to economy in multiple effect.

As a consequence, consumption of goods and services, including imported consumption and productive goods, would minimize, the other one. Besides, reduction of total demand locally may direct productive capability towards production of export goods, which means promotion of state of trade balance through usage of such financial policy, but in case of opulence, what happens is absolutely opposite.

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<sup>1</sup> *Murdakhai Kerianin, Inter. Economy is Policies Entrance, translated by Moh'd Ibrahim Mansour & Ali Masoud Atia, Riadh, Mars House, 2007, p.p.308-308.*

This can be explained by the following equation of national calculations(2):

$$Y = C + I + G + (X-M) \dots\dots\dots(1)$$

$$Y = S + C + T \dots\dots\dots(2)$$

$$(X - M) = S + (T-G) - I \dots\dots\dots(3)$$

$$(X-M) = (T-G) + (S-I) \dots\dots\dots(4),$$

where:

Y = national income

C = consumption spending

I = Investment spending on plant, equipment, etc.

G = government spending on goods and services

X = exports , M = imports, T = taxes, S = Private savings, (T – G) = Public savings

By re-arrangement of equation sto obtain net exports, we get:

Equation (4) expresses in the left side the trade balance, but in the right side it expresses net public savings, to which added net of private savings (S-I). It is also noticed from equation (4) that surplus of level of imports over than exports leads to deficit of trade balance. On the level of state budget, surplus of public expenditure over public imports leads to occurrence of deficit in it, and occurrence of the opposite leads to excess in both (X-M) and (T-G). It is worthy to mention that private sector of Libyan economy does not play fundamental part in economic activity, un comparison with public one. So, effect of net private savings (S-I) on trade balance (X-M) in Libyan economy can be excluded under the existence of public sector dominating most of economic activity. By re-arranging equation (4), we can get the following one:

$$(T-G) = ( X-M) - (S-I) \dots\dots\dots(5)$$

From equation (5) it is clear that state of budget can be affected by status of trade balance as well as by the difference between saving and investment for private sector. Under the absence

of big role of private sector in Libyan economy, the trade policy has big impact on state budget. When restricting movement of imports directing to inside by maximizing customs, imposing restrictions on quantities of imports or by censorship on foreign exchange, these lead to increase in prices of imported merchandises, which in its turn, minimizes the size of imports through reduction of demand on them, causing promotion of state of trade balance. It is expected that public expenditure on imported merchandises tends to decrease with increase of outcome of public revenues, especially if imports have been restricted by imposing raise of customs duties, which leads to promote state of state budget.

From the above, it is clear that it is necessary to apply economic policies affecting both state budget and trade balance, in a manner that achieves economic stability without occurrence of any deformations. Deficit of state’s budget, if accompanied with surplus of trade balance, is a guarantee of occurrence of equilibrium in its general frame,(3) and vice-versa. But occurrence of deficit in both state budget and trade balance may lead to undesirable economic effects. And in case of surplus of them, this might apparently appear happy event, but this may not express success of economic policies relating to state budget and trade balance. This can hide defect or absence of prosperity of economy via minimization of imports and state expenditure, or dependence of economy on a source about to exhaust as a financer of exports and public revenues.

### **2 - Analysis of Extent of Economic Vulnerability of Libyan Economy During 2000 – 2008**

In view of data of Table (1), we notice that extent of economic vulnerability in Libya was fluctuating in this period: 2000 – 2003, where it has decreased from (44.8%) in 2000 to (43%) in 2001. This was due to decline of exports toward nominal national output from (33.4%) in 2000 to (30.5%) in 2001.

<sup>2</sup> Sami Khalil, *Theory of Macroeconomics, Kuwait, 1999, p.p.149-150.*

<sup>3</sup> Mahmoud Dagher & Salam El-shami, *Research Paper titled (Analysis of Relationship between Public & External Sectors in Libya), Alsatel Journal, Issue 3, Misurata, 7 Oct., University, 2007, p.121.*

the reason was decline of oil exports from (30.5%) in 2000 to (23%.1) in 2001, due to decline of oil prices in international markets in 2001. Besides, increase of national output has its effect in reduction of extent of vulnerability. But in 2002 the extent of vulnerability of Libyan economy to abroad has arisen to (72.3%) despite continuance of rise of nominal national output, but rise of exports and imports has the biggest effect, which has been reflected in form of rise of economic vulnerability, where rate of exports to nominal national output has raised to (41.2%), of which oil exports formed (33.4%), and (31.0%) as for imports. The reason of increase of value of both exports and imports of Libyan economy in 2002 was amendment and standardization of exchange rate since begging of the year as one of policies of economic reform.

In 2003, extent of vulnerability has again declined to reach (68.8%) despite rise of rate of total exports as well as oil exports to national output, but reduction in value of imports and rise of nominal national output had an effect that exceeded the one of rise in exports size on extent of economic vulnerability, causing to decrease them.

As for the years following 2003, particularly 2004 – 2008, they had undergone continuous rise in extent of economic vulnerability reaching highest rate (98.1%) in 2008, this was due to continuous increase in rate of exports rate to nominal national output of the same period, for it reached acme (72.7%) in 2008, the oil exports formed (71.2%) of such rate, under the unprecedented and continuous rises in prices of crude oil in international markets in 2004 – 2008. it is worthy to mention that rate of imports to nominal national output was fluctuating in that period despite rise of imports continuously, that's due to fluctuation of rises in both nominal national output and value of imports.

### **3- Analysis of Status of State Budget of Libyan Economy During 2000 – 2008**

#### **Total Revenues**

Total revenues have achieved remarkable rise in 2001 – 2002, where annual average of their growth in 2001, in comparison with 2000 (28%.7), while such average in 2002, in comparison with 2001, was (42%.9). such rise was due to increase of oil revenues in total of total revenues from (47.3%) in 2000 to (60.1%) in 2001, and to (76.4%) in 2002. further,

average of annual growth of oil revenues in 2001 was (63.5%) and (81.8%) in 2002. it is worthy to mention that despite decline of non-oil imports in 2001-2002 in (2.6%) and (15.6%) respectively, the impact of increase of oil revenues on total revenues was higher, due to their trend to increase.

As in 2003, and despite increase in non-oil revenues in (103.2%) in comparison with 2002, the level of total revenues has decreased in (533.9\$) million, rated (6.2%) in comparison with 2002. This was due to decline of oil revenues in (2622.0) million dinars, rated (40.0%) in comparison with 2002.

As for period from 2004-2008, it witnessed continuous increase in total revenues, but its average was fluctuating, in view of fluctuation of average of increase in oil revenues. In general, average of growth of total revenues between 2004-2008 was (33.2%), while average of growth of oil revenues during the same period was (34.0%) Concerning non-oil revenues, they have decreased in 2004 and 2005 in (23.8%) and (12.9%) respectively. But the years 2006, 2007, and 2008, annual average of growth has witnessed remarkable rise, reaching (29.1%), (34.2%) and (76.1%) respectively, but mean of contribution of non-oil revenues in total of revenues in 2004-2008 remained low, reaching (9.8%), so the mean of share of oil revenues out of total revenues of the same period (90.2%), asserting dominance of oil revenues over total ones.

The considerable development witnessed by crude oil prices and increase its revenues have their impact in increase of total revenues of Libyan economy.

#### **Total Expenses**

Total expenses recorded raise in 2001 in comparison with 2000, where average of annual growth of such expenses was (7.3%). This was due to increase of current expenses amounting (443.4) million dinars, rating (14.1%), while expenses of transformation decreased in rate of (0.1%) during the same year, to reduce their contribution to total total expenses from (29.4%) in 2000 to (27.3%) in 2001.

Total expenses have also achieved remarkable rise in 2002 in comparison with 2001, by (2855.4) million dinars, namely (50.7%). This was due to

Year	Exports	Oil exports	Imports	Size of trade exchange	nominal national output	Rate of exports to output	Rate of oil exports to output	Rate of imports to output	Extent of economic vulnerability
2000	6160.0	5630.3	2106.0	8266.0	18456.9	33.4	30.5	11.4	44.8
2001	6591.0	4992.0	2895.0	9486.0	21618.7	30.5	23.1	13.4	43.9
2002	12511.0	10121.2	9408.0	21919.0	30330.5	41.2	33.4	31.0	72.3
2003	16483.4	15857.4	9216.0	25699.4	37360.7	44.1	42.4	24.7	68.8
2004	22619.4	21479.4	11398.4	34017.8	48105.4	47.0	44.7	23.7	70.7
2005	37791.9	36612.9	14637.9	52429.8	66450.7	56.9	55.1	22.0	78.9
2006	51552.4	50268.6	15674.2	67226.6	80729.9	63.9	62.3	19.4	83.3
2007	59182.2	57760.9	22303.8	81486.0	89260.3	66.3	64.7	25.0	91.3
2008*	76818.0	75291.8	26856.3	103674.3	105728.4	72.7	71.2	25.4	98.1

Source: -Abduallah Moh'd Shamia, Research titled "Libyan Exports & Their Role in Economy", Economic Researches Journal, Vol.3, Issue 2, Benghazi, Center of Economic Sciences Researches, 2005.

Central Bank of Libya, Economic Leaflet, several issues.

Table 1: Extent of economic vulnerability of Libyan economy to abroad (million dinars).

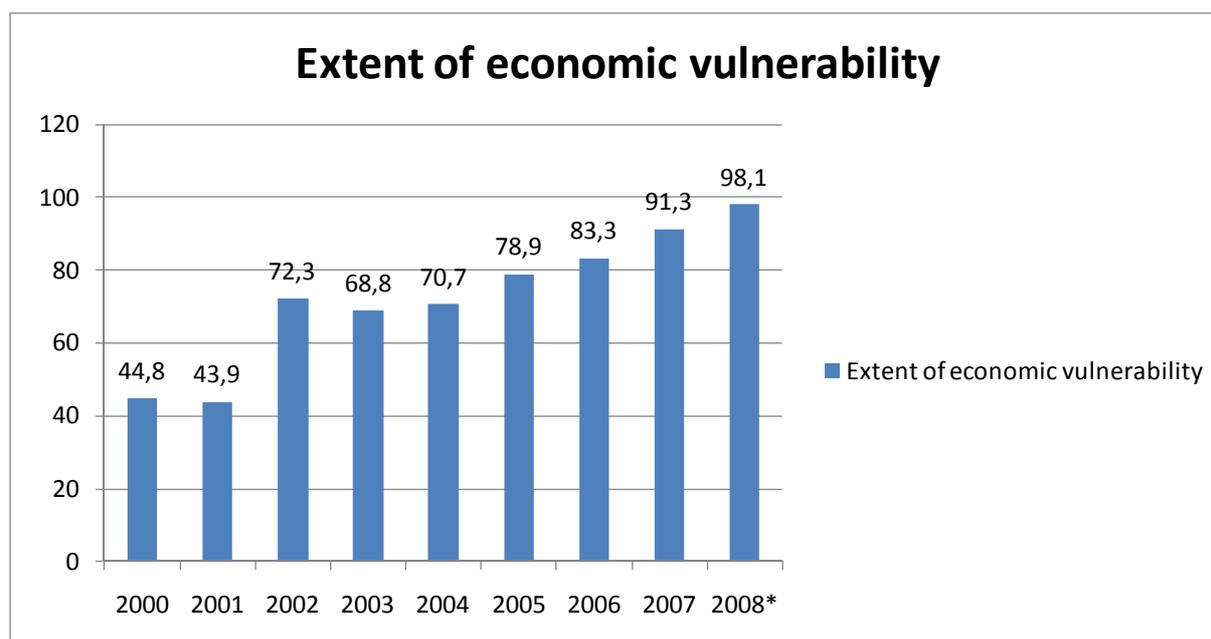


Figure 1: Extent of economic vulnerability of Libyan economy to abroad.

increase of expenses of transformation in rate (140.5%) in addition to increase of current expenses rating (17.1%), and rate of transformation expenses to total expenditure has rose rating (43.6%) in 2002 in comparison with (27.3%) in 2002.

In 2003, decrease occurred in level of total expenses in comparison with 2002 which was

parallel to reduction in total revenues of the same year. Level of total expenses has decreased from (8487.0) million dinars in 2002 to (6866.2) million dinars in 2003, with decrease rate of (19.1%), due to decrease of both current expenses and of transformation ones rating (15.0%) and (31.7%) respectively in view of decrease of total revenues during the same year.

Description	2000	2001	2001	2003	2004	2005	2006	2007	2008
<b>Total incomes:</b>	<b>4662.2</b>	<b>5998.8</b>	<b>8574.1</b>	<b>8040.2</b>	<b>23087.0</b>	<b>37106.0</b>	<b>47088.0</b>	<b>53366.3</b>	<b>72741.2</b>
-oil	2203.0	3603.0	6551.0	392.0	19956.0	34378.0	43566.0	48638.3	64417.0
-non-oil	2459.2	2395.8	2023.1	4111.2	3131.0	2728.0	3522.0	4728.0	8324.2
Rate of oil incomes to total incomes (%)	47.3	60.1	76.4	48.9	86.4	92.6	92.5	91.1	88.6
Average of growth of oil incomes (%)	--	63.5	81.8	-40.0	407.9	72.3	26.7	11.6	32.4
Average of growth of non-oil incomes (%)	--	-2.6	-15.6	103.2	-23.8	-12.9	29.1	34.2	76.1
Average of growth of total incomes (%)	--	28.7	42.9	-6.2	187.1	60.7	26.9	13.3	36.3
<b>Total expenses:</b>	<b>5250.2</b>	<b>5631.6</b>	<b>8487.0</b>	<b>6866.2</b>	<b>17230.0</b>	<b>21343.0</b>	<b>21378.0</b>	<b>30883.0</b>	<b>4415.5</b>
-operational	3153.2	3596.6	4210.3	3577.7	6720.0	8282.0	9054.0	11890.0	11874.8
-transformation	1541.0	1539.0	3701.7	2530.0	6718.0	10273.0	11039.0	18993.0	28903.3
-distribution of wealth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3337.4
-extra	556.0	496.0	575.0	758.5	3792.0	2788.0	1285.0	0.0	0.0
Rate of expenses pf transformation to total expenses (%)	29.4	27.3	43.6	36.8	39.0	48.1	51.6	61.5	65.5
Average of growth of transformation expenses (%)	--	-0.1	140.5	-31.7	165.5	52.9	7.5	72.1	52.2
Average of growth of operation expenses (%)	--	14.1	17.1	-15.0	87.8	23.2	9.3	31.3	-0.1
Average of growth of total incomes (%)	--	7.3	50.7	-19.1	150.9	23.9	0.2	44.5	42.8
<b>The balance of state budget</b>	<b>-588.0</b>	<b>367.2</b>	<b>87.1</b>	<b>1174.0</b>	<b>5857.0</b>	<b>15763.0</b>	<b>25710.0</b>	<b>22483.3</b>	<b>28625.7</b>
Average of growth of surplus (%)	--	--	-76.3	1247.9	398.9	169.1	63.1	-12.6	27.3

Source: Central Bank of Libya, Economic Leaflet, several issues.

Table 2: Status of state budget of Libyan economy in 2000 – 2008, (million dinars).

As for the period: 2004 – 2008, the total expenses have achieved continuous increase whose average characterized with fluctuation, according to turnings over occurring in averages of increase achieved in both operating and transformation (investment) expenses. Average of growth of total expenses over 2004 – 2008 was (26.5%), and rate of expenses of transformation to total total expenditure after 2005 was (59.5%) in average, due to increase of totall expenditure on projects of

infrastructure, service, productive and crediting different projects<sup>(14)</sup>.

#### Net of State Budget

<sup>14</sup> Central Bank of Libya, Annual Report, 2007, p.46.

State budget has achieved continuous revenues over 2001 – 2008, but they were fluctuating relating to transaction of total revenues and total expenses of the same period. By tracing data, we notice that 2001 has witnessed surplus of balance of (367.2) million dinars after undergoing deficit of (588.0) million dinars in 2000 and decrease in 2002 of (280.1) million dinars, namely; rate of (76.3%) comparing with 2001, this was due to increase of total expenditure in a manner bigger than increase in total revenues of the same period, because of the big increase in transformation expenses amounting (140.5%) in comparison with 2001, then surplus of budget has again arisen continuously in 2003 – 2006, but average of such increase was fluctuant according to movement of total revenues and total expenses. In 2007, surplus of state budget has decreased (3226.7) million dinars in a rate of (12.6%) in comparison with 2006, due to increase of total expenditure of 2007 in a rate of (44.5%), for increase of total revenues whose rate was (13.3%) over the same year, comparing with 2006. in 2008, surplus of budget has again arisen reaching (28.6%) million dinars for (22.5) million dinars over 2007, in a rate of (27.3%). It was noticeable that increase of oil and non-oil revenues, as well as decrease of operating expenditures and of average of increase of transformation expenditures have the eminent impact in rise of surplus of state budget over 2000.

#### **4 - Analysis of Status Trade Balance of Libyan Economy in 2000 – 2008**

##### **Exports**

Data of Table (3) refer to scope of dominance of oil exports on total exports over 2000 – 2008, where they exceeded (90.0%) of total of exports in most of research years, except 2001 and 2002 when such rate was (75.7%) and (80.9%) which means that national economy is greatly effected by alterations occurring in national market of oil, and such alterations undergo outside factors uncontrollable in the inside.

In view of status of total Libyan exports over 2000 – 2008, it is noticeable that they have achieved continuous increases, but average of such increase was fluctuant due to fluctuations in increases of both oil and non-oil exports. In 2001, average of growth of total exports was (7.0%) which was lowest average of growth over the period of the research. That was a result of decrease of oil exports due to decrease of oil prices in that period, where average of growth of oil exports was (11.3%), but development in non-oil exports has led to rise in value of total exports comparing with 2000.

As for 2002, policy of amending and standardization of exchange rate applied since beginning of the year, and slight rise resulted in prices of raw oil played significant role in rise

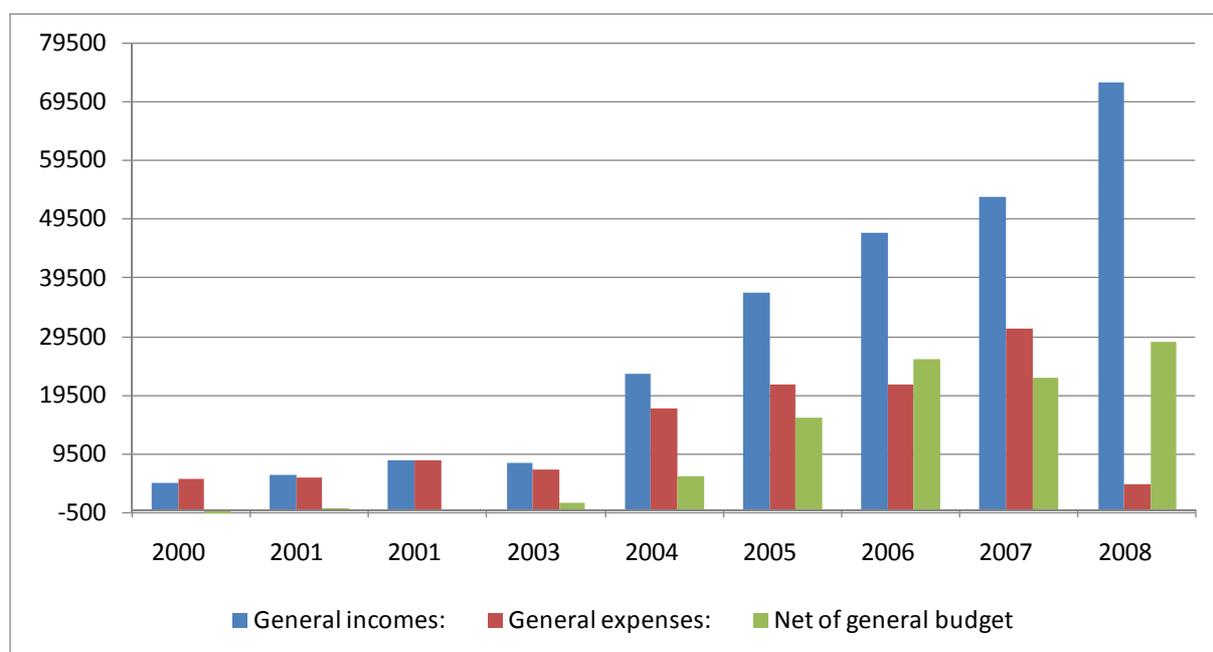


Figure 2: Status of state budget of Libyan economy.

of value of exports<sup>(12)</sup> whose annual average of growth was (89.8%) which represents biggest growth of exports over period of the study. It is worthy to mention that average of growth of oil exports over the same year was approximately (102.7%).

After 2002, particularly in 2003 – 2008, oil exports have begun to take the biggest rate of total Libyan exports. Mean of rate of their contribution to total exports was (97.3%) as a result of successive and unprecedented rises in prices of oil in international markets, which led to clear promotion in total Libyan exports whose compound average of growth over 2003 – 2008 was (36.0%), where compound average of growth of oil and non-oil exports over the same period was (36.5%) and (19.7%). Despite average of growth in non-oil exports over 2003 – 2008 was bigger than average of growth of oil exports over the same period, the mean of their contribution to total exports has not exceeded (2.7%).

### **Imports**

Libyan imports have achieved continuous rise over 2000 – 2008 except in 2003 in which value of imports has decreased comparing with 2000. In 2001, average of growth of imports was (37.5%) achieving increase of (789.0) million dinars in comparison with 2000, in 2002, imports have increased in rate of (225.0), namely; (6513.0) million dinars in comparison with 2001. It was clear that average of growth of imports over 2001 – 2002 was bigger than of one of growth of exports over such years, due to cancellation of work in import budget in 2002, removal of significant portion of restrictions on transfer, and allowing private activity to import accordingly,<sup>(13)</sup> in addition to state's adoption of policy of amending and standardization of exchange rate since beginning of 2002.

In 2003, imports have decreased (2.0%) amounting (192.0) million dinars, comparing with 2002.

despite that, imports of 2003 were sufficient to satisfy the desired demand<sup>(14)</sup>

Rise in imports has returned greatly in 2004 – 2008 where their average of growth over that period was (23.9%), as result of rise of investment activity in Libyan economy.

### **Trade Balance**

Trade balance represents result (outcome) of movement of exports and imports of an economy over a time period. When tracing data of Libyan trade balance, we notice that it has achieved continuous excesses over 2000 – 2008, but quantity of such excess has decreased in 2001 and 2002 by (8.8%) and (16.0%), due to rise of imports in a quantity bigger than rise of exports over such two years.

After 2002, particularly the period 2003 – 2008, rises in excess of trade balance have succeeded in fluctuant averages according to movement of exports and imports. Average of compound growth of excess was (47.0%).

It is worthy to mention that such has been achieved as a result of promotion of incomes of exporting raw oil in view of rise of its prices level in international markets over such period.

We can say that trade policy has witnessed significant developments over 2000 - 2008. Prior to 2002, Libyan economy used to follow policy of manufacture directed to satisfy need of local market, so principle of quantity protection has been adopted, by organizing action of importing via importing balance, in a manner that no merchandise that can be produced locally may be imported except in the quantity that satisfy need of local demand, in view of inefficiency of local production.<sup>15</sup>

But such policy of protection has undergone radical changes at beginning of 2002 via cancellation of import budget, as well as decrease of customs tariff of big number of goods.<sup>(16)</sup>

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<sup>12</sup> Central Bank of Libya, *Annual Report, 2002*, p.39 & p. 88.

<sup>13</sup> General People's Committee of Planning, *Survey of Economic & Social Trends in Libya (1990-2004)*, 2005, p.16.

<sup>15</sup> General People's Committee of Planning, *previous reference*, p.17.

<sup>16</sup> *Ibid.*, p.30. <sup>10</sup> *Ibid.*, p.30-31.

Despite cancellation of quantity protection meets requirements of liberalizing trade and international economic integration, it causes local economy to face many problems, among which:

- rise in extent of economic vulnerability, which is undergone by Libyan economy. Such rate reached (98.1%) in 2008.
- Decrease in rate of competition ability of merchandise sectors in favor of imported products, which led to deterioration of many local industries, in addition to feeling of local consumer of preference of imported product in comparison with the imported one.
- This may lead to deterioration of payments balance and state budget and their tendency to deficit, as well as the negative impact on economic growth and living level, especially under deterioration of oil prices in international markets.

### **5 - Analysis of Mutual Effect between Items of state Budget and of Trade Balance over the Period 2000 – 2008**

From data of Table (4), it is clear that there is tangible and distinguished relation between items of state budget and ones of trade balance. There is a coordination between movement of exports and total incomes, in addition to compromise between development of status of total expense and movement of imports, which led to creation of compromise between both excess of state budget and excess of trade balance.

We can trace annual growth averages from items of state budget and of trade balance stated in Table (4), which represent mirror reflecting the relation between state budget and trade balance in Libyan economy. We can explain that through: 1. Trends of average of growth of exports and total incomes despite their fluctuations, were compromising in most years

2. Trends of average of growth of incomes and total expenses despite their fluctuations, were compromising in most years

3. As a result of these two points, averages of growth of both excess of total budget and excess of

trade balance were coordinating and in almost one trend.

The significant developments which occurred on the level of state budget and trade balance have happened in a manner parallel to oil developments in global markets through unprecedented rises of raw oil prices especially over 2004 – 2008, which led to increase of value of Libyan exports, consequently to rise of total incomes especially incomes, leading to increase in levels of total expense particularly of transformation. Since Libyan economy greatly depends on imports in meeting need of local demand on consumer and investment goods, then increase of expenses of transformation and operational expenses has led to increase of level of imports.

### **6-The Trends of Rate of net State Budget and Trade Balance to National Output over 2000 – 2008**

It is known that result of movement of exports and imports are represented in excess or deficit in trade balance. The matter is so concerning result of movement of total incomes and total expense which represents excess or deficit of state budget. In view of noticeable promotion occurred in situations of oil affairs through rise of their prices over 2000 – 2008, Libyan economy has achieved continuous excesses in both state budget and trade balance over the same period. To know the relation between excess of state budget and trade balance, they have been related to nominal national output, as stated in Table (5). We see that rate of excess of state budget to nominal national output has decreased in 2002 to (0.3%) for (1.7%) in 2001, after 2002, specifically in 2003 – 2006, such rate started to continuously rise, while decreased in 2007 by (25.2%) for (31.8%) in 2006, then rate of total incomes to nominal national output of 2008 has risen to (27.1%). On the other hand, rate of excess of trade balance to nominal national output has acted the same conduction of rate of excess of state budget to nominal national output, where it has decreased in 2002 to (10.2%) for (17.1%) in 2001. after 2002, specifically in 2003 – 2006, such rate started to continuously rise, while decreased in 2007 by (41.3%) for (44.4%) in 2006, then rate of excess of trade balance to nominal national output of 2008 has risen to (47.3%).

Description	2000	2001	2001	2003	2004	2005	2006	2007	2008
<b>exports:</b>	<b>6160.0</b>	<b>6591.0</b>	<b>1251</b>	<b>16483.</b>	<b>22619.</b>	<b>37791.9</b>	<b>51552.4</b>	<b>59182.</b>	<b>7681</b>
<b>-oil</b>	5630.3	4992.0	1012	15857.	21479.	36612.9	50268.6	57760.	7528
<b>-non-oil</b>	529.7	1599.0	2389.	626.0	1140.0	1179.0	1283.8	1421.3	1536.
<b>Rate of oil exports to total exports (%)</b>	91.4	75.7	80.9	96.2	95.0	96.9	97.5	97.6	98.0
<b>Average of growth of oil exports (%)</b>	--	-11.3	102.7	56.7	35.5	70.5	37.3	14.9	30.3
<b>Average of growth of exports (%)</b>	--	7.0	89.8	31.8	37.2	67.1	36.4	14.8	29.8
<b>imports:</b>	<b>2106.0</b>	<b>2895.0</b>	<b>9408.</b>	<b>9216.0</b>	<b>11398.</b>	<b>14637.9</b>	<b>15674.2</b>	<b>22303.</b>	<b>2685</b>
<b>Average of imports growth (%)</b>	--	37.5	225.0	-2.0	23.7	28.4	7.1	42.3	20.4
<b>Trade balance</b>	<b>4054.0</b>	<b>3696.0</b>	<b>3103.</b>	<b>7267.4</b>	<b>11221.</b>	<b>23154.0</b>	<b>3578.2</b>	<b>36878.</b>	<b>4996</b>
<b>Average of trade balance growth</b>	--	-8.8	-16.0	134.2	54.4	106.3	55.0	2.8	35.5

Source: Abdullah Mohamed Shamia, research titled "Libyan Exports & Their Role In economy", Economic Researches Journal, 3rd Vol., issue 2, Benghazi, Center of Researches of Economic Researches, 2005.  
Central Bank of Libya, economic Leaflet, different issues.

Table 3: Status of trade balance of Libyan economy over 2000 – 2008, (million dinars).

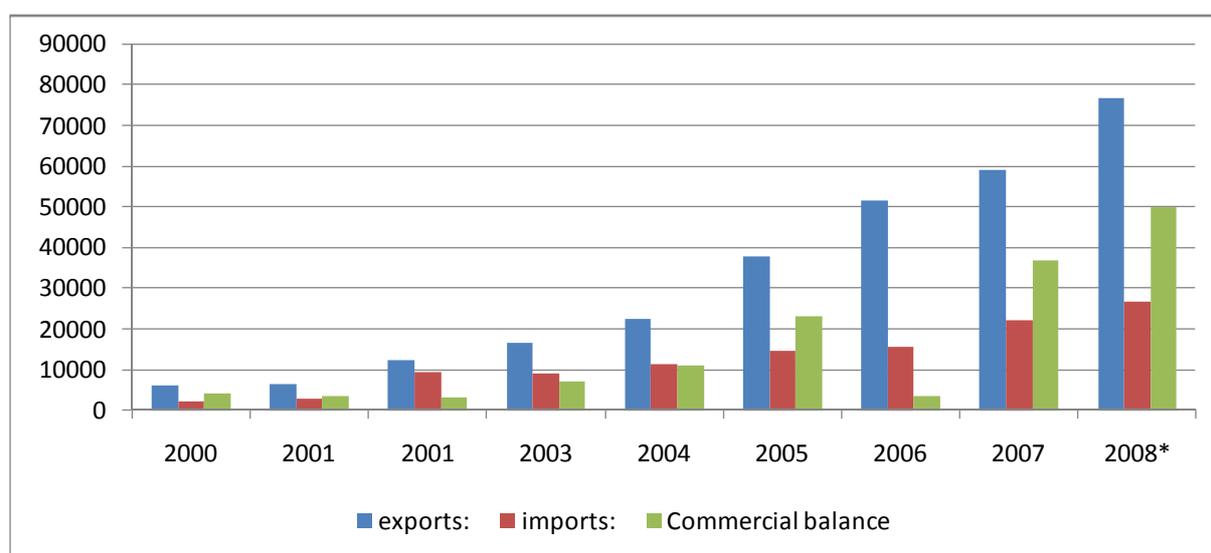


Figure 3: Trade Balance in Libyan Economy.

Through the above analysis, we see that rate of the aforementioned excesses to nominal national output has gone in most years of research in one direction, expressing existence of relation between

movements of state budget via movement of total incomes, and between movements of trade balance via movement of exports and imports

Year	Exports	Imports	Trade balance	Income	Expenses	The balance of state budget	Average of exports growth	Average of imports growth	Average of trade balance growth	Average of income growth	Average of expenses growth	Average growth of state budget
2000	6160	216	4054	4662.2	5250.2	-588	-	-	-	-	-	-
2001	6591	2895	3696	5998.8	5631.6	367.2	7	37.5	-8.8	28.7	7.3	-162.4
2002	12511	9408	3103	8574.1	8487	87.1	89.8	225	-16	42.9	50.7	-76.3
2003	16483.4	9216	7267.4	8040.2	6866.2	1174	31.8	-2	134.2	-6.2	-19.1	1247.9
2004	22619.4	11398.4	11221	23087	17230	5857	37.2	23.7	54.4	187.1	150.9	398.9
2005	37791.9	14637.9	23154	37106	21343	15763	67.1	28.4	106.3	60.7	23.9	169.1
2006	51552.4	15674.2	35878.2	47088	21378	25710	36.4	7.1	55	26.9	0.2	63.1
2007	59182.2	22303.8	36878.4	53366.3	30883	22483.3	14.8	42.3	2.8	13.3	44.5	-12.6
2008	76818	26856.3	49961.7	72741.2	44115.5	28625.7	29.8	20.4	35.5	36.3	42.8	27.3

Source: Tables (2) and (3)

Table 4: Mutual effect between items of state budget and trade balance over the period 2000 – 2008, (million dinars).

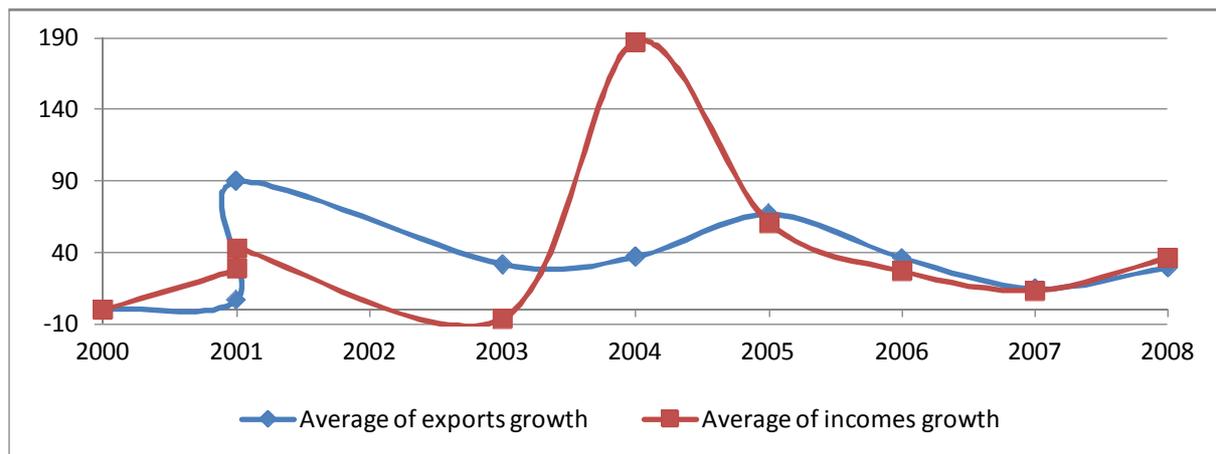


Figure 4-A: The relation between total incomes and exports.

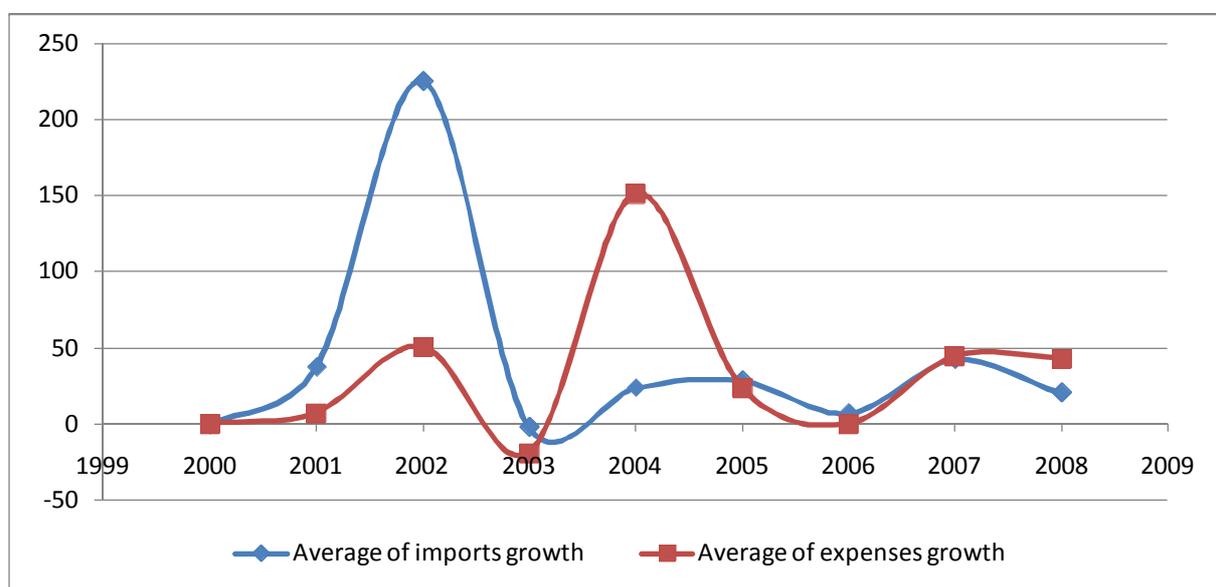


Figure 4-B: The relation between total expenses and imports.

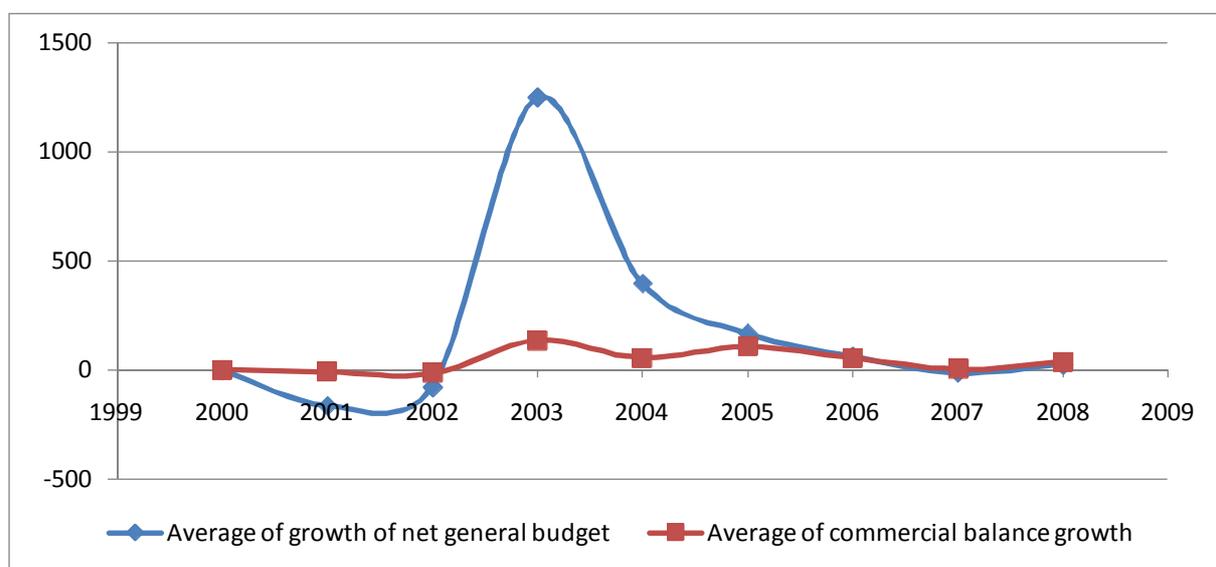


Figure 4-C: The relation between the balance of state budget and trade balance.

Description	2000	2001	2001	2003	2004	2005	2006	2007	2008*
Trade balance	4054	369	31030	726.4	11221	23154	35878.2	36878.4	49961.7
Balance of state budget	-588	367.2	87.1	1174	5857	15763	25710	22483.3	28625
Nominal national output	18456.9	21618.7	30330.5	37360.7	48105.4	66450.7	90729.9	89260.3	105728
<b>Rate of total trade balance to nominal national output</b>	<b>22</b>	<b>17.1</b>	<b>10.2</b>	<b>19.5</b>	<b>23.3</b>	<b>34.8</b>	<b>44.4</b>	<b>41.3</b>	<b>47.3</b>
<b>Rate of the balance of state budget to nominal national output</b>	<b>-3.2</b>	<b>1.7</b>	<b>0.3</b>	<b>3.1</b>	<b>12.2</b>	<b>23.7</b>	<b>31.8</b>	<b>25.5</b>	<b>27.1</b>

Source: Tables (2) and (3).

Table 5: The trends of rate of both net state budget and trade balance to national output over 2000 – 2008, (million dinars).

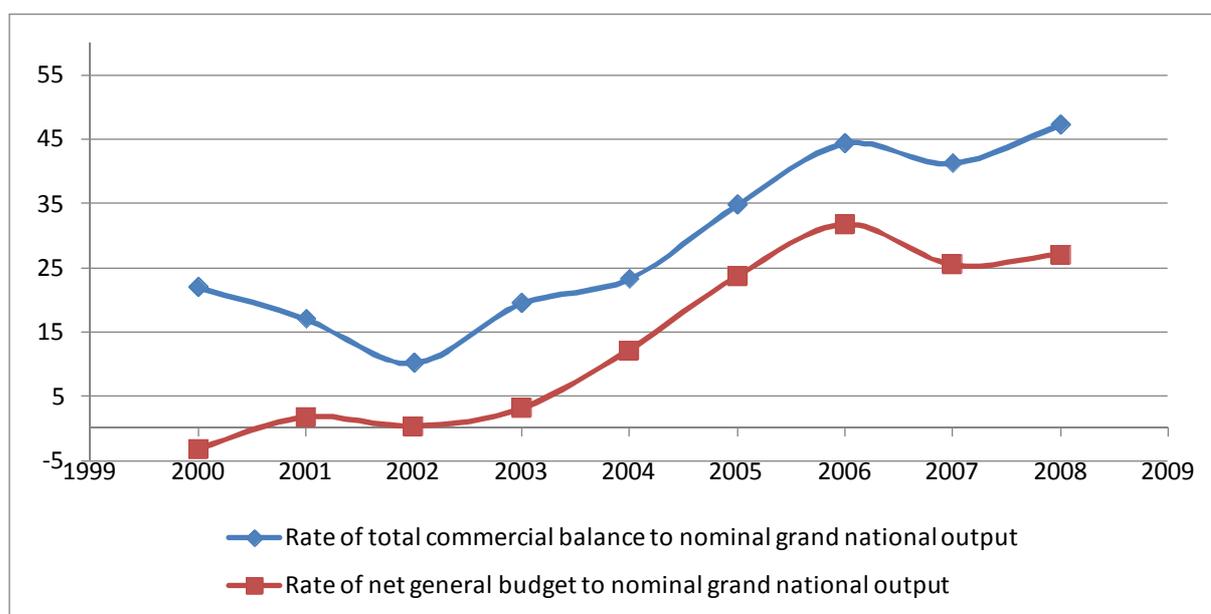


Figure 5: The trends of rate of both net state budget and trade balance to national output.

Through the above analysis, we see that rate of the aforementioned excesses to nominal national output has gone in most years of research in one direction, expressing existence of relation between movements of state budget via movement of total incomes, and between movements of trade balance via movement of exports and imports.

## Conclusion

This research presented analytic exposition of the subject of relation between state budget and trade balance over the period: 2000 -2008,

through study of some aspects represented in: analysis of extent of economic vulnerability, analysis of status of trade balance, analysis of status of state budget, analysis of mutual effect of both items of state budget and ones of trade balance, and trends of rate of excess in both state budget and trade balance to nominal national output in Libyan economy, for the purpose of studying hypotheses of research and to achieve its target. Through study and analysis, it has been detected that relevant significant developments have occurred to Libyan economy. They are:

1. Libyan economy undergoes high extent of

vulnerability to external world, by dependence on foreign trade represented in exports which most of them are crude oil and imports of consumption and investment goods, which means the national output never plays fundamental role in comparison with size of foreign trade in Libyan economy. Namely; weakness of nominal national output in face of the big, continuous and renewing requirements of state and people whether in terms of consumer or investment goods.

2. Oil exports still take total Libyan exports despite the promotion occurring in non-oil exports over the period: 2003 – 2008, but such was not sufficient to rid of dominance of the exhausting resource. Mean of contribution of non-oil exports over that period did not exceed (2.7%) of total exports, and Libyan imports have not lost its share in increase over the studied period in view of cancellation of quantity restrictions on imports and censorship on foreign exchange, in continuous rise especially in last years, emphasizing dependence of Libyan economy on imports in meeting huge portion of local demand on consumer and investment goods. But in spite of increase in value of imports, the trade balance remained preserving achievement of excesses along the period of study, depending on the continuous rises of prices of crude oil in global oil markets.

3. Rise of outcome of total revenues, benefiting from rise of oil revenues in view of rise of crude oil prices in global market greatly, with simple contribution of non-oil revenues which have promoted especially in recent years of the period of the research, something that has reflected on total expenditure by continuous increase especially relating to expenses of transformation for the sake of financing different projects of development in an attempt to direct Libyan economy toward development,

promotion and minimizing dependence on oil as a chief resource of financing all sectors, economic activities, foreign trade, effort to maximize averages of growth of national output, and minimizing extent of economic vulnerability to outside. It is worthy to mention that net state budget has been greatly affected by the changes occurring in global oil markets through achieving continuous excesses over the period of 2001 – 2008.

4. The big promotion occurred in prices of raw oil has an obvious effect on oil exports then oil revenues, which led total expenditure to considerable rise. Since Libyan economy depends on imports to meet demand of its people of consumer and investment goods, increase of total expenditure has led to rise of imports. This proves scope of relation between state budget and trade balance through relation between movements of exports and total revenues and total expenditure and imports, and such relation is governed by dominance of the exhausting resource which is affected by external factors out of control of Libyan economy, something make it liable to risk in case of occurrence of any declines in oil global markets.

5. Rate of excess in both trade balance and state budget to nominal national output in most of period of the research goes in one trend, emphasizing again the mighty connection between state budget and trade balance of Libyan economy.

6. Under cancellation of role of censorship on foreign exchange and cancellation of quantity restrictions over imports, the tools of state budget represented in total revenues and total expenses become effective in restricting movement of imports as precautionary action toward any undesirable developments in oil global markets.

*Corresponding author:*

*Ing. Mansoor Maitah, Ph.D. et PhD.*

*Czech University of Life Sciences Prague, Department of Economics*

*Kamycká 129, Prague- Suchdol, Czech Republic*

*Phone: +420224382139*

*e-mail: maitah@pef.czu.cz*

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## Econometric Analysis of Milk Value Chain

K. Matulová, P. Bubáková, O. Škubna, T. Taussigová

Czech University of Life Sciences Prague, Faculty of Economics and Management, Department of Economics

### Abstract

This article deals with the basic analysis of price transmission in the milk agri-food chain. The analysis is aimed at deriving the fundamental relationships between milk prices at the individual levels of the chosen vertical. The results are then validated with the use of statistical hypotheses testing. From the derived single equation models, it is clear that there is a strong difference in the leverage of individual factors influencing the price at different levels of the milk value chain. The results were elaborated within the research intention IVZ MSM 6046070906.

### Key words

Agri-food Chain, Milk, Price Transmission, Statistical Test.

### Anotace

Článek se zabývá základní analýzou cenové transmise v zemědělsko-potravinářské vertikále mléka. Analýza se zaměřuje především na odvození základních vztahů mezi cenami mléka na jednotlivých úrovních vybrané vertikály. Výsledky jsou ověřeny za využití statistických testů. Z dosažených výsledků jednotlivých jednorovnicových modelů plyne, že v rámci cenové tvorby na jednotlivých úrovních dané vertikály existují značné rozdíly co do činitelů ovlivňujících výslednou cenu. Poznatky prezentované v článku jsou výsledkem řešení IVZ MSM 6046070906.

### Klíčová slova

Zemědělsko-potravinářská vertikála, mléko, cenová transmise, testovací statistika.

### Introduction

A product chain analysis is a useful tool for monitoring the influence of individual market subjects on the overall development of the given industry. Individual product chains within the agri-food sector are very well monitored in the Czech Republic from a statistical point of view. This is mainly due to previous historical periods when agriculture was marked out by a relatively direct dependency of individual product chains in a rather confined area.

As a consequence of globalization processes, some of the fundamentals related to the product chains in general – and within agriculture especially – have already been disrupted. Nevertheless, primarily because of food security, it is reasonable to monitor not only the volume of basic foodstuffs but also the possible relationships between price creations at individual levels of the product chain.

In this context, the concept of price transmission is introduced in the economic theory. This term is

used for analyzing the proportional changes of inputs and the transmission of these changes into the changes of outputs.

In many processing industries, it was found out following: the growth of input price is almost immediately projected to output price, whilst the fall of input price does not bring that marked fall in output price and usually there is also a time delay in between these two falls (Peltzman, 2000).

This may also be the case of the milk price studied in this article (see charts 1 and 2 bellow). Therefore, we may suggest that the transmission process of price in given vertical chain is rather asymmetric. This idea is supported by the results of dairy sector studies in other countries (e.g. Kinnucan et al., 1987; Frigon et al., 1999).

Although the product market may be fairly similar to the perfect competition market, the production itself goes through an imperfect market environment at other levels of the product chain. The imperfect market environment means that the

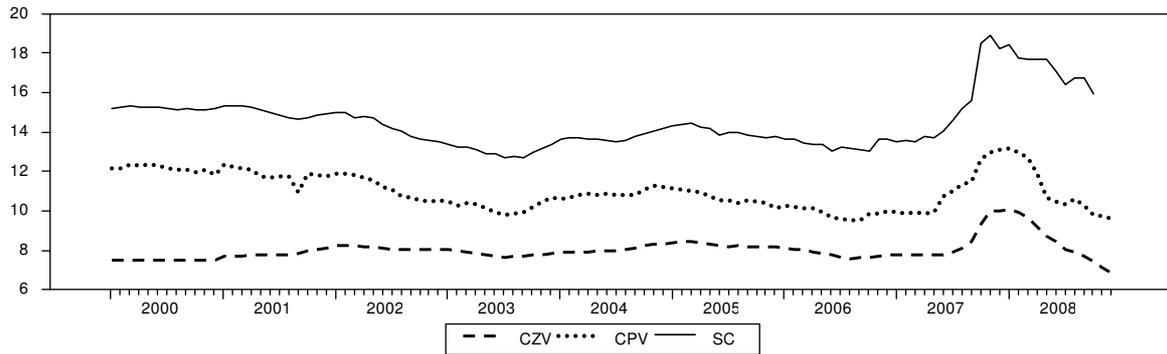


Chart 1: Agricultural Price, Producer Price, Consumer Price of Milk in CZK per litre.

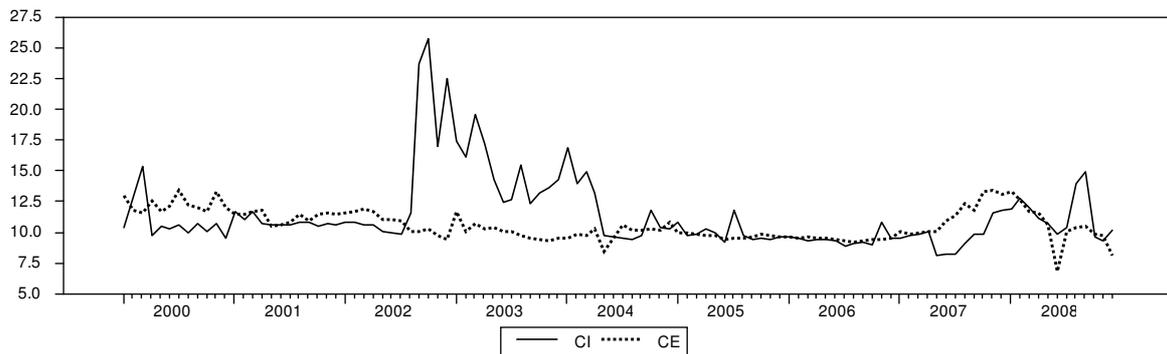


Chart 2: Import Price, Export Price of Milk in CZK per litre.

economic forces in the product chain are not evenly transmitted within the subject at separate levels.

Econometric methods are one of the useful tools that can be used to cover a wide range of market impacts within the price transmission. These methods are able – with different levels of success – to explain the impact of individual variables. Specifically, the asymmetry of price transmission at the different levels of the milk product chain and the possibilities of its modelling with the use of econometric tools are the main interest of this article, which deals with the fundamental relations for price transmission in the dairy market in the Czech Republic.

The following charts (1 and 2) show the time development of individual types of price analyzed in this paper.

There is evidence of significant change in the price development of analyzed values from the end of the year 2007. The rapid increase in agricultural price began in October 2007 – during this time, the price reached its highest value for the last 11 years. The price continued to grow until January 2008, when it

reached its maximum and then started to decline. Also, producer price and consumer price demonstrated the same development during the period under discussion.

This shock was primarily caused due to increased demand in Europe and Asia. In Europe, Czech, German and Italian producers led the increase in demand. In the development of export and import price, the influence of abnormal demand can be seen as well. All these facts contributed to an increase not only in milk itself but also in milk products – i.e. products with added value.

The data set is gathered from the Czech Statistical Office and from papers of the Ministry of Agriculture of the Czech Republic, and covers the period from January 2000 to December 2008 (hence, the total number of observations is 108). The analysis of the milk vertical chain uses the time series of agricultural, producer, consumer, export, and import price of milk. The data set of the first three mentioned is gathered in Czech Crown per litre, while both export and import price is obtained by dividing the total price and the total amount.

$$CZV_t = fce (CZV_{t-\tau}, CPV_t, CPV_{t-\tau}, SC_t, SC_{t-\tau}, CE_t, CI_t) \quad (1)$$

$$CPV_t = fce (CZV_t, CZV_{t-\tau}, CPV_{t-\tau}, SC_t, SC_{t-\tau}, CE_t, CI_t) \quad (2)$$

$$SC_t = fce (CZV_t, CZV_{t-\tau}, CPV_t, CPV_{t-\tau}, SC_{t-\tau}, CE_t, CI_t) \quad (3)$$

RATS software version 6.0 is used to estimate and to test individual models. Ordinary least squares method (OLS) is employed. The variables – agricultural price, producer price, and consumer price – are simulated with the use of single equation econometric models.

Firstly, the general economic models are set up:

Where:

CZV...agricultural price (1l of unrefined milk)

CPV...producer price (1l of processed milk)

SC.....consumer price (1l of processed milk)

CE.....export price (processed milk in the package up to 2l)

CI.....import price (processed milk in the package up to 2l)

t.....time period

$\tau$ .....lag

In the general models, all above mentioned variables are covered. Then, the variables derived from estimated models are examined – variables' significance is analysed.

Several fundamental hypotheses can be postulated, which are divided into three examined groups - agricultural price, producer price and consumer price.

### Agricultural Price Single Equation Model

Agricultural price hypotheses:

- Lag values and producer price influence the agricultural price.
- Consumer price together with export and import price do not contribute to the development of the given endogenous variable.

The linear form of the model is used. The general model of the dependent variable CZV – agricultural price – involves all reflected variables. The dummy variable is put into the model for price shock interception (October 2007 – March 2008), which is discussed in previous chapter (within the discussion

concerning the development of individual types of prices). The lagged variables are included in the model as dynamising factors. Generally, information criteria are useful tools for setting the maximum number of lags. The Schwarz information criterion (SIC) indicates a maximum of only two lags, while in contrast the Akaike information criterion (AIC) indicates thirteen lags. For estimation purposes, it is useful to use SIC as it indicates a lower number of maximum lags.

In the following process, the estimated model is modified so it includes only significant variables. Therefore, in the model, the CZV variable is dependent on the CZV{1 to 2}, and CPV{0 to 1} variables (note: CZV{1} = CZVt-1). But this model is rejected, because it does not fulfil the fundamental assumptions of the econometric model – i.e. in this case, heteroskedasticity is detected, and a robust estimation cannot be made.

The given model (1) needs to be linearized as the previously mentioned problems during the modelling indicate that the model is not linear in its parameters. Linearizing the model is based on logarithmic transformation (e.g. CZV\* = lnCZV). In this model, the explanatory variables remain the same – i.e. CZV\*{1 to 2}, CPV\*{0 to 1}. The hypothesis of homoskedasticity existence is not valid in this case, but the use of robust estimation helps to resolve the problem. Nevertheless, this model is rejected because the other statistical hypotheses are disturbed (i.e. stability, functional form, and normal distribution of random variable).

Finally, the model is estimated with the use of the differences of data set available (e.g. dCZVt = CZVt – CZVt-1). A maximum lag of one is selected on the basis of the SIC computation. The anomaly in differences is simulated with the use of a dummy variable, but the model then does not fulfil statistical hypotheses. Therefore in the final model, the dummy variable is not used. The final results of the single equation model of the CZV variable are shown in the following Table 1.

Linear Regression - Estimation by Least Squares

**Dependent Variable DCZV**

Monthly Data 03/2000 - 12/2008

Usable Observations	106	Degrees of Freedom	104
Centered R**2	0.703400	R Bar **2	0.700548
Uncentered R**2	0.703904	T x R**2	74.614
Mean of Dependent Variable	-0.006603774		
Std Error of Dependent Variable	0.160871950		
Standard Error of Estimate	0.088032644		
Sum of Squared Residuals	0.8059736245		
Log Likelihood	108.18711		
Durbin-Watson Statistic	1.907853		

Variable	Coeff	Std Error	T-Stat	Signif
*****				
1. dCZV{1}	0.620073	0.061612	10.06413	0.000000
2. dCPV	0.202389	0.034464	5.87249	0.00000005

Table 1 – Results of the Econometric Model CZV

Specification tests		T-Stat.	P-value
Test for Autocorrelation	Breusch-Godfrey SC Test	0.27862	0.59761
	Durbin h test	0.10139	0.91924
Test for Heteroscedasticity	Breusch-Pagan test	5.40702	0.14431
Structural Stability Test	Chow test	5.15323	0.00234
Functional Form Test	RESET test with quadratic	0.11340	0.73643
	RESET test with quadratic and cubic	0.08756	0.91623
Test for Normality	Jarque-Bera test	376.3686	0.00000

Table 2: Results of the Econometric Model CZV – Specification Tests.

From the total number of 108 observations, only 106 values are actually usable because of the differences and final lag of one in the model. In regard to the number of variables included in the model, the total number of degrees of freedom is 104. Centered R2 reaches the value of 0.703, i.e. the explained variable dCZV is interpreted by the given predetermined variables from 70.3 %. The Durbin-Watson Statistic shows the result is close to value of 2, i.e. first-order autocorrelation is not present in the model. The evidence of a lagged endogenous variable on the right side of the given model may cause the value of the discussed variable to be misleading, and therefore other suitable random variables autocorrelation tests must be used to confirm the absence of autocorrelation here. A correlation matrix is used to test multicollinearity among explanatory variables, and Jarque-Bera test, the null hypothesis about normal distribution of the random variable is rejected.

its presence is negated. According to the T-test, all of the estimated parameters are statistically significant at a high level of significance. Statistical hypotheses of the given model are proved by the specification tests (see Table 2). The significance level is 0.05. Because of the existence of a lagged endogenous variable in the model the random variables autocorrelation is tested with the use of a Durbin h test and a Breusch-Godfrey SC test, the null hypothesis is accepted, i.e. autocorrelation is not present in the model. The Breusch-Pagan test is used to test homoskedasticity, again, the null hypothesis is accepted, i.e. heteroskedasticity is not present in the model. The results of the Reset test show the proper selection of the model's functional form. Due to the significant value of the Chow test, the alternative hypothesis about instability of estimated parameters is accepted. On the basis of a Infringement of the parameters' stability estimate, and also of the normal distribution of the random

variable results in the fact that the statistical tests do not have to have the required distribution.

The final econometric model can be written in following linear form of model (4).

The facts resulting from the character of buyer-supplier relationships in the dairy sector, i.e. in this case, the relationship between farmers and dairies can be summarized with following statements:

- Contracts are concluded for a minimum period of six months.
- As a result of minimum response to the situation in the market, purchasing price arranged in advance may fluctuate within a certain range during the given contracted period.

The agricultural price cannot respond to the market situation with significant price change as it is dependent on the value from the previous time period. Owing to this fact, significant price changes are powdered in other levels of the given food vertical. Therefore, the dependence of the endogenous variable dCZV at only its first lagged value – not the other lags – is reasonable.

The influence of the exogenous variable dCPV is driven mainly by the relationship between the dairies and the distributors of processed dairy products (wholesalers). This relationship also changes according to the market situation. The development of the market situation strongly influences the distributors and, nowadays, because of their growing economic power they are able to transfer the impacts of market changes to the dairies. Due to the structure of the dairies' market (oligopsonistic structure) in relation to the farmers, dairies mainly transfer the negative price changes to the farmers.

Real values (dCZV) together with theoretical values (TeodCZV) of endogenous variable calculated on the basis of the given linear single equation model are shown in Chart 3.

There is no need to compute elasticity to find out which of the predetermined variables have the significant influence on the given endogenous variable as all variables used in the model are expressed in identical units of measurement, and therefore their values can be mutually compared. The influence of dCZV{1} is stronger than the influence of dCPV.

Monthly changes in the consumer price are not statistically significant, i.e. consumer price does not influence the agricultural price (confirmation can be seen at the beginning of the year 2008, when the fall in agricultural price was followed by a moderate increase in consumer price). This fact follows from economic theory – in many processing industries it was discovered that whilst an increase in input price is almost immediately projected to output price, a drop in input price is followed by a delayed and only partial drop in output price (Peltzman, 2000). This phenomenon can be explained by two possible causes. In the first case, the basis can be found in inventory management, i.e. the changes in inventory price are not shown until the moment when the inventories are removed from the storage, and long-term character of buyer-supplier relations. The second explanation comes out of the existence of market strengths, i.e. the existence of imperfect competition – subjects on the market are strong enough to maximize their profit – amongst the other ways – by their ability to delay and by influencing the volume of the given product to restrict the input price drop influence to the output price (Lechanová et al., 2006).

$$dCZV_t = 0,620073 * dCZV_{t-1} + 0,202389 * dCPV_t + u_t$$

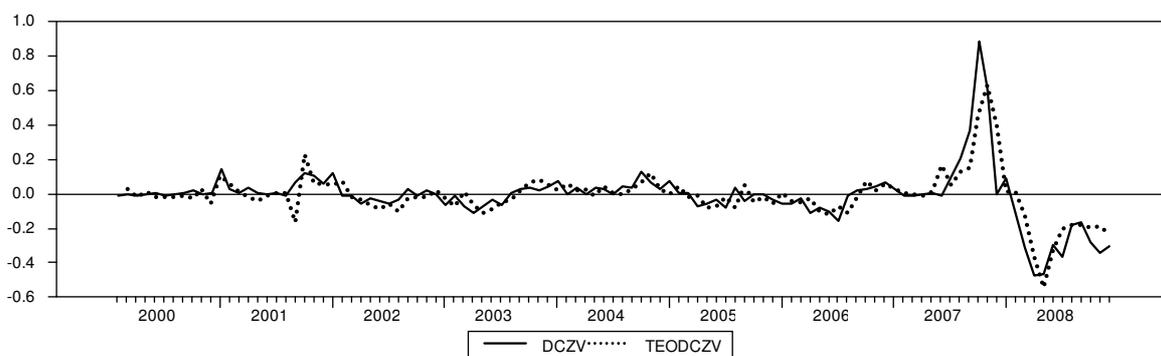


Chart 3: Real and Theoretical Estimated Values – dCZV.

Owing to the industry character of milk and dairy products production, the influence of export price and import price (note: price of processed milk in package) are not statistically significant within the EU market as proved by the final model (4). One of the reasons may be the minor volume of total import and export compared with the production and long-term buyer-supplier relations between the farmers and the dairies.

### Producer Price Single Equation Model

Producer price hypotheses:

- Producer price is influenced by the agricultural price for the identical time period, and by the consumer price.
- Export and import price do contribute to the development of producer price.

This model of the dependant variable CPV – producer price – involves all reflected explanatory variables. Again, the dummy variable is put into the model for the same price shock interception. The model is estimated with the use of linear form – its usability will be tested. The information criterion is used to set up the maximum number of lags for the following delayed variables – CZV, CPV, and SC – the results of AIC indicate eight lags, the results of SIC indicate only four lags in maximum, therefore the SIC results are used in the model. In the next stage, the estimated model is modified to a version

where it includes three significant variables. The results of the single equation model estimation are given in Table 3.

From the total number of 108 observations, only 107 values are usable due to a lag of one in the final model. In regard to the number of variables in the model, the total number of degrees of freedom is 102. Centered R<sup>2</sup> reaches the value of 0.955, i.e. the endogenous variable CPV is explained by given the predetermined variable from 95.5 %. The Durbin-Watson Statistic shows the result is higher than the value of 2, i.e. first-order autocorrelation is not present in the model. Again, because of the evidence of a lagged endogenous variable in the model, random variables autocorrelation tests must be used to confirm the absence of autocorrelation here.

The results obtained by the correlation matrix show that multicollinearity is proved only between the explanatory variables CZV and CZV{1}. This may affect the interpretation of the influence of the discussed explanatory variables for the given endogenous variable. There is also a strong association between the endogenous variable CPV and its lagged value together with export price. According to the T-test, all of the estimated parameters are statistically significant to a high level of significance. Statistical hypotheses of the given model are proved by the specification tests (see Table 4).

#### Linear Regression - Estimation by Least Squares

Dependent Variable CPV

Monthly Data 02/2000 – 12/2008

Usable Observations	107	Degrees of Freedom	102
Centered R <sup>2</sup>	0.954508	R Bar <sup>2</sup>	0.952724
Uncentered R <sup>2</sup>	0.999680	T x R <sup>2</sup>	106.966
Mean of Dependent Variable	11.004392523		
Std Error of Dependent Variable	0.930721142		
Standard Error of Estimate	0.202367797		
Sum of Squared Residuals	4.1771779862		
Regression F(4,102)	535.0343		
Significance Level of F	0.00000000		
Log Likelihood	21.68440		
Durbin-Watson Statistic	2.274183		

Variable	Coeff	Std Error	T-Stat	Signif
*****				
1. Constant	0.813589	0.320539	2.53819	0.012655
2. CZV	1.038382	0.136714	7.59528	0.000000
3. CZV{1}	-1.044132	0.139376	-7.49147	0.000000
4. CPV{1}	0.857891	0.038639	22.20265	0.000000
5. CE	0.073801	0.029425	2.50809	0.013715

Table 3: Results of the Econometric Model CPV.

Specification tests		T-Stat.	P-value
Test for Autocorrelation	Breusch-Godfrey SC Test	2.30037	0.12934
	Durbin h test	0.00000	1.00000
Test for Heteroscedasticity	Breusch-Pagan test	1.50607	0.68087
Structural Stability Tests	Chow test	2.57249	0.05850
Functional Form Tests	RESET test with quadratic	1.01565	0.31596
	RESET test with quadratic and cubic	0.51461	0.59931
Tests for Normality	Jarque-Bera test	71.51081	0.00000

Table 4: Results of the Econometric Model CPV – Specification Tests.

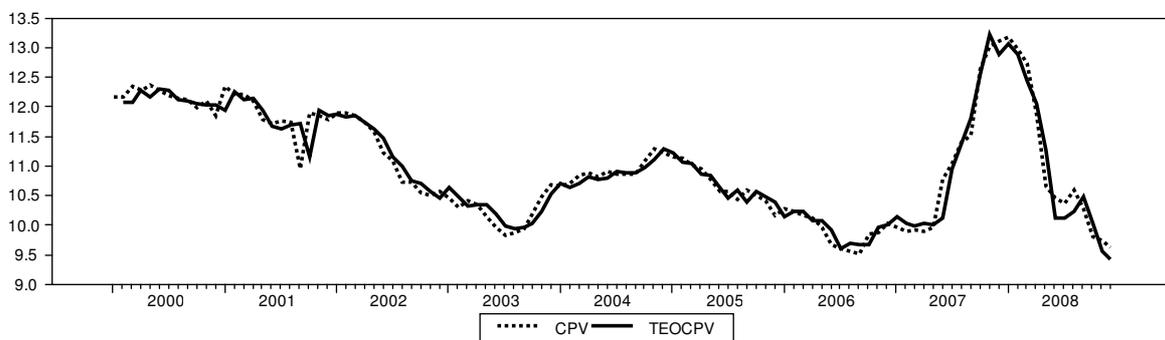


Chart 4: Real and Theoretical Estimated Values – CPV.

The final econometric model is written in its linear form (5):

$$CPV_t = 0,8136 + 1,0384 * CZV_t - 1,0441 * CZV_{t-1} + 0,8579 * CPV_{t-1} + 0,0738 * CE_t + u_t \quad (5)$$

The level of significance is 0.05. The existence of autocorrelation is tested by the Durbin h test, and the absence of autocorrelation is proved. On the basis of the Breusch-Pagan test, the null hypothesis is accepted, i.e. heteroskedasticity is not present in given model. The Chow test proves the stability of parameters estimated but at its frontier value. The suitable functional form of the model is proved with the Reset test. Due to the results of the Jarque-Bera test, the null hypothesis about normal distribution of the random variable is rejected, therefore the statistical tests do not have to have the required distribution.

The real (CPV) and the theoretical (TeoCPV) values of the given endogenous variable calculated on the basis of the linear single equation model are shown in Chart4.

First the lagged production price has the strongest influence at producer price CPV. As has already been discussed in a previous section of this chapter, when dealing with the processed material the dairies are tied to the buyer-supplier contracts. Equally, they conclude contracts with the wholesalers and retail chains for a certain period of time. The price is given in advance in the contract and it is mainly dependent on the development during the previous period (see 4.1 above – the impact of inventories). The price oscillations are limited by precautions of wholesalers or retail chains (e.g. lowering the producer price in dependence on special offers in retail chains). The raw milk is sold only in the case of the dairies' oversupply, and the price is haggled over according to the current situation at the market.

The export price variable is significant (note: export price of processed milk). Recently, the volume of

Czech export is growing, namely to Slovakia and Germany, and also to Hungary.

Both lagged and present values of the CZV variable are included in the final model as they are individually statistically significant. While the present agricultural price has a positive influence on the endogenous variable, its one period lagged variable is the opposite. The price in general is determined by the interaction of supply and demand on the market. The difference in the direction of impact of these two discussed explanatory variables (CZV, CZV{1}) is typical as it comes from economic price cyclic behaviour in the agri-food market as demonstrated by the Cobweb theorem (7):

$$P_t = P_0 * (-1)^t * r^t \quad (7)$$

Where:  $P_t$  ....Price in time  $t$

$P_0$  ...Price in time  $t = 0$

$r$ .....Ratio of the gradient between supply and demand curves in absolute values

$t$ ..... time period

Because the present value of the CZV variable is positive and its first lagged value is negative, the final influence of the agricultural price is not significant. Another fact that supports this assumption is the high level of multicollinearity between these variables – 96 % (i.e. variables have a very similar development).

The producer price model (5) consists of more explanatory variables than the agricultural price model (4). Therefore, for better evaluation of the influence of predetermined variables on the endogenous variable, the elasticity computation on the basis of average values is put to use. The results confirm that the lagged endogenous variable CPV{1} has the strongest influence – 1% change of this variable influences the given endogenous variable from 0.86 %. The same change of export price affects CPV from 0.07 %. 1 % growth in the present agricultural price results in 0.758 % growth of the given endogenous variable, while the same growth of CZV{1} leads to a 0.764 % decrease in CPV. From the given results of the elasticity computation, it is clear that dairies are strongly influenced by their own prices from the previous period, while agricultural producers are not strong enough to be able to influence producer price – i.e. they are under the conditions of imperfect competition.

The parameters of import price, consumer price, and dummy variable are not statistically significant. According to the dairy products' structure together with the structure of retail chains (or wholesalers),

the influences can be shown in irregular time periods of various length. Therefore, it is not possible to model it. A high level of dairy products' substitution can cause a low influence of consumer price to the producer price. Another reason not to use the consumer price as an explanatory variable may be the character of the data set – producer price data has a similar development to the data for the agricultural price (see Chart 1). As for the import price, this is probably also caused by the character of the data set. The dummy variable used for the price shock interception is not statistically significant, as the price shock has been already modeled with the use of lagged variables CZV and CPV.

### Consumer Price Single Equation Model

Consumer price hypotheses:

- Consumer price is influenced by agricultural price and producer price.
- There is evidence of export price influence, while import price is not significant for the development of consumer price.

This model of the dependant variable SC – consumer price – involves all reflected explanatory variables. The dummy variable is put into the model for the same price shock interception. The model is estimated with the use of linear form and its suitability will be tested. The information criterion is used to set up the maximum number of lags of the following delayed variables – CZV, CPV, and SC – the results of AIC indicate eight lags, the results of SIC indicate only five lags maximum, therefore the SIC results are used in the computation. The estimated model is then modified to a version where it includes four significant variables. The results of the single equation model estimation are given in Table 5.

From the total number of 108 observations, only 105 values are usable due to a lag of one in the final model. In regard to the number of variables in the model, the total number of degrees of freedom is 101. Centered R<sup>2</sup> reaches the value of 0.955, i.e. the endogenous variable SC is explained by the given predetermined variable from 95.5 %. The Durbin-Watson Statistic shows the result is close to the value of 2, i.e. first-order autocorrelation is not present in the model. Random variable autocorrelation tests must be used to confirm the absence of autocorrelation.

The results obtained by the correlation matrix show that multicollinearity between the predetermined variables is not present, but there is a strong

association between the explained variable and its lagged value. This may affect the interpretation of the influence of discussed explanatory variables at the given endogenous variable. According to the T-Linear Regression - Estimation by Least Squares

test, all of the estimated parameters are statistically significant to a high level of significance. Statistical hypotheses of the given model are tested with the use of the specification tests (see Table 6).

With Heteroscedasticity-Consistent (Eicker-White) Standard Errors

**Dependent Variable SC**

Monthly Data From 02/2000 – 10/2008

Usable Observations	105	Degrees of Freedom	101
Centered R**2	0.954553	R Bar **2	0.953204
Uncentered R**2	0.999591	T x R**2	104.957
Mean of Dependent Variable	14.542380952		
Std Error of Dependent Variable	1.392258489		
Standard Error of Estimate	0.301180083		
Sum of Squared Residuals	9.1616536690		
Log Likelihood	-20.94453		
Durbin-Watson Statistic	1.723244		

Variable	Coeff	Std Error	T-Stat	Signif
*****				
1. CZV	-0.287359	0.096209	-2.98681	0.00281907
2. CPV	0.515262	0.155549	3.31255	0.00092451
3. SC{1}	0.725809	0.083989	8.64172	0.00000000
4. TIME	0.011702	0.003954	2.95967	0.00307971

Table 5: Results of the Econometric Model SC.

Specification test		T-Stat.	P-value
Test for Autocorrelation	Breusch-Godfrey SC Test	2.13405	0.14406
	Durbin h test	0.35701	0.72108
Test for Heteroscedasticity	Breusch-Pagan test	8.37664	0.03884
Structural Stability Tests	Chow test	2.18716	0.09446
Functional Form Tests	RESET test with quadratic	3.60154	0.06061
	RESET test with quadratic and cubic	4.54415	0.01294
Tests for Normality	Jarque-Bera test	529.8217	0.00000

Table 6: Results of the Econometric Model SC – Specification Tests.

5.

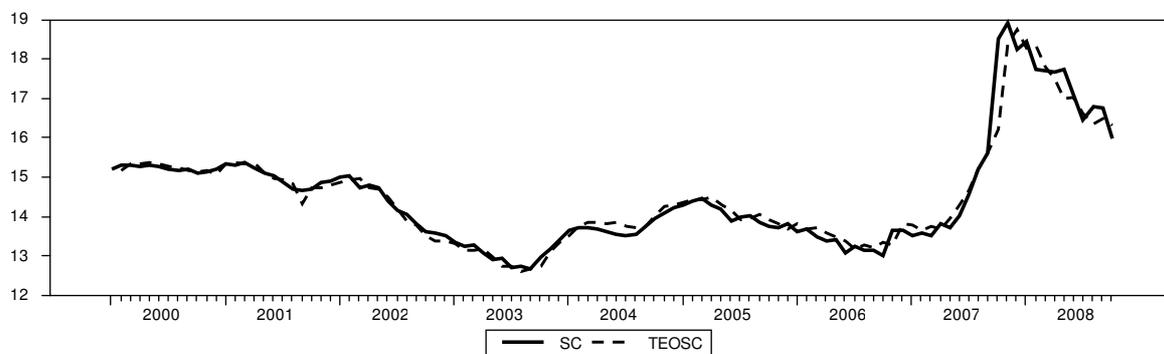


Chart 5: Real and Theoretical Estimated Values – SC.

The final econometric model can be written in the following linear form (6).<sup>(6)</sup>  

$$SC_t = -0,2874 * CZV_t + 0,5153 * CPV_t + 0,7258 * SC_{t-1} + 0,0117 * TIME_t + u_t$$

The real (SC) and theoretical (TeoSC) values of the given endogenous variable calculated on the basis of the linear single equation model are shown in Chart In the given econometric model of consumer price shown above, the following parameters are statistically significant – CZV, CPV, SC{1}, and Time.

Even though the model does fulfil the requirements of statistical tests, its economic verification shows the relationships among the variables used in the model are not correct. From an economic view, it can be assumed that individual variables influence the given endogenous variable, but the parameters may be distorted because of the following – absence of the constant variable (i.e. by not using the constant variable in the model, other estimated parameters take the possible distortion instead of the constant and the results then may be misleading), and the presence of the time variable. Hence, use of the given model is not possible, as the parameters do not have the required value in economic practice.

## Conclusion

This article introduces the models of price transmission in the milk value chain. Three econometric models were composed – an agricultural price model, a producer price model, and a consumer price model. The statistical tests of the consumer price model together with its economic verification showed its inapplicability; therefore we did not further discuss this one.

Hypotheses concerning the agricultural price are fulfilled, i.e. the development of agricultural price is strongly influenced by its lag-1 variable and producer price. On the other hand, consumer price is not one of the factors influencing agricultural price. Export price and import price do not contribute to the development of the discussed endogenous variable.

The reason why agricultural price cannot respond immediately to the market change (and therefore why the significant price changes are powdered in other levels of given food vertical) is given by its dependency on its value from the previous time

period. This dependency is based on two facts – milk purchasing price is usually arranged in advance and it may fluctuate only within a certain given range during the contracted period.

We suppose the influence of producer price on agricultural price is driven mainly by the relationship between the dairies and the wholesalers. Nowadays, the importance of the distributors of processed dairy products is growing (due to their economic power) – the wholesalers are therefore able to transfer (mainly the negative) impacts of market changes to the dairies, but due to the oligopsonistic dairies' market structure the dairies also transfer mainly the negative price changes to the lower level of this food vertical, i.e. to the farmers. Therefore we assume the asymmetric price transmission may be primarily caused by the existence of imperfect market competition within this sector.

The influence of export price and import price is not statistically significant (within the EU market). The minor volume of total export and import compared to the total production and long-term relations between the farmers and the dairies may be one of the reasons.

Producer price hypotheses are only partly confirmed – i.e. the agricultural price together with the export price contributes to the development of the given endogenous variable. The consumer price and import price are not relevant for an explanation of producer price creation.

From the results of producer price model it is clear, that dairies are strongly influenced by their own price from previous period, while the agricultural producers are not strong enough to be able to influence the producer price. These results also confirm that Czech dairy market can be characterized by imperfect market competition.

The final hypotheses concerning the consumer price are partly confirmed, but the model does not fulfil relevant economic verification, therefore – as the model is not usable – there is no need to discuss the significance of the model's explanatory variables.

The irrelevancy of consumer price in the computation of both agricultural price and the producer price model may mainly be caused by the existence of retail chains on the market. The power of these enterprises enables them to effectively suppress price transmission, particularly its direct displays at the individual levels of the given vertical. The reason why agricultural price is influenced by producer price can be expressed as the result of imperfect market competition at all levels of the milk value chain.

*Corresponding author:*

*Ing. Kateřina Matulová*

*Czech University of Life Science in Prague, Department of Economics*

*Kamýčká 129, Prague 6 - Suchbát, Czech Republic*

*Phone: +420224382088*

*email: matulova@pef.czu.cz*

The given results should be considered an initial analysis of the milk value chain. For deeper examination of this sector – i.e. market structure, context of price transmission creation – further econometric analysis is needed (e.g. the use of VAR or VECM models).

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## International Standards of Corporate Social Responsibility

L. Stanislavská, K. MargarISOVá, K. Šťastná

Czech University of Life Sciences Prague, Faculty of Economics and Management

### Abstract

The article deals with internationally acknowledged standards and norms in the sphere of corporate social responsibility. It introduces the concept of social responsibility, the so-called triple-bottom line, in terms of which the company focuses not only on the economic growth but it also takes into account environmental and social aspects of its business activities. The article presents five norms and standards which stem from the triple-bottom line concept. The norms and standards are in the article briefly characterised, which is followed by their comparison based on four previously stated criteria. The results of the comparison show that there is no such norm which would meet current company requirements.

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### Key words

Corporate social responsibility, triple-bottom line, international standards and norms Anotace.

### Abstrakt

Článek se zabývá mezinárodně uznávanými standardy a normami v oblasti společenské odpovědnosti firem. V článku je představen koncept společenské odpovědnosti, tzv. triple- bottom- line, v rámci něhož se firma zaměřuje nejen na ekonomický růst, ale bere v potaz i environmentální a sociální aspekty svého podnikání. V článku je uvedeno pět norem a standardů, které vycházejí z konceptu triple-bottom-line. Normy a standardy jsou v článku stručně charakterizované a následně je provedeno srovnání na základě čtyř předem stanovených kritérií. Výsledky provedeného srovnání ukazují, že neexistuje norma, která by vyhovovala aktuálním požadavkům firem.

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### Klíčová slova

Společenská odpovědnost firem, triple-bottom-line, mezinárodní standardy a normy.

### Introduction

The notion of social responsibility started to spread more dramatically towards the end of the 20th century when worries about the environment were beginning to grow, especially in connection with climatic changes, which led to the development of environmental reporting. In this period the so-called Triple Bottom Line (the rule of triple responsibility) emerged, recommended by the consultants of Sustainability Corporation. Based on the Triple Bottom Line, corporations should be also

concerned with activities in an environmental and social sphere and not only focus on monitoring financial aspects of their enterprise business.

Although there is no unified definition of corporate social responsibility (henceforth CSR), we can find unison in understanding the CSR as a CSR is seen as a concept which goes beyond philanthropy and compliance to address the manner in which companies manage their economic, previous termsocial,next term and environmental impacts

and their stakeholder relationships in all their key spheres of influence: the workplace, the marketplace, the supply chain, the community and the public policy realm. (Franc et al., 2006; Hediger, 2010; Steinerová, 2008). According to Davis (2005), corporate responsibility begins where the laws end. It is about what companies do with regards to making a positive contribution to society above and beyond that which constitutes their legal obligations.

The questions of corporate social responsibility are even dealt with by the European Commission, which in 2001 published a pivotal document entitled Green Paper. According to the European Commission, the “corporate social responsibility means voluntary integration of social and ecological views into every day’s corporation’s operations and interactions with an outside world“ (Green Paper, 2001). During February introduction of the most current report on the European competitiveness, Günter Verheugen, vice chairman of the European Commission, said the following: „Socially responsible corporations will be in a better position than those that still has not accepted the CSR, because they may present themselves with the number of strong points including loyal employees whom they can rely on. Our report shows that the CSR is good in good times, however, in bad times it is something we must have for us to overcome these bad times“ (Trapp, 2009). Generally, experts agree that socially responsible corporations have, in a long-run, a better chance of survival and success. According to Clow and Black (2008), corporations performing activities that are viewed positively, generate quality publicity and clients’ loyalty. Companies that try hard to fight unfair practices, pollution, harassment in the workplace and other negatively viewed activities, protect themselves from law suits and negative hearsay from unsatisfied consumers and employees. By decent acting in all of these areas, the company may protect itself from the risk of damage of its public image and strengthen positive understanding of its activities by the public.

### **Triple Bottom Line**

The term was introduced in 1994 by Joh Elkington. The idea behind the TBL idea was that business and investors should measure their performance against

a new set of metrics—capturing economic, social and environmental value added - or destroyed - during the processes of wealth creation (Elkington, 1998).

Social responsibility requires a shift in the perspective of one’s own social role from the position of "profit only" to a wider concept in the context of the so-called three Ps - "people, planet, profit" (Trnková, 2004). It means to function with respect to the so-called Triple Bottom Line where the firm concentrates not only on its economic growth but also on environmental and social aspects of its business activities (Norman, MacDonald, 2004). Because the society does not function in isolation from the outside world but it is its integral part. What is more, the assessment of the firm’s activity by its surroundings and the state of this environment has a direct impact on commercial success of the company (Trnková, 2004).

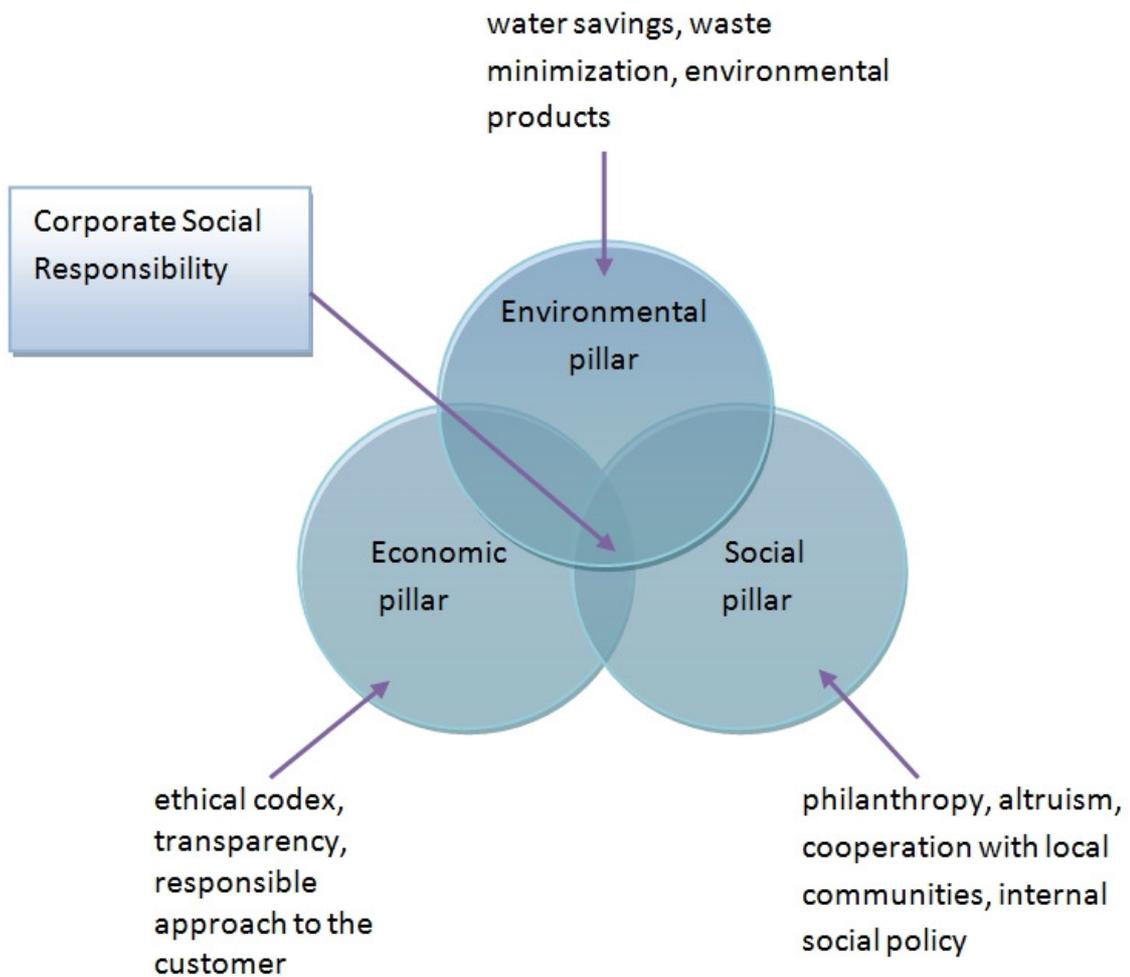
### **Economic pillar**

Among principal socially responsible activities belonging into an economic pillar we can include the creation and maintenance of an ethical codex, transparency, a responsible approach to the customer or the building of relations with suppliers (Prskavcová, 2007; Trnková, 2004). In her publication “The CSR Concept in Practice“, Magdaléna Steinerová, Business Leaders Forum, characterises a responsible approach to the customer as providing clear and precise information about products and services and giving evidence and taking care of customers’ complaints (Steinerová, 2008). According to Philips Kotler, corporate ethics policy – measures, which all employees of the corporation must follow - should be set by every company. These measures concern relations with distributors, advertisement standards, customer services, setting up prices, the development of products and last but not least, general ethical standards (Kotler et al., 2007).

### **Social pillar**

A social pillar should be best divided into two areas, internal and external.

The internal area is often referred to as the so-called corporate social policy, whereas the external area deals with philanthropy, altruism, cooperation with



Source: Carew, Mitchell (2008); adapted by the author

Fig. 1: The pillars of Corporate social responsibility.

local communities (local special interest groups) (Prskavcová et al., 2008).

The internal area presents corporate social policy (Prskavcová et. al, 2008), or corporate work environment (Steinerová, 2008). The internal social area covers SA 8000 (Social Accountability) management standard.

Social policy is a tool for maintaining the satisfaction of employees, which consequently leads to the increase in a corporation's profit (Prskavcová et. al., 2008). Motivated employees are very productive, their feeling of pride stemming either from the corporation's behaviour towards the outside world or the firm policy oriented at its employees. Besides productivity, what is very important for the company is the loyalty of its employees, which reduces expenses for hiring new work force and the satisfaction of employees, which in the end reflects itself in the approach towards

company's customers (Steinerová, 2008). When setting up the internal social policy, it is necessary to estimate correctly the needs and wishes of workers. No financial benefits, which are not favoured among workers, will lead to their loyalty. Therefore, the internal social policy cannot be effective unless the needs of the employees of the company have been previously researched.

A socially responsible corporation generates its effort to have good neighbouring relations – it reduces its negative impact and takes part in solving local problems. All this comes back in the reduction of risk and positive reception of the company by local community, from which potential customers and employees are being recruited. The firm may present itself as a good neighbour by, for instance, a financial support of public activities and projects. Another possibility may be in involving the employees of the company in voluntary beneficial activities for the local society as a part of their

working hours (Steinerová, 2008). When planning programmes for the support of the community, thorough knowledge of a local community is vital as well as the knowledge of its problems and from that emerging needs.

### Environmental pillar

In this ecological, pillar which is a part of social responsibility, firms focus especially on the reduction of a negative impact of their activities on the environment. In corporate practice, this ecological approach is implemented through the so-called environmental management. The environmental management can be best characterised as intentional influence on those company activities and products, which have, had or can have a negative impact on the environment (Prskavcová et al., 2008). Among standardised systems of environmental management belong ISO 14001 or EMAS (Environmental Management Auditing Standard).

### Objectives and Methodology

Following the concept of corporate social responsibility, the objective of this article is to characterise the most significant standards and norms which modify the corporate social responsibility and to compare given standards on the basis of selected criteria.

The work will be carried out in the following steps:

1. Brief characteristics of the five most significant standards and norms.

2. Comparison of selected norms

1. Norms will be compared on the basis of selected criteria – criteria will be selected following the findings from researched professional literature,

2. Selected criteria:

Regulated area: social x environmental x economic  
incidence: worldwide x within the EU  
possibility of certification: yes x no  
target organizations: international corporations x all enterprises

3. Conclusions

### Results and discussion

In order for the public not to accuse corporations of taking advantage of the CSR as the means of marketing communication, it is suitable to make use of the existing norms or standards from the area of social responsibility.

Jaroslav Prachař (2008), from Correct Business Association, mentions other reasons for the implementation of a norm that would regulate the CSR in organisations. They are as follows:

- general trends to modify (improve) results, unless there follows a check;
- necessity to provide true information to interested parties;
- necessity to work with feedback and unify opinions and measures;
- obtain information for benchmarking;
- maintain worldwide trends;
- IMPORTANT – the increase of trust in organizations.

### International Norms and Standards in the Area of Corporate Social Responsibility

In the area of measuring and reporting on social responsibility, there exist a number of national and international norms and standards. They differ from one another in their strictness, quality, viewpoint perspective, difficulty and in their purpose (Šancová et. al., 2005). In the labyrinth of all these initiatives, the following five are pre-dominant:

- SA 8000
- AA 1000
- ISO 26000
- OECD Guidelines for Multinational Enterprises
- EMS (ISO 14000, EMAS)

### SA 8000 SOCIAL ACCOUNTABILITY – Social Responsibility

SA 8000 is a certification norm which sets requirements in the area of child labour, forced labour, BOZP, discrimination, work hours, right to congregation and evaluation. However, it also states requirements for a management system. It was created by Social Accountability International (SAI), a non beneficial non governmental organization in the US. The organization has great experience in these questions and endeavours to

maintain high international prestige (Prachař et. al., 2008).

Only an independent certification organization accredited by the SAI can issue a certificate about the agreement with the SA8000 international norm requirements. The SA8000 specifies the requirements for corporate social responsibility in 9 areas:

- Child Labour,
- Forced and Compulsory Labour,
- Health and Safety,
- Freedom of Association & Right to Collective Bargaining,
- Discrimination,
- Disciplinary Practices,
- Working Hours,
- Remuneration,
- Management Systems (SA 8000, 2008).

#### **AA 1000 ACCOUNTABILITY/ASSURANCE STANDARD**

AccountAbility's AA1000 series are principles-based standards to help organisations become more accountable, responsible and sustainable. They address issues affecting governance, business models and organizational strategy, as well as providing operational guidance on sustainability assurance and stakeholder engagement (AA1000, 2007).

AA 1000 is a norm generally applicable to all types of organizations (private and governmental), whose objective is to examine the credibility and quality of CSR reports by organizations in the area of economic, environmental, social and ethical responsibility. The owner of this norm is Account Ability, a non beneficial organization with headquarters in England, whose aim is the support of fair trade (Prachař et. al., 2008).

This standard endeavours after a complex approach (unlike for instance ISO 14000, which primarily focuses on environmental areas). What is more, AA 1000 also includes:

- Constructing socially responsible strategies;
- Methods of communication with involved parties;

- Ethical audit;
- Choice of indicators and CSR reporting, etc. (Čaník, Čaníková, 2008).

#### **ISO 26000**

ISO - "International Organisation for Standardization" - is an independent organization concerned with the creation of international standards for industry. ISO standards are voluntary mechanisms managed by market and as such they can be realized by private economic organizations.

Since June 2008 there exists a current proposal of the ISO 26000 norm. It is also the first time when the process of creating the ISO norm is shared by corporations, governments, non governmental organizations (NGO), unions, consumer organizations as well as research and consultant institutions (Winistörfer, 2008).

The upcoming ISO 26000 norm, dealing with social responsibility, is driven by a general finding that social responsibility is the basis of sustainability of every organization (Prskavcová, 2007).

ISO 26000 aims to assist organizations and their network in addressing their social responsibilities and providing practical guidance related to operationalizing SR, identifying and engaging with stakeholders and enhancing credibility of reports and claims made about SR. Furthermore, the standard aims to:

- Emphasize performance results and improvements.
- Increase customer satisfaction and confidence.
- Promote common terminology in the SR field.
- Be consistent, and not in conflict, with existing documents, treaties, conventions and other ISO standards (Castka, Balzarova, 2008).

#### **OECD GUIDELINES FOR MULTINATIONAL ENTERPRISES**

The OECD Guidelines for Multinational Enterprises (the Guidelines) are recommendations addressed by governments to multinational enterprises. They provide voluntary principles and standards for responsible business conduct consistent with applicable laws. The Guidelines aim

to ensure that the operations of these enterprises are in harmony with government policies, to strengthen the basis of mutual confidence between enterprises and the societies in which they operate, to help improve the foreign investment climate and to enhance the contribution to sustainable development made by multinational enterprises (OECD, 2008). OECD measures are written in the form of a detailed ethical of codex and they touch the following areas of enterprise activities: transparency, relations among employees, environment protection, struggle against corruption and competition. They also include the definition of responsibility for suppliers and sub suppliers (Šancová et. al., 2005).

These measures also call for better openness and, what is more, they recommend that companies should provide information in the following areas:

- results of company's economy;
- company's plans and objectives;
- owner's relations and rights to vote;
- the list of members of executive board and management and their financial evaluation;
- foreseeable risk factors;
- the questions of the relation with employees and other stakeholders;
- management structure and company's policy (Čaník, Čaníková, 2008).

Enterprises may voluntarily acknowledge these standards; however, this approach can neither be audited nor certified (Čaník, Čaníková, 2008).

## **EMS**

In general an EMS is considered at the part of a management system of an organisation, in which specific competencies, behaviours, procedures and demands for the implementation of the operational environmental policy of the organisation are defined. An EMS can also be seen as a set of interrelated elements used to establish policy and objectives and to achieve those objectives (Visser et al., 2008)

These management systems present an active approach of the enterprise towards the environment as they help to observe, manage and reduce the impact of enterprises' activities on the environment. Thus they contribute to a more responsible

approach of the enterprise to the environment. The implementation of these systems into the enterprise and its practice means more open communication with public about the approach of the enterprise to the environment (Čaník, Čaníková, 2008). It concerns internationally acknowledged and trustworthy systems, whose reliability, among others, provides independent examination by an external body.

EMAS – the EU Eco-Management and Audit Scheme – is a voluntary initiative designed to improve the environmental performance of organisations. It was initially established by European Regulation 1836/93, and has subsequently been replaced by Council Regulation 761/01 (Visser et al., 2008).

Engel and Tóth mention principal EMAS requirements:

- a full accord of environmental management system with ISO 14000 norm requirements;
- the improvement of environmental performance and reduction of environmental load;
- accord with environmental legislative;
- regular publishing of environmental statements.

The ISO 14001 norm includes pivotal factors of an effective environmental management system, which may be used for both services as well as manufacture sectors. The norm requires that the society would define environmental goals and target values and that it would create management system necessary for their achievement. It further requires that the society would replenish the system with processes, approaches and activities (Prskavková, 2007).

## **Comparison of Norms according to their Interests**

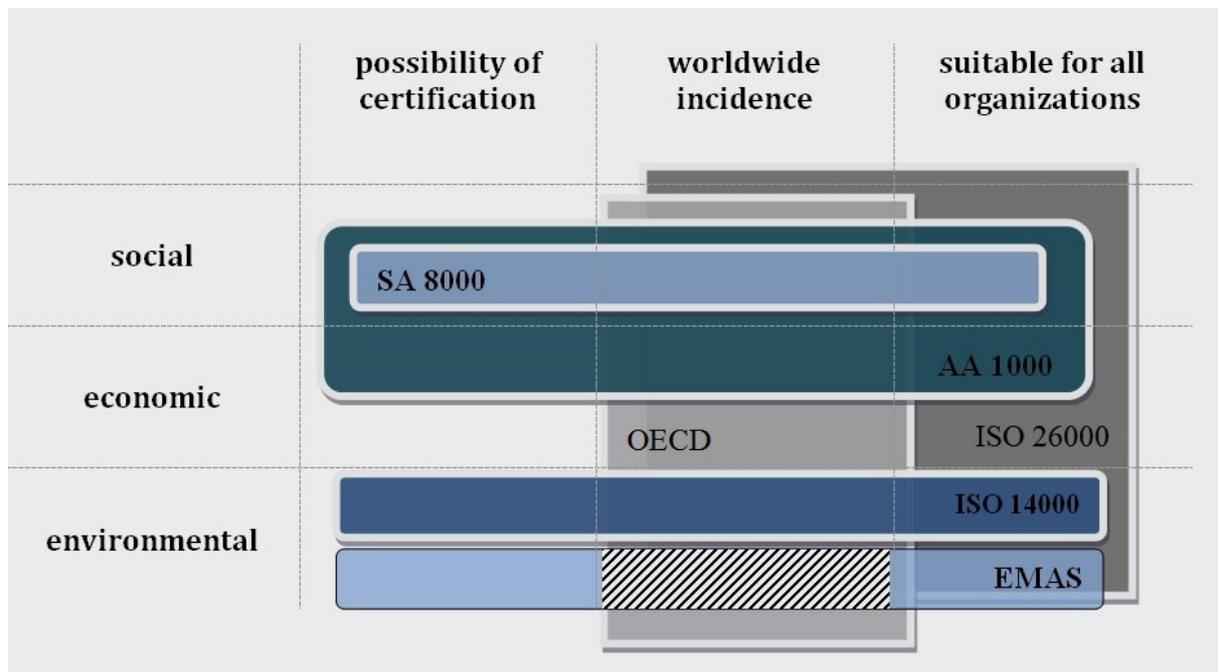
All five norms endeavour to reach a multi-sector scope or, in other words their applicability in various sectors of business. They all are based on philosophy which takes into account the requirements and expectations of stakeholders (Šancová et. al., 2005).

Table 1 presents the comparison of introduced norms based on the selected criteria. It presents

	Adjust area			Range		Possibility of certification		Target groups		Norm's author	Short description
	social	environmental	economic	EU	World	yes	no	international organization	all organization		
SA8000	■				■	■			■	Social Accountability International (USA)	Norm for better work conditions
AA1000	■		■		■	■			■	AccountAbility (VB)	Norm which create a structure for corporate social responsibility
ISO 26000	■	■	■		■		■		■	International organization for ISO normalization	Norm for corporate social responsibility
OECD Guidelines	■	■	■		■			■		OECD	OECD directive for supranational organization
EMS	ISO	■	■		■	■			■	International organization for ISO normalization	System of environmental management
	EMAS		■	■	■	■			■	European parliament	Environmental management

Source: adapted by the author

Figure 2: Comparison of Norms according to their Interests.



Source: adapted by the author

Figure 3: Grafical Comparison of Norms according to their Interests.

areas regulated by particular norms, their scope of performance from a geographical point of view, the possibility of norm certification, their target group – that is for what type of company norm is determined, ho are its wits creators and a brief characteristics.

The comparison of norms from the area of social responsibility shows that norms very often regulate a social sphere of trade. Norms SA 8000, AA 1000, ISO 26000 and OECD measure deal with the behaviour of the enterprise towards its employees. The most extensive norms are OECD measure and upcoming ISO 26000 – they include all three areas

of social responsibility (social, economic and environmental), that is they cover the whole so-called Triple Bottom Line. The disadvantage of OECD measures is the fact that they are restricted only to international corporations. The CSR is a concept set mainly by multinational enterprises; however, there is a general tendency to spread the concept even to national and local businesses. This problem could be solved by the upcoming ISO 26000 norm. Authors promise its suitability applicable to all types of enterprises. At the same time it will modify all CSR areas. However, the problem remains in the impossibility of the norm to be certified. It will concern only recommendations or manuals whose adherence cannot be checked by a third party. On the one hand, the certification of a norm brings the increase in expenses; on the other it ensures an objective assessment of socially responsible activities in the enterprise. This is the fact where the author of this text sees the greatest weakness of the upcoming norm.

## **Conclusion**

We can say that the contribution of social responsibility for a particular company is unquestionable. A critical viewpoint at multinational corporations is becoming to be an integral part of the lifestyle of young and educated people. These customers put emphasis on ecological and social approaches of companies to economic activities. These people not indifferent to the company's handling its employees or to arrogant business polluting the environment by their activities. However, access to this information provided by the media interested in the matter is rather simplified. Affairs concerning non ethical behaviour of some companies may ruin their prestige, notwithstanding the sum of financial sanctions that the companies accused of such practices must pay. If a company becomes

conscious of these facts, it can actually use them for its own profit. In the time of customers' aversion to classical marketing tools, correctly performed activities of social responsibility may be used as strong competitive weapons. The concept of corporate social responsibility can also be viewed as a new approach toward corporation management. Successful implementation of social responsibility to corporation management will positively influence the relation of public to the corporation and thus the chance of the corporation to succeed on the market will grow.

In economic science and company's practice, there emerged a number of approaches whose objective was to describe corporate social responsibility. Business ethics, sustainable development, environmental management and social management are the most common concepts describing the given problematic. Similarly, tools - standards, norms, behaviour codex, measures and others – according to which companies can orientate in the question of social responsibility – are rather incomprehensible. They either focus on particular topics, or they are too general. They are specific for individual sector, and they are valid locally or globally. The comparison of norms in this work shows that there is no such norm which would cover the whole area of social responsibility and that would be suitable for all types of enterprises and last but not least, which would enable its certification. In her dissertation work the author of this text will further concentrate on the questions of generally applicable norms regulating social responsibility. The objective of her work will be to propose a model suitable for small, middle-sized as well as large companies. The model will further provide a manual for implementing the concept of social responsibility and its successful application.

*Corresponding author:*

*Ing. Lucie Stanislavská*

*Czech University of Life Sciences Prague, Department of Management*

*Kamýcká 129, 165 21 Prague-Suchbát, Czech Republic*

*e-mail: stanislavska@pef.czu.cz*

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## Global trends in risk management support of agriculture

J. Špička

University of Economics, Prague, Faculty of Business Administration, Department of Business Economics

### Abstract

The aim of this paper is to make an international comparison of risk management policies in OECD countries as well as in selected emerging economies. The results are based on the data from OECD Producer Support Estimates Database and General Services Support Estimates Database, a study of agricultural insurance schemes carried out by the European Commission and an overview of risk-related policy measures formulated by the OECD. The results indicate that all OECD countries have the price stabilizing support for at least some commodities. Although the share of market price support in the producer support estimates has been decreasing for a long time, it still remains an important component in most countries around the world. The analysis also revealed the pilot experiences with index based insurance in developing countries whose economy is considerably dependent on agriculture.

### Key words

Agriculture, agricultural policy, risk management, market price support, income stabilization.

### Anotace

Cílem příspěvku je provést mezinárodní komparaci politik zaměřených na řízení rizik v zemích OECD a v prahových ekonomikách. Výsledky jsou založeny na databázi odhadu produkčních podpor (OECD), databázi odhadu podpory obecných služeb (OECD), studii o systémech zemědělského pojištění, zpracovanou výzkumným centrem Evropské komise, a na přehledu OECD o politikách zaměřených na řízení rizik. Výsledky ukazují, že všechny země OECD aplikují v určité míře systém stabilizace cen. Ačkoliv podíl podpory tržních cen na odhadu produkčních podpor dlouhodobě klesá, zůstává podpora tržních cen stále důležitým nástrojem řízení rizik ve většině zemí světa. Analýza rovněž odhalila první zkušenosti s indexním pojištěním v rozvojových zemích, jejichž hospodářství je významně závislé na zemědělství.

### Klíčová slova

Zemědělství, zemědělská politika, řízení rizik, podpora tržních cen, stabilizace příjmů.

### Introduction

Agricultural production has always been exposed to many risks. The uncertainty of future incomes complicates both short-term production decisions and long-term planning which can adversely affect the provision of loans to farmers. The key drivers of farm profit or loss are production risks pertaining to the price and yield volatility of agricultural commodities. Because of the existence of heterogeneous agricultural policies over the world, which have recently changed due to the global economic crisis, it is highly topical to focus on the risk-related effects of the past and current public support of agriculture.

Omitting risk and uncertainty in decision has been criticized in the neoclassical theory of the firm since the 1960s. Over the last decades, better insight has been developed about risk assessment, risk preferences and value of information. Since the second half of the 90s of the 20th century, discussions on the topic of risk management in agriculture have been taking place at a global level. The literature on farmers' risk exposure usually covers price risk [5, 7, 14], yield risk [7, 13], both price and yield risk [3, 16] and the spectrum of the most frequently used risk management tools in agriculture [9, 10, 11, 12]. Most professional papers have been devoted to the issue of agricultural insurance as the most active and functional tool supporting stability in the field of agricultural business [1, 3, 11].

Many studies argued against the common definition of risk and uncertainty which considers risk as imperfect knowledge where the probabilities of the possible outcomes are known, whereas uncertainty exists when these probabilities are not known. Hardaker et al. [6] defined uncertainty as imperfect knowledge and risk as uncertain consequences, particularly exposure to unfavorable consequences. Risk is therefore not value-free, usually indicating an aversion for some of the possible consequences. Harwood et al. [7] offered more specific definition of risk. They defined risk as uncertainty that “matters” and may involve the probability of losing money, possible harm to human health, repercussions that affect resources (irrigation, credit), and other types of events that affect a person’s welfare. Uncertainty (a situation in which a person does not know for sure what will happen) is necessary for risk to occur, but uncertainty need not lead to a risky situation. Chavas [2] argued that the debate about distinction between risk and uncertainty ultimately boils down to an argument about the existence and interpretation of probability. He did not draw a sharp distinction between risk and uncertainty and uses the terms interchangeably. There has not been a clear consensus on definition of risk yet. However, this paper concentrates on pure risk which is considered as downside risk only, although the business risk usually incorporates both downside and upside risk.

The main groups of risk in agriculture result from the specific features of the agricultural sector and from the trends in agrarian policy. The OECD publications [11, 12] may be considered as significant and relatively comprehensive studies of income risk management in agriculture. The overview of the European agricultural risk management schemes was introduced in the common research project EC-JRC-ISPRA Italy with data contributed from European countries [1]. This study constituted the basis for analyzing strategies to integrate risk management tools within the Common Agricultural Policy (CAP). The strategic objective of the parallel research projects was to analyze the potential of different risk management tools for stabilizing farm household incomes in the EU [9]. The results of these surveys were used within the impact assessment of the CAP Health Check [4].

Some papers also examined the relationship between the farmers’ operating risk and current subsidies. Based on the simulation at the commodity level the results revealed that partially or fully decoupled payments extend the farmers’ decision-making possibilities. The current subsidies are a suitable complement to other commonly used risk management tools primarily designed to reduce the farmers’ and farm income variability [15].

## **Material and Methods**

Risk management strategies can be grouped into three categories [8]: risk prevention, risk mitigation and risk coping strategies. Prevention and mitigation strategies focus on income smoothing, while coping strategies focus on consumption smoothing. Prevention strategies are intended for reducing the probability of a downside risk. They can also be called “risk reduction strategies”. These are introduced before a risk occurs. Reducing the probability of an adverse event occurring increases the producers’ expected income and reduces the income variance with a positive impact on wealth. These strategies primarily include [12] market price support measures (through price stabilization), market interventions such as private storage support (financing for producers to build or upgrade farm storage and handling facilities), non-marketing of agricultural products, support to production techniques such as water management (irrigation, drainage, flood control etc.), the purchase of certified seeds and animal breeds, pest and disease control, technical assistance and extension, and the inspection of agricultural products and food safety measures.

Whereas preventive strategies reduce the probability of the risk occurring, mitigation strategies reduce the potential impact if the risk were to occur. Risk mitigation strategies have an ex-ante effect. They can take several forms, for example, payments with a variable rate (or countercyclical payments) compensating for all or part of the income losses suffered according to a pre-established formula, subsidies for risk management tools (insurance systems, futures markets), income tax smoothing systems, income diversification support, support of vertical integration, contracting etc.

Coping strategies can relieve the impact of the risk once it has occurred. They include mainly ex-post

measures. The main forms of coping consist of disaster relief payments, ad hoc assistance, individual dis-saving/borrowing, migration, selling labour or the reliance on public or private transfers. In this case, the important role of the government lies in providing agricultural support programs such as calamity funds and other measures to manage sanitary or phytosanitary crises, safety nets, ad hoc state aid, social assistance etc.

The aim of this paper is to make an international comparison of risk management policies in OECD countries as well as in selected emerging economies. The analysis is based on the data from PSE database (Producer Support Estimates) and the GSSE database (General Services Support Estimate). A significant part of the PSE is market price support (MPS) which is defined as transfers from consumers and taxpayers to agricultural producers arising from policy measures that create a gap between domestic market prices and border prices of a specific agricultural commodity, measured at the farm gate level [12]. The individual measures have different labels describing their features. Any payment is defined as subject to a variable rate where the formula determining the level of payment is triggered by a change in price, yield, net revenue or income, or a change in production cost. If not, the payment has a fixed rate.

Because the European agriculture is very heterogeneous, the second part of the analysis is devoted to a closer view on a risk management schemes in the EU. There are various agricultural insurance systems in the EU which are defined as follows [1]. Single-risk insurance covers against one peril or risk, or even two but of a non-systemic nature (most often hail, or hail and fire). Combined (peril) insurance means a combination of several risks covered (two or more risks, mostly with hail as basic cover). In some countries (e.g. France) this type of insurance is also referred to as multi-risk insurance. Yield insurance guarantees the main risks affecting production. In the case of crops, the main risks affecting the yield (e.g. drought) are comprised. Premiums can be calculated from individual historic yield or from regional average yield. Losses (and premiums) can be calculated either by qualifying the losses due to each individual risk separately, either as the difference between the guaranteed yield and the insured yield. Whole-farm insurance consists of a combination of

guarantees for the different agricultural products on a farm. Depending on the coverage of guarantees, it can be whole-farm yield insurance or whole-farm revenue insurance.

In some EU countries there are also the stabilization accounts, the individual bank accounts for self-insurance which are publicly regulated or promoted. The withdrawal can be based on yields, revenues or other indices.

## **Results and discussion**

Assistive devices for visually handicapped people As shown in tables 1 and 2, the share of risk related measures in the PSE has been decreasing for a long time. In the OECD area, it dropped to 66 % in the 2000s compared to more than 75 % in the 1990s (in emerging economies, the share reached 50 % in recent years). MPS takes the most substantial part of the risk related measures in the majority of OECD countries and the emerging economies as well. Hence risk reduction can be considered as the most supported risk management strategy over the world. Nevertheless, the share of MPS in the PSE has decreased - from ca 30 % in 1986 to ca 10 % in 2008. On the other hand, the significance of the fixed rate payments has increased. Fixed rate payments based on output, area, animal numbers, receipts or income were slightly less than the variable payments at the end of the 1980s, while they were close to six times higher in the 2000s. In the emerging economies, the MPS was negative in the 1990s and domestic prices were isolated from world prices. This changed in the 2000s.

Risk reduction measures other than MPS have become a more important part of the risk management support in OECD countries. The USA and EU pay more attention to technical assistance/extension, pest and disease control. Water management support has slightly dropped, but it is expected to be more important in the future due to the greater weather volatility. Market risk management strategy - spreading sales - is a very widespread strategy in agriculture, but government assistance for private storage and non-marketing of agricultural products is rare.

Variable rate payments (VRP) and insurance subsidies are the essential components of the risk mitigation measures in PSE. VRP are implemented explicitly to stabilize farmers' receipts (ex ante).

They only generate transfers when receipts are below a target level and include loan deficiency payments, marketing loan gains (allow contract crop producers to repay price support loans at the lower of the announced loan rate or the prevailing world market price) and storage payments providing producers interim funds to help them store rather than sell their products when market prices are low. Canada and the USA are two countries where VRP are most significant, reflecting the traditional higher exposure to climatic risk and recourse to insurance and stabilization payments. These systems are operated by the federal and/or provincial governments with contributions from farmers. As a consequence of decreasing MPS, VRP have increased in the USA and Australia.

Subsidies to agricultural insurance systems are widespread. Insurance payments exist in most EU countries and 5 emerging economies (Brazil, Chile, Russia, Ukraine and Argentina). The USA has a long history of subsidized crop insurance systems. There is a special Federal Crop Insurance Program which offers more complex agricultural insurance aimed at covering losses in revenue, not only yields. As pointed out by JRC-ISPRA [1], the total support including funds for the administrative costs of the insurance companies and reinsurance amounts to 72 % of total premiums. The European subsidies to insurance premiums are around 32 %. On the other hand more complex insurance coverage is usually more expensive for farmers, so that the average premium rates in the USA (9 %) are much higher than in Europe (4 %). Agricultural insurance schemes in EU are heterogeneous (table 3). There are two extremes – countries with simple agricultural insurance schemes which have relatively low risk exposure to adverse weather fluctuations and where livestock production plays an important role (BE, DE, DK, UK, IE, NL), and countries with high weather risk exposure and sophisticated risk management systems (ES, FR, IT, GR, CY). In some south European countries there is also state supported reinsurance based on PPP (PT, ES and IT). Insurance payments can be put in all WTO boxes, depending on implementation criteria.

Income tax smoothing schemes has been of peripheral importance in PSE risk mitigation measures so far. According to the OECD definition,

these consist of allowing taxable income to be spread over a multi-year period, thereby smoothing disposable income. But its low share in the PSE could be misleading. In most countries, transfers within income tax smoothing schemes are not included in the PSE, either because the system is not specific to farmers (Netherlands) or because, while the option is only available to farmers, the value of the tax concession is not estimated. This risk management tool is still underestimated.

The ex post risk coping measures have increased in most OECD regions. They are frequently used in Australia, Canada, EU, USA and many emerging economies. While disaster relief payments and ad hoc assistance are common in most OECD countries, support for social assistance and debt management measures have prevailed in emerging economies (China is the only one with a significant level of disaster relief payments). Social assistance which helps farmers to alleviate poverty and emergency situations has been of great importance for Chinese farm households.

Some risk reduction measures have been provided through general services to agriculture. This includes water management (infrastructure assistance for water management off the farm), collective pest and disease control measures and inspection services. Support for these general services has increased in most OECD countries as well as in most emerging economies.

Since the beginning of the 21st century new weather risk management tools have been developed – index insurance and weather derivatives. Concluding these contracts and their trading is called weather hedging (weather insurance or weather hedging). The aim of weather hedging is, above all, to decrease the volatility of profit or cash flow depending on weather fluctuations and thus to protect the company in cases of adverse weather development.

The index insurance and weather derivatives are based on an independent measurable quantity, the development of which correlates with the farm yields or revenues from agricultural production. This concept, as opposed to classical agricultural insurance (which uses loss adjusters for assessing damages on the farm), is based on an objective, transparent and easily measured specified external factor. Its correlation with the agricultural

production and the spatial correlation is, on the contrary, an essential condition of using these products. The measurement of meteorological phenomena is relatively easily attainable and objective. Moreover, modern satellite technologies providing highly reliable measurements and a relatively dense network of ground meteorological stations are available at present. The principle of weather hedging based on the objectivity of the measured factors, eliminates the risk of asymmetric information and at the same time involves low monitoring and loss assessment costs, which makes the parametric products more attainable generally. On the other hand, the most often quoted disadvantage of these products is the contract basis

risk relating to the potential discordance between the real damage and the financial benefit from an index-based contract.

Basis risk and strong insurance support schemes are the main reasons why weather hedging is not widespread enough. Mainly the micro-finance institutions have been involved in pilot programs in lower income countries with agriculture as a significant and vital part of national economy (Argentina, Colombia, Ethiopia, India, Malawi, Morocco, Nicaragua, Peru, Thailand, and Ukraine). Some pilot studies have also taken place in Europe and the USA. Well developed index insurance schemes currently run in Canada and Mexico.

		USA		Canada		EU		Australia		Japan	
		92-97	02-07	92-97	02-07	92-97	02-07	92-97	02-07	92-97	02-07
<i>Risk reduction</i> measures in PSE, of which	€ M	14 109	13 352	1 876	2 513	58 005	51 308	772	298	44 592	32 484
- Market Price Support (MPS)	%	81.3	69.2	98.7	98.9	97.9	96.4	82.0	49.0	99.2	99.2
- Other risk reduction measures <sup>*)</sup>	%	18.7	30.8	1.3	1.1	2.1	3.6	18.0	51.0	0.8	0.8
<i>Risk mitigation</i> measures in PSE, of which	€ M	2 948	5 879	930	1 191	359	465	70	319	1 790	1 263
- Variable rate payments	%	86.0	77.9	100.0	100.0	58.5	33.8	0.0	43.3	65.7	61.4
- Insurance subsidies	%	14.0	22.1	0.0	0.0	41.5	66.2	0.0	0.0	34.3	38.6
- Futures markets subsidies	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- Income tax smoothing schemes	%	0.0	0.0	0.0	0.0	0.0	0.0	100.0	56.7	0.0	0.0
<i>Risk coping</i> measures in PSE, of which	€ M	553	856	11	1 012	418	1 131	97	181	40	23
- Disaster relief/ad hoc assistance	%	100.0	100.0	100.0	100.0	80.6	83.1	100.0	100.0	100.0	100.0
- Social assistance/debt rescheduling	%	0.0	0.0	0.0	0.0	19.4	16.9	0.0	0.0	0.0	0.0
Total PSE	€ M	24 089	31 860	3 337	5 255	91 397	104 094	1 246	1 256	48 736	36 644
Total risk related measures in PSE	€ M	17 610	20 087	2 817	4 717	58 782	52 904	939	797	46 422	33 770
Share of risk-related measures in PSE	%	73.1	63.0	84.4	89.8	64.3	50.8	75.4	63.5	95.3	92.2
Share of MPS in PSE	%	47.6	29.0	55.5	47.3	62.1	47.5	50.8	11.5	90.8	87.9
Share of MPS in risk-related measures	%	65.2	46.0	65.7	52.7	96.6	93.5	67.4	18.2	95.3	95.4
Risk related measures in GSSE	%	2.9	3.0	18.8	27.2	1.9	5.3	12.1	14.8	28.3	30.1

Notes: \*) Private storage/non marketing, water management, certified seeds/breeds, technical assistance/extension, pest and disease control  
Source: Own calculations based on OECD (2009)

Table 1. Structure of transfers from risk management policies in selected OECD countries (average of the periods).

	Brazil		China		Russia		South Africa		Ukraine		
	95-97	02-05	93-97	02-05	92-97	02-05	94-97	02-05	92-97	02-05	
<i>Risk reduction</i> measures in PSE, of which	€ M	-3 911	603	-2 702	12 488	-4 652	4 433	892	577	-3 021	-667
- Market Price Support (MPS)	%	x	87.2	x	89.3	x	97.7	99.9	100.0	x	x
- Other risk reduction measures <sup>*)</sup>	%	x	12.8	x	10.7	x	2.3	0.1	0.0	x	x
<i>Risk mitigation</i> measures in PSE, of which	€ M	93	117	0	0	7	44	0	0	623	204
- Variable rate payments	%	65.6	35.9	x	x	0.0	0.0	x	x	100.0	100.0
- Insurance subsidies	%	34.4	64.1	x	x	100.0	100.0	x	x	0.0	0.0
- Futures markets subsidies	%	0.0	0.0	x	x	0.0	0.0	x	x	0.0	0.0
- Income tax smoothing schemes	%	0.0	0.0	x	x	0.0	0.0	x	x	0.0	0.0
<i>Risk coping</i> measures in PSE, of which	€ M	926	635	772	2 559	1 660	139	15	26	186	12
- Disaster relief and ad hoc assistance	%	0.0	0.0	42.6	34.0	0.7	2.9	100.0	100.0	0.0	0.0
- Social assistance/debt rescheduling	%	100.0	100.0	57.4	66.0	99.3	97.1	0.0	0.0	100.0	100.0
Total PSE	€ M	-2 284	2 377	311	25 535	235	5 759	924	687	-1 435	178
Total risk related measures in PSE	€ M	-2 892	1 355	-1 930	15 047	-2 984	4 617	907	603	-2 212	-452
Share of risk-related measures in PSE	%	x	57.0	x	58.9	x	80.2	98.2	87.8	x	x
Share of MPS in PSE	%	x	22.1	x	43.7	x	75.2	96.4	84.0	x	x
Share of MPS in risk-related measures	%	x	38.8	x	74.1	x	93.8	98.2	95.7	x	x
Risk related measures in GSSE	%	23.9	12.5	3.5	3.3	9.3	40.7	6.2	17.7	9.7	41.6

Notes: \*) Private storage/non marketing, water management, certified seeds/breeds, technical assistance/extension, pest and disease control, "x" = not applicable

Source: Own calculations based on OECD (2009)

Table 2. Structure of transfers from risk management policies in selected emerging economies (average of the periods).

Public support/Insurance	Livestock insurance only	Single risk insurance	Combined insurance	Yield insurance
Non-subsidized private insurance	EE, FI <sup>1)</sup>	BE, BG, DK, FR, DE, GR, HU, IE, NL, SE, UK	BG, FR, HU, SL, SE	
Subsidized private insurance		AT, CZ, IT, LU, PT, RO, SK, SL, ES, LV, LT, PL	AT, CZ, IT, LU, PT, RO, SK, ES, PL	AT, FR <sup>2)</sup> , IT, LU, ES
Insurance administered by public sector		CY	CY, GR	
Ad hoc aids	AT, BG, CY, CZ, DK, FI, DE, GR, HU, IE, LU, PL, RO, SK, SL, ES, SE, UK, LV, LT			
Calamity fund	AT, BE*, BG, DK*, FR*, DE*, IT, NL*, PL, PT*, LT			
State-run reinsurance	PT, ES, IT			
Stabilization accounts <sup>**)</sup>	FI, ES, SE			

Notes: 1) Single-risk insurance, combined insurance, 2) Whole-farm yield insurance, \*) Public calamity funds, partially subsidized, \*\*) Individual bank accounts for self-insurance which are publicly regulated or promoted.

Source: Bielza M. et al. (2008), own processing

Table 3. Public support of agricultural risk management systems in EU.

## Conclusion

Market development, climate change, technological development, and company interests generate new kinds of risks and potential crises which it will be necessary to solve sensitively, efficiently and effectively.

The results indicate that the maximum tariffs were fixed after the WTO Uruguay Round Agreement on agriculture in 1995, which banned countercyclical border measures (variable levies), but countries could react to world price fluctuations by modifying the applied tariffs and applying special safeguard measures within the WTO rules. All OECD countries have the price stabilizing support

for at least some commodities. Although the share of market price support in the PSE has been decreasing for a long time, it still remains an important component in most countries around the world.

There are heterogeneous risk management support schemes in the world. While the emerging economies can be described as countries with a low level of risk management support, in the OECD area there are both countries with highly subsidized risk-related measures, which mainly rely on MPS (Japan), and countries with level of risk management support below OECD average, that rely heavily on VRP (USA, Canada). The share of MPS in the PSE has sharply decreased since the end of the 1980s, mainly as a consequence of the classification of the market distorting measures to the WTO Amber Box, such as MPS and most kinds of deficiency and stabilization payments based on current output or area. On the other hand, the WTO Green Box includes support for general services, water management, extension and advisory

services, inspection services, training, and pest and disease control, the support of which will probably have higher priority.

The future development of governmental risk management support will depend on the frequency and consequences of the risks occurring as well as on the budgetary policy of countries and regions (the influence of the economic crisis will have an impact). Thanks to the progress in insurance and hedging and with the support of micro-finance institutions, the less developed countries that are considerably dependent on agriculture, can implement new risk management tools – index insurance and weather derivatives.

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*Corresponding author:*

*Ing. Jindřich Špička*

*University of Economics, Prague, Faculty of Business Administration, Department of Business Economics*

*W. Churchill Sq. 4, 130 67 Prague 3, Czech Republic*

*Phone: 00420224098650, email: jindrich.spicka@vse.cz*

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## Possibilities of web-conferencing systems for disabled students

P. Benda, M. Havránek, V. Lohr, Z. Havlíček

Czech University of Life Sciences Prague, Faculty of Economics and Management, Department of Information Technologies

### Abstract

This paper deals with issues of web-conferencing systems accessibility and usability. These systems and applications are becoming increasingly popular in the educational process. Unfortunately, the majority of web-conferencing systems are not designed for users with disabilities. The aim of this paper is to describe possibilities of web-conferencing system for teaching handicapped students and explain the benefits of using this solution for common education. The main part of testing the hypothesis and possibilities were carried out in the Adobe Acrobat Connect system which is commonly used in the educational process at CULS.

### Key words

Accessibility, web-conferencing system, education, assistive devices Anotace.

### Anotace

Příspěvek se zabývá problematikou přístupnosti a použitelnosti web-konferenčních systémů. Tyto systémy a aplikace jsou ve vzdělávacím procesu stále populárnější. Bohužel, většina web-konferenčních systémů, není pro uživatele se zdravotním postižením přístupná. Cílem této práce je popsat možnosti web-konferenčních systémů pro podporu výuku zdravotně znevýhodněných studentů a nastínit výhody použití tohoto řešení při běžné výuce. Ověřování hypotéz a možností systému bylo prováděno zejména v programu Adobe Acrobat Connect, který je běžně využíván pro vzdělávání studentů na ČZU.

### Klíčová slova

Přístupnost, web-konferenční systém, výuka, kompenzační pomůcky.

### Introduction

Accessibility to the Internet information defines a set of standards which make information technology and software applications more easily usable by those who are affected by various disabilities. The solution of the disabled students' problems by means of information technology is based on the acquisition and information processing by disabled student with the help of specialised equipment. The main objective in education of disabled students is to find optimal technical equipment. They can therefore have education as easy to access as any other student and quality life without any information barriers. The Adobe Connect (formerly Breeze) system is exploited at CULS. This system allows designing education with the help of the videoconferencing system. One

of the possible utilizations of this system is to offer the educational material for disabled students.

### Material and Methods

The aim of this paper is to describe the possibilities of the web-conferencing system for teaching handicapped students and explain the benefits of using this solution for a common educational process. The method involves processing of several expert sources and their comparison as well as utilization of the web-conferencing system in education. The main accessibility guidelines are based on WCAG, version 1. The Adobe Acrobat Connect web-conferencing system is exploited at CULS, on that account the main part of testing the accessibility issues is made in this system.

In the first step, the system was tested for the fundamental elements of accessibility. The second

step was to identify opportunities for the web-conferencing systems in the educational process. The proposed hypothesis and possibilities, which are mentioned below in this article, have been tested in teaching of regular as well as distance students. Several users with different disabilities were identified among these students.

## **Results and discussion**

Assistive devices for visually handicapped people belong to one of the financially most costly pieces of equipment. Visual restrictions pose such a severe disadvantage in the working environment that their compensation through the usage of special tools is financially very demanding. In the majority of cases, the degree of visual impairment or a full loss of vision require a solution at a high technical level. Over the past three years information technology has developed to a stage which allows even the vision impaired people to choose from several possibilities of using the Internet.

Assistive devices are used as an instrument which makes it easier to cope with disabilities and helps the clients to live more like a healthy population. These devices do not provide only the compensation of deprivation of certain physical, mental or sensory functions, but they also may prevent further losses (for example - to help a person to engage in employment and social integration process). [4]

### **Confrontation of costs of assistive devices for visually handicapped people**

This section provides a comparison of several assistive devices in terms of their performance and cost. The solution for visually impaired users is based on the mobile or stationary personal computers which are equipped with special software according to individual angles of usage.

These assistive devices are a collection of separate tools, which are based on a personal computer, monitor (for the visually impaired users it is usually larger), keyboard and other standard components and specific equipment (scanner, sound card, amplified speakers or headphones, tactile display). This collection is also equipped with the standard and specific software.

In the Czech Republic the types of assistive devices are described by legislation. The visually impaired

people are covered by Act No. 182/91 Coll., as amended, No. 206/95 in Point III, paragraph 4 [2] as follows:

- - Digital reading device for blind people with voice output (voice reader)
- - Digital magnifier for visually impaired people (digital magnifier)
- - Digital magnifier for almost blind people with voice output (digital magnifier with voice support)
- - Electronic notepad with voice output and Braille display for blind people (electronic notepad)

As described further, the solution based on the usage of the web-conferencing system is not considered assistive technology as listed in the Act No. 206/95.

This system can partially replace some of the financially expensive equipment, which is installed in the lecture classrooms in order to provide the equalization of education for handicapped students as required by the university policy.

Web-conferencing systems and applications are becoming increasingly popular in educational, corporate, and non-profit organizational settings. These applications are used for a variety of purposes, including online collaboration, presentations, webinars, training, desktop sharing, and more. Unfortunately, the vast majority of web conferencing applications are not designed with people with disabilities in mind, and as a result, such tools are not accessible to people with these special needs. [6]

### **Possible utilization of web-conferencing system for visually handicapped students**

Visually disabled user (also student) uses the personal computer with special arrangement in standard and also in specific way. Personal computer can facilitate some work with information for common user. In other way, sightless users are not able to perform some common activities without special equipment or only in considerably complicated way. Simple example of such activities for students during the lesson could be the projection of presentation in PPT format or description of some C++ program functions by the help of data projector on canvas in lecture room.

Comparison Aspect	Voice reader	Digital Magnifier	Digital Magnifier with voice support	Electronic Notepad
Range of prices (EUR)	4000 – 5000	4000 – 6000	5000 – 6500	4000 – 6000
Monitor	15" - 17"	19" - 21"	19" - 21"	---
Sound Blaster + CD (DVD)	yes	yes	no	yes
Screen reader	yes	no	yes	yes
Enlarging software for Windows (software)	no	yes	as necessary	no
Enlarging software for scanner (scanner)	no	yes	as necessary	no
Text editor	yes	yes	yes	yes

Table 1: "Assistive devices for visually handicapped user – autonomous PC equipment" [2]

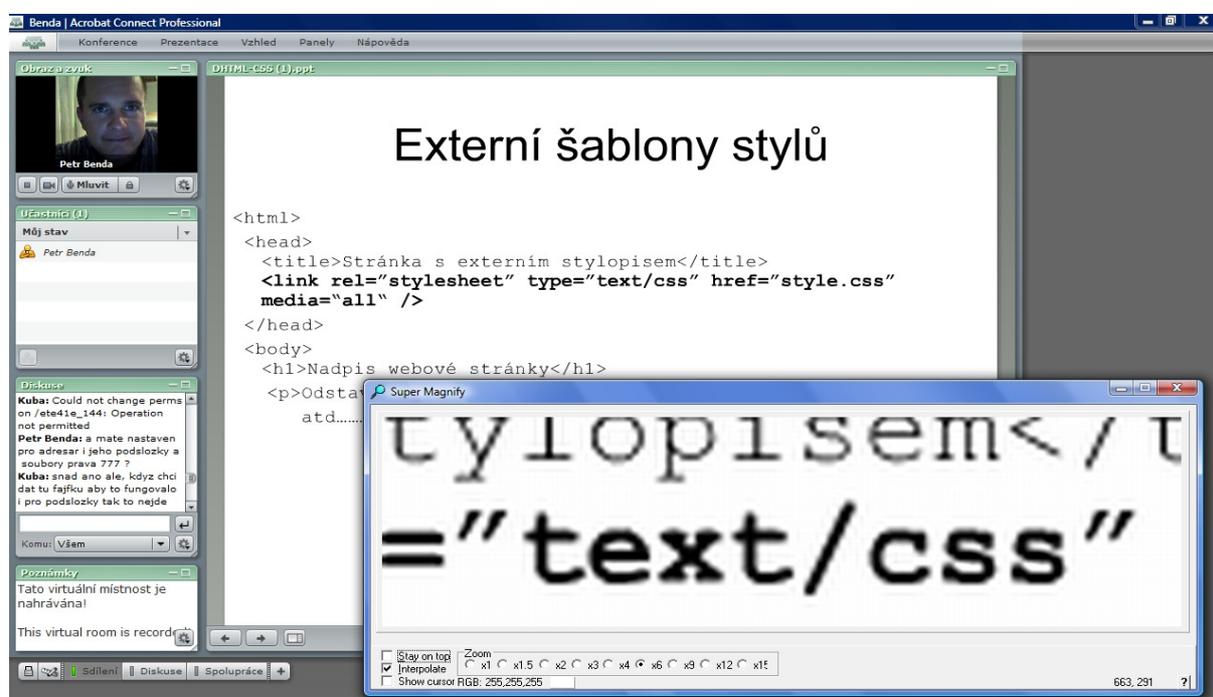


Figure 1: Adobe Connect web-conferencing system in combination with software magnifier"

If it is necessary to make accessible this sort of presentation also for students with visual handicap, it is necessary to equip lecture room by the special equipment, that is very expensive and often it can not cover specific needs of student. Or it is possible to prepare whole presentation before and attend to student for example special consultation, in which is given topic described without visual presentation.

By the usage of web-conferencing system it is possible to offer whole lecture for students by the help of data projector right in the lecture room and

at the same time distribute it online via the internet. So, the lecture is in the same quality like at common projection of electronic materials, but for students, there is offered another information channel, which in addition it is possible to record, etc. In case of Adobe Acrobat Connect - for display this presentation on the side of student, it is necessary to have only common web browser with free Flash Player software and internet connection. For the creation of this type of presentation on the teacher's site, it is enough to upload education material to the virtual room at the Adobe Connect server or for example start to share the screen of

teacher's computer in virtual room, etc. Students are able log into this room by the simple www link and access specifications.

Student with visual handicap can listen to the lecture right in lecture room and further they can use special accessories, which they have for example in their laptop, for magnification or specific display of offered presentation. If there are involved students with lower level of inflection, it is possible to use common functions of operating system or internet browser for display the presentation. By the usage of this system of students with higher level of visual handicap, it is possible to magnitude the presentation in browser through the software magnifier at the student's computer, etc.

### **Possible utilization of web-conferencing system for student with auditory impairment**

The principle of this system for the hearing disabled students is very similar to the previous case with the difference that a teacher must contact the teaching of applied microphone attached to teacher's computer. Auditory impaired student can use this audio channel to adapt and increase volume of the presentation to his headphones or to his induction loop. Student is connected to this channel only through the internet browser. Teacher can speak quite normally and the change of the volume is attached already to each student. In the case of online consultations, and recorded materials, there is an appropriate option the connection of the web camera, which picks up teacher's face. Students with a higher degree of hearing disability can try speech reading without greater problems and fully understand the issues of presentation.

### **Adobe Connect**

Adobe Acrobat Connect (former Breeze) is the web conferencing software that enables individuals and small businesses to instantly communicate and collaborate through online personal meeting rooms. [1]

Hosts can expand the viewing area for shared applications, documents, and whiteboards to fill the entire screen of participants. Hosts can choose to synchronize the view of all participants. Hosts can

view who is in the meeting room in addition to the participant's role (host, presenter, or participant) and status (whether the participant is connected). Share presentations, videos, or applications in full-screen mode. Annotate over screen sharing using standard whiteboarding tools and shapes. [1]

Teacher can share presentations and multimedia right from your desktop, and get feedback from hundreds of participants - students, all using a web browser and the Adobe Flash Player runtime, already installed on over 98% of internet-connected personal computers.

There are a lot of possibilities for the usage of this system in education. It could be online consultations, creation of tutorial materials or the participation at scientific conference. At CULS, there is this system managed by the IT support - Center of IT support in education. This system is in common usage of several departments at FEM CULS on the present. But the main utilization of this system is still focused especially on scientific conferences. For every teacher in this system can be reserve special virtual room, which can be visited by only selected users, all users, or users who knows the password. Education in these virtual rooms is possible to record, but it is not condition. Eventually this record would be accessible by the help of standard web address from any other web page, like in Moodle system etc.

### **Additional features**

It is possible to use special set of keyboard shortcuts as well. In Adobe Connect system there is necessary to install Adobe Acrobat Connect Add-in. If the application focus is placed in the main window, it is possible to press, for example, the CTRL + space bar to place the focus in the top-level menu and then use arrow keys to browse through the menu options. User can navigate vertically and horizontally within each menu. Or if virtual user wants to toggle "Raise Hand Status" it is possible by shortcut CTRL + up arrow, user can go from slide to slide by using the left/right arrow keys or, alternately, Page Up and Page down, etc. There are a lot of shortcuts for specific situations. There are described in detail in Acrobat Connect Add-in help menu. [1]

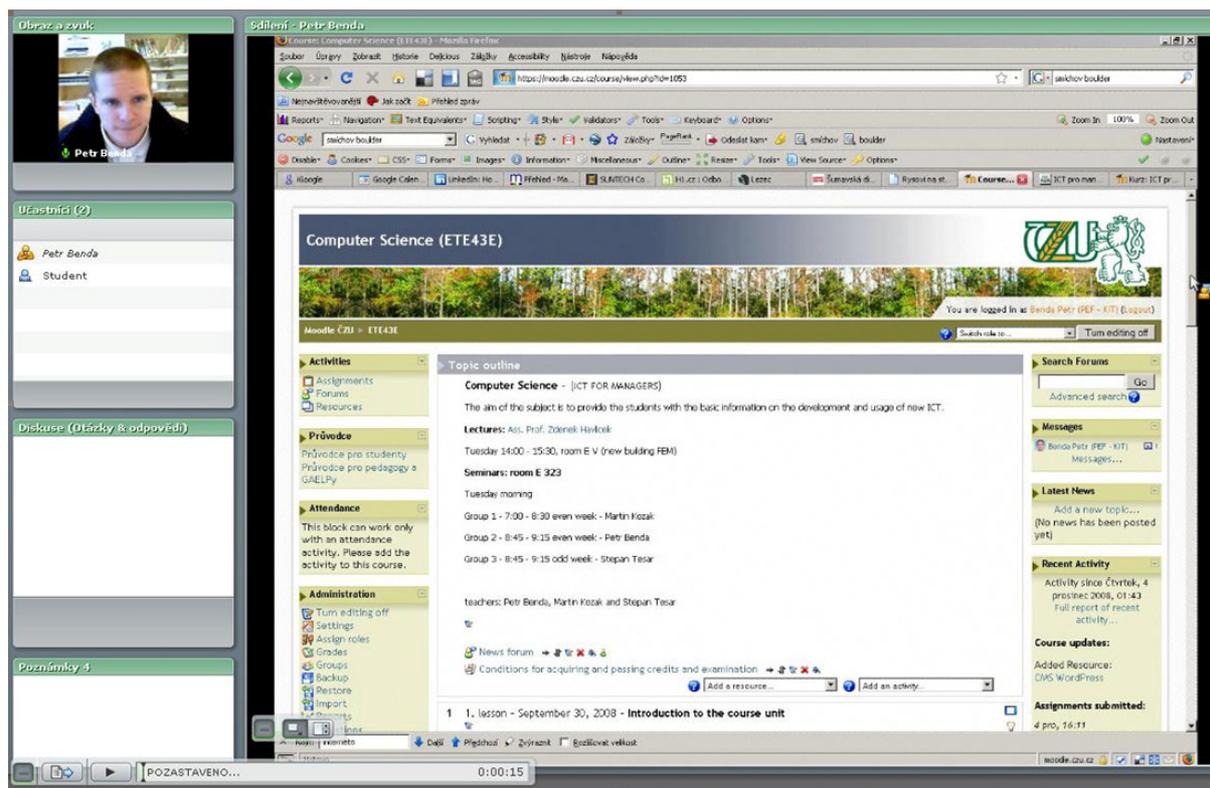


Figure 2: Adobe Connect web-conferencing system.

### Other advantages of the Adobe Connect system not only for students with disabilities

In addition to the above-mentioned possibilities and advantages of the use of the Adobe Connect system in education, there is a benefit in the form of the possibility of recording the lecture, exercises and online consultations. Thus material can be prepared for students to multiple views through their internet browser with a freely available Flash Player software installed, headphones, and without any additional demands on the equipment. The data intensity of this record is much smaller than by the usage of the conventional digital record and teacher has a set of tools to finalize the product.

The advantage of this teaching is the possibility of connection to the lecture for students who are currently sick or they are on their internships abroad, etc. Student may attend this lectures or exercises from home and do not lose the important information. Another option is the management of consultation or lecture to students from the distance. For example, consultation of seminar projects with students of distance learning is very convenient both, for the teacher as well as for interested students. By the possibilities of this system would be practically at the same quality as

the contact consultation in the office, but the potential of videoconferencing to enrich distance learning needs to be widely recognised as well as the technology embedded in curriculum delivery and in distance learning programmes. [5]

### Accessibility problems

If it is needed to create a working environment for a disabled employee, it is necessary to take into account his disability and adapt the work environment to an individual's specific needs. For systems which serve a large number of different users, there is not possible to make adjustments for each user. Many systems still have some accessibility barriers for some group of users. Hadi Rangin's study suggests that Adobe Connect supports a fair degree of keyboard accessibility but it is still not sufficient for effective interaction by keyboard users. It is also not accessible to screen reader users. [6]

This study compares several web-conferencing systems, and each shows various problems from the perspective of some groups of disabled users.

Webcasting proved the most acceptable way of supporting a common synchronous environment.

Having identified a feasible synchronous method we can now investigate hypothesized benefits for staff, students, and patients of combined e-health e-learning. [3]

## **Conclusion**

This paper describes the commercial Adobe Connect System. This web-conferencing system is commonly used at the Czech University of Life Sciences Prague and the authors have a lot of experience with this system. Some free or open source software which is based on similar principles could also be used for the needs of impaired students, but no free systems of comparable quality have been found. Although the Adobe Connect System is described here, the key principles and the ways of how students – users can work with this kind of systems, remain the same and the described methods would be useful in any other system or solution.

*Corresponding author:*

*Ing. Petr Benda*

*Czech University of Life Sciences Prague, Department of Information Technologies*

*Kamýcká 129, 165 21 Prague-Suchbát, Czech Republic*

*Phone: +420 224 382 045*

*e-mail: bendap@pef-czu.cz*

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## Interoperability of Knowledge Units in Plant Protection: Case Studies

M. Beránková, M. Houška, R. Kvasnička

Czech University of Life Sciences Prague

### Abstract

In this work, we provide two case studies on interoperability and transfer of knowledge in the environment of a company dealing with plant protection. We find that the area of plant protection is highly oriented on working with knowledge. In this case interoperability of knowledge can play an important role in acquiring knowledge from different environments to solve specific problem in companies dealing with plant protection. Nevertheless, the concept of interoperability is well-developed on the level of data and information only.

We stem from our previous works, where we defined a logical concept for the interoperability of knowledge on the level of knowledge units. The objective of this work is to show how to apply our process model of knowledge interoperability in a particular plant protection company. Two case studies are provided in order to demonstrate distinguishing between simple knowledge transfer and knowledge interoperability.

### Key words

Interoperability, knowledge transfer, plant protection, knowledge unit, process model.

### Anotace

Tato práce obsahuje dvě případové studie interoperability a transferu znalostí v prostředí firmy zabývající se ochranou rostlin. V této oblasti je práce se znalostmi velmi důležitá, neboť se zde vyskytuje mnoho problémů, pro jejichž řešení jsou potřeba vysoce odborné znalosti. V tom případě může být aplikace principů interoperability znalostí velmi přínosné pro vyhledávání znalostí v různých prostředích. Koncept interoperability je však dobře rozpracován pouze pro úroveň dat a informací, nikoliv pro úroveň znalostí.

Na základě našich předchozích prací, kde jsme navrhli koncept na úrovni procesních modelů pro interoperabilitu znalostí, v této práci ukazujeme, jak je možné tento koncept využít v praxi, v prostředí ochrany rostlin. V práci rovněž ukazujeme rozdíl mezi prostým transferem znalostí a jejich interoperabilitou.

### Klíčová slova

Interoperability, knowledge transfer, plant protection, knowledge unit, process model.

### Introduction

Interoperability and interoperability of knowledge, respectively, is a process. Process modelling techniques are often used for the description and formalization of knowledge processes. Raamesh and Uma [1] deal with the issue of knowledge discovery in databases; in particular, they generate optimal test cases from Unified Modelling Language diagrams using Intelligent Software Agents for highly reliable systems in order to improve the efficiency of software testing.

In general, a standard definition of interoperability is provided by IEEE [2] as "... the ability of two or more systems or components to exchange information and to use the information that has been exchanged." The definition covers mainly the interoperability of data and information. On that level, a lot of applications based on international standards for interoperability have been developed. According to Ibrahim et al. [3], WiMAX (Worldwide Interoperability for Microwave Access) IEEE 802.16 is the most promising wireless technology for providing broadband access. In their study, the authors deal with providing quality-of-service (QoS) across the

WiMAX to the applications considering the point-to-multipoint (PMP) mode and propose the QoS model for the WiMAX. It allows them to obtain data for traffic analysis and control, as well as to study various scheduling algorithms for different types of traffic.

Urrego-Giraldo and Giraldo [4] study enterprise interoperability. They mention that the concepts involved in the current frameworks, enterprise models and languages offering a standard guide to the enterprise modelling do not support a dynamic adaptation of the models aiming to the interoperability. Thus, they provide a multi-system multidimensional framework to be able to manage the complex and dynamic organizational knowledge. They see the key role of ontologies; according to them, the ontology supports the integration and interoperability of different enterprise models.

Ontology and ontological modelling can also be used to enhance efficiency of supply chain management, especially if impaired by inconsistent exchange and sharing of knowledge semantics among supply chain partners [5]. In this case, a schematic language should be used to ensure a correct communication between domain experts and users. Ye et al. [5] also provide a case study from the area of heterogeneous supply chains and show how to define formal semantics of ontologies of supply chain management (Onto-SCM) for effective knowledge interoperability.

It is a common issue to work with knowledge in the area of plant protection. Gonzalez-Diaz et al. [6] used both literary sources and experts to acquire knowledge for their expert system on plant protection in pepper (*Capsicum annuum* L.). Based on production rules they are able to recognize 11 weeds, 20 insects, 14 diseases and 3 biotic factors and control measures. The authors present very satisfactory results from experts' and non-experts' evaluations.

Gonzalez-Andujar et al. [7] present expert system for seedling weeds identification in cereals that helps farmers and extension workers to identify weed species. The expert system uses a hierarchical classification and a mix of the text description, photographs and artistic pictures in order to help non-expert users to be able to make identification of

the weeds. The authors also mention educational impacts of their system.

Based on the above-mentioned theses we deduce that the area of plant protection is highly oriented on working with knowledge. In this case interoperability of knowledge can play an important role in acquiring knowledge from different environments to solve specific problem in companies dealing with plant protection. Nevertheless, the concept of interoperability is well-developed on the level of data and information only.

In this work we stem from our previous works, where we defined a logical concept for the interoperability of knowledge on the level of knowledge units – a specific atomic form of knowledge representation. The objective of this work is to show how to apply our process model of knowledge interoperability in a particular plant protection company. Two case studies are provided in order to demonstrate distinguishing between simple knowledge transfer and knowledge interoperability.

## **Material and methods**

### **Knowledge Units**

In their work Dömeová et al. [8] suggested to define "knowledge unit" as a special, well-structured type of knowledge unit (KU), as contents of one production rule related to the successful solving of an elementary problem. Formally, knowledge unit can be recorded as

$$KU = \{X, Y, Z, Q\}$$

where

X stands for a problem situation,

Y stands for the elementary problem being solved in the framework of the X problem situation,

Z stands for the objective of solving the elementary problem,

Q stands for a successful solution of the elementary problem (result).

The elementariness of knowledge is predetermined by the elementariness of the problem. The elementary problem is a problem or a part of a

complex problem which is impractical to be further divided into more simple subproblems. Criteria for assessing the degree of elementariness are defined by the knowledge user, because they depend on his or her ability to understand and apply the rules included in knowledge unit. This is in conformity with Zack's definition of knowledge units [9].

Knowledge unit may be expressed as a whole in natural language. As mentioned above, there is no exclusivity; each part of elementary knowledge has several facultative ways of expression and almost all of their combinations are feasible.

Knowledge unit can also be expressed by natural language as follows:

*“IF you want to solve the elementary problem Y in the problem situation X to reach the objective Z, THEN apply the solution Q.”*

### **Operations with Knowledge Units**

*Drill-down operation* with knowledge units [10] allows switching hierarchical levels of details from more general to more specific, i. e. transition from complex problem to elementary problem (or just problem). The drill-down operation can be formalized as follows:

$$KU^{(i+1)}_j = f(KU_{ij}),$$

where

$KU_{ij}$  is the  $j$ -th knowledge unit on the  $i$ -th hierarchical level and

$KU^{(i+1)}_j$  is the  $j$ -th elementary knowledge on the next hierarchical level of detail.

Formally, “dd” operation will be hereafter used for specification of drill-down operation, so the equivalent form of the statement is:

$$KU^{(i+1)}_j = dd(KU_{ij}).$$

It means to execute the following assignment:

$$X_{ij} \rightarrow \emptyset \text{ (omitted);}$$

$$Y_{ij} \rightarrow X^{(i+1)}_j;$$

$$Z_{ij} \rightarrow Y^{(i+1)}_j;$$

$Q_{ij} \rightarrow Z^{(i+1)}_j$  has to be and “manually” added into the hierarchical structure, because it is a completely

new element that has no pattern on the  $i$ -th hierarchical level.

*Equivalency operation* with knowledge unit is a formal operation that allows declaring two knowledge units as equivalent. Let  $KU_i$  and  $KU_j$  knowledge units. Then they are equivalent, i.e.

$$KU_i \cong KU_j,$$

if and only if

$$X_i = X_j;$$

$$Y_i \cong Y_j;$$

$$Z_i \cong Z_j;$$

$$Q_i \cong Q_j.$$

The symbol “ $\cong$ ” means a semantic equivalency of each pair of text variables  $Y_i$  and  $Y_j$ ,  $Z_i$  and  $Z_j$ , and  $Q_i$  and  $Q_j$ .

### **Interoperability Process of Knowledge Units**

Process of knowledge interoperability is basically a demand-driven process; however, the supply side could also initiate that process. If it has some unique knowledge units available, it will be interested in their exploitation in a different environment in order to produce some benefits.

For the formalization of the knowledge interoperability process, we use the methodology “Architecture of Integrated Information Systems” developed by Scheer [11]. In particular, we use two kinds of the ARIS models [12]:

- Process-oriented function tree model that describes relationships between processes on the highest hierarchical level;

- Extended Event Driven Process Chain (eEPC model) that represents each process flow in detail. “Extension” means that some auxiliary elements (such as data clusters or organizational units) are used there and linked to individual functions.

We start with modelling on the most general level to express these relationships between the whole processes. For this purpose, we use a process oriented function tree; see figure 1.

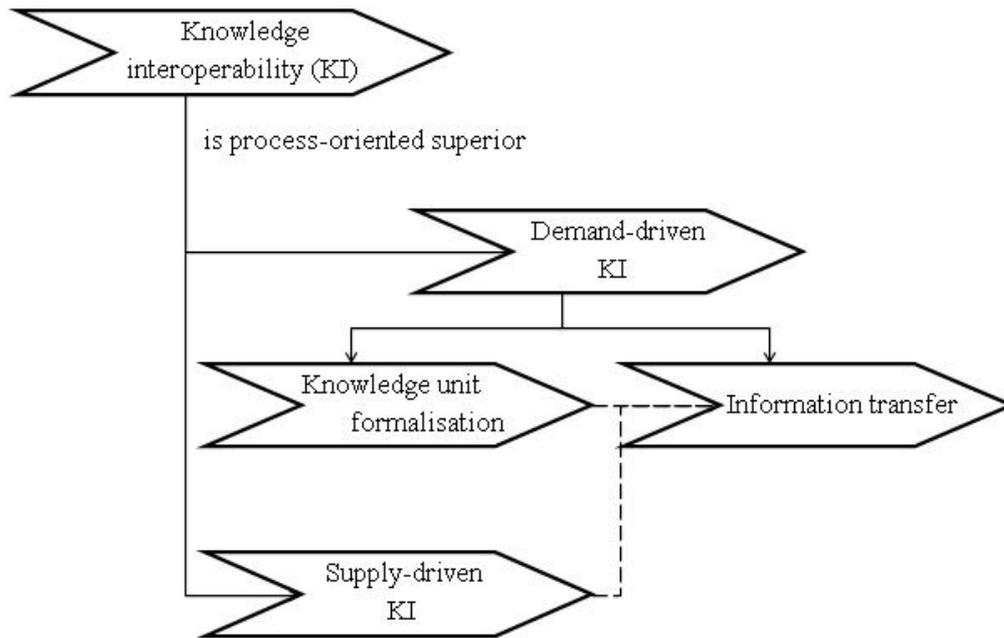


Figure 1: Process-oriented function tree for interoperability of knowledge.

Now, we will concentrate to the demand-driven process and formalize it by eEPC models. Formally, we decided to split the demand-driven process into two phases. The first one is in the demand side; it is an auxiliary phase that allows peer communication with different environments. The second phase covers the exchange of information between environments in order that the demand side is able to complete the knowledge unit.

For the demand side, the process is run by an event elicited by some independent decision-making; someone (a user) has to feel that a new knowledge unit is necessary for the specific problem solving and decide on the acquisition of the unit by the knowledge interoperability process.

Naturally, the user always tries to acquire a missing part(s) of the knowledge unit in his environment; asks his colleagues, searches the internet, books or other sources that are familiar to him. This effort may be successful; in this case, the process can finish, because the user has achieved his objective.

If the user was not successful, he has to create a communication interface in order to be able to search for the knowledge unit in another environment and exchange messages correctly with it. Ontology represents such an interface; but firstly, the user has to express and formalize the subject of his aim, the knowledge unit or its parts,

respectively. The problem situation “X” stems from user’s environment, so it should be always known. Furthermore, the user could know some subset of “Y” and “Z”; all of them, none of them or one of them. On the other hand, the solution “Q” is always unknown and the user at least searches for it. A formal expression of the knowledge unit is produced by this function.

After the knowledge unit has been formalized, the user usually needs to cooperate with an expert from the branch of knowledge/ontology engineering. He should create ontology to be able to communicate with other environments and search for similar term structures. This is the end of the knowledge unit formalization process, which runs the connective process “Information transfer”.

For a formal model of the knowledge unit formalization process see figure 2.

Unlike them, we are able to specify exactly how to work with information to obtain knowledge or knowledge unit. First we have to explain why we decided to denote this process as “Information transfer”, when we are dealing with the interoperability of knowledge. As we mentioned above, the demand side never calls for the whole knowledge unit; it always knows at least a problem situation “X”. In this case, it is enough to add the missing parts of the knowledge unit to make it complete; it means to acquire the solution “Q” and

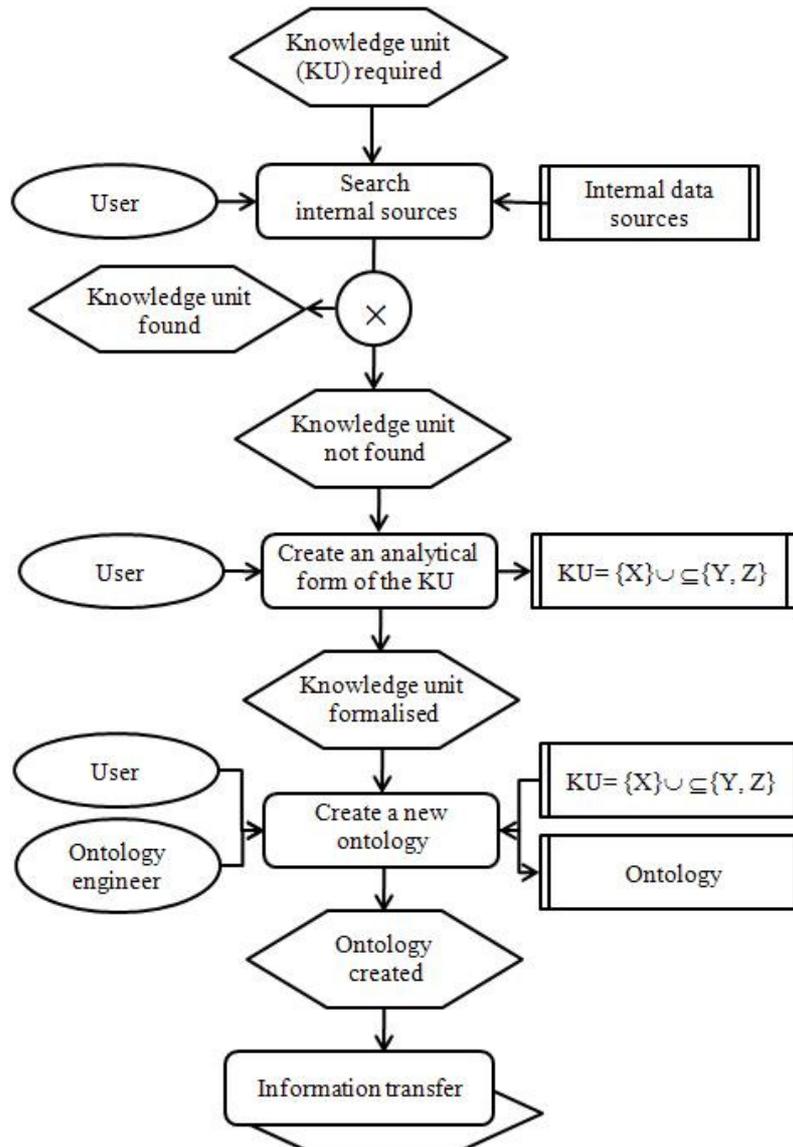


Figure 2: Knowledge unit formalisation process.

sometimes the objective “Z” and/or the elementary problem “Y”. As individuals, all of them “Y”, “Z” and “Q” have the quality of information, so we can say:

“Knowledge interoperability (or knowledge transfer, respectively) is realized by the acquisition of information.”

This thesis is in concordance with one way of view of knowledge that is generally accepted in the community of knowledge sciences. More authors, e.g. [13], [14] or [15], declare that knowledge is some kind of enriched information.

A complete ontology is the necessary condition for the activation of the information exchange process. In the ontology, there are all the relevant terms

from the incomplete knowledge unit, as well as relationships among these terms.

The call for the missing information follows. The ontology is the input for this function that is executed by the ontology engineer. He systematically explores other environments and searches for structures similar to his ontology. His effort could sometimes fail; in this case, the process finishes and knowledge interoperability cannot be successfully achieved.

As soon as the missing information is found, cooperation between the ontology engineer and a supply side member is required. They should work together and enhance the original ontology with new information; make it complete in order for the

user from the demand side to also complete his knowledge unit.

For a formal model of the information transfer process see figure 3.

## Results and Discussion

In this section, we provide two real case studies from the environment of a plant protection company in order to show differences between the transfer and interoperability of knowledge. First let us briefly introduce the company. Since 1992, Agro Žamberk, a.s. has provided different services for farmers [16]; in particular, storing and supplying the farmers by industrial fertilizers and plant protection preparations. Throughout the years, it also has started its business in the area of trading with fuels, agro-chemistry products, oils, tyres and other commodities. Both case studies are connected with the agenda of the department of fertilizers, chemistry and coal managed by Mr. Miroslav Mikulecký.

According to him, knowledge transfer is the most common way of problem solving in the company and in his department, respectively. Frequently, an employee solves such problems when he provides advisory services to a client. In this case he puts effort to find appropriate knowledge and provide it to the client to solve his problem. The advisory service is usually for free, but as a part of a marketing strategy of the company, it contributes to the increase of revenues from trading with plant protection products.

Case 1: Weeds problem of a private farmer (transfer of knowledge)

*A private farmer observed that some weeds grew up in his field of winter wheat. He was able neither to identify the weeds nor select an appropriate preparation to eliminate it. He visited the company with the sample of weeds to identify it and buy the right plant protection preparation.*

In this case the company (and its consultant, respectively) should provide knowledge. Apparently, it plays the role of knowledge supply side; nevertheless, the consultant has to find the answer to the client's problem first. The equivalent event that starts the process is "Knowledge required" and "Knowledge unit required",

respectively; this is an initial event for the process "Knowledge unit formalization", which is primarily assigned to the demand side of the interoperability process (see figure 2).

Obviously, the process should be executed by the consultant. He cannot suppose that his client (a farmer) is able to express and represent his knowledge in a specific form of knowledge unit or in another type of knowledge representation. Thus, the consultant should follow the process and manage his dialog with the client.

### *Step 1: Search internal sources*

First the consultant tries to identify the species of the weeds. For this purpose he uses internal data sources – a herbarium with typical weeds for the specific location and main crop. He is successful; according to main characteristics of the weeds he is able to specify it – Silky Bent Grass (*Apera spica-venti*). But the problem is more complex; he also should recommend a preparation to eliminate it. He has never faced this problem and so he has no record in internal sources how to proceed, what an appropriate solution is. Therefore, the process has to continue.

### *Step 2: Create an analytical form of knowledge unit*

The consultant is now able to specify his problem exactly and determine knowledge unit KU11 as follows:

$$KU11 = \{X11, Y11, Z11, Q11\},$$

where

X11 = "winter wheat growing";

Y11 = "Silky Bent Grass in the field";

Z11 = "to eliminate the weeds";

Q11 = "to choose an appropriate preparation".

The consultant sees the above-mention knowledge unit as too general. It provides him the solution of his problem, but he is not able to execute it. Thus, he should make the knowledge unit KU11 more specific through the application of the operation "drill-down". So,

$$KU21 = dd(KU11),$$

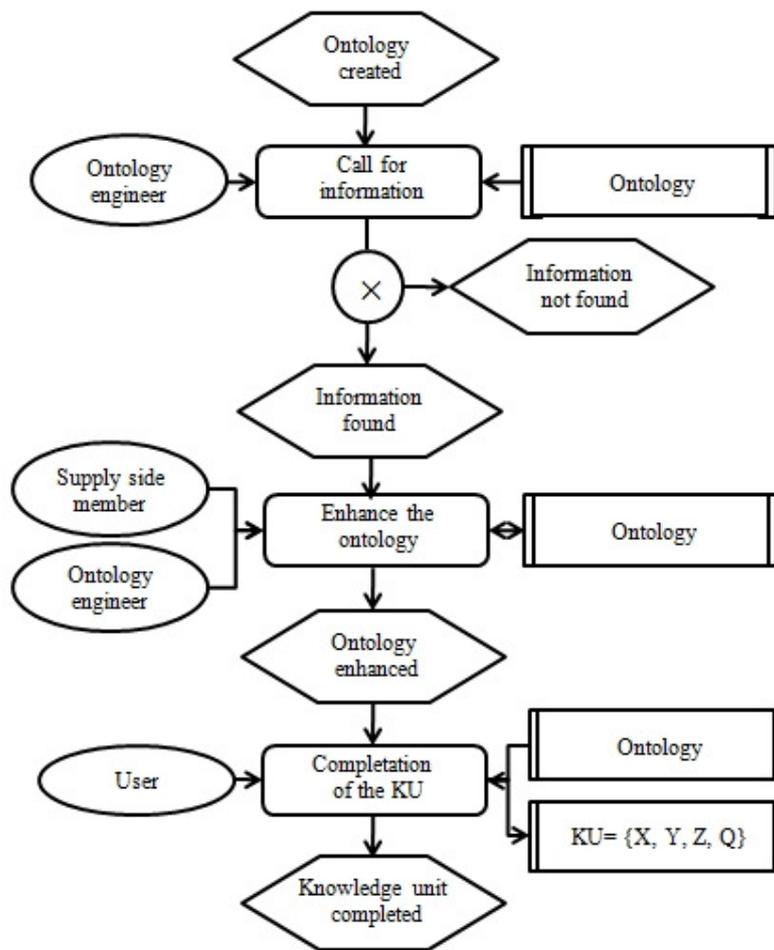


Figure 3: Information transfer process.

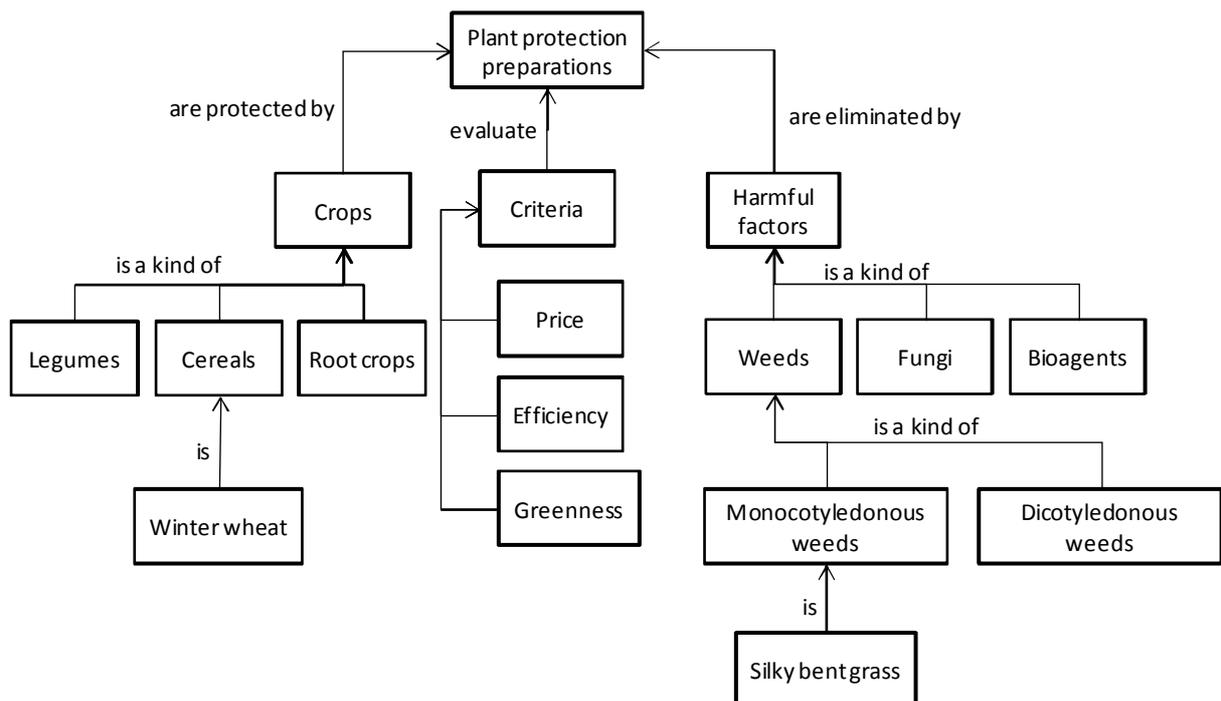


Figure 4: Ontology for the weeds problem.

where

X21 = "Silky Bent Grass in the field";

Y21 = "to eliminate the weeds";

Z21 = "to choose an appropriate preparation".

Q21 = unknown.

Step 3: Create a new ontology

The consultant is not able to continue without exact specification what "an appropriate preparation" is. He should create an ontology that helps him to express relevant terminology and relationships among individual terms, respectively. The ontology (here represented by a semantic network) also helps him to ask the client for additional information. See figure 4.

Now the consultant can specify what "the appropriate" means. The plant protection preparation has to

- cause no damage on the field of winter wheat, so the farmer must avoid using ones with contraindication of cereals;
- eliminate monocotyledonous weeds in general and silky bent grass, ideally;
- be the cheapest, the most efficient, or the most greenness.

The knowledge unit provided by the consultant to the client has to be unambiguous. Thus the client has to specify the criterion for the final recommendation. He prefers the criterion "price per unit". So the consultant can apply the following equivalency of knowledge units:

$KU21 \cong KU22$ ,

where

X22 = X21 = "Silky Bent Grass in the field";

Y22 = Y21 = "to eliminate the weeds";

Z22  $\cong$  Z21 = "to choose the cheapest preparation"  
( $\cong$  "to choose an appropriate preparation");

Q22 = unknown.

The further procedure is not complex. The consultant makes a list of available preparations those are registered and approved to be applied in the Czech Republic using the National Registry of State Phytosanitary Administration and catalogues of suppliers of individual preparations. His final recommendation stems from the following table:

The knowledge unit KU22 is completed now:

X22 = "Silky Bent Grass in the field";

Y22 = "to eliminate the weeds";

Z22 = "to choose the cheapest preparation";

Q22 = "to apply Herbaflex, 2 l/ha for 112 CZK/ha";

and due to the above-defined equivalency

$KU21 \cong KU22$

also

X21 = "Silky Bent Grass in the field";

Y21 = "to eliminate the weeds";

Z21 = "to choose an appropriate preparation";

Q21 = "to apply Herbaflex, 2 l/ha for 112 CZK/ha".

The final recommendation to the client is as follows:

"IF you want to eliminate the weeds in case of Silky Bent Grass in the field by an appropriate preparation, THEN you should apply Herbaflex, 2 l/ha for 112 CZK/ha."

Now the knowledge transfer process is over and the whole business process can continue, probably by negotiation about the conditions of the contract.

## Case 2: Interpersonal conflict in plant protection department (interoperability of knowledge)

*The head of the plant protection department face the following problem. Two of highly-qualified experts are not able to cooperate because of interpersonal antipathy. It leads to the decrease of performance of the whole department. The head is an expert in the area of plant protection but he has never faced such a problem. His current knowledge is insufficient to solve the problem.*

Preparation name	Price (CZK/package)	Package (kg, l)	Application (per 1 ha)	Costs (CZK/1ha)
Attribut SG 70	4 067	0.3 kg	0.06 kg	813
Calipuron	247	5 l	2 l	247
Grodyl Plus	11 065	0.5 kg	0.03 kg	664
Herbaflex	559	10 l	2 l	112
Hurricane	5 309	1 kg	0.2 kg	1 062
Sumimax	2 473	0.3 kg	0.06 kg	495
Tolian Flo	1 591	5 l	1.5 l	477
Zeus	3 348	1.5 kg	0.3 kg	670

Table 1: Comparison of individual preparations.

Subject to the knowledge interoperability process, the head is definitely in the position of a demand side. He calls for knowledge to solve the above-mentioned problem. The initial phase of the process is the same like in Case 1; first a knowledge unit should be formalised.

*Step 1: Search internal sources*

No idea, no internal sources on the problem are available.

*Step 2: Create an analytical form of knowledge unit*

The head orders information about the problem into analytical form of the knowledge unit KU11,

where

X11 = “management of the department”;

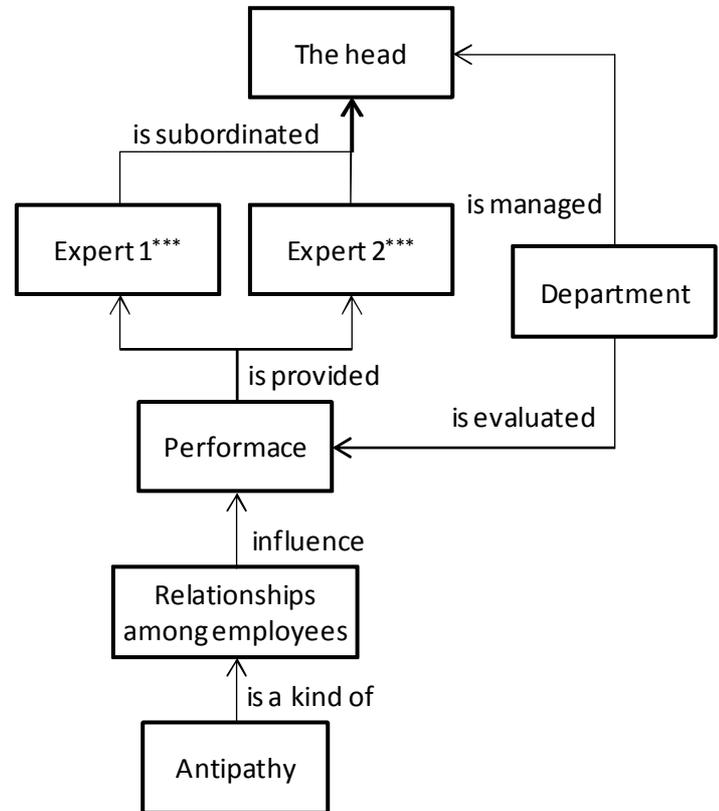
Y11 = “to normalize relationships between experts”;

Z11 = “to increase the performance of the department”;

Q11 = unknown.

*Step 3: Create a new ontology*

According to [17], this is a well-structured problem; the head knows all parts of the knowledge unit except the solution. He has no opportunity to find the solution in his environment, thus he has to create ontology for his problem and the problem situation, respectively. See figure 5.



\*\*\*Note: The authors of the paper know the names of both experts, but they have no permission to quote them in the paper.

Figure 5: Ontology for the problem of interpersonal conflict. After the ontology has been created, Information Exchange process can start.

*Step 1: Call for information*

The head should call for information in other environments. In this case he finds the information in the area of personal management. He asks his colleague dealing with personal management and its psychological aspects for an advice. The head

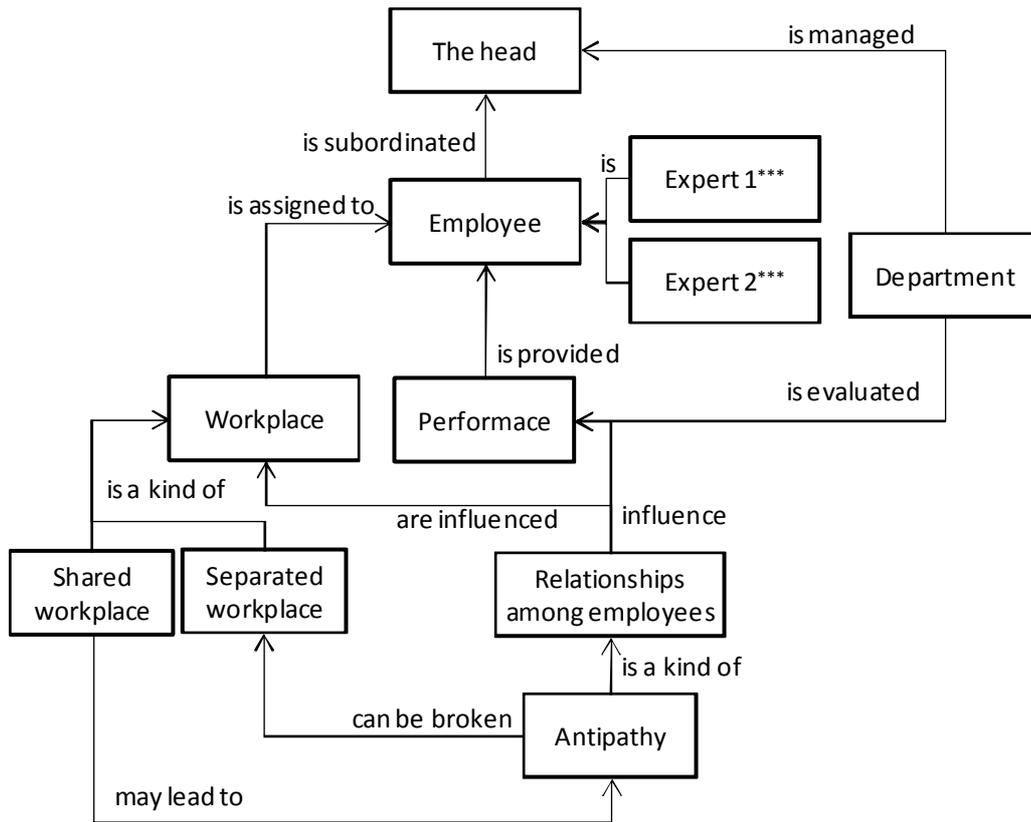


Figure 6: Enhanced ontology for the problem of interpersonal conflict

describes him the problem and forward him the above-mentioned ontology to complete it.

*Step 2: Enhance the ontology*

According to his knowledge and experience, the personal management expert enhances the ontology. He adds there other important terms, aspects and categories to find the required information. The enhanced ontology is as follows (see figure 6).

Based on figure 6, the required information can be provided to the head. Obviously, the personal management expert aims at the aspect of the problem that has been omitted by the head: the impact of workplace on relationships among employees as well as the impact of shared and separated workplaces on interpersonal antipathies.

*Step 3: Complete the knowledge unit*

New information provided by the personal management expert completes the knowledge unit KU11 as

X11 = “management of the department”;

Y11 = “to normalize relationships between experts”;

Z11 = “to increase the performance of the department”;

Q11 = “to provide separate workplaces to both experts”.

Expressed in natural language, the knowledge unit sounds as

“IF you want to normalize relationships between experts in management of the department in order to increase the performance of the department, THEN you should provide separate workplaces to both experts.”

The knowledge unit is complete and the process of knowledge interoperability is over.

Technical remark: In above-introduced story, the authors of the paper played the role of ontology engineers; they helped to the head of the department to express and formalise his problem as well as to the personal management expert to enhance the ontology to be both formally correct and understandable for the head. Now we also

know the real end of the story; the problem was successfully solved, antipathy between the experts is broken and the department provides its standard performance.

## **Conclusion**

Interoperability is a specific type of knowledge transfer. The difference between knowledge interoperability and knowledge transfer lies in environments; knowledge transfer is realized in homogenous environment, knowledge interoperability in heterogeneous environment. Both of them are demonstrated in our cases; first one deals with knowledge transfer, responsible employee solved his problem by use of another weeds and preparations database. Second one deals with knowledge interoperability, the consultant had to solve his problem through the assistance of the human resources manager.

We also showed that process of knowledge transfer (including knowledge interoperability) and tools for it are easy to use. There are no other additional costs, except time of responsible employee, mostly manager, who has to solve the particular problem.

*Corresponding author:*  
*Ing. Milan Houška, Ph.D.*  
*Department of Systems Engineering*  
*Czech University of Life Sciences Prague*  
*Kamýcká 12, 165 21, Prague 6*  
*Phone: +420 224 382 35*  
*Email: houska@pef.czu.cz*

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However, problem solving is his daily work and our approach can help him make it easier.

In the second case, the manager used knowledge from different environment, but it is environment he knows quite a good. In our further work, we are going to enrich our approach about such a tool, which could be used for knowledge interoperability also in heterogeneous environments he does not know much or anything, at all.

Ontology is the theme, which is enhanced nowadays, many universities, institutions deal with semantic networks and use them for knowledge storage. Such networks also could help other users as a new knowledge sources and our tools can help users to work with them.

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## Classification of the EU countries labour markets

B. Kába

Czech University of Life Sciences Prague, Faculty of Economics and Management, Department of Statistics

### Abstract

The objective of the paper is to classify the labour markets of the EU member states on the basis of selected employment and unemployment indicators. In order to achieve the study target, the adequate multivariate exploration procedures have been chosen. In the first part of processing original data, principal component analysis (PCA) was employed. PCA is a multivariate statistical procedure used to reduce the number of observed variables into a smaller number of uncorrelated variables with a minimum loss of information. Moreover, the PCA results can be used for effective ranking of the EU countries according to observed indicators of labour markets. This paper describes the crucial steps in PCA and procedure for ranking mentioned and it reviews how PCA-based statistics are constructed and interpreted. The results of the study have demonstrated the range of application and advantages of the multivariate statistical approaches represented in this paper.

### Key words

Classification, employment, unemployment, principal component analysis, cluster

### Anotace

Cílem příspěvku je klasifikace trhů práce členských zemí EU na základě vybraných ukazatelů zaměstnanosti a nezaměstnanosti. Pro dosažení uvedeného cíle byly zvoleny odpovídající vícerozměrné postupy průzkumové analýzy dat. V první fázi zpracování disponibilních dat byla využita analýza hlavních komponent (PCA). Jedná se o vícerozměrnou statistickou proceduru užívanou k redukci počtu studovaných proměnných na menší počet nekorelovaných proměnných s minimální ztrátou informace. Výsledky PCA mohou být dále využity pro účelnou klasifikaci studovaných objektů (členských zemí EU) podle uvažovaných ukazatelů trhů práce. Daný příspěvek popisuje klíčové etapy PCA a zmiňované klasifikační procedury a shrnuje, jak statistiky založené na PCA jsou konstruovány a interpretovány. Výsledky studie demonstrují okruh použitelnosti i přednosti vícerozměrných statistických postupů uvedených v tomto příspěvku.

### Klíčová slova

Klasifikace, zaměstnanost, nezaměstnanost, analýza hlavních komponent, shluk

### Introduction

An important prerequisite for sustaining social cohesion and political stability in the European Union is a well-functioning and adaptable labour market. It is therefore understandable that such a great degree of attention is paid to monitoring its development – not only in the individual EU 27 countries, but also through a comparison of them. Eurostat uses a number of indicators for monitoring employment and unemployment. As far as comparative purposes are concerned, various levels of employment and unemployment, structured according to such factors as gender, age, level of education attained by job seekers, the length of

unemployment, etc., are the most appropriate ([3], [5]). An isolated analysis of individual indicators does not make it possible to unequivocally evaluate the status of the labour market in individual countries, as these indicators reflect processes that take place simultaneously and with complex levels of interaction. This means that, in order to use the information contained within all the individual indicators in a comprehensive manner, it is necessary to select the corresponding multi-dimensional statistical procedures ([1], [4], [5]).

The objective of this particular paper, which is methodological in nature, is to classify the labour market in the twenty-seven member states of the

EU using selected available employment and unemployment indicators. The realisation of this objective was founded on the use of multi-dimensional Principal Component Analysis (PCA) and Cluster Analysis (CA) statistical methods ([1], [2], [6]). The analysis included an assessment of whether it is possible to find groups of countries amongst the individual EU 27 member states that have a similar labour market situation. Attention was also paid to identifying the indicators that are decisive for monitoring employment and unemployment.

### **Material and methods**

The following were included for all of the twenty-seven EU member states in the analysis:

P1 – employment rate – total

P2 – employment rate, by highest level of education attained – levels 0 – 2 (ISCED 1997)<sup>1</sup>

P3 – employment rate, by highest level of education attained – levels 3 – 4 (ISCED 1997)

P4 – employment rate, by highest level of education attained – levels 5 – 6 (ISCED 1997)

P5 – unemployment rate (ILO definition) – total

P6 – unemployment rate – females

P7 – unemployment rate, by age group – less than 25 years

P8 – unemployment rate, by age group – between 25 and 74 years

P9 – long-term unemployment rate – total.

All the data that were used pertain to 2009 and were obtained from the EU Labour Force Survey (LFS)

database. The computations have been performed using the SAS programme package, version 9.1.

The classification and comparison of the labour markets in the member states of the EU 27 was based on the use of principal component analysis (PCA) and cluster analysis (CA) techniques. PCA is a statistical method that makes it possible to compress multi-dimensional statistical data and reduce the number of original variables (which are often highly co-related) through the use of a lower number of uncorrelated variables, or principal components. Each component is constructed as linear combination of the original variables and the weights for each principal component are given by the eigenvectors of the correlation matrix of the initial variables. The principal components are sorted in descending sequence according to the decrease in their variability as measured by eigenvalues that have been analysed using a correlation matrix. As it is generally only the first few principal components (two or three) that contain a significant portion of the variability for the set of objects being analysed, it is possible to limit the analysis to using only these components.

For the purposes of this particular study, the PCA method was supplemented with CA procedures. In order to identify and create clusters, i.e. groups of objects where the objects within one group are mutually similar whilst objects that are not mutually similar are in different groups, procedure K – means clustering (a non-hierarchical classification algorithm) was applied ([6]).

### **Results**

The PCA method is mathematically founded on a certain decomposition of a correlation matrix of available variables, which should contain several correlation coefficients that are more important. In order to assess this characteristic, i.e. factorability, in an exact manner, the KMO (Kaiser-Meyer-Olkin) value is used ([6]). PCA is considered to be an appropriate method to use for a particular set of data if the KMO values for the data are greater than 0.5 (see ([6])). Table 1 provides the average KMO value as well as the individual KMO values for the individual variables.

The presented data show that the prerequisites for the correct application of the PCA method have been met.

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<sup>1</sup> Levels 0 – 2: pre-primary, primary and lower secondary education. Levels 3 – 4: upper secondary and post-secondary non-tertiary education. Levels 5 – 6: tertiary education (according to the International Standard Classification of Education, ISCED 1997)

When converting the original variables into principal components, the first step was to calculate the eigenvalues for the correlation matrix. Eigenvalues and the proportion of the total variation explained by each principal components are listed in table 2.

Application of Kaiser–Guttman criterion (see [6]) of retaining only those components whose eigenvalues are greater than 1 for subsequent analysis yielded the first two principal components PC1 and PC2, which accounted for 81,06 % of the total variance. The remaining components were considered less significant. From the eigenvectors obtained in the PCA, the first component can be given as:

$$PC1 = -0,316P1 - 0,230P2 - 0,330P3 - 0,302P4 + 0,359P5 + 0,363P6 + 0,371P7 + 0,359P8 + 0,345P9. \quad (1)$$

Similarly, the second principal component can be expressed as:

$$PC2 = 0,497P1 + 0,435P2 + 0,304P3 + 0,252P4 + 0,377P5 + 0,308P6 + 0,183P7 + 0,369P8 - 0,040P9. \quad (2)$$

An important output from the analysis of the principal components is the component loadings, which represent the correlation of a component with the individual variables that are being analysed. These aforementioned component loadings – determined on the basis of a varimax rotation (the rotation procedure enhances interpretation of the components without changing their statistical explanatory power – see [6]) – are summarised in Table 3.

From Table 3, it is obvious that the first principal component correlates most strongly with the unemployment rates P5 – P9 in the EU 27 member states. Taking into account that the first principal component explains the greatest proportion of overall variability, these unemployment indicators P5 – P9 can be designated as being the most important for describing the variability of the analysed data. The second component correlates strongly or mid-level strongly with the employment levels (indicators P1 – P4) in the EU 27 member states. These particular indicators are therefore less important from the perspective of describing the variability in the database that is available.

During the next phase of the analysis, the first two principal components, which helped to summarise the multi-dimensional data contained in the indicators for the labour markets in the EU 27 member states, were used to sort the individual countries according to the monitored employment and unemployment indicators. For the purpose of organising the data in this way, the study constructed an indicator PC that aggregated the information provided by all of the indicators considered. This indicator was defined as a linear combination,

$$PC = w_1 \cdot PC1 + w_2 \cdot PC2, \quad (3)$$

where PC1 and PC2 represented the values from the first and second principal components respectively and  $w_i$  ( $i = 1, 2$ ) were the weights assigned on the basis of the PCA results. The specified weights represent the proportion of overall variance, which was explained by the applicable component. It is necessary to note that the equation (3) can easily be generalised even for a greater number of principal components, which could be identified by the aforementioned Kaiser criterion. In this case, the PCA-based indicator would have shape (4):

$$PC = \sum_{i=1}^k w_i \cdot PC(i). \quad (4)$$

The absolute values of the weights are defined as “explanation ratios of total variance” and their signs (plus or minus) are determined according to the predominant number of pluses or minuses for the component loadings. If more than half of the component loadings of the PC(i) is negative then  $w_i$  is negative, otherwise it becomes positive. The values for the PC indicator calculated using the above-specified method for the individual EU 27 member states and the applicable sequence for these countries are specified in Table 4 (see columns 1 and 2).

Based on analysis of the relationships (1) – (3), it becomes apparent that the labour market in the majority of the countries which have a negative PC score (there are fourteen in total) is, when compared to the overall EU 27 level, as a rule characterised by an above-average level of employment (overall rate and rate for persons with an education level of 3 – 4 or 5 – 6) and, in

particular, a below-average unemployment rate (broken down according to the overall unemployment rate, the unemployment rate for women and the unemployment rate for persons between 25 and 74 years of age) and generally also a lower than average unemployment rate for persons under the age of 25 and a below-average long-term unemployment rate. On the other hand, the labour market in those EU 27 member states with a positive score – as compared to the overall EU 27 level – generally has a below-average level of employment (this in particular applies to persons with an education level of 3 – 4) and an above-average unemployment rate (in particular in the case of the unemployment rate for persons under the age of 25 and the long-term unemployment rate). Table 4 shows that the first ten countries, sequenced according to their PC ranking, include only two of the “new” member states that were

accepted into the EU in 2004: Cyprus (in fourth place) and Slovenia (in fifth place). The average value of the PC scores for the “old” EU member states, i.e. the EU 15, is –0.346 as compared to the average PC value for the twelve new EU member states, which is 0.432. For this reason, the next phase of the analysis tested the hypothesis that the value of the PC scores for the new EU member states is based on the same distribution as the PC scores for the EU 15 as opposed to a one-sided alternative. In order to verify this hypothesis, a non-parametric Wilcoxon Rank Sum test was performed, from which the resulting p – value was 0.098. The tested hypothesis was therefore not rejected, i.e. from the perspective of the considered employment and unemployment indicators there was no difference proven as regards the labour markets in the old and new EU member states.

KMO Measure: Overall				0,700				
P1	P2	P3	P4	P5	P6	P7	P8	P9
0,720	0,656	0,642	0,867	0,619	0,774	0,643	0,617	0,916

Source: own calculation according to data of the EU Labour Force Survey

Table 1. Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy.

Components	Eigenvalue	Individual Percent	Cumulative Percent
PC1	6,164	68,49	68,49
PC2	1,131	12,57	81,06
PC3	0,710	7,89	88,95
PC4	0,387	4,30	93,25
PC5	0,310	3,44	96,69
PC6	0,131	1,46	98,15
PC7	0,099	1,10	99,25
PC8	0,066	0,74	99,99
PC9	0,002	0,01	100,00

Source: own calculation according to data of the EU Labour Force Survey

Table 2. Eigenvalues of correlation matrix of indicators P1 – P9.

Variables	PC1	PC2
Total employment rate	– 0,267	0,907
Employment rate, by highest level of education attained – levels 0 – 2	– 0,146	0,721
Employment rate, by highest level of education attained – levels 3 – 4	– 0,426	0,772
Employment rate, by highest level of education attained – levels 5 – 6	– 0,407	0,685
Total unemployment rate	0,943	– 0,260
Unemployment rate – females	0,904	– 0,323
Unemployment rate, by age group – less than 25 years	0,833	– 0,438
Unemployment rate, by age group – between 25 and 74 years	0,937	– 0,266
Long-term unemployment rate – total	0,633	– 0,579

Source: own calculation according to data of the EU Labour Force Survey

Table 3. Component loadings for rotated components.

The results provided in Table 4 also indicate a tendency of certain countries to cluster. These tendencies were identified using a non-hierarchical K – means clustering method, which categorised the EU 27 member states into four clusters on the basis of the employment and unemployment indicators that were analysed. For a more illustrative description of the identified clusters, the calculated cluster averages for the indicators P1 – P9 were compared with the values for these same indicators at the overall EU 27 level. The results of this comparison are provided in Table 5.

From these results it is apparent that the least favourable values for the monitored indicators characterising employment and unemployment in the EU 27 member states in 2009 were recorded in the Baltic States and Spain, which were included in the first cluster. In the case of these countries, high unemployment rates were typical in particular for persons between 25 and 74 years of age. The countries comprising the second cluster (including the Czech Republic) attained relatively favourable results for the individual labour market indicators, which had an employment rate lower than the EU27 average only in the case of persons with a “pre-primary, primary and lower secondary education”. The best results for all of the analysed indicators were attained by the countries in the fourth cluster. They differ from the other EU 27 member states on the basis of low values for the individual considered categories of unemployment rates, in particular a very low value for long-term unemployment rate.

All presented results were based on the analysis of overall employment and unemployment indicators of 27 EU member states. It must be noted, however, that 91% of the EU territory is made up of rural areas, i.e. areas where the population density is below 150 inhabitants per square kilometre and 56% of the EU population live in predominantly rural (PR) and significantly rural (SR) areas<sup>1</sup> In

addition, it must be mentioned that rural areas provide 55% of employment. Therefore it would be useful to complete the set of the analyzed labour market indicators with indicators related only to rural areas. However, national statistic offices of EU countries publish such specialized indicators in a limited extent. With regard to this fact, the following variables were added to the original ones - P1 – P9:

P10 – employment rate in PR or SR respectively in rural areas

P11 – unemployment rate in PR or SR respectively

P12 – long-term unemployment rate in PR or SR respectively

P13 – employment rate in the primary sector in PR regions

In order to classify labour markets of EU member states and their ranking using the indicator (4), all disposable variables P1 – P13 were applied. The achieved results (see columns 3 and 4 of Table 4) were very similar to the above-commented results concentrated in Table 4 (columns 1 and 2). Eleven EU member states were ranked – according to the PC ranking – to the same positions as when applying variables P1 – P9. Seven countries changed their ranking by one position, 6 countries by two positions and 3 countries changed their ranking by 3 positions. In addition, it was possible to state that even on the basis of an extended set of indicators P1 – P13, no difference between the labour markets of 15 old and 12 new EU member states was proven ( p – value was 0.116).

The relationship between the ranking values acquired both from variables P1 – P9 and from the extended set of variables P1 – P13 was quantified using the Spearman's correlation coefficient. This coefficient reached the value of 0.982 which signals a very close relation between both sets of ranking values. Hence we can state that both described procedures of EU labour market classification (making use of 9 or 13 employment and

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<sup>1</sup> Predominantly Rural region (PR) – more than 50 % of the population of the region is living in rural local units

Significantly Rural region (SR) – 15 % to 50 % of the population of the region is living in rural local units

unemployment indicators respectively) are in effect mutually interchangeable and both of the allow – at

Countries	PC scores (1)	PC ranking (2)	PC scores (3)	PC ranking (4)
Belgium (BE)	0,26	15	0,47	17
Bulgaria (BG)	- 0,65	11	- 0,23	14
Czech Republic (CZ)	- 0,55	12	- 0,47	11
Denmark (DK)	- 2,45	2	- 2,36	2
Germany (DE)	- 1,17	6	- 1,04	8
Estonia (EE)	1,70	23	1,21	22
Ireland (IE)	1,06	20	0,75	19
Greece (EL)	1,29	21	1,23	23
Spain (ES)	3,77	27	3,17	27
France (FR)	0,56	18	0,56	18
Italy (IT)	0,78	19	0,97	20
Cyprus (CY)	- 1,86	4	- 1,79	4
Latvia (LV)	2,97	26	2,31	25
Lithuania (LT)	1,74	24	1,20	21
Luxembourg (LU)	- 1,12	8	- 1,02	9
Hungary (HU)	1,65	22	1,79	24
Malta (MT)	- 0,54	13	- 0,30	13
Netherlands (NL)	- 3,28	1	- 2,94	1
Austria (AT)	- 2,34	3	- 2,17	3
Poland (PL)	0,30	16	0,41	16
Portugal (PT)	0,36	17	0,30	15
Romania (RO)	- 0,35	14	- 0,33	12
Slovenia (SI)	- 1,51	5	- 1,33	5
Slovakia (SK)	2,29	25	2,58	26
Finland (FI)	- 0,70	10	- 0,62	10
Sweden (SE)	- 1,14	7	- 1,14	7
United Kingdom (UK)	- 1,07	9	- 1,19	6

Source: own calculation according to data of the EU Labour Force Survey

Table 4. Ranking of EU 27 countries based on PC scores.

Cluster	Countries	P1	P2	P3	P4	P5	P6	P7	P8	P9
1	EE, LT, SK, LV, ES	0,94	0,60	0,93	0,99	1,68	1,50	1,59	1,72	1,49
2	SI, DE, LU, UK, FI, BG, CZ, MT, PT	1,02	0,94	1,02	1,02	0,81	0,82	0,85	0,79	0,81
3	RO, BE, PL, FR, IT, IE, EL, HU	0,93	0,85	0,93	0,98	1,01	1,03	1,20	0,99	1,10
4	NL, DK, AT, CY, SE	1,13	1,19	1,12	1,04	0,62	0,61	0,68	0,58	0,27

Source: own calculation according to data of the EU Labour Force Survey

Table 5. Ratio of cluster averages for the indicators P1 – P9 and values at the overall EU 27 level.

least in an implicit form – consideration of certain specifics of the rural development in EU countries.

### Conclusion

The majority of data for the labour market are multi-dimensional in nature. As a result, standard statistical methods are not appropriate for analysing them, as it would not be possible to describe and synthesise the relations between the individual factors and parameters that characterise the labour market. The objective of this particular study was to describe and demonstrate the usability of certain multi-dimensional methods, primarily principal component analysis, as an appropriate analytical

tool to use for summarising the information contained in the larger number of indicators used for the labour market. With the help of this technique, it was possible to identify the most important indicators from the given set of EU 27 employment and unemployment indicators and, by subsequently applying a CA method, assessing which of the EU 27 member states are similar from the perspective of the considered labour market indicators. However, it has to be noted, the multivariate statistical methods employed in this study are data exploratory tools, i.e., their fundamental purpose is to describe a structure of

relationships within a large data set without explaining why it exists.

The benefits brought by this study consist of the proposal and verification of the usability of a specific measuring method that makes it possible to perform a synthetic evaluation of the information provided by the analysed employment and unemployment indicators. The proposed composite indicator PC – defined by the relations (3) or (4) – integrates large amount of information into easily understood formats and it could be implemented as a fast method in routine analysis. The advantage of this measuring method, which is based on the linear

combination of extracted principal components, is the fact that it does not place any demands on the distribution assumptions for the analysed data. The results of this study have proven that the proposed measuring method can be used to attain the effective and unambiguous classification of the labour markets across countries or over time.

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*Corresponding author:*

*Doc. RNDr.Bohumil Kába, CSc.*

*Czech University of Life Sciences Prague, Department of Statistics*

*Kamýcká 129, 165 21 Prague 6 – Suchbátka, Czech Republic*

*Phone: +420 224 382 236*

*e-mail: kaba@pef.czu.cz*

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## ICT industry and resources based analysis of maintenance SME in the Central Europe

Š. Tesař, Z. Havlíček, V. Očenášek

Czech University of Life Sciences Prague, Faculty of Economics and Management, Department of Information Technology

### Abstract

Highly competitive situation in Information and Communication technology (ICT) maintenance industry requires a precise analysis of all important factors and carefully defined company strategy which addresses each of these aspects. This paper presents a resource based analysis of family run SME, operating in IT parts and consumables market. In order to understand this complex view, it first describes the company background. It briefly presents the industry key success factors and company strategy of the SME. The value chain analysis helps to name the main organization's capabilities and evaluates them in terms of costs and customer willingness to pay. Resource audit provides an analysis of key company tangible, intangible and human resources. The outcome of this audit shows that most of SME resources are of an intangible nature. Contrary to the higher mobility of today's resources, intangible resources of SME such as company reputation, culture and strategic business relations, are mostly immobile and inimitable. Based on the audit all key resources and capabilities are appraised by their strength and importance relative to closest rivals. Results are presented in graph which recognizes the key strengths (family run business related) and weaknesses (IT and finance). The results of the resourced based analysis lead to recommendations for changes in order to create and retain competitive advantage.

### Key words

ICT, resource based analysis, resources, capabilities, strategy, SME.

### Anotace

Vysoká konkurence v sektoru servisu a podpory informačních a komunikačních technologií vyžaduje zevrubnou analýzu všech spolupůsobících faktorů a jim odpovídající kvalitní firemní strategii. Obsahem tohoto příspěvku je zdrojová analýza společnosti z kategorie malých a středních podniků (MSP) působící v oblasti distribuce náhradních dílů a spotřebního materiálu. Definice klíčových faktorů úspěchu odvětví a jejich porovnání se strategií podniku, spolu s vyhodnocením hodnotového řetězce vytváří rámec pro vyhodnocení strategické pozice MSP. Výsledkem provedené zdrojové analýzy dostupných zdrojů a schopností MSP je skutečnost, že většina těchto zdrojů je nemateriální povahy. Oproti typicky vysoké mobilitě dnešních zdrojů jsou zdroje MSP, jako je pověst společnosti, její kultura a strategické obchodní vztahy většinou imobilních a nenapodobitelných. Výsledky zdrojové analýzy jsou oceněny v závislosti na jejich strategické váze a relativní důležitosti vzhledem k nejbližší konkurenci. V návaznosti na těchto výsledcích jsou definována doporučení pro úpravu firemní strategie tak, aby byla i v budoucnu zachována vysoká konkurenceschopnost MSP.

### Klíčová slova

ICT, zdrojová analýza, zdroje, schopnosti, strategie, MSP

### Introduction

Resource based analysis will be carried on a business with background in IT products distribution. Analyzed SME is a family run company founded in 2003 as a spin-off of medium

IT after sales service company. "SME represent 99% of all European companies and approximately 66% of jobs in the private sector. As the driving force of the enterprise sphere, growth, innovations, competitiveness and employment, they are the true heart of the European economy" (Havlíček et al.;

2008). The original idea was to benefit from the existing business relations to the full extent. Since a multi-manufacturer service center cannot be active in sales to keep its independency, a new distribution company was founded. Exploiting the outstanding relationship of its managers with the key contacts, it has shortly developed intense cooperation with major computer manufacturer. SME has always been very customer oriented company with good sense for business opportunities. It helped the manufacturer with startup of their re-introduced printer business and recently supports the major change its business model (direct to channel and retail).

SME benefits from the long order processing and lead times of the centralized European logistics

which in Czech Republic very often reach 2 weeks. In consumables and spare parts this constitutes a major problem for the customer and very often results in their decline from the preferred IT equipment manufacturer. SME provided a clear concept which led to big improvements in major key performance indicators (KPI) in a very short time. This has won SME a reputation of fast solution maker. In the meantime SME has been recognized not only locally in the Czech Republic, but also on the European level.

Both distribution and retail channels depend heavily on the e-commerce concept. While a certain percentage of the end users still prefer in-person shopping at the retail store, distribution relies mainly on e-commerce.

### Industry Key Success Factors

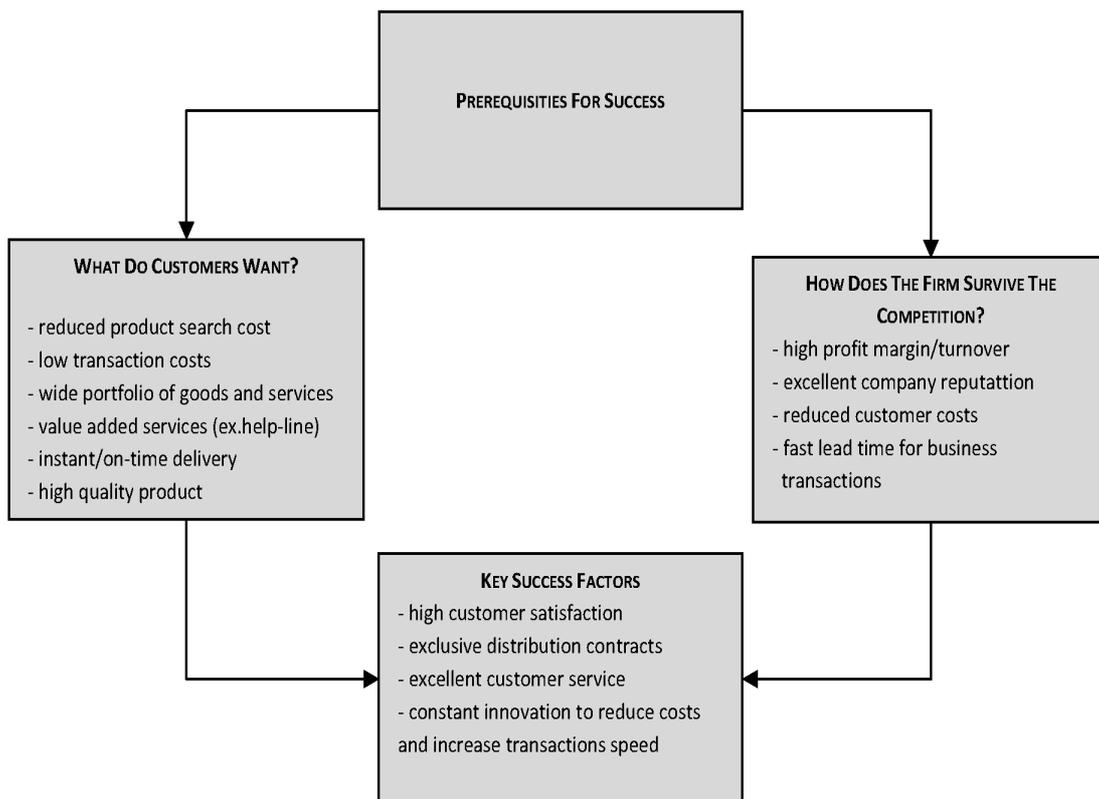


Figure 1: Key Success Factors for the Retail and Distribution Industry (Grant, 2008).

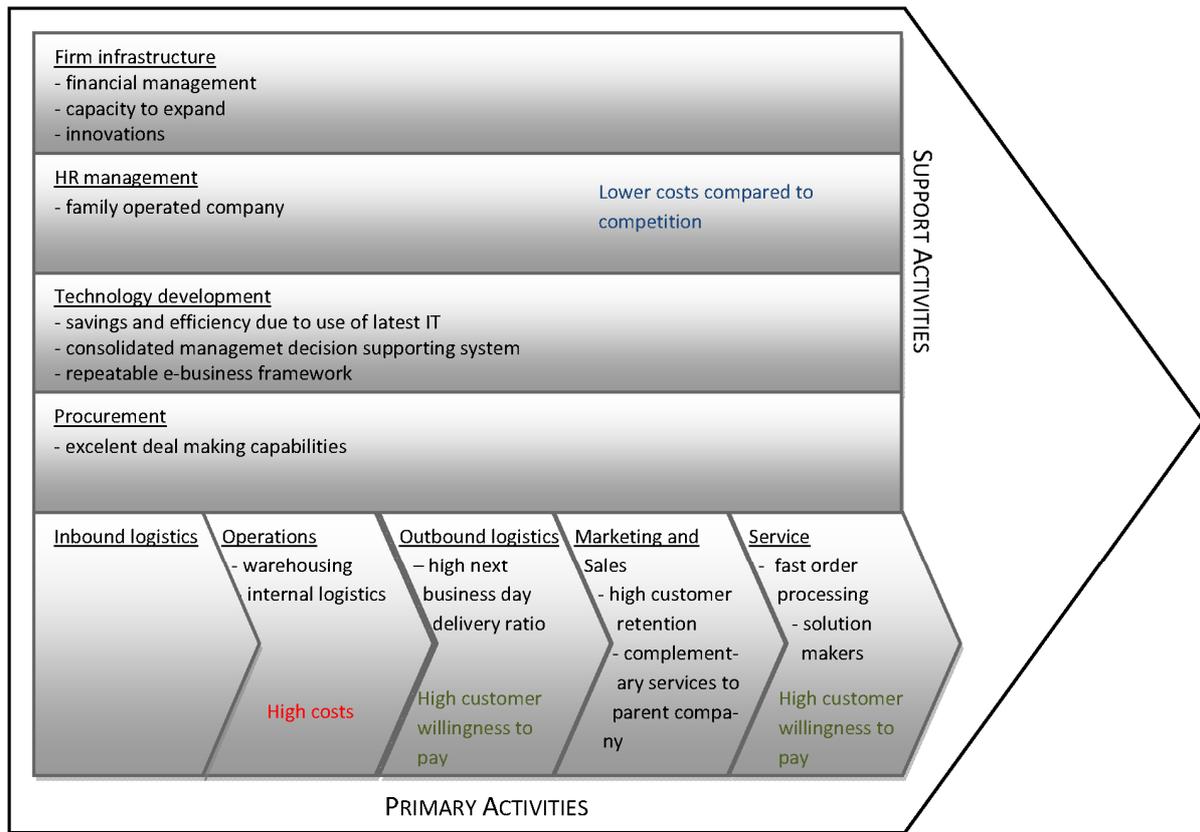


Figure 2: Value Chain of SME (Based on Porter, 1985).

### Value chain analysis

Analysis of value chain points out the main organization's capabilities.

Analysis confirms SME value chain corresponds with the original Porter's model with emphasis on Support activity - Technology and Primary activity - Marketing and Sales.

From a financial perspective, in order to widen it's the profit margin (Ghemawat, 2001), SME may consider further speeding up the order processing lead time and delivery times and lower the costs of logistics. Although this is widely adopted aspect of the distribution service, family run company such as SME, can bring in the little extra which will then make the difference and will be appreciated (and paid for) by the customer. With high costs for warehousing and internal logistics the option could be external logistics solution, perhaps outsourcing to specialized logistics company.

### Resources and capabilities

We have determined SME resources and capabilities. They are:

In order the resource or capability should provide a competitive advantage, two conditions must be met: Scarcity and Relevance (Grant, 2008). SME operates in a business with low entry barriers, high power of both customers and suppliers and fierce competition. The main resources which comply with the criteria above are:

- Company reputation
- Company culture of family run company
- Dedication, loyalty and motivation
- Openness to new knowledge
- Fast adaptability to changes
- Long term relationship with major IT manufacturers
- Fast order processing
- High customer retention ration
- Complementary services to parent company

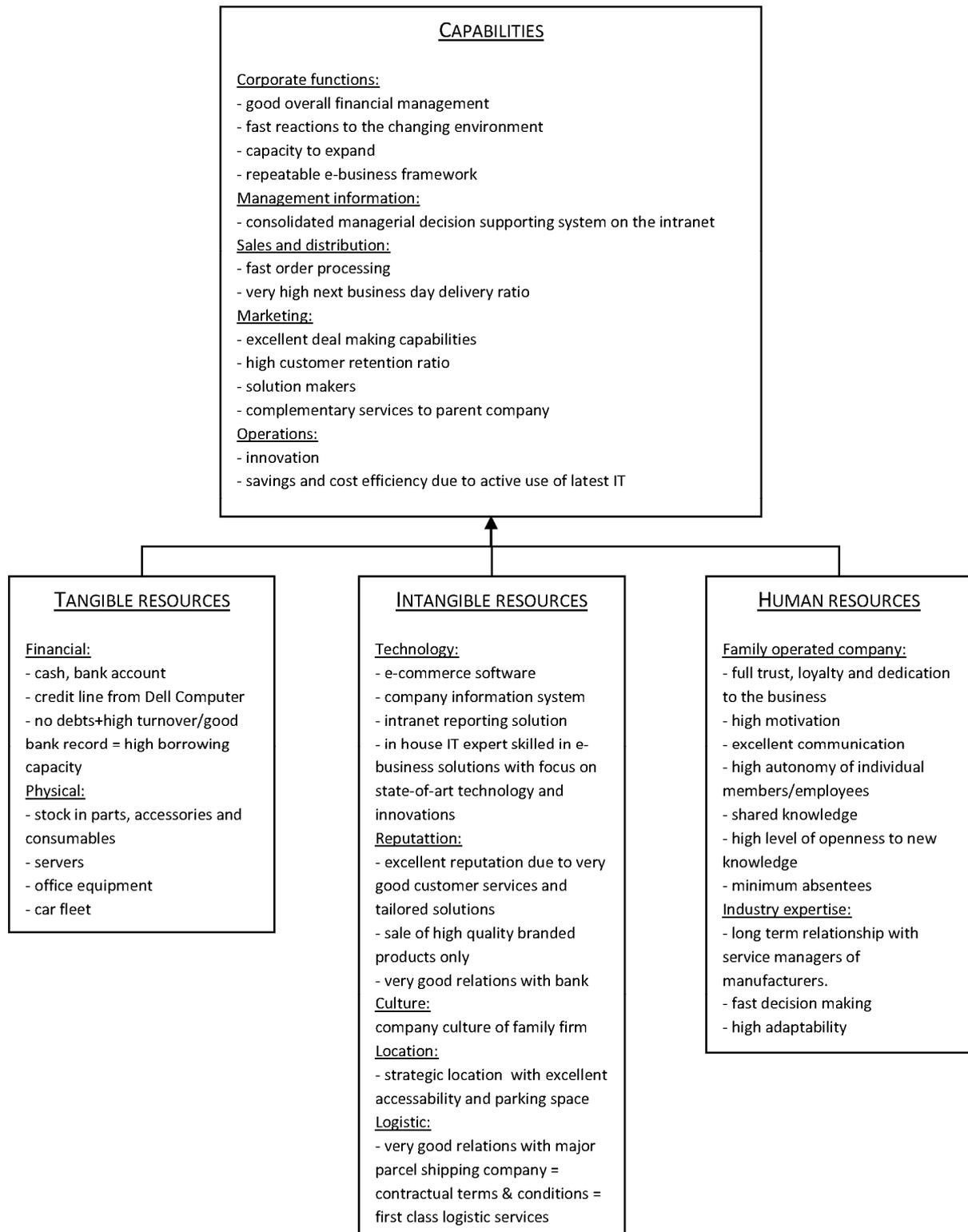


Figure 3: Capabilities and Resources of SME (Based on Grant, 2008).

Discussions can be carried on the scarcity of certain resources and capabilities. Fast order processing has been adopted by major distributors. However, small, family run business can always prove much more invention and through high dedication make the important difference.

In order to maintain the once established competitive advantage, these resources and capabilities must fulfill the requirements of Durability, Transferability and Replicability. As we can clearly see, the most of the selected resources and capabilities above are based on the individual

and social qualities of family members, their business expertise and various complementary skills. These may stand and fall with these individuals. In opposition there is the Company reputation which can show certain momentum and resistance to aging effects. Since the organizational capabilities together with complementary resources are not easy to transfer (Grant, 2008) we can conclude on low transferability of the selected resources and capabilities. Long time relationship with major manufacturers based on personal level is main resource which cannot be easily and fast replicated. Fast adoption of over the time built resources and capabilities, very often brings very high disproportionate adoption costs. Also resources and capabilities based on company culture of a family run company are unique and as such hard to imitate.

As a family run company SME has little problems with appropriating the returns to competitive advantage. Company profits are directed according to the agreed strategy to support further growth, expansion and innovation. This may however be an important point once the company reaches the moment when it will need to hire employees outside of the family.

We have learned that:

- Most of the SME resources are of intangible (intangible and human) nature.
- The profit earning potential comes from sustainable established resources and capabilities based mostly on family individuals' qualities, which as such are hard to imitate, but their durability in long term is disputable.

### **Resources and capabilities appraisal**

To identify key strengths and key weaknesses we need to evaluate their relative importance in conferring the sustainable competitive advantage which is the source of the superior profit. Secondly, we will compare these strengths and weaknesses against the competitors.

While some points of the appraisal can be evaluated according to the available reports, they do not "always portray accurately the financial situation of an organization since financial instruments, such as derivatives, are often accounted for 'off-balance

sheet' and, hence, mask the true financial position of the organization." (Grant, 2008)

The appraisal is subjective and expresses the point of view of the author.

Using the outcome of the appraisal above, we can present the results in the following table, listed by the relative strength and strategic importance of individual resource or capability.

Most of the SME resources and capabilities are positioned at the right top quadrant, which represents the focus of the company to high ratio of usage of its potential.

Two key weaknesses fall into IT category – Decision supporting systems and Intranet reporting. These weaknesses have their origin at the beginning where SME was established as an extremely low overhead company with low initial investment. Both weaknesses can be addressed by increased investment into IT. Third weakness is of financial nature. In order to support future growth, SME needs additional financial resources. One of the possibilities is to leverage the good relation with the bank and zero debt. Another possibility is re-defining the flow and distribution of the company returns.

On the edge of the scale we can find the E-commerce software. In order to emphasize the online aspect of its business and fully exploit the e-commerce opportunities. SME should consider outsourcing of this resource to specialized company which can run the system using dedicated IT personnel and focused industry expertise.

As we can see, office equipment and car fleet are the superfluous strengths. SME has very little use of these resources. While there is little SME can do with the office equipment, it should consider redefining the logistic processes to benefit more from the strong car fleet either by savings on the outsourced parcel service or by introduction of new added value services. With respect to the expertise of the existing specialized logistics companies the recommendation to SME would be to reduce the car fleet and use the extra resources elsewhere.

Based on the identification of the key strengths, SME should fully exploit all the resources and connected capabilities based on the family nature of

Resources/Capabilities		Code	Importance	Relative strength	
Tangible res.	Financial	Cash, bank account	R1	6	3
		Dell credit line	R2	6	9
		High borrowing capacity	R3	5	6
	Physical	Stock	R4	7	9
		Servers	R5	6	5
		Office equipment	R6	3	5
		Car fleet	R7	3	7
Intangible res.	Technology	E-commerce software	R8	6	5
		Company IS	R9	6	3
		Intranet reporting	R10	6	5
		IT expert, latest technology	R11	7	6
	Reputation	Reputation	R12	9	8
		Sale of branded good only	R13	7	7
		Good bank relations	R14	6	6
	Culture	Family company	R15	9	9
	Location	Strategic location	R16	8	7
		Accessibility and parking	R17	6	7
Human res.	Logistic	Low cost, First class logistic services	R18	7	6
	Family operated	Loyalty and dedication	R19	8	8
		Motivation	R20	8	8
		Communication	R21	8	6
		High autonomy	R22	4	9
		Knowledge	R23	8	6
	Industry expertise	Relationship	R24	9	8
	Decision making	R25	8	7	
	Adaptability	R26	8	7	
Capabilities	Corporate functions	Financial management	C1	7	5
		Reactions to changing environment	C2	8	7
		Capacity to expand	C3	6	7
		Repeatable concept	C4	6	6
	Management information	Intranet DSS	C5	7	3
	Sales and distribution	Order processing	C6	8	9
		Fast delivery	C7	8	7
	Marketing	Deal making	C8	9	8
		Customer retention	C9	8	7
		Solution making	C10	9	8
		Complementary services	C11	9	9
	Operations	Innovation	C12	8	7
		Cost efficiency	C13	8	9

Table 1: Appraising SME resources and Capabilities (Based on Grant, 2008).

the company. Major resource of competitive advantage of family run company is its organizational culture and dedication to the entrepreneurship.

Entrepreneurship in family firms is supported by a culture that values new knowledge acquired from customers, suppliers and competitors (Morris, 1998).

Loyalty, communication and information sharing, together with reduced overhead and management costs plus openness to the changes and new knowledge provide the competitive edge over the competition.

„Looser, decentralized organizations, in which autonomy and coordination through mutual adjustment is viewed as legitimate, will be more

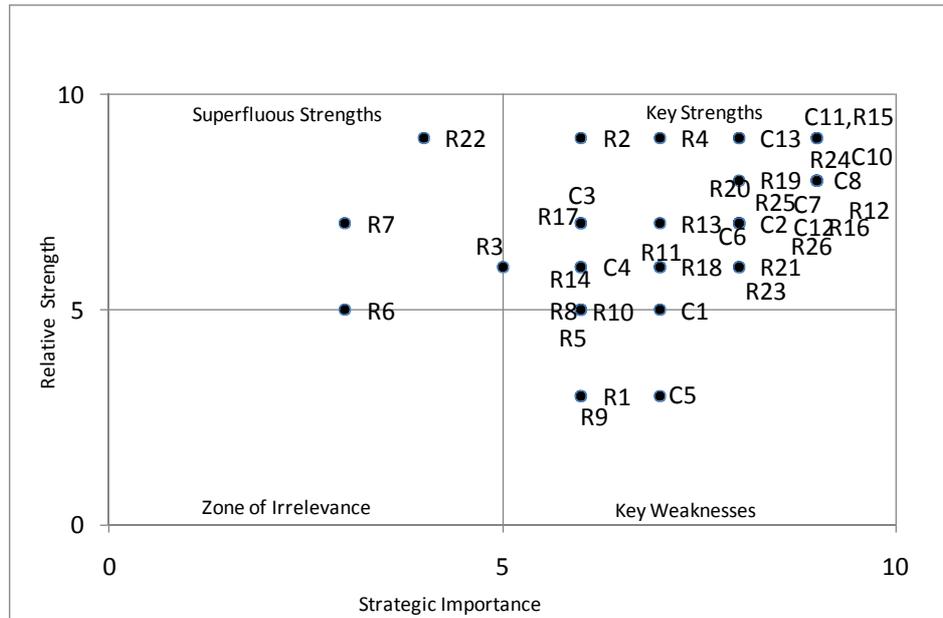


Figure 4: Appraising SME resources and Capabilities (Based on Grant, 2008).

sensitive and responsive to changing conditions.“  
(Kanter, 1983)

Complementary services to the parent company and Relationship with major IT companies are the other key strengths. In the industry these two capabilities, if fully deployed, may increase the competitive advantage and generate more business opportunities. We can define Deal and Solution Making and Cost efficiency as Core Capabilities of SME (Prahalad and Hamel, 1990).

## Conclusion

Based on the findings above SME should re-define its strategy, so by the time, when the initial resources brought in by the parent company will be exploited, SME would keep the competitive advantage. This is how the SME strategy should look like:

- Retain and build the profile of the smart company, close to the major IT manufacturers.
- Fully exploit the potential brought in by the nature of the family run company.
- Distribute the returns in favor of finance of the further growth, supported by innovation of the IT systems. (This can be also achieved by outsourcing part of the technology).

The unique expertise in the territory of the Central and Eastern Europe with its shared history, cultural and national specifics provides an important competitive advantage to be considered and that is the capability of repeatable business concept. This can be even empowered by the possibility of low cost transition to other territories where the ongoing process of transformation and development of the local economies represents an important strategic alternative.

SME has full potential to match the strategy to the rapidly changing environment of this central European region. High autonomy of its partners together with decision making capabilities represent the ultimate prerequisite for flexible adjustments of company capabilities in order to keep the competitive advantage. Organizational structure of the family run company supports creativity and search for new business opportunities in many terms. „The evolutionary path the firm can go is often rather narrow“ (Teece et al, 2001). In case of SME the obvious suggestion of the path is the history in IT after sales service and complementary business. This does not have to be necessary true. We have already mentioned that the e-business framework of SME can be easily repeated. That, together with the natural entrepreneurship of the family run company, means that SME can restructure its business in a very different way, industry and/or market.

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*Corresponding author:*

*Ing. Štěpán Tesař, doc. Ing. Zdeněk Havlíček CSc., Ing. Vladimír Očenášek  
Czech University of Life Sciences Prague, Department of Information Technology  
Kamýcká 129, 165 21 Prague-Suchbát, Czech Republic  
E-mail: stepan@tesarovi.cz, havlicek@pef.czu.cz, ocenasek@pef.czu.cz*

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## Map Resources – ECO Farms in the Czech Republic

J. Vaněk<sup>1</sup>, I. Brožová<sup>2</sup>, J. Jarolímek<sup>1</sup>, P. Šimek<sup>1</sup>, T. Vogeltanzová<sup>3</sup>, E. Červenková<sup>1</sup>

<sup>1</sup> Czech University of Life Sciences Prague, Faculty of Economics and Management, Department of Information Technologies

<sup>2</sup> Czech University of Life Sciences Prague, Faculty of Economics and Management, Department of Economics

<sup>3</sup> Czech University of Life Sciences Prague, Faculty of Economics and Management, Department of Languages

### Abstract

The present paper deals with the creation of maps for the sake of a special map portal using the database of eco farms in the Czech Republic. The map output is being developed and implemented within the framework of the Research Program in mutual cooperation of the Department of Information Technologies, Information and Consulting Centre, other departments of the Faculty of Economics and Management CULS Prague with external partners, especially with the Ministry of Agriculture (Environment and Ecological Agriculture Section, Department of Ecological Agriculture) and the Institute of Agricultural Economics and Information (UZEI) - Division of Agro-environmental Policy in Brno. The maps are visualized by means of MPPR 1.0 system and have been processed – in the pilot stage - for the South Bohemian Region eco farms. The results represent initial data from 2009 (as at 31st December 2009) that have been processed, verified and complemented in the course of 2010.

### Key words

Map portal, web browser, Google Maps, eco farm, ecological agriculture, Act No. 242/2000 Coll.

### Anotace

Příspěvek prezentuje tvorbu mapových podkladů jako výstup speciálně vytvořeného mapového portálu s využitím datové základny ekologických farem v ČR. Mapový výstup je vyvíjen a implementován v rámci řešení výzkumného záměru ve spolupráci Katedry informačních technologií, Informačního a poradenského centra, Katedry ekonomiky a dalších pracovišť Provozně ekonomické fakulty ČZU v Praze, dále ve spolupráci s externími partnery, především s MZe ČR (Odbor environmentální a ekologického zemědělství, oddělení ekologického zemědělství) a ÚZEI - pracoviště Brno (Oddělení Agroenvi politika). Mapové podklady jsou zobrazovány prostřednictvím systému MPPR 1.0 a pilotně zpracovány pro ekofarmy na území Jihočeského kraje. Výsledky řešení představují výchozí data za rok 2009 (k 31. 12. 2009), průběžně zpracovávaná, dále ověřovaná a doplňovaná v průběhu roku 2010.

### Klíčová slova

Mapový portál, webový prohlížeč, Google Maps, ekofarma, ekologické zemědělství, zákon č. 242/2000 Sb.

### Introduction

Ecological agriculture is an activity that can – thanks to its multifunctional nature - enhance sustainable development in rural areas by means of quality food production, environmental protection and care, development of services that are vital for inhabitant stabilization, and by focusing on non-food agricultural products. It has been developing in the Czech Republic since the beginning of the 90's whereas the greatest dynamics can be observed in the past few years.

Ecological agriculture issues are therefore an obvious part of the "Economy of the Czech Agriculture Resources and their Efficient Use within the Framework of the Multifunctional Agri-food Systems" Research Program. Of course, the fore-mentioned research program includes as well chosen aspects of ICT development, in this case the "Information Technologies for a Better Information Availability in Regions" sub-period and then "Information Technologies for Regional Development".

The paper deals with map creation as an output of a purpose-developed map portal using the database of eco farms in the Czech Republic.

## Objectives and methods

In order to realize a map output, a universal software solution MPRR 1.0 (Regional Development Map Portal) has been created. The final output was verified by implementation over the eco farms database – in the pilot stage, the region of South Bohemia has been chosen because of its dominance from the viewpoint of agricultural enterprises number and area of ecologically farmed land.

### Technical Solution – MPRR 1.0 Map Portal

MPRR 1.0 was created by the Department of Information Technologies in cooperation with the Information and Consulting Centre and runs within the Apache Web Server. All objects visualized in the map portal have been saved under the form of UTF-8 character set in MySQL 5 database. To visualize geographical position of the individual elements, Google Maps API version 3 [3] [4] by Google Inc. company was implemented in order to provide constant map updating and to make other related Google Inc. functions available. The SW solution itself was developed in JavaScript (in which the Google Maps [5] application is accessible) using the JQuery framework [6] while JQuery plugin bMap 1.3 [6] and MarketCluster Library for Google Maps API v3 [7] were used for further SW functions. The former has been modified to meet map portal requirements.

Map data loading was realized by means of JSON [10] technology using PHP Nette Framework [9] and Dibi database layer [11]. The Nette Framework was chosen for the sake of required application quality and elimination of safety threats. Google Maps Icons [12], modified to the required form, have been used as graphical elements to visualize the individual objects in maps.

Whole SW solution on the World Wide Web platform has been created as a modern robust application enabling further enhancement and development. It is available not only on conventional end-use devices (PC or portable computers with a concrete web browser) but as well on mobile and dedicated devices. In the final testing phase, the application was tried out on different

versions of five most used web browsers<sup>1</sup> and many minor web clients.

In consideration of a potentially high number of visualized objects in the first map preview (eventually in any further previews too), these objects have been aggregated into the so-called clusters. The aggregation is automated upon map scale and number of objects on a certain area. Changing the map scale leads on one hand to an automated deaggregation of bigger clusters into smaller ones, or eventually to the individual objects (zoom in), or on the other hand, to the aggregation into bigger clusters (zoom out). Aggregate objects (object clusters) are indicated by the zoom icon with a numeric indication of the exact number of objects included (see fig. 1, 2, 3).

For clarity and user comfort sake, the objects are classified according to the defined criteria into individual clusters. Application users then dispose of a very simple and effective tool that enables filtering certain object clusters (groups) and view only the objects required (choose data objects preview).

### Map Output – Eco Farms in the Czech Republic (South Bohemian Region)

As at 31st December 2009, 344 South Bohemian farms were registered in the database of the Czech Ministry of Agriculture [8]. This number accounts for almost 13% of all eco farms in the Czech Republic whereas these farms cultivate approximately 15% of the ecological agriculture total area in the Czech Republic. The map depicts 334 farms while 10 were taken off during data verification process (due to incorrect enlistment in the South Bohemian Region). The farms are subdivided into specialized eco farms and those combining conventional and eco-agriculture.

After clicking on the farm icon in the map, basic farm identification data are displayed (company trade name, eco farm name, address and legal form) – see fig. 4. Moreover, map users can then view

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<sup>1</sup> MS Internet Explorer, Mozilla Firefox, Google Chrome, Safari, Opera

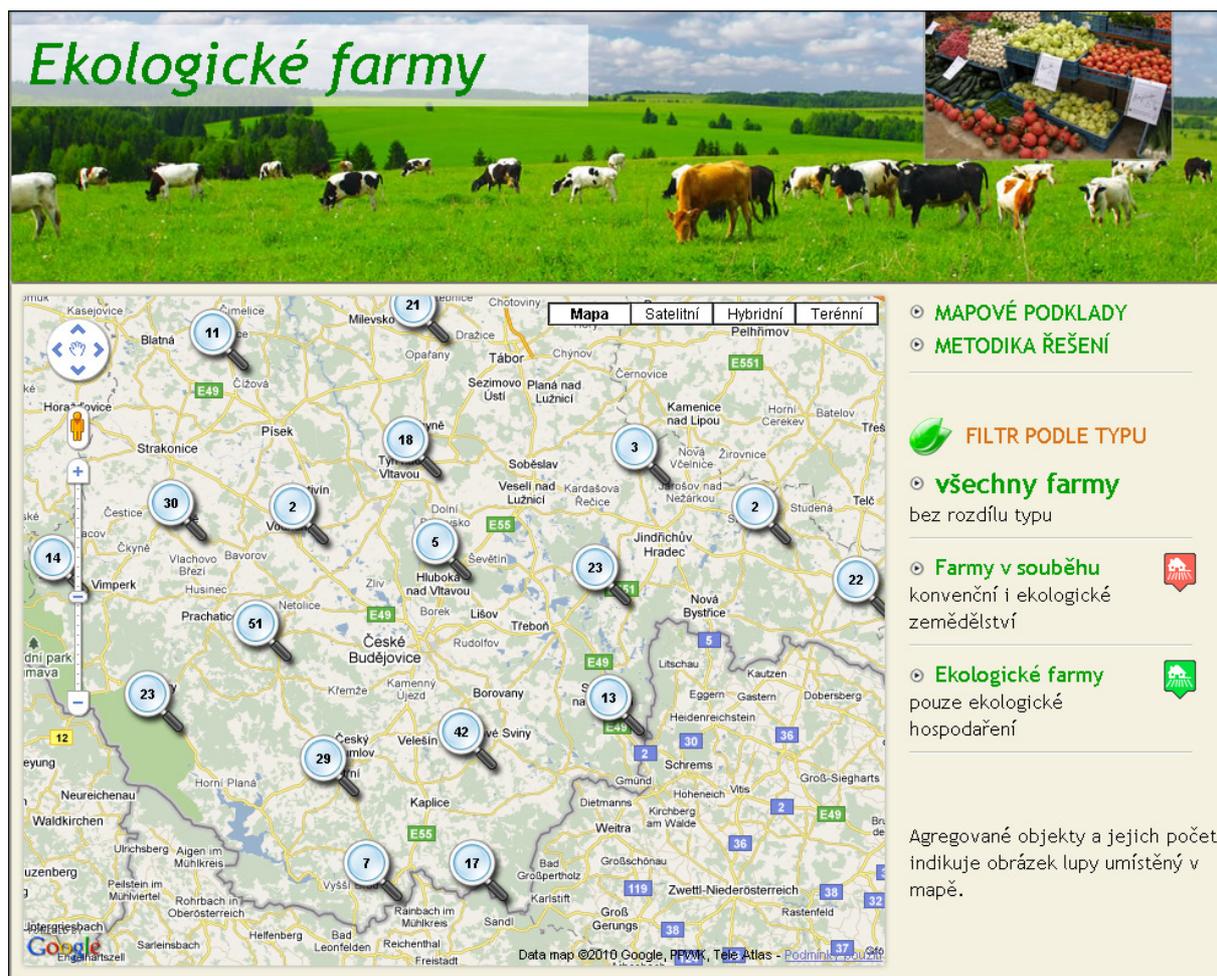


Figure 1: Implicit preview of the map portal – South Bohemian Region (eco farms clusters).

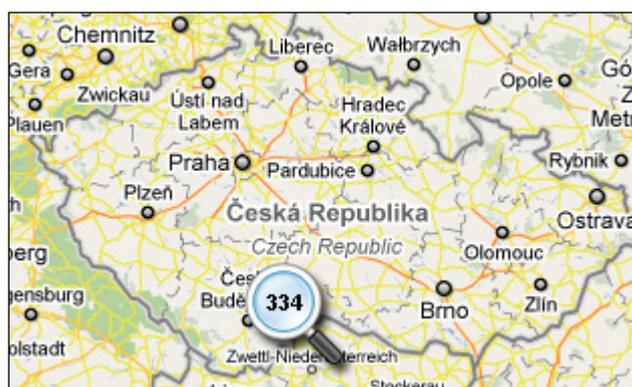


Figure 2: Overall view of the pilot solution – South Bohemian Region (334 objects – eco farms).

detailed information such as land area of the individual cultures both in transition period within the framework of eco-agriculture (abbreviated PO in Czech) and eco-agriculture system (abbreviated EZ in Czech), animal production focus area, control bodies and authorities etc. – using the "More information on the farm" link (see fig. 5).

While working with the maps, precise location of an eco farm can be viewed using all Google Maps functionalities, including Map, Satellite, Hybrid and Terrain views (see fig. 6, 7).

Primary mapping data were exploited from the database of the Ministry of Agriculture that is compiled by control authorities and organizations

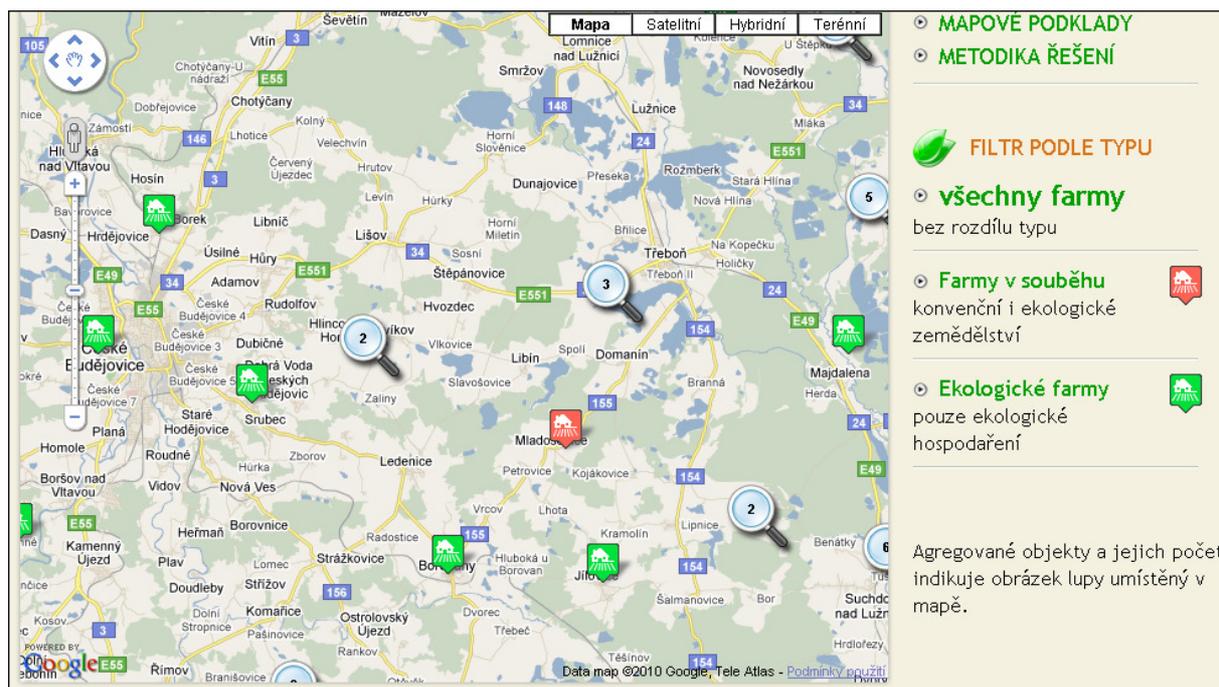


Figure 3: Zoomed area - preview of the individual eco farms or eco farms groups.

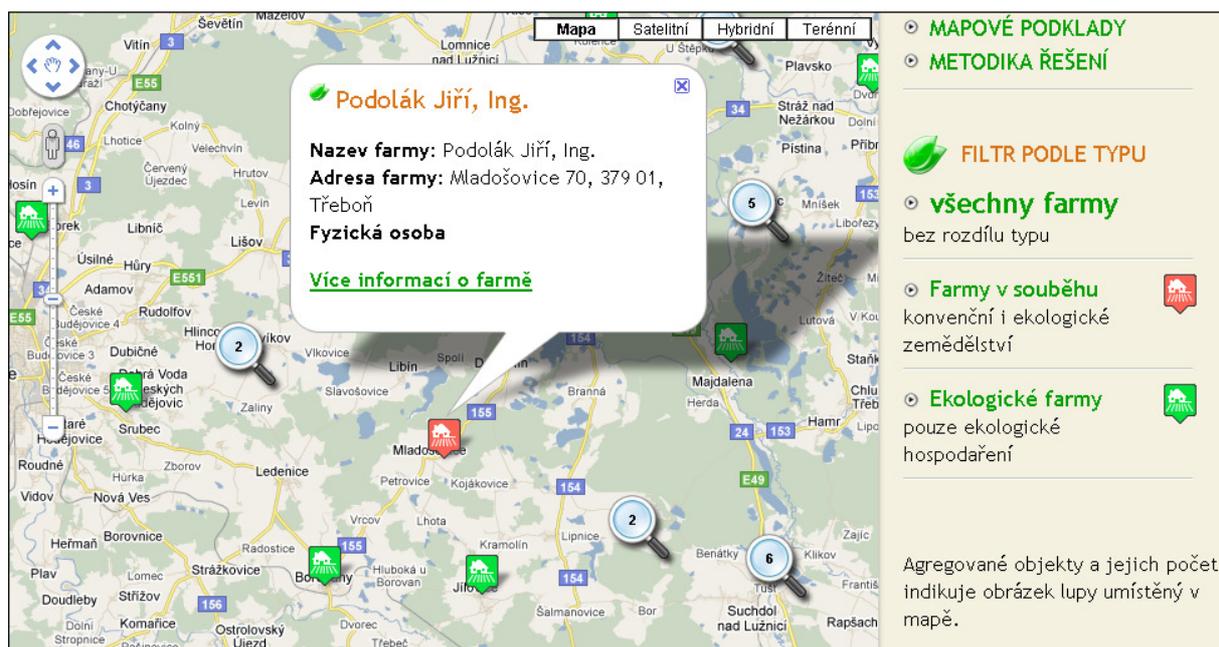


Figure 4: Basic information on the object (eco farm).

while registering and controlling eco farms in the course of the year in question [8]. The data were then elaborated and processed using the LPIS evidence (Land Parcel Identification System) and verified in close cooperation with the Institute of Agricultural Economics and Information (UZEI) - Division of Agro-environmental Policy in Brno. The data were also confronted and compared with public databases and information sources (e.g. the

Companies Register) and sometimes complemented by own survey (telephone survey, local inquiry). Together with high validity of the database, the most accurate eco farm map positioning (registered place of business) was the uttermost aim.



Figure 5: Basic and detailed information on the object (eco farm).  
(land area in the transition period, total area, animal production focus, Regional Agency for Agriculture and Rural Areas, control body)

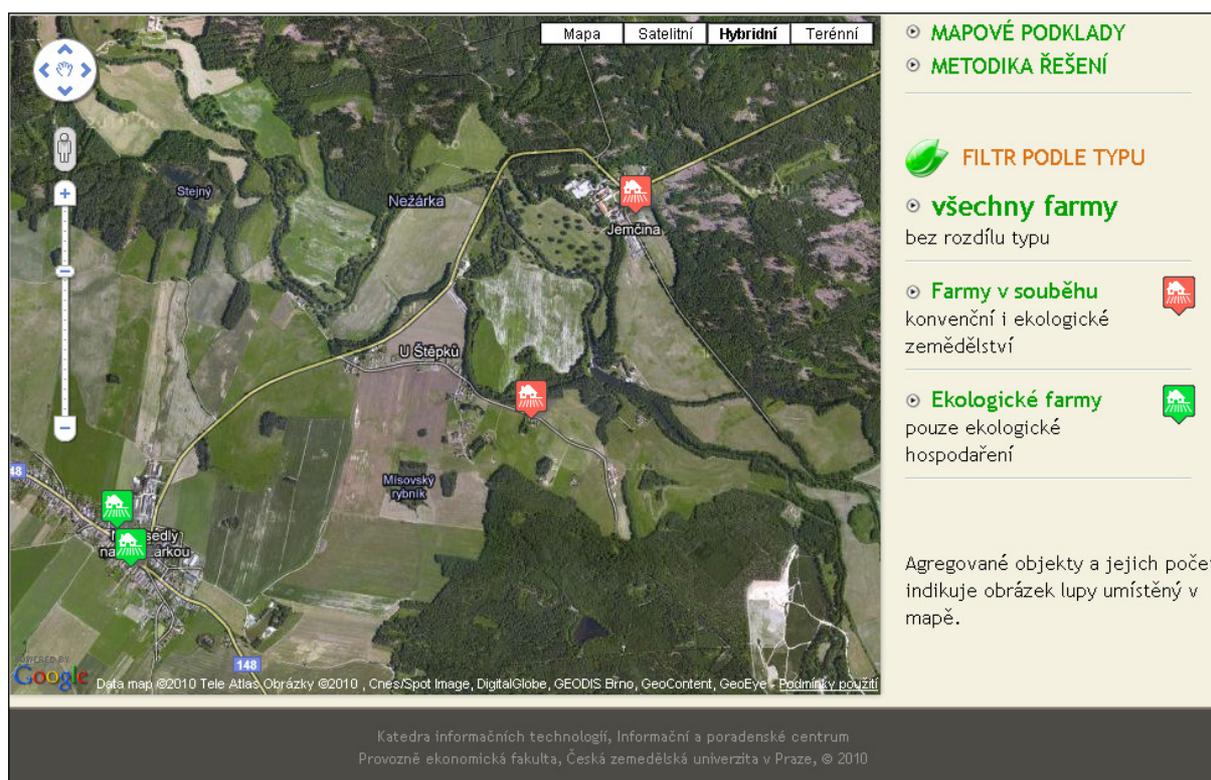


Figure 6: Hybrid map with zoomed objects.

## Results and discussion

MPPR 1.0 [13] is a complex SW solution of geographical object presentation within the World Wide Web platform.

Basic application functions are as follows:

- visualizing an object;
- visualizing basic information on the object marked;
- "More information on the farm" option;

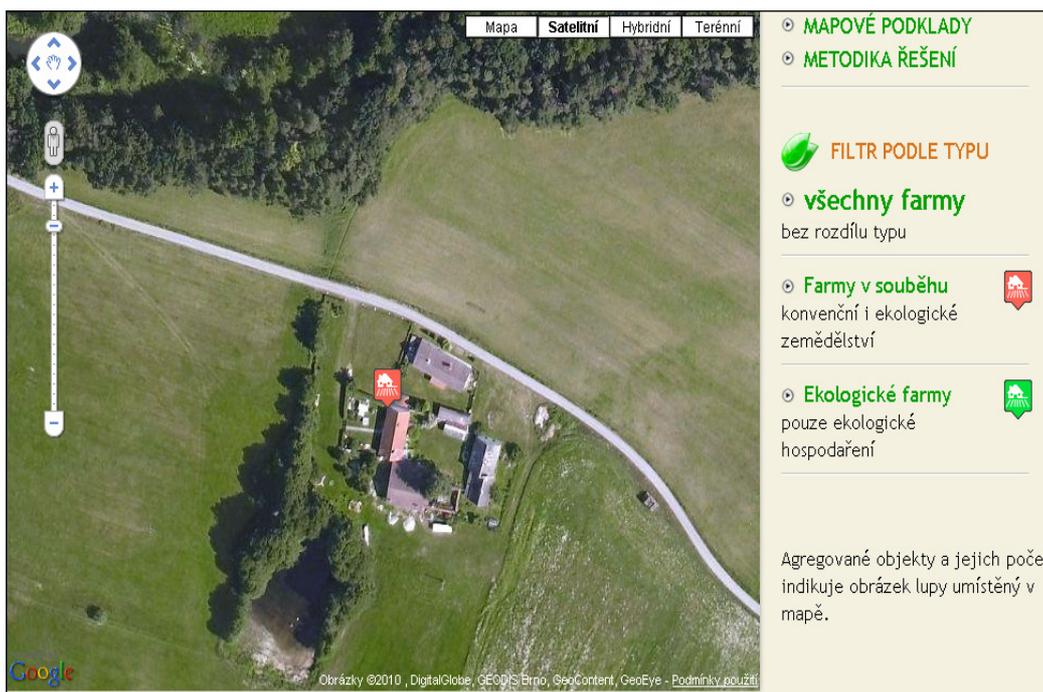


Figure 7: Detailed zoom (detailed visualization of exact object/premises location).

- map scale change (zoom in, zoom out);
- aggregation of objects into clusters;
- clusters disintegration into individual objects;
- customized object filtering and classification by specific criteria;
- dynamic change of the number of visualized objects.

Basic features of MPRR 1.0 application:

- high safety;
- general applicability;
- intuitive navigation;
- accessibility on most end-use devices;
- high speed (fast response time and data loading);
- relatively easy modification of displayed object information;
- modification options concerning graphic object interpretation;
- map type options (standard, satellite, hybrid, terrain).

The MPRR 1.0 solution represents qualitatively a brand new perspective of map data creation and, in comparison with the existing solutions, entails many original elements (optimized original icons, cluster analysis, object aggregation and deaggregation, viewing basic information and optional detailed information, customized preview

etc.). Map data related to organic farming (eco farms) have not been created yet, as far as the authors are aware.

The final solution displayed in the map portal (data validity and map location accuracy) stems from the best effort to validate and complete all data, including efforts to find out an accurate and relevant eco farm location and its subsequent map positioning. The map output includes as well a detailed methodology.

The data presented in the paper account for the solution as at 30th November 2010 – data correctness will not cease to be verified.

The map portal is intended to be widely used especially by the state administration, professionals in the field and students. However, it can be used by general public too as it is freely available on the specialist AGRIS web portal: <http://mapy.agris.cz/ekologicke-farmy/mapove-podklady/>.

## Conclusions

A substantial system extension is planned for the subsequent period, including first other regions (in relation to the number of eco farms in the region) and later on covering the whole area of the Czech

Republic together with providing relevant, up-to-date data on organic farming on-line.

Based on the discussions with the Ministry of Agriculture and other partners, the present solution has a high potential for further development. For instance, by means of a secured access (login, password) the system could not only provide a detailed inventory of the individual enterprises but as well – in the extended version – controls/certification evidence, results etc.

The MPRR 1.0 solution can be respectively utilized by eco farms (owners) to promote their products, services etc.

*Corresponding author:*

*Ing. Jiří Vaněk, Ph.D.*

*Czech University of Life Sciences Prague, Department of Information Technologies*

*Kamýcká 129, 165 21 Prague-Suchdol, Czech Republic*

*Phone: +420 224 382 279*

*e-mail: vanek@pef.czu.cz*

Having in mind the development dynamics, the database has to be updated yearly (continuously) owing to both newly registered subjects (it is again vital to verify, complete and chart the data) and subjects that stopped their operation in the eco-agriculture field or lost relevant certification.

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