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Identification of the Patterns Behavior Consumptions by Using Chosen Tools of Data Mining - Association Rules

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Abstract

The research and development in sustainable environment, that is a subject of research goal of many various countries and food producers, now, it has a long tradition. The research aim of this paper allows for an identification of the patterns behaviour consumptions by using of association rules, because of knowledge´s importance of segmentation differences between consumers and their opinions on current sustainable tendencies.

The research area of sustainability will be in Slovakia still discussed, primarily because of impacts and consumer´s influencing to product´s buying, that are safety to environment and to nature.

We emphasize an importance of sustainability in consumer behaviour and we detailed focused on segmentation differences between respondents. We addressed a sample made by 318 respondents. The article aims identifying sustainable consumer behaviour by using chosen data mining tool - association rules.

The area of knowledge-based systems is widely overlaps with the techniques in data mining. Mining in the data is in fact devoted to the process of acquiring knowledge from large amounts of data. Its techniques and approaches are useful only when more focused external systems as well as more general systems to work with knowledge. One of the challenges of knowledge-based systems is to derive new knowledge on the basis of known facts and knowledge. This function in a sense meets methods using association rules. Association rules as a technique in data mining is useful in various applications such as analysis of the shopping cart, discovering hidden dependencies entries or recommendation. After an introduction and explanation of the principle of sustainability in consumption, association rules, follows description of the algorithm for obtaining rules from transaction data. Then will present the practical application of the data obtained by questionnaire survey. Calculations are performed in the free data mining software Tanagra.

Key words

Responsible consumption, apriori, association rules, consumer, sustainability.

Introduction

The responsibility for sustainable development therefore has been spread over the different levels in the society, including the broad mass of consumers (Lušňáková - Kleinová, 2012). The importance of sustainable consumption has been more and more rising over the last decades - in international environmental politics as well as for the consumer. In modern and particular Western societies, the consumers are increasingly discovering their potential in participating policies and influencing economic activity through lots of diverse channels, among them the channel of consumption behaviour. When consuming, the consumer now has attributed at least co-responsibility towards sustainability (Loo et.al., 2014). Consumptions nowadays not only restricted to meet the private needs, but goes beyond as it also regards social justice and the environmental aspects. In business and in consumer behaviour, sustainability is defined as building long-term consequences into processes by managing a business in such a way that processes or the overall state of organizational-dependent resources can be maintained over an indefinite time horizons (Jacobsen, 2011).

Due to the development of database technology and systems in recent years, the importance of the data mining has been increased rapidly of or business domains like marketing, financing and telecommunication. Association rule mining is a data mining technique that finds frequent patterns or associations in large data sets (Chen et.al., 2014) was first introduced (Agrawal –Imielinski - Swami, 1993) in order to mine association rules on large transactional databases. (Agrawal - Srikant, 2006) have developed the most popular association rule mining algorithm called Apriori. This algorithm is easy to implement but slow due to the lots of passes over the data set.

Apriori algorithm is a popular and a classical algorithm in data mining. The main idea of the approach is to find a useful pattern in various sets of data. The algorithm suffers from many drawbacks, concluded Yadav et al. (2013).

Mining association rules in large database is one of data mining and knowledge discovery research issue, although many algorithms have been designed to efficiently discover the frequent pattern and association rules, Apriori and its variations are still suffer the problem of iterative strategy to discover association rules, that‘s required large process. In Apriori and Apriori-like principle it‘s known that the algorithms cannot perform efficiently due to high and repeatedly database passes (Fageeri et al. 2014).

Mining frequent item sets is a major key process in data mining research. Apriori and many improved algorithms are lowly efficient because they need scan database many times and storage transaction ID in memory, so time and space overhead is very high. Especially, they are lower efficient when they process large scale database. The main task of the improved algorithm is to reduce time and space overhead for mining frequent item sets. Because, it scans database only once to generate binary item set array, it adopts binary instead of transaction ID when it storages transaction flag, it adopts logic AND operation to judge whether an item set is frequent item set. Moreover, the improved algorithm is more suitable for large scale database, concluded Liu et al. (2013).

Mining generalized association rules between items in the presence of taxonomies has been recognized as an important model in data mining. The classic Apriori itemset generation works in the presence of taxonomy but fails in the case of nonuniform minimum supports. Wang et al. (2011) extended the scope of mining generalized association rules in the presence of taxonomies to allow any form of user-specified multiple minimum supports. This method considers taxonomy of itemset, and can discover some deviations or exceptions that are more interesting but much less supported than general trends. Finally, the algorithms is validated by the example of transaction database. The result indicates this algorithm is successful in discovering consumer‘s purchasing behavior by user specifing different minimum support for different items.

Association rule mining, generally, is understood as positive association rule mining. Positive association rule is stated as “if A occurs in a transaction, then B will likely also occur in the same transaction” (Wu et.al, 2004). However, with the increasing usage of data mining technology, researchers have recently focused on finding alternative patterns like negative associations (Antonie - Zaiane, 2004; Wu et al., 2004). The following example given (Wu et al., 2004) illustrates negative association rules: “birds can fly is a well-known fact, but penguins cannot fly although they are birds”. Negative association rules provide valuable information to data owners, but there are few algorithms that are proposed in the literature for negative rule mining.

Main objective of this paper is to identify patterns of behaviour which we are gained by using interview. Based on association rules, we attempted to create a consumer models. This important information’s we will analyse by using quantitative research methods, concretely data mining techniques - association rules (Mura et al., 2012). This approach provide its user with possibility of looking into past (quantity and type of sold products), identifying a current state (profitable customers, risk customers) and what is most important nowadays – opportunity to forecast the future. From the methodological aspect paper is focused on applying chosen data mining tool – association rules in the consumer behaviour. That technique is practically demonstrated information about customers and their purchasing behaviour from the different aspects.

Materials and methods

As a method of research, we chose questionnaire. The survey was conducted online via Google Documents or through social networks and email but also at universities in printed version from February to May 2013. Overall, we received 318 completed questionnaires. Representativeness

of the sample by sex, residence, age, social status, education and income group was verified using the Chi-Square Goodness of Fit Test. The test results confirmed the representativeness of the sample in terms of gender and residence, which is a prerequisite for the realization of further analyses.

Behaviour patterns of customers using association rules and statistical methods. Association analysis is the process of discovering association rules, relationships and dependencies between attributes and their values (Kozelová et.al, 2012). The analysis is performed on the incidence of these attributes and their values in the transactions. In the area of knowledge-based systems can be a recommendation using association rules and considered one of the possible methods of acquiring knowledge from a variety of data, or already known knowledge. (Horská - Berčík, 2014). To generate recommendations for the user may be using one of the at least three strategies. These vary in shape transactions, which are used for mining association rules, respectively, using different metrics in the final stages recommendations. To obtain rules from transaction data can be used Apriori algorithm.

Association rules: The concept of association rules was introduced by scientist Agrawal (Miština, 2007). From there the following definition where, L = I_1, I_2, I_m is a set of binary attributes called items. Than T is a database transaction. Each transaction is represented as a binary vector, where t[k] = 1 if t buys item I_k and t[k] = 0 other. May X is a set of specific items L. We call it, a transaction t corresponds X if it is for all items I_k v X, [k] = 1. Under Association rules are represented in the form of implication X=> I_j, where X is set of certain items in L and Ij is one item from L, which isn´t real in X. The rule is satisfactory in the set of transactions T with factor of trust $0 \leq c \leq 1$ if minimum c % from transactions in T, that are significant to X and Ij too. Trust is usually referred to as c.

Given the set of transactions T, we are interested in generating all rules that satisfy certain additional constraints of two different forms: Given the set of transactions T, we are interestedin generating all rules that satisfy certain additionalconstraints of two difierent forms:

1.Syntactic Constraints: These constraints involve restrictions on items that can appear in a rule. For example, we may be interested only in rules that have a specific item Ix appearing in the consequent, or rules that have a specific item I_y appearing in the antecedent. Combinations of the above constraints are also possible - we may request all rules that have items from some predefined itemset X appearing in the consequent, and items from some other itemset Y appearing in the antecedent.

2. Support Constraints: These constraints concern the number of transactions in T that support a rule. The support for a rule is defined to be the fraction of transactions in T that satisfy the union of items in the consequent and antecedent of the rule.

Support should not be confused with confidence. While confidence is a measure of the rule‘s strength, support corresponds to statistical signicance. Besides statistical significance, another motivation for support constraints comes from the fact that we are usually interested only in rules with support above some minimum threshold for business reasons. If the support is not large enough, it means that the rule is not worth consideration or that it is simply less preferred (may be considered later).

In this formulation, the problem of rule mining can be decomposed into two subproblems:

1. Generate all combinations of items that have fractional transaction support above a certain threshold, called minsupport. Call those combinations large itemsets, and all other combinations that do not meet the threshold small itemsets. Syntactic constraints further constrain the admissible combinations.For example, if only rules involving an item Ix in the antecedent are of interest, then it is suficient to generate only those combinations that contain Ix.

2. For a given large itemset Y = I_1,I_2...I_k, k >2, generate all rules (at the most k rules) that use items from the set I_1,I_2...I_k,. The antecedent of each of these rules will be a subset X of Y such that X has k -1 items, and the consequent will be the item Y - X. To generate a rule $X \rightarrow Ij \mid c$, where X = I_1,I_2...I_j+1,.I_j-1....I_k, take the support of Y and divide it by the support of X. If the ratio is greater than c then the rule is satised with the confidence factor c; otherwise it is not. Note that if the itemset Y is large, then every subset of Y will also be large, and we must have available their support counts as the result of the solution of the first subproblem. Also, all rules derived from Y must satisfy the support constraint because Y satisfies

he support constraint and Y is the union of items in the consequent and antecedent of every such rule. Having determined the large itemsets,the solution to the second subproblem is rather straightforward. In the next section, we focus on the first subproblem. We develop analgorithm that generates all subsets of a given set of items that satisfy transactional support requirement.To do this task eficiently, we use some estimation tools and some pruning techniques.

Promotion rule is defined as the percentage of transactions in L, which contents XI_j. It denotes as s. Support essentially represents the frequency of occurrence of a given set of items in the database. *Support and confidence are measures (metrics) for association rules.*

Trust (confidence) is the probability of the right hand side rule condition occurrence left side. It is therefore the percentage of rules whose left side is X and Y right of all whose left side is X.

Lift (interest): This rate determines how many times more often X and Y occur together than would be if they were statistically independent. In contrast to expectations is dependent on rules of thumb. The formula for calculating metrics lift:

$$\text{lift}\,(X\rightarrow Y) = \text{lift}\,(Y\rightarrow X) = \frac{p\,(x \text{ and } Y)}{p\,(X)\,p\,(Y)} = \frac{\text{trust}\,(X\rightarrow Y)}{\text{support}\,(Y)} = \frac{\text{trust}\,(Y\rightarrow X)}{\text{support}\,(X)} \quad ()$$

Apriori: To find frequently occurring sets of items can be used Apriori algorithm, which is stated in the paper Agrawal. Apriori sequentially generates sets of frequent items, the proceeds from the smallest (with the fewest elements) to largest. As far as possible, from the frequent sets with n elements generating sets with n+1 element. Set of frequent sets having n elements is called Ln. The procedures recommendation using association rules from the said general scheme differs in that instead of Neighbourhood Formation is the algorithm used data mining association rules. Its outputs are the rules containing some items on the left and right sides. In the third phase is recommended for all items that are listed in the consequences (on the right) obtained rules. Therefore it is possible to take a limited number of items (N best), or any that meet certain criteria, such as where a degree exceeds a defined threshold.

Respondent´s characteristics of the questionnaire survey

In our survey has a majority of the female part of the population 68.55 %. Interviewed men were 31.45 %. In terms of verification of the representativeness of the sample we found that Chi-Square Goodness of Fit Test based on the value Pr > = 0.05 ChiSq assumption about the representativeness of the sample.

For better classification concept of domicile, we decided to only two variables: the city and the countryside. Structuring into smaller units, optionally define a dwelling by population in many cases distorted because respondents often do not know the basic demographic statistics. We can see that in our research is distributed evenly city (57.10 %) and the rural (42.9 %). In terms of verification of the representativeness of the sample we found that chi-square test goodness of fit based on the value Pr > ChiSq = 0.099 confirmed presumption of representativeness of the sample.

The age ranges were generated by age of the population of Slovakia located on the Statistics Office (under the current 2013). The largest age group is 18 - 24 years (63.72 %), followed by the age group 25 - 34 years (21.45 %). At least numerous age groups represent the interval from 55 to 64 years (2.84 %). The resulting age structure is not relevant in terms of representativeness. The result of chi-square test goodness of fit, we rejected the argument on the representativeness of the sample.

The structure of socio-economic status was again transposed by the Statistical Office of the Slovak Republic. We found out that it is unrepresentative sample of the population, as the largest groups again are students (64.98 %). There are relatively large groups like: employed in the private sector (15.14 %) and employed in the public sector (13.88 %). Positive survey is the fact that we have obtained the views of groups: senior (0.95 %), unemployed (2.21 %) and women on maternity leave (2.84 %).

Table 1 is a presentation of the group of respondents in terms of income and status. We can see that the students belong to the largest group of respondents and divided into several income groups: no income to between 300 € and 601 - 1 000 €. Answer “no income” they

Status	none	till 300 €	301-600 €	601-1000 €	1001-1500 €	1501-2000 €	above 2000 €
pensioner			2	1			
maternity leave		7		2			
unemployed		3	3	1			
student	78	103	20	5			
employed in the private sector		1	10	19	9	3	6
employed in the public sector		1	17	21	3	1	

Source: own survey

Table 1: Comparison of respondents´ structure in terms of income and status.

Status	secondary education without graduation	secondary school with graduation	bachelor education	master education	elementary education
pensioner		1		2	
maternity leave		1		8	
unemployed		4		2	
student	1	46	2	13	1
employed in the private sector	2	12		29	
employed in the public sector		3		40	

Source: own survey

Table 2: Comparison of respondents‘ structure in terms of education and status.

understand respondents´ answers as financial dependency on parents. Given the fact we suppose they themselves do not work, but the study. In the latter case it is possible to have a brigade and is able to earn up to 300 €, optionally understand money income they receive from their parents.

Income structure was formed according to the structure of income populations in the national economy and has again been transposed by the Statistical Office of the Slovak Republic. The largest group consists of respondents who have a net monthly income of up to 300 € (36.16 %). Follows a group of people with no income, we expect students and unemployed (24.84 %). Another group of respondents are earning from 300 to 600 € (16.35 %) and the last major group of the respondents with incomes from 600 to 1000 € (15.72 %). Above the € 1 000 per month, yet there are three groups of cases: 1000 - 1500 € (3.77 %), 1 500 - 2000 € (1.26 %) and above 2 000 € (1.89 %).

Income structure was formed by the structure of the Statistical Office. We note that this is an unrepresentative sample of the population. The largest group consists of respondents with secondary school graduates (60.57 %). Followed there is a group of people with higher education Grade 2 (30.28 %) and the group of respondents with a university degree 1st grade (7.26 %). Secondary education school had only 1.58 %, and primary education had only one respondent and the share of 0.32 % of the total.

The second table that deals with the structure of is a group of respondents surveyed by education and status. A positive finding is that the survey respondents are employed in government and in the private sector and this target group we want to focus in other analyses.

Results and discussion

Behaviour patterns of the consumption

Economic sustainability is a term that is used to identify and describe ways of using available resources to their maximum potential. The entire goal of these strategies is to use resources, natural or not, responsibly and efficiently to receive continuous benefits throughout the long term (Horská - Yespolov, 2013; Belová et al., 2012). Plenty factors and circumstances may influence the consumer’s buying decision to a different degree. Summarized, there are three main potential

groups of determinants. These are the sustainable consumption:

- values, needs, motivations and personal involvement/importance of the product;
- information, knowledge and uncertainty (information access, understanding, trust and credibility);
- behavioural control, availability of the product, and perceived consumer effectiveness.

The investment support of the adding „sustainable“value to food products should continue in upcoming period 2014-2020. Only the targeted support can be the incentive for enhancing economic viability of enterprises as well as the tool for improving competitiveness of the food industry. This plan corresponds with the vision of forming the European food sector as a world leader being competitive in the long term (Mezera - Špička, 2013). As discussed earlier, marketing has witnessed changes as the sustainability is making its way in marketing practices. There is need to consider sustainability to develop marketing strategy, which means that the company has to adopt sustainability in strategic marketing practices and marketing mix. But, on the other hand, it is not easy to formulate and implement, because customer is the one according to needs and wants of whom marketing strategy of the company is designed. (Kumar et.al. 2012).

The effort was to see to identify patterns of behaviour which we are gained by using interview. Based on association rules, we attempted to create a consumer models. Due to the nature of the questionnaire where two large and specific groups of respondents, we decided to split a pattern of behaviour into four groups:

- *Consumers - non-students in terms of consumer behaviour when purchasing food (Table 3)*
- *Consumers - students in terms of consumer behaviour when purchasing food (Table 4)*
- *Consumers - non-students in terms of consumption (Table 5)*

N	Antecedent	Consequent	Lift	Support (%)	Confidence (%)
1	"Q5 = till 30 €"	"Q2 = till 1 hour"	1.89565	22.018	80.000
2	"Education = master education - "status = employed in private sector"	"Age = "25 - 34"	1.50345	22.018	80.000
3	"Age = "25 - 34" - "Q2 = till 1 hour"	"Address = city"	1.32997	21.101	79.310
4	"Age = "25 - 34" - "status = employed in private sector"	"Address = city"	1.28564	21.101	76.667
5	"Q2 = 2 - 3 hour" - "status = employed in state sector"	"Education = master education"	1.27388	21.101	95.833
6	"status = employed in state sector"	"Education = master education"	1.20843	36.697	90.909
7	"Sex = man" - "Q6 = I plan buying without list"	"Education = master education"	1.18157	22.018	88.889
8	"Sex = man" - "status = employed in state sector"	"Education = master education "	1.17288	27.523	88.235
9	"Net Income = 301 - 600 €"	"Sex = man"	1.15721	23.853	83.871
10	"Q5 = till 30 €"	"Sex = man"	1.14979	22.936	83.333
11	"Education = master education " „Address = country“	„Sex = man“	1.14322	26.606	82.857
12	„Sex = man“ - „Age =“25 -34““	„Education = master education“	1.12988	31.193	85.000
13	"Q1= every second day"	"Sex = man"	1.11053	30.275	80.488
14	"Q5 = till 30 €"	"Education = master education"	1.10772	22.936	83.333
15	"Age = "25 - 34""	"Education = master education"	1.10008	44.037	82.759

Source: own survey

Table 3: Consumers - non-students in terms of consumer behaviour when purchasing food.

- *Consumers - students in terms of consumption (Table 6)*

Association analysis of the output is sorted by the values Lift, therefore, in determining the rate of how many times more often X and Y occur together than would be if they were statistically independent.

The highest rate of reported Interest reply within 30 million or 22.018 % of respondents purchases to 30 € and 80 % of those who spend up to 30 € purchase within hours.

The following is information that 22.018 % of respondents are people working in the private sector and in the public sector and have a college education. 80 % of these people are also aged 25 to 30 years.

22.018 % of men planned to buy, but not to the list, and 88.889 % of them are university graduates.

23.853 % of respondents have income from 301 to 600 € and 83.871 % are men.

Association analysis of the output is sorted by the values Lift, therefore, in determining the rate of how many times more often X and Y occur together than would be if they were statistically independent.

Highest interest rate reported net income of 300 million or 37.864 % of respondents receive grants to 300 € 75.728 % who meet the previous conditions are students - males aged 18 to 24 years of secondary school graduates.

The second part of the questionnaire was given to the issue of sustainable consumption and basic environmental sustainability attributes. We tried to identify certain patterns of behaviour in terms of sustainability.

We can state the following: The highest rate of Interest shows the status-employed in the public sector, so 35.714 % of respondents and 90.09 % of respondents have a college education. For more detailed identification of this group, we arrive at the next information. 36.60 % of respondents said that consumes the goods he buys and 25 - 34 years, subject to the following two information 85.41 % has a garden and higher education and try to separate waste.

Because we analysed specific group not just in terms food consumption, but also environmental behaviour, we continued deeper analysis of the behaviour among students.

34.951 % of respondents aged 18 to 24 years, bought the food actually consumed and where unused food residues move livestock. Confidence 87.805

N	Antecedent	Consequent	Lift	Support (%)	Confidence (%)
1	"Net income = till 300 €"	"status = student" - "Sex = man"	1.13043	37.864	75.728
2	"status = student" - "Net income = till 300 €"	"Sex = man"	1.13043	37.864	75.728
3	"Net income = till 300 €"	"Sex = man"	1.13043	37.864	75.728

Source: own survey

Table 4: Consumers - students in terms of consumer behaviour when purchasing food.

N	Antecedent	Consequent	Lift	Support (%)	Confidence (%)
1	"status = employed in state sector"	"Education = master education"	1.24169	35.714	90.909
2	"Q10 = yes, I consume" - "Age = "25 - 34""	"Q4 = he/she has a garden"	1.19583	36.607	85.417
3	"Q10 = yes, I consume" - "Age = "25 - 34""	"Education = master education"	1.16667	36.607	85.417
4	"Education = master education" - "Q14 = I try to separate"	"Q10 = yes, I consume"	1.16148	37.500	93.333
5	"Q4 = he/she has a garden" - "Q14 = I try to separate"	"Q10 = yes, I consume"	1.15556	34.821	92.857
6	"Education = master education" - "Q4 = he/she has a garden"	"Q10 = yes, I consume"	1.10394	49.107	88.710

Source: own survey

Table 5: Consumers - non-students in terms of consumption.

N	Antecedent	Consequent	Lift	Support (%)	Confidence (%)
1	"Age = "18 - 24"" - "Q10 = yes, I consume" - "Q13 = I provide to domestic animals"	"Q4 = he/she has a garden"	1.24743	34.951	87.805
2	"Age = "18 - 24"" - "Address = country"	"status = student" - "Q4 = he/she has a garden"	1.24106	36.893	87.356
3	"Age ="18 - 24"" - "Sex = man"	"Education = secondary education with graduation"	1.12815	58.252	90.909
4	"status = student" - "Age = "18 - 24"" - "Sex = man"	"Education = country"	1.12815	58.252	90.909

Source: own survey

Table 6: Consumers - students in terms of consumption.

% indicates that 85.75 % of those respondents who meet the previous conditions have a garden. For more detailed identification of this group, we gain next information. 58.252 % of the respondents are men aged 18 - 24, while 90.90 % have secondary education and come from the countryside.

Conclusion

Famous saying of the French philosopher and lawyer in one person, the founder of modern scientific gastronomy and great gourmand Jean Anthelme 19th century, Brillat - Savarin needs no introduction: “Tell me what you eat and I´ll tell you who you are”, will further advancing sustainable food consumption. The association rules seem as an effective data mining rule from the methodological aspect. On the base of the mining results we can say following: Younger people are entering into transactions. They are more confident, have specific ideas about the quality of the product, its image purposefully sought products purchased with knowledge of the matter, but also a new generation of consumers, like the generation of parents still limit their purchases of money. Unlike their parents, however, so does not adhere to the Slovak food since grown to a global brand, notes the changes in consumer behaviour. High environmental awareness but still a low share of purchased environmentally friendly and socially acceptable products. There are some facts of our research in the following of statistical processing:

- more than 78 % of people who have their own garden, or use their balcony for seasonal supply said they harvested with its officially not cover year-round consumption;
- 21 % of respondents said they cover year-round consumption, but they must also have their own cellars where crops can be stored;
- 21.7 % of respondents in the course of the year to buy up the crop, but 78.3 % note that domestic production is sufficient for them all year. It can be said that the state cannot, must resolve consumers themselves, to ensure the self-help;
- we wondered whether respondents actually consume all food purchased, 85.85 % of respondents said that consumes all bought food;
- in the context of sustainable consumption, we investigated, as well as how consumers treat the foods purchased in, and beyond that they consume 45.74 % of respondents said they consumed foods as soon as possible.
- The second almost equally large group 44.48 % of respondents purchased food stocks. Only 9.78 % of respondents prefer fresh food and so soon after buying them and consumed,
- 54.4 % of respondents are aware that eats more food than it actually needs. Nearly 30 % of respondents are trying to eat less.

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Quantification of Changes in the State of the CR Agricultural Land Fund from 2001-2013

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Anotace

Cena zemědělské půdy v Česku je výrazně nižší než v ostatních státech EU, ale její úrodnost a způsob obdělávání se od okolních zemí neliší. Zemědělská půda v ČR ubývá, cca 12 ha/den (MZe, 2012). Orná půda v ČR ztrácí svoji produkční hodnotu z hlediska zajištění potravinové bezpečnosti, převedením orné půdy do víceletých kultur, trvalých travních porostů, výsadbou rychle rostoucích dřevin, zalesněním aj. Hlavním cílem výzkumu bylo analyzovat vývoj stavu zemědělské půdy v ČR za období let 2001-2013. Výsledek: Negativním jevem je to, že k vyšším úbytkům zemědělské půdy dochází i na kvalitnějších půdách (hodnocení dle průměrné úřední ceny na bázi BPEJ). Úbytek kvalitativně lepší zemědělské půdy ve vybraných krajích (50,1% ZPFČR), je v porovnání s celostátním úbytkem menší. Vývoj úbytku orné půdy ve třech kvalitativně nejhorších krajích ČR ve sledovaném období je sice výrazně vyšší než průměr ČR, ale hospodaření na méně kvalitních půdách není ekonomicky výhodné. Z hlubšího hodnocení dvaceti jedna okresů ČR (30,15% ZPF ČR) vyplývá, že pozitivním vývojem relativních změn stavu zemědělské půdy vůči rozloze okresu, prochází jen tři okresy, 13 okresů má relativní úbytky nižší než relativní úbytek ČR. Dílčím cílem bylo zjistit, zda existuje závislost mezi velikostí obce (dle počtu obyvatel) a změnou ve výměře zemědělské půdy, především z hlediska úbytků zemědělské půdy. Na vzorku 56 obcí nebyla prokázána silná těsnost závislosti mezi sledovanými veličinami.

Klíčová slova

Úbytek zemědělské půdy, orná půda, trvalé travní porosty, tržní cena zemědělské půdy, úřední cena půdy, dotace, pacht.

Abstract

The price of agricultural land in the Czech Republic is significantly lower than in other EU states; however, its fertility and method of cultivation does not differ from surrounding countries. Agricultural land area in the CR is decreasing about 12 ha/day (MoA, 2012). Arable land in the CR is losing its production value, from a food security standpoint, through the conversion of arable land into perennial cultures or permanent grassland, outplanting of fast-growing woody plants, afforestation, etc. The main aim of the research was to analyse developments in the state of agricultural land in the CR in the period 2001-2013. Result: One negative phenomenon is the fact that a larger decrease in agricultural land is happening even on higher-quality lands (an evaluation according to the average official price based on CSEU – Classified Soil-Ecological Units). The decrease in qualitatively better agricultural land in selected regions (50.1 % of the ALF CR – Agricultural Land Fund of the Czech Republic) is lower in comparison with the nationwide decrease. The development of the decrease in arable land in the three qualitatively worst regions of the CR, within the monitored period, is significantly higher than the CR average; however, farming on lower-quality lands is not economically advantageous. A deeper evaluation of twenty-one districts in the CR (30.15 % of the ALF CR) shows that only three districts are experiencing a positive development in the relative changes in the state of agricultural land in relation to the area of the district. 13 districts have relative decreases lower than the relative decrease in the CR. A partial aim was to find out whether there is any dependency between the size of a municipality (according to the number of inhabitants) and a change in the acreage of agricultural land, especially from the viewpoint of decreases in agricultural land. From a sample of 56 municipalities, no strong dependence between the monitored quantities was proven.

Key words

The loss of agricultural land, arable land, permanent grass growths, market price of agricultural land, official land price, subsidies, rent.

Introduction

The main aim is to analyze the development of changes in the use of agricultural land in the CR in the period 2001-2013.

The main aim will be fulfilled on the basis of partial aims:

- Quantification of use of the agricultural land fund, i.e. changes in the state of arable land, and of the growth in permanent grassland on primarily high-quality soil in the CR in the time period 2001-2013, according to an available database of the Czech Office for Surveying, Mapping and Cadastre (COSMC).
- A statistical analysis evaluating the dependency of a selected factor (percentage change in the proportion of agricultural to municipal land, sized in ha) on the size (number of inhabitants) of a municipality or town, in a chosen collection of qualitatively better soils.

For what reasons should agricultural enterprises purchase agricultural land? Economists agree that there is a high probability that the acreage of small farms throughout Europe will decrease more and more, and that these farms will then terminate their activities (Kristensen et al., 2004). Better monitoring and understanding of the factors which lead farmers to leave agricultural land is important, and provides a valuable guide for land-use policy (Prishchepov, 2013). Čechura (2012) deals with an analysis of technical efficiency and the total productivity of production factors in agriculture in the Czech Republic. Factors connected with institutional and economic changes, as well as the growth in agricultural subsidies, are among the most important factors which determine technical efficiency and the productivity of production factors.

If the direct payments are effectively used in the production of agricultural crops, they have a positive impact on both the tenants of agricultural land and the landowners, who can benefit in return from the support provided to tenants (Ryan et al., 2001, Patton et al., 2008). Higher rents will eventually increase land prices, because in the future rent will be an important factor which creates value in agricultural land (Kuchler, Tegene, 1993). After 1990, the transformation process in the Czech Republic led to high fragmentation in agricultural land fund ownership – c. 2.5 mil. owners (the number of owners who could fully use their property rights and deal with the land) – and thereby also an excess of supply over demand for agricultural land. Moreover, the period 2001-2011 explains the quantitative changes in the agricultural land market after the law on the sale of state land was put into practice (1999) and after the accession of the Czech Republic to the European Union (Pletichová, Gebeltová, 2013). Sklenička et al. (2013) holds a similar opinion. The fragmentation of holdings, i.e. the fragmentation of land ownership, has resulted in considerable differences in the price of agricultural land in the CR and the EU-15 countries. This is one of the most powerful reasons why market prices remain at a low level. It applies particularly to land determined for agricultural activities, but also partly to land being purchased, when it is speculated that such land will be converted to a non-agricultural use, most often development. Skaloš (2010) states that spatial variability in the price of agricultural land is determined by factors which reflect agricultural use, and also by specific properties which are fundamental for the conversion of agricultural land to non-agricultural purposes. Although the motives for obtaining agricultural land for non-agricultural or speculative purposes are large, non-agricultural use of agricultural land is usually a less significant driving force behind the growth in agricultural land prices.

Researchers (Pandey, Seto, 2014) are investigating the influence of urbanization on the loss of agricultural land in India from 2001-2010. The analysis points out that the loss is more significant around small towns than large ones (min. 1 % loss of the agricultural land fund), in special economic zones, and in countries with a high rate of economic growth. An important conclusion is that the loss of agricultural land takes place mainly in countries with agricultural land of a higher quality. Since 2006, losses of agricultural

land have been steadily growing. Krushelnicki and Bell (1989) attribute the loss of agricultural land in Canada primarily to urbanization. The authors understand this fact as a persistent problem in managing the range of production resources and regulating land use. The authors put forward a price proposal, on the basis of which it is possible to identify possible changes in land use before they occur, and furthermore to redirect urban growth to less qualitatively significant parts of the country. A detailed spatial analysis of changes in landscape coverage was made by Angonese and Grau (2014) in suburban areas of subtropical Argentina from 1972 to 2010. The total change in land cover is characterized by the enlargement of cities and a 10 % growth in forested areas by means of mountain pastures, which lost 66 % of their original area.

Land use change is the result of human–environment interactions across a range of spatial and temporal scales. An analysis of changes in this system, e.g. as result of changes in agricultural policy EU, therefore requires an integrated perspective addressing both the geographic and economic dimensions of change. Different approaches have been developed in recent years to link the spatial and economic aspects of land chase (Britz et.al., 2011). Changes in land-cover type are possibly the clearest and most informative indicators of a change in state and characteristics of the environmental systems (Robson and Berkes, 2011). For these reasons, systematic monitoring and assessment of land-cover dynamics are recognized as sources of highly relevant information for planning, conservation, and management of the environment (EEA, 2010).

Materials and methods

1. The paper was elaborated on the bases of the following materials:

- Research reports and investigations of the Institute of Agricultural Economics and Information (IAEI) in the area of the statistical evaluation of the state of the agricultural land fund for the period 1990-2013
- Czech Report on the state of agriculture, Ministry of Agriculture, (MoA, 2006, 2012)
- Czech Situation and Outlook Report – Land (CSOR, MoA, 2009, 2012)
- Czech Office for Surveying, Mapping and Cadastre (COSMC, 2002-2014)
- Czech Statistical Office (CzSO, 2014)
- Database FAOSTAT-Agriculture (FAO, 2014)
- Farm Accountancy Data Network (FADN, 2014)

2. Relationships, methods and procedures used

- Basic research methods are used in the paper: the method of secondary data collection, analysis and synthesis of documents, comparison, qualified estimation, the time series method and basic indices.
- The paper uses the software programme Microsoft Excel 97. A regression and correlation analysis will be done based on work with this program.
- The first level of the monitoring of changes in the use of agricultural land will be carried out at the CR level for the period 2001-2013, in which changes in the state of selected kinds of agricultural land (arable land, permanent grasslands) as well as total agricultural land will be analysed. The results will be compared with selected EU states and countries closely adjoining the CR (Visegrad Four).
- The second level of investigation will be carried out at the level of 14 regions: a) a change in the state of particular kinds of agricultural land, b) according to the criterion “price of agricultural land by Classified Soil-Ecological Units (CSEU)” and decrease in agricultural land in a specific CR region, c) “rent per hectare of agricultural land”. The evaluation will be carried out in regions with above-average and the lowest values of rent. The results will be compared with the CR average.
- The third evaluation of changes in the state of selected kinds of agricultural land will be carried out at the level of the lowest territorial division – at the district level. These districts will be chosen based on the intersection of three criteria (the official land price, the market land price, and a percentage of arable land) which qualitatively determine the best areas in terms of land value. In the selected collection of regions, a time series analysis will be carried out. Its aim will be to find out the extent to which agricultural land is degraded by being changed into other cultures or converted to non-agricultural use, and at the same time experiencing a change in natural fertility (according to updating

of the CSEU value) (Voltr, in MoA, 2012b). Within the framework of the above-mentioned territorial division, the investigation will be elaborated more deeply to include lower administrative units (units with an extended territorial scope). Within the lower administrative units a regression analysis will be carried out, in which a dependent variable y = the relative change in the extent of agricultural land in view of the acreage of the municipality for the period 2009-2013 (ha), and an independent variable x = the size of a territorial unit (number of inhabitants) in the year 2012.

Results and discussion

The price of agricultural land in the Czech Republic is significantly lower than in other EU states; however, the land's fertility and method of cultivation does not differ too much from surrounding countries. The area of agricultural land in the CR decreases by about 12 ha/day (MoA, 2012). Based on developments in recent years, one can expect prices of agricultural land to rise, also on account of a gradual equalization with the EU states. However, it can be predicted that the growth will be gradual.

The interest in agricultural land is increasing in connection with the provision of direct payments paid per hectare of agricultural land, and also in connection with an increased interest in the growing of energy crops. On account of the described changes in agriculture which occurred after 1989 (Pletichova, Gebeltova, 2013), 76 % of agricultural land in the CR is today under the management of tenants, not owners. In 2000, as much as 84 % of farmland was rented; in 2010 this share amounted to 78 %, and in 2012 it was 76 %. The share of rented land to total land area in Czech agriculture is, after Slovakia, the highest of all EU countries (MoA, 2012a).

1. Quantification of changes in the agricultural land fund for 2001 – 2013 at the CR level

As in the entire EU, the area of agricultural land in the CR is decreasing. Arable land is losing its value, in terms of land as a production factor. Besides natural soil degradation, this includes conversion of arable land into perennial cultures and permanent grasslands, the outplanting of fast-growing woody plants, afforestation, etc. We are led to believe that photovoltaic power stations are built only on poor-quality soil on sloping land. On the contrary – power stations are often situated on land with a high classification value and, at the same time, they degrade the landscape. Brownfields are used insufficiently. The quality of agricultural land is decreasing with the growing rate of erosion. The state of land in the EU is currently being discussed in reports made by the Joint Research Centre (JRC) and the European Commission. "It is clear that if we want to continue not only producing food in Europe but also preventing flooding or, vice versa, resisting droughts and climate change, and also supporting biodiversity growth, the EU must take legislative action for the protection and sustainable use of land in Europe" (EU, 2012).

The states of agricultural land in the Czech Republic, including selected kinds of agricultural land, changed from 2001 to 2013 in the following way (Table 1): The total acreage of agricultural lands registered in the Land Register of the CR decreased by 57,568 ha (a decrease of 1.35 %); arable land decreased by 89,386 ha (-2.91 %), and this decrease was largely transformed into an increase in permanent grasslands (an increase of 2.96 %). Graph 1 shows detailed year-on-year daily changes in agricultural land, as well as changes for the period 2001-2013 in the CR (Table 2).

In an international comparison with European states, a change in the area of agricultural land[1], a similar result as in the CR in the monitored period 2001-2013, is obvious in France (-1.83), where the daily decrease in agricultural land is 135 hectares; however, in acreage the agricultural land is 6.8 times larger than in the CR. In Germany, the decrease in agricultural land in the period 2001-2013 amounts to 1.85 % of agricultural land, which represents 78 ha/day (3.9 times larger than the acreage of agricultural land in the CR).

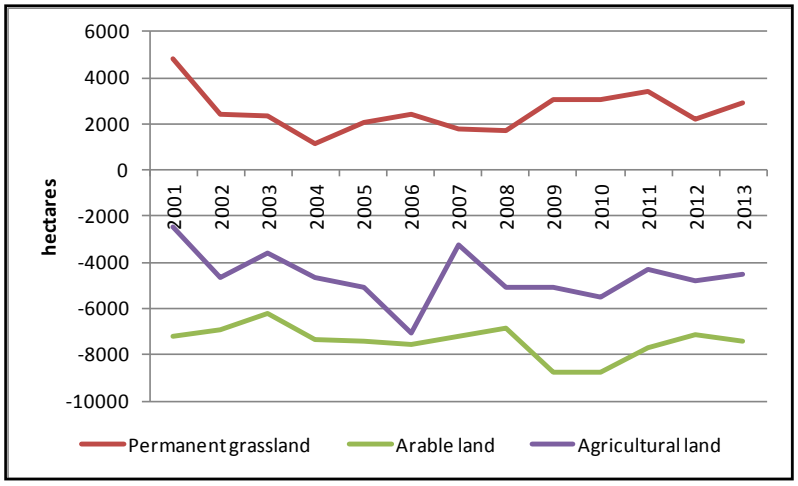
One neighbouring country which, in light of its position and closeness of its border, can compete in agricultural production with the Czech Republic is Poland, which recorded a decrease in the same period, 16.92 %. The decrease represents a significant change in the state of agricultural land (hereinafter only AL), -749.44 ha/day, which is explainable by 3.5 times the AL acreage towards the CR, but not positive.

[1] Source: Own calculations according to FAO, 2014 monitored period from the years 2001-2013

Agricultural land thous. (ha)	2001	2002	2003	2004	2005	2006	2007
Permanent grassland	966	968	971	972	974	976	978
Arable land	3 075	3 068	3 062	3 055	3 047	3 040	3 032
Agricultural land	4 277	4 273	4 269	4 265	4 259	4 252	4 249
		2008	2009	2010	2011	2012	2013
Permanent grassland		980	983	986	989	992	994
Arable land		3 026	3 017	3 008	3 000	2 993	2 986
Agricultural land		4 244	4 239	4 234	4 229	4 224	4 220

Source: Land Fund Yearbook 2002-2014, COSMC Prague

Table 1: States of acreage of selected kinds of agriculture land in 2001-2013.



Source: Own calculations according to Land Fund Yearbook 2000-2014, COSMC Prague

Graph 1: Average annual change in the acreage of agricultural land and its selected kinds for the period 2001-2013 (hectares)

	2001-2013	2001-2013	2001-2013	2001-2013
Agricultural culture	Average annual change (ha)	The average daily change (ha)	Absolute change (ha)	Relative change (%)
Permanent grassland	2,569	7.13	28,579	2.96
Arable land	-7,430	-20.64	-89,386	-2.91
Agricultural land	-4,616	-12.82	-57,566	-1.35

Source: Own calculations according to Land Fund Yearbook 2000-2014, COSMC Prague

Table 2: Changes in the states of agricultural land for the period 2001-2013.

Hungary, with a comparable acreage of agricultural land to the CR (1.26 times) recorded a decrease in AL by 9 % and a daily decrease in AL of 131.50 ha, a result which does not sound optimistic. Values in Slovakia are alarming as well (decrease in the monitored area of 14.43 % of AL; daily decrease in AL of 81.02 ha). These data also sound negative in relation to the acreage of agricultural land in Slovakia, which is at the level of 45 % of the acreage of agricultural land in the CR (FAO, 2014).

2. Change in the state of agricultural land at the level of 14 CR regions

a) Change in the state of particular kinds of agricultural land

Of the total acreage of 4,277,435 ha (2001) of agricultural land in the CR, there was a decrease of 57,568 ha (1.346 %), and the present acreage of agricultural land (2013) is 4,219,867 ha. The area of arable land in the CR in 2001 was 3,075,178 ha, and by 2013 (2,985,792 ha) this

had decreased by 89,386 ha. This was largely due to its conversion into permanent grasslands (PGG), forested areas and non-agricultural use.

There was a decrease in agricultural land in all monitored regions. A more significant decrease was recorded in the Prague region, the capital (-5.43 %), Highlands region (-2.73 %) and Moravia-Silesia region (-3.18). The area of the Olomouc region recorded an increase of 0.69 %.

An evaluation of the decrease in agricultural land in particular regions has to be carried out not only with the help of values of the physical decrease in ha, but also in relation to the total change in the region's acreage in the monitored period. There were significant changes in the extent of the area of regions[2] in 2004-2005, in the regions of Highlands, South Moravia, Olomouc and Moravia-Silesia. Significant deviations from the CR average were found by calculation, just in these regions (Table 3).

The impact of the change in a region's acreage on the percentage change in the acreage of agricultural land (Table 3) in the monitored regions and years (2004-2005) is as follows[3]:

The Highlands region registered a significant decline in the extent of agricultural land in 2001-2013 (2.731 %), which differs considerably from the CR average (1.346 %) (Table 3). However, in 2004-2005 there was a decrease in this region's acreage by 12,982 ha (1.87 %). This change is also reflected in the acreage of particular agricultural crops. In relative terms, the extent of agricultural land has improved. The share of agricultural land in the region's acreage in 2004-2005 increased from 60.58 % to 60.69 %.

The South Moravia region, with a change in the state of agricultural land of +0.3 % (Table 3), achieves even better results in relative terms. In 2004-2005, the extent of this region increased by 12,959 ha (+1.83%). In relative terms in the mentioned years, the share of agricultural land in the region's acreage increased by 53,515, to 59.97 %.

The acreage of the Olomouc region increased by +2.08 % in 2004-2005; however, the ratio between the agricultural land and the region's acreage did not change significantly (+0.02 %). The result is confirmed in Table 3.

Values for the Moravia-Silesia region do not look optimistic in comparison with the national average. The total acreage of the region decreased (-1.95 %) as well as the share of agricultural land in the region's acreage (-0.23 %).

[2] Belonging of municipalities in district of administration was adjusted to the 1.1.2005 by a new regulation of the Ministry of Internal Affairs No. 388/2004 Col. from 24.6.2004 which change the regulation from 2002. Changes happened in determination of districts of administration.

[3] Sources: Calculations of authors according to yearbooks of agricultural land fund 2005 and 2006 (CSMC)

Region	Change in AL		Change in PGG		Change in AgL	
	ha	%	ha	%	ha	%
Central Bohemian	-9904	-1.774	1633	2.331	-8012	-1.196
South-Bohemian	-9693	-3.022	3384	2.103	-6111	-1.232
Pilsen	-9147	-3.445	3543	3.356	-5563	-1.447
Karlovy vary	-3418	-5.957	2108	3.275	-1362	-1.086
Ústí	-6230	-3.322	3811	5.542	-3037	-1.091
Liberec	-5834	-8.244	4552	7.434	-1205	-0.855
Hradec Králové	-3618	-1.860	594	0.848	-3015	-1.075
Pardubice	-4774	-2.368	1507	2.525	-3327	-1.212
Highland	-9876	-3.028	-1319	-1.582	-11488	-2.731
South-Moravian	-6668	-1.855	1818	6.464	-1294	-0.303
Olomouc	-4542	-2.152	6482	12.939	1899	0.685
Zlín	-4950	-3.905	1573	2.826	-3013	-1.537
Moravian-Silesian	-9724	-5.405	-1103	-1.267	-10891	-3.817
City Prague	-1010	-6.487	-4	-0.458	-1149	-5.431
Total CR	-89 386	-2.907	28 579	2.959	-57 568	-1.346

Note: AL – agricultural land, PGG – permanent grass growths, AgL – agricultural land, Base = year 2001
Source: Authors according to Land Fund Yearbook 2002-2014, COSMC Prague

Table 3: Change in the acreage of agricultural land, arable land and permanent grassland in the regions in the years 2001-2013.

A significant decrease in agricultural land in the capital city of Prague (-5.43 %) is not due to a change in the region's total acreage, but to the conversion of agricultural land to non-agricultural use.

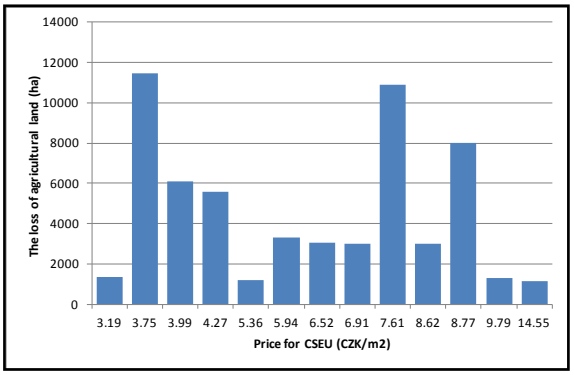
A change in the size of the cadastral areas of the CR was addressed in the research „Land Use Land Cover Change" under the auspices of the international commission IGU LUCC (International Geographical Union – Commission on Land Use and Land Cover Change) (Bičík, 2010). The database created within the framework of this research represents a collection of 8,903 BTU (Basic Territorial Units), covering the whole Czech Republic. BTUs were created by combining cadastres whose acreage had not changed significantly during the monitored period (by not more than 1 %).

b) Change in the state of agricultural land in the CR regions in confrontation with the price of agricultural land for CSEU

Region	Price for CSEU[1)] in CZK/m^2	Decrease in AgL[2)] in ha
Karlovy Vary	3.19	-1 362
Highland	3.75	-11 488
South-Bohemian	3.99	-6 111
Pilsen	4.27	-5 563
Liberec	5.36	-1 205
Pardubice	5.94	-3 327
Ústí	6.52	-3 037
Hradec Králové	6.91	-3 015
Moravian-Silesian	7.61	-10 891
Zlín	8.62	-3 013
Central-Bohemian	8.77	-8 012
Olomouc	7.45	1899
South-Moravian	9.79	-1 294
City Prague	14.55	-1149

Source: [1)] Voltr (IAEI), In: MoA, (2012b), official price for 2012
[2)] Authors according to Land Fund Yearbook 2002-2014, COSMC Prague
Table 4: Change in the state of agricultural land in the CR according to region (2001-2013) and evaluation of agricultural land on the basis of CSEU.

A negative phenomenon is that the more significant decreases happen even on land of better quality (an evaluation according to the average official price on the CSEU base (CSEU - Classified Soil Ecological Unit)), i.e. with official prices 7.61 CZK/m^2 and 8.77 CZK/m^2.



Source: Authors according to Voltr (In: MoA, 2012b), Land Fund Yearbook 2002-2014, COSMC Prague
Graph 2: Loss of agricultural land in 2001-2013 according to official prices in 2012 (monitoring in CR regions)

c) Evaluation of agricultural land in terms of rent

Rent is one of the cost items which influences the profitability of the economy. It is therefore simultaneously an expression of the interests of land owners on the one side, and of enterprising subjects on the other. In another investigation, a rent value was used (CZK/ha, EUR/ha) as a criterion of the interest (preference) in the use of agricultural land for entrepreneurial activity. The level of rent takes into account not only the fertility of agricultural land, but also the amount of claimed subsidies (SAPS, national payments, payments from the Rural Development Programme), attractiveness of the area (suburban area) and proximity to the neighbouring country. The evaluation was carried out in six regions with above-average values of rent and three regions with the lowest rent values.

The average rent in the CR moves within a range of 2 % of the official price (MoA, 2012a). With the average official price of agricultural land at 6.23 CZK/m2 (CSOR land, 2012), it is possible to consider 1,246 CZK/ha (48.85 EUR/ha) as the average level of rent. In another investigation, regions which reach higher than average rent levels were chosen. Of the 14 CR regions, six were selected for the evaluation: Olomouc, Central Bohemia, Ústí, Zlín, South Moravia and Hradec Králové (Tables 3, 5). The regions account for 53.7 % of the acreage of the CR. The region of Ústí, which is mostly an LFA (less favoured area), also falls within the set of regions. There, the rent level is influenced not only by the fertility of the rented agricultural land, but also by the amount of subsidies and the fact that it is a border area with Germany.

	Region	CZK/ha	EUR/ha
1	Olomouc	1 980.79	77.663
2	Central-Bohemian	1 738.27	68.154
3	Ústí	1 528.92	59.946
4	Zlín	1 528.20	59.918
5	South-Moravian	1 505.02	59.009
6	Hradec Králové	1 292.84	50.690
7	Highland	1 230.02	48.227
8	Moravian-Silesian	1 207.53	47.345
9	Pardubice	1 202.37	47.143
10	Jihočeský	1 168.02	45.796
11	Karlovy Vary	1 156.17	45.331
12	Pilsen	980.54	38.445
13	Liberec	786.72	30.846
14	Prague*)	x	x

Note: *) In the FADN network was not able to find out data (the database provides data of less than 3 enterprises)
Source: FADN, 2014, exchange rate CZK/EUR for 2012: 25,505 CZK/EUR

Table 5: Level of rent (price per ha), CR regions, 2012.

In the selected regions, which represented agriculturally important land, it was found that:

- The decrease in arable land of 2.19 % is comparable with the national average. However, it is essential to take into account that this is land of considerably higher quality.
- In the case of the conversion of arable land into permanent grasslands, the evaluation is not always unambiguously negative, because an increase in PGG acreage is considered positive in terms of anti-erosion measures. In the selection of plots for non-agricultural purposes, the importance of arable land should be accepted and its extraction from the agricultural land fund should be reduced. At the same time, it is also necessary in this regard to structure the territorial plans. Within the strategy, the territorial plans should support the development of housing construction and infrastructure, but within the context of sustainable agriculture. The largest decreases in arable land in particular regions were detected in the region Zlín (63 % of arable land) and the region Ústí (65 % of arable land). The increase in PGG in the monitored area of the six regions significantly exceeds CR values. The value increase of 4.6 % is influenced mainly by the Olomouc region. There was an increase in PGG of 89 % in 2004-2005, which was influenced by a 2 % increase in the region's total area.
- The decrease in agricultural land, meaning the land acreage which is irreversibly excluded from the agricultural land fund in selected regions, is lower in comparison with the nationwide decrease. This is a positive result. The smallest decreases are observed in the South Moravia region. According to the class of soil, the highest average official price of all CR regions (5.23 CZK/m2) is assigned to this region, and the results correspond with the law concerning protection of the agricultural land fund.

According to the criterion "rent in CZK/ha", the regions Hradec Králové, Pilsen and Liberec were in the last three places (Tables 3, 7).

Use of agricultural land in areas with the lowest rents and, at the same time, with low official prices (Table 7):

- The percentage value of PGG acreage in the monitored areas is significantly higher than the CR average. In these areas, PGG supports the reduction of land degradation through erosion. The mentioned regions are among the LFA areas of the CR. The share of LFA land in the Pilsen region represents 15 % of the less favourable areas of the CR. In the region of Karlovy Vary, 52 % of the land is managed in less favourable areas for agriculture of the entire CR, and in the Liberec region it is 3.5 % of the LFA acreage of the CR[4].
- The development of the decrease in arable land in the monitored period by CR region is considerably higher than the CR average; however, farming on lower-quality lands is not economically advantageous. Through the conversion of arable land to PGG, protective elements are preferred as well as less invasive management of agricultural land.
- The decrease in agricultural land in these regions does not differ significantly from the CR average.

In addition to the change in acreage of particular kinds of agricultural land, there are also changes in the production capability of land. Changes in the average official price in the monitored CR

[4] Source: MoA, 2012a

Agricultural land according to cultures	Arable land		Permanent grassland		Agricultural land	
Selected region of the ČR	Absolute change (ha)	Relative change (%)	Absolute change (ha)	Relative change (%)	Absolute change (ha)	Relative change (%)
The selected region:	**-35900**	**-2.19**	**15911**	**4.618**	**-16472**	**-0.772**
Total for Czech Republic	**-89386**	**-2.907**	**28579**	**2.959**	**-57568**	**-1.346**

Source: Own calculations according to the Agricultural Land Fund Yearbook 2002-2014, COSMC, Prague

Table 6: Decreases in the agricultural land of six selected regions in 2001-2013.

Agricultural land according to cultures	Arable land		Permanent grassland		Agricultural land	
Selected region of the ČR	Absolute change (ha)	Relative change (%)	Absolute change (ha)	Relative change (%)	Absolute change (ha)	Relative change (%)
The selected region:	**-18387**	**-4.647**	**10215**	**4.381**	**-8130**	**-1.249**
Total for Czech Republic	**-89386**	**-2.907**	**28579**	**2.959**	**-57568**	**-1.346**

Source: Own calculations according to the Agricultural Land Fund Yearbook 2002-2014, COSMC, Prague

Table 7: Three regions with the lowest rent value (regions Hradec Králové, Pilsen, Liberec).

regions according to the updated CSEU were published by Voltr (Moa, 212 b). The research of the authors of this paper shows that decreases in agricultural land also happen in regions where official prices according to the updating of CSEU are increased (e.g. the region Hradec Králové). In addition to the degradation of agricultural land by the decrease, degradation is also caused by a loss of the production capability of the land. Examples include the South Moravia region (the original official price[5] is 9.79 CZK/m^2, after updating 8.75 CZK/m^2), Moravia Silesia region (the original official price is 7.61 CZK/m^2, after updating 7.35 CZK/m^2), Olomouc region (the original official price is 7.45 CZK/m^2, after updating 7.02 CZK/m^2) and Zlín region (the original official price is 8.62 CZK/m^2, after updating 7.74 CZK/m^2).

3. 3. Evaluation of changes in the state of agricultural land at the level of lower administrative units

a) Evaluation on a district basis

The third evaluation of the importance and quality of agricultural land was carried out at the CR district level, i.e. at the level of lower territorial divisions. The specific selection of districts was based on the simultaneous fulfilment of the three criteria (conditions) mentioned below. The criteria have the value of the CR average, and selected districts must take a value above its level. There are also some data available from the following years; however, the chosen criteria were available concurrently only for the year 2007.

The criteria in the CR (average values for 2007):

1. the official price ≥ 5.24 CZK/m2 (source: MoA regulation No. 287/2007 Col., In: MoA, 2009, Appendix 1, pp. 66-67)
2. percentage of arable land ≥ 71.3 % (source: CSOR- land, 2009, p. 7)
3. market price 3.735 CZK/m2 (source: MoA, 2009, p. 78, Appendix 6; price map, IAEI, 2007, In: MoA, 2009, p. 46)

The number of districts which fulfilled the chosen criteria:

1. criterion /official price/ 30 districts
2. riterion /percentage of arable land/44 districts
3. criterion /market price/ 25 districts

Number of CR district: 78

In the intersection of the selected criteria, the resulting number of districts was found to be 21; they occupy acreage of 1,272,463 hectares, which corresponds to 30.15 % of the acreage of the agricultural land of the Czech Republic (data from 2013). In the sample, six districts were included from the Central Bohemia region, two districts from the Hradec Králové region, three districts from the Pardubice region, and five districts from the South Moravia region. The Olomouc region is represented by three districts, Ústí by one district. The last district is the City of Prague. In the 21 selected districts, the classification was

[5] Price of agricultural land in the cadastral area before the updating of CSEU in the CR (2012)

focused on evaluating changes in the acreage of agricultural land from 2001-2013, which indicates that agricultural land increased in three districts (Prague – east, Hradec Králové, Brno – country, and Olomouc). It would also be appropriate in this case to make a quantitative evaluation of the decrease in agricultural land in relation to district size6. In seven districts of the sample there was a reduction of the district, mainly due to territorial changes in 2006-2007. In six districts, an increase in the acreage of the districts could be observed (changes in 2004-2005 and 2006-2007). In cases where the change was smaller than 1,000 ha, the area was understood to be "without change in acreage" (Table 8).

The decrease in the share of agricultural land to the size of the investigated districts in the CR for the period 2001-2013 was 1.248 %. Of the 21 evaluated districts, 13 have a decrease smaller than this, which represents 61.64 % of the acreage of agricultural land of the examined districts. Growth in the share of agricultural land in the district acreage was recorded in 3 districts (Kolín, Přerov, Brno – country); in the other 18 districts, a decrease was observed in the share of AgL in the district acreage (Table 8). The highest positive value for the change in AgL share in the district acreage was 3.1 % (Kolín), and the largest negative change was -6.37 % (Prague – east).Evaluation on base of municipalities with extended scope (21 districts = 56 municipalities)

b) Evaluation based on municipalities with an extended scope (21 districts = 56 municipalities)

Twenty-one districts were further evaluated at the level of 56 municipalities with an extended scope. These included Prague, the Pardubice region (5 municipalities), Ústí (3 municipalities), Olomouc region (9 municipalities), South Moravia region (18 municipalities), Hradec Králové region (5 municipalities) and the Central Bohemia region (15 municipalities). A partial aim in this more detailed assessment was to determine, through detailed regression analysis, whether there is a relationship between the size of municipality (according to number of inhabitants) and a change in the acreage of agricultural land, especially with regard to decreases.

In the monitored sample of 56 municipalities, which represent the classification (CSEU) and market value (price per m2) of valuable CR areas, a significantly strong tightness of dependence was not proved between the level of change in the share of agricultural land and the extent

	Number of districts	Acreage of respective AgL 2013 (ha)	% of respective acreage of AgL on acreage of 21 districts
Decrease of AgL caused by decrease of district, share of AgL/district acreage grows	2	114051	8.96
Decrease of AgL caused by decrease of district, share of AgL/district acreage decreases	7	453845	35.67
Decrease of AgL without change in district acreage, share of AgL/district acreage decreases	7	353352	27.77
Decrease of AgL with increase of district acreage, share of AgL/district acreage decreases	1	69062	5.43
Decrease of AgL was caused by increase of district, share of AgL/district acreage grows	1	84594	6.65
Decrease of AgL was caused by increase of district, share of AgL/district acreage decreases	3	197559	15.53
In total (21 districts)	21	1272463	100.00
Number of districts with growing change of share of AgL in district acreage	3	198645	15.61
Number of districts with decreasing change of share of AgL in district acreage	18	1073818	84.39
Number of districts with smaller decrease than is the CR decrease (1.248 %)	13	784556	61.64

Source: Own calculations according to the Agricultural Land Fund Yearbook 2002-2014, COSMC, Prague

Table 8: EEvaluation: Change in the share of agricultural land (AgL) in district acreage from 2001 to 2013 in 21 selected districts in the CR for the period 2001-2013.

of the municipality (y), and the size of the municipality according to number of inhabitants (x). This was defined by a linear regression function in the form:

$Y = 0{,}000000002x^5 - 0{,}0000005x^3 + 0{,}00004x^4 - 0{,}0015x^3 + 0{,}0272x^2 - 0{,}1708x - 0{,}2587$

$R^2 = 0{,}2695 = 26{,}95\%$

The presumption that the higher the number of inhabitants in a municipality the larger the decrease in the share of agricultural land in the district acreage was not proved for the selected municipalities.

Conclusion

The decrease in agricultural land from both a quantitative and qualitative viewpoint is a natural phenomenon of every civilized society. With population growth, proportions of agricultural and non-agricultural land change. The aim of every state or society is to preserve natural wealth and its diversity for future generations and to ensure the sustainability of agriculture.

In the Czech Republic from 2001 to 2013 (Table 1), the state of agricultural land, including selected cultures, changed in the following ways: The total acreage of agricultural land registered by the Land Register of the CR decreased by 57,568 ha (a decrease of 1.346 %); the acreage of arable land decreased by 89,386 ha (-2.91 %), which was transformed mostly into an increase in permanent grasslands (an increase of 2.96 %). The authors carried out the evaluation not only at the national level, but also at the level of selected regions and municipalities. When assessing the decrease in agricultural land in particular regions, it was necessary to carry out the evaluation not only using values of absolute decreases in hectares, but also in relation to the total change in the acreage of the region in the monitored period. There were significant changes in the acreage of some regions in 2004-2005, and this was clearly reflected in changes in the state of agricultural land in these regions. In evaluating absolute changes in the acreage of agricultural land within a region, it is also necessary to take into account changes at the regional level. The research further shows that one negative phenomenon is that higher decreases in agricultural land also occur on land of better quality (evaluation according to the average official price (5.24 CZK/m^2) based on CSEU), i.e. with official prices of 7.61 CZK/m^2 and 8.77 CZK/m^2. A more detailed investigation carried out by Voltr. (decreases in agricultural land occurred from 1995-2012, according to prices of agricultural land using classified soil ecological units (CSEU) at the level of the cadastral areas of the CR) led to the conclusion that in a proportional organization, according to the acreage of agricultural land in particular price categories, there is a higher relative decrease on lands of better quality near cities (Voltr, In: MoA, 2012b).

The authors´ research indicates that the relative decrease (0.77 %) in qualitatively better agricultural land from 2001-2013 in the selected regions (50.1 % of the agricultural land fund of the CR) is smaller in comparison with the nationwide decrease (1.346 %). This is a positive result. The relative decrease in arable land in these areas (2.19 %) is comparable to the national average. However, it is essential to bear in mind that this is land of significantly better quality. The development of the decrease in arable land (%) in the three quantitatively worst regions of the CR (Karlovy Vary, Pilsen, Liberec) in the monitored period is significantly lower than the CR average; however, farming on lands of lower quality is not economically advantageous. Through the conversion of arable land into PGG, protective elements are preferred as well as less invasive management of agricultural land. The decrease in the share of the agricultural land fund (21 studied districts) in the size of the investigated districts in the period 2001-2013 was 1.248 %. Of the 21 evaluated districts, 13 have a decrease lower than this, which represents 61.64 % of the agricultural land acreage of the examined districts. Growth in the share of agricultural land in the district acreage was recorded in three regions (Kolín, Přerov, Brno – country). In the other 18 districts, a decrease in the share of agricultural land in the district acreage was recorded (Table 8). It is not possible to consider that in the future, values of relative changes in the shares of agricultural land in the area of the municipality will increase. However, it is necessary to be mindful of their modest and stable development.

One partial aim was to find out whether there is a relationship between the size of municipality (according to number of inhabitants) and a change in the acreage of agricultural land, especially with regard to decreases in agricultural land in the selected 56 municipalities. Here, however, the regression analysis did not prove a strong tightness of dependence between the quantities.

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Microsimulation Model Estimating Czech Farm Income from Farm Accountancy Data Network Database

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Anotace

Důchod ze zemědělské činnosti patří mezi nejdůležitější indikátory ekonomické situace zemědělských podniků a celého zemědělství. Předkládaná práce se zaměřila na zjištění optimální metody odhadu zemědělského důchodu v ČR, která se opírá o mikro-ekonomickou databázi reprezentovanou Zemědělskou účetní datovou sítí (FADN). Využití databáze FADN je odůvodněné zejména reprezentativností výsledků extrapolovaných na celou Českou republiku a možností provádění analýz na mikroekonomické úrovni. Hlavním podnětem pro zpracování studie bylo vypracování odhadu zemědělského důchodu, který je založen na metodice FADN, o tři čtvrtě roku dříve před zjištěním finálních oficiálních výsledků šetření FADN. Vlastní navržená metodika odhadu důchodu a postupy pro simulační výpočty byly úspěšně testovány s využitím databáze FADN pro dva předcházející účetní roky. Součástí tohoto článku je popis vlastního metodického přístupu k odhadu zemědělského důchodu a ověření jeho vhodnosti.

Klíčová slova

Odhad zemědělského důchodu, Zemědělská účetní datová síť FADN, aproximace produkční a nákladové složky důchodu, mikrosimulační model.

Abstract

Agricultural income is one of the most important measures of economic status of agricultural farms and the whole agricultural sector. This work is focused on finding the optimal method of estimating national agricultural income from micro-economic database managed by the Farm Accountancy Data Network (FADN). Use of FADN data base is relevant due to the representativeness of the results for the whole country and the opportunity to carry out micro-level analysis. The main motivation for this study was a first forecast of national agricultural income from FADN data undertaken 9 months before the final official FADN results were published. Our own method of estimating the income estimation and the simulation procedure were established and successfully tested on the whole database on data from two preceding years. Present paper also provides information on used method of agricultural income prediction and on tests of its suitability.

Key words

Farm income estimation, FADN, production and cost approximation, microsimulation model.

Introduction

This paper provides an overview of a new approach to micro-level farm income estimation and its components based on the Farm accountancy data network (FADN) database, using the case of the Czech Republic. The outcome of the designed microsimulation model is an estimation of economic results in agriculture about 9 months before the FADN survey for the particular accounting year is finalized. The results serve to present a complete picture of the agricultural sector, to inform the formulation of national agricultural policies, to assess the impacts of policy decisions, to design new policies and programs or to help to identify emerging trends in farming.

This kind of estimation is presented for the first time. The aim of the authors is to provide an introduction into their own methodology and its verification and to present results of the designed model.

The Council Regulation (EC) No 1217/2009 states that "the purpose of the data network shall be to collect the accountancy data needed for, in particular: (a) an annual determination of incomes on agricultural holdings coming

within the field of the survey defined in Article 5; and (b) a business analysis of agricultural holdings."

Only farms whose size (based on number of animals and utilised area) exceeds a minimal economic threshold are collected by the FADN survey. Region, economic size and type of farming are the three dimensions for which the data shall be representative. It enables to cover the most relevant part of the agricultural activity of each EU Member State. All EU Member States must follow the same rules of bookkeeping for the FADN purpose which enables to create unique fully harmonised micro-economic database (European Commission, 2013)

Farm Accountancy Data Network was set up in the Czech Republic by the decision of the Ministry of Agriculture in 2003 and the responsible body to operate the network is Liaison Agency FADN CZ is the Institute of Agricultural Economics and Information (IAEI), nevertheless the concept of the data network in the Czech Republic was launched already in 1995. Data based on EU FADN method has been collected since 2004 which allows for creating10-year panel data by the end of 2014.

FADN CZ database, submitted to the European Commission, consists of about 1422 farms in 2011 and 1369 farms in 2012 (Hanibal et al. 2012, 2013). The reported results are processed from the full dataset submitted to the European Commission.

There are numerous means used to describe development in agriculture. One of them is the set of indicators called Standard Results which define structural and economic conditions on the farms. The variables of Standard Results were established by the European Commission and a precise definition is provided in document RI/CC 882. One of the key Standard Results measures evaluating economic results of the farms via agricultural income is Farm Net Value Added (FNVA) and Farm Net Income (FNI).

Farm net value added is equal to total production plus balance current subsidies and taxes minus total intermediate consumption and minus costs of depreciation. FNVA is remunerating work, land and capital (paid or own fixed factors) allowing comparison of the farms no matter whether the production factors are coming of family or non-family sources (European Commission, 2013). FNVA is the indicator enabling to compare economic results of family farms using mainly own labour and land to the legal entities such as agricultural holdings who don't own but rent the majority of utilized land and use paid labour (as is typical in the Czech Republic). FNVA is considered as the key economic indicator allowing to measure level of income and production efficiency of farmers not only in national conditions but also at the EU level (Hanibal et al., 2013).

Farm net income is equal to FNVA plus balance subsidies and taxes on investment minus total external factors (wages, rent and interest paid). FNI is in the context of the present study considered as a final indicator which in its aggregated form represents national agricultural income. FNI stands for the final economic indicator measuring profit or loss coming from agricultural activities of farms. It includes also unpaid work remuneration of family unpaid farmers (Hanibal et al., 2013).

Farm income is justly taken into consideration for discussions on policy forming and evaluating at it is an essential indicator providing evidence on the viability of the agricultural sector.

Many other significant indicators are likewise estimated as separate components of the final indicators. These include value of production, costs, and subsidies defined by the indicators calculated according to EU FADN methodology.

"The Community typology needs to be so arranged that homogeneous groups of holdings can be assembled in a greater or lesser degree of aggregation and that comparisons of the situation of holdings can be made" as stated by Commission Regulation (EC) No 1242/2008 (2008). The significant benefit of FADN database is the possibility to carry out analysis on the micro level, to analyse specific fields of interests (LFA, type of farming etc.) and to apply microsimulation methods.

Agriculture has its own specifics, which needs to be taken into consideration not only for modelling (Allen, 1994) but for all types of analysing. Quantity and quality of the production is determined mainly by local circumstances and natural conditions. Prices more depend on the global situation and government decisions. Agriculture is subject of protectionism (Moon, 2011) which is determining both the quantity and prices of production, but has also impact on farm income and management.

Using the microsimulation model in this study we can answer the question how the economic result of the national agriculture will evolve taking into consideration basic assumptions in the analogous sense as indicate Li, O'Donoghue (2013).

Ballas, Clarke, Wiemers (2005) declared that it

was proved that it is worth to use microsimulation models to evaluate the impact of policy changes at the micro-level and they underlined the power of the models to create large-scale data sets of micro units characteristics.

Among other appreciated advantages of microsimulation models is an opportunity to link data with many other source databases, advantageous data storing in form of a list, and the possibility to update models or to project data (Ballas, Clarke, Wiemers, 2005, 2006).

Analogous work to ours was also conducted for Canada. The Canadian Agricultural Dynamic Microsimulation Model (CADMS) is created and operated by Agriculture and Agri-Food Canada. CADMS delivers forecasts regarding farm-level revenues, expenses and program payments for individual agricultural companies. The results of CADMS moreover allow providing farm income outlook in more disaggregated form (e. g. type of farming) which is appreciated value added of the model. (Galbraith, Bakhshi, Kung, Kjaer, 2011).

Macroeconomic outcome of national agricultural and entrepreneurial income is provided by the Czech Statistical Office through the Economic Accounts of Agriculture. Other macroeconomic sources of information and forecasts of agricultural income in Europe are published by Outlook of OECD-FAO (2013) and Prospects of the European Commission (2013).

Materials and methods

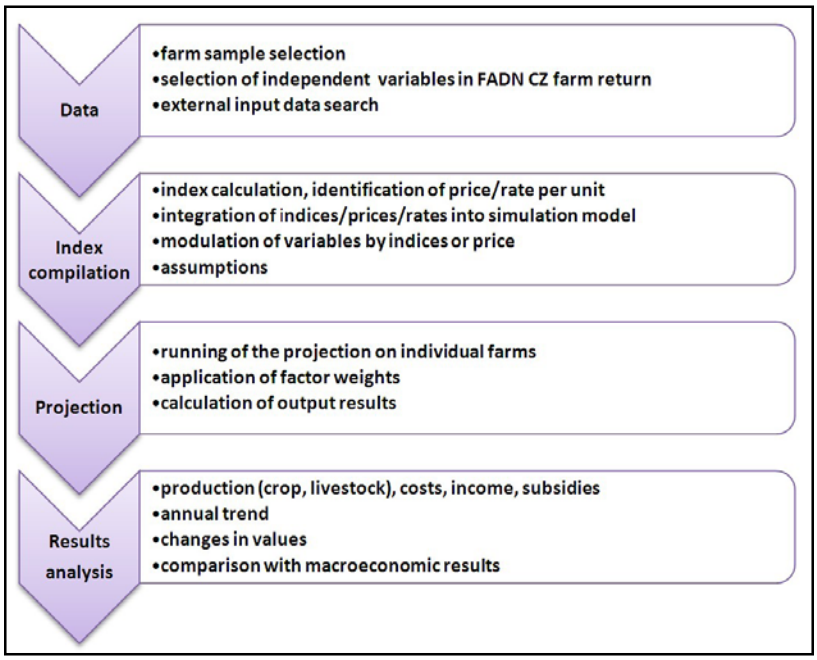
Using the FADN database it is possible to analyse particular features of farming the researcher is interested in, or aggregated weighted data representing whole country. In this study both of these benefits of the FADN database were applied. Firstly the set of independent indicators on the farm level was adjusted by the computed year-on-year indices and secondly the results of the estimated farm sample were weighted and aggregated to give an overview of economic conditions in Czech agriculture.

The investigation also includes an examination of potential sources of input information on production, costs and subsidies components.

Year-on-year unchanged production structure was assumed and depreciation level was taken into account for this estimation.

The software FADN CZ Projection was used for modelling. This application is an essential tool for estimating economic results on the individual level of the FADN CZ database.

Process of the estimation itself can be separated into 4 stages (Figure 1).



Source: own processing

Figure 1: Procedure of the estimation process.

At the beginning, variables to be changed are to be identified. The next step is to define the changes and indices composition. Thereafter a recalculation of the simulated dataset is completed and standard results are calculated. At the end, estimated data are weighted and aggregated to the national level.

National database of FADN survey is used as data source for the presented work. Czech FADN farm return differs from the EU FADN format in the greater detail of information obtained. Detailed records of FADN CZ database allow the combination of input information from various appropriate sources, leading to more accurate results of the estimation. For instance, FADN CZ collects information on livestock daily weight gain or more categories of crops, so important crops such as spring and winter wheat, or spring and winter barley, are differentiated.

The basic items of the individual FADN farm returns are to be recalculated by the year-on-year change measure. Every single index is used to estimate new item of the farm return for each farm in the selection of the representative sample. The items of the farm returns which are not considered to be changed remain at the same level as in the source year. The most up-to-date accounting year dataset in FADN database is used for the one-year projection.

Identification of the variables from FADN database intended to be changed was based on the knowledge of the income components and significance of individual indicators. To confirm variables selection and to avoid omission of significant variables, a statistical method (Meloun, 2004, 2006) was used to measure the dependence of individual variables on the whole subdivisions (production, costs, and subsidies). The statistical program SPSS 16.0 was used for an analysis of correlation. On the empirical and statistical basis, 354 items were selected for adjustment (of which 264 for changes in the crop production, 70 for changes in the livestock production, 20 variables for agricultural products and 26 items for the costs). The extent of the selected variables can be updated for the actually estimated year such as the set of subsidies which are to be updated yearly.

The estimation of **the crop balance sheet** variables is achieved by using the compound indices for the selected individual items.

Opening valuation:

$$IOv = \frac{\sum_{i=1}^{n} KZ_{N-1,i}}{\sum_{i=1}^{n} PZ_{N-1,i}} \cdot \frac{\overline{CZ}_{N-1}}{\overline{CZ}_{N-2}}, \quad (1)$$

where CZ is an average price of agricultural producers in September of year N-1 and N-2, KZ is the closing valuation of the inventory (in tons), and PZ is the opening valuation of the inventories (in tons) in FADN database in year N-1.

Value of farm use of seeds:

$$IFUs = \frac{\sum_{i=1}^{n} O_{N,i}}{\sum_{i=1}^{n} O_{N-1,i}} \cdot \frac{\bar{C}_N}{\bar{C}_{N-1}}, \quad (2)$$

where O is sowing area and C is an average year price of agricultural producers in the estimated year N and previous year N-1.

Value of farm use of feed:

$$IFUf = \frac{\bar{C}_N}{\bar{C}_{N-1}}, \quad (3)$$

where C is an average year price of agricultural producers in the estimated year N and previous year N-1.

Sales in market price:

$$ISA = \frac{\sum_{i=1}^{n} P_{N,i}}{\sum_{i=1}^{n} P_{N-1,i}} \cdot \frac{\bar{C}_N}{\bar{C}_{N-1}}, \quad (4)$$

where P is the quantity of the harvested crop production and C is the average year price of agricultural producers in the estimated year N and previous year N-1.

Transmission to own processing:

$$IOP = \frac{\bar{C}_N}{\bar{C}_{N-1}}, \quad (5)$$

where C is an average year price of agricultural producers in the estimated year N and previous year N-1.

Own consumption:

$$IOC = \frac{\bar{C}_N}{\bar{C}_{N-1}}, \quad (6)$$

where C is the average year price of agricultural producers in the estimated year N and previous year N-1.

Closing valuation:

$$ICV = \frac{\bar{C}_N}{\bar{C}_{N-1}}, \quad (7)$$

where C is the average year price of agricultural producers in the estimated year N and previous year N-1.

Edited value indicators for a change in **livestock production** are as follows: opening valuation, purchase of animals, sale of animals at market price, transmission to own processing, own consumption, closing valuation.

In the frame of livestock estimation the following composite index is used:

$$I = \frac{\bar{C}_N}{\bar{C}_{N-1}} \cdot \frac{\sum_{i=1}^{n} PO_{N,i}}{\sum_{i=1}^{n} PO_{N-1,i}}, \quad (8)$$

where C is the average price of agricultural producers and PO is number of animas on 1st April in the estimated year N and previous year N-1.

Among **processed products** from livestock production are cow milk and milk products, eggs and honey. For those, change in market price was used as a basic value indicator and then, depending on individual case, also change in opening valuation of stocks, intermediate consumption - feed (in thousands CZK), own consumption and the closing valuation.

$$\textit{Index milk} \quad Iml = \frac{\sum_{i=1}^{n} HN_{N,i}}{\sum_{i=1}^{n} HN_{N-1,i}}, \quad (9)$$

where HN is the value of purchased milk in year N and N-1.

$$\textit{Index honey} \quad Imd = \frac{\overline{CS}_N}{\overline{CS}_{N-1}} \cdot \frac{\sum_{i=1}^{n} P_{N,i}}{\sum_{i=1}^{n} P_{N-1,i}}, \quad (10)$$

where CS means consumers price and P is quantity of production in year N and N-1.

$$\textit{Index eggs} \; Iv = \frac{\bar{C}_N}{\bar{C}_{N-1}} \cdot \frac{\sum_{i=1}^{n} P_{N,i}}{\sum_{i=1}^{n} P_{N-1,i}}, \quad (11)$$

where C is average producer´s price and P is quantity of production in year N and N-1.

On the cost side are adjusted direct costs (as purchased and own seeds and seedlings, fertilizers, crop protection products, purchased and own feedings, medicines and veterinary equipment) and farming overheads (as machinery and building current costs, fuel and lubricants, electricity, other energy, contract work, breeding and veterinary services, personal expenses, insurance.

List of presented items can be expanded or reduced for different versions of the estimate, depending on availability of information on year-on-year development of costs.

$$\textit{Personal expenses index} \; Ion = \frac{\bar{M}_N}{\bar{M}_{N-1}} \cdot \frac{\overline{PO}_N}{\overline{PO}_{N-1}}, \quad (12)$$

where M is average wage in agriculture and PO refers to average number of employees in agriculture for year N and N-1.

Other cost items are adjusted based on the available input information from the report ‚Input agricultural price indices' issued by the Czech Statistical Office.

The last part of the income composition is the area of subsidies. One-year estimate of income crucially relies on identification of rates for individual subsidies and on information about the total allocated and disbursed grants in the estimated year. Since the calculation is made at the end of the estimated year, majority of this information is usually known.

The subsidies rates are applied to the quantity of the units registered in FADN farm return in year N-1. The index is applied for the calculation of the year-on-year change of the subsidies where the units are not monitored. Whenever only total subsidy amounts are known, the total amount is added into the calculation subsequently. In such cases the detailed classification analyses are conditioned by the additional estimation of the subsidies distribution. The procedure for determining the estimated subsidies shall be annually reviewed and adapted to the current situation of the year.

Identified external sources were used as input information for composing the compound indices. The main information source is the Czech Statistical Office which provides particularly on-line public datasets ‚Input agricultural price indices (corresponding period of previous year = 100)', ‚Average quarterly prices of selected products and services sold to agriculture', ‚The average monthly prices of agricultural products', ‚Livestock as of April 1st', ‚Estimated harvest of selected agricultural crops', ‚Information on estimate of yield and production of agricultural crops in the Czech Republic as of 15 September', ‚Harvest of agricultural crops' and ‚Trend in sowing areas: 31 May'. The commodity portal of the Czech Ministry of Agriculture was used to gather information on eggs and milk production.

Results and discussion

Estimation of 2013 results and verification of the model by 2011 and 2012 results testing is provided based on above methodology.

Estimation of agricultural income in 2013

The first estimate of the outcome of agricultural income in 2013, based on microeconomic data was processed according to the methodology described

above. At the time of the calculation, agricultural producer prices for the period from January to November 2013 and annual changes in major cost items for the first three quarters of 2013 were known from external sources. Estimation of subsidies was prepared on the basis of announced and anticipated rates by the Ministry of Agriculture for year 2013.

The farmers achieve good economic results as the estimate indicates year-on-year increase of the Farm net income, considered as a final economic indicator, by 4.2 %. The estimated value of 19.77 billion CZK for 2013 is the best result of farm income during the last 10 years (Figure 2).

The other key indicator Farm net value added increased by 2.4%.

Total production shows also an increasing trend, which leads to growth of 3.7 % to 130.57 billion CZK. The most important factor in this increase is crop production, whose value increased by 4.7 % mainly due to an increase in the value production of potatoes and oil crops (rape). Livestock production improved by 3.2 %, the increase was particularly found in milk production, pork and poultry meat production. Results of beef production are the same as in the previous year and egg production occurs noticeable declining in 2013.

Total expenses grow by 3 % to 143.48 billion CZK, primarily due to a significant increase in the price of feed and seeds.

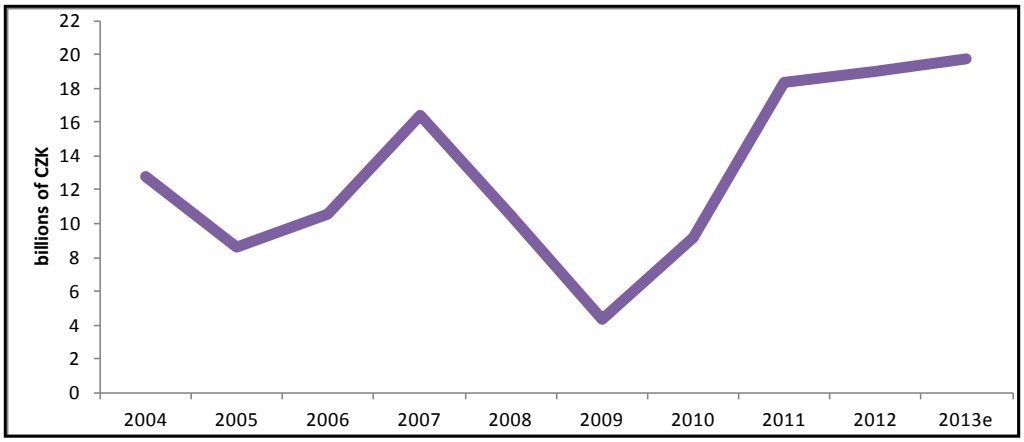
Subsidies, as was expected, increased modestly by 0.7 % to 31 billion CZK.

Estimates of economic results presented in a more detailed breakdown are displayed in Table 1.

Main indicators	2012	2013e	% Change
Total output	125.86	130.57	3.7
Crop production	69.83	73.13	4.7
- cereals	33.31	33.77	1.4
- oil-seed crops	13.66	14.64	7.2
- vegetables	3.89	4.09	5.3
- fruit	1.15	1.3	12.5
Livestock production	44.5	45.92	3.2
- milk and milk products	21.48	22.68	5.6
- beef	8.35	8.25	-1.3
- pigmeat	7.54	7.92	5.1
- poultrymeat	4.58	4.89	6.8
- eggs	1.81	1.44	-20.6
Total costs	139.35	143.48	3
Intermediate consumption	93.62	97.39	4
Specific costs	52.94	56.21	6.2
- seed and plants	6.4	6.74	5.4
- fertilisers	8.66	8.81	1.7
- crop protection	7.31	7.47	2.3
- feed	24.24	26.8	10.6
Farming overheads	40.69	41.18	1.2
External factors	31.91	32.27	1.2
Subsidies (ex. on investments)	30.81	31.03	0.7
Gross farm income	62.29	63.46	1.9
Farm net value added	48.47	49.64	2.4
Farm net income	18.97	19.77	4.2

Note: 2013e – estimated results
Source: FADN CZ, own processing

Table 1: Breakdown of the estimated economic results for 2013 compared to 2012 final FADN results in billions of CZK.



Source: FADN CZ, own processing

Figure 2: Farm net income development since 2004, based on FADN CZ in billions of CZK.

Estimation accuracy – aggregated results

The whole suggested methodology was verified by empirical testing it (Armstrong, 2006) on two previous years where the estimated results could be compared to the actual final FADN results. Verification was carried out in the form of processing farm economic results estimate for 2011 based on FADN 2010 data and 2012 estimates based on FADN 2011 data. For the purpose of good quality verification of the system, two different periods of input information were used for the calculation. Input information available up to April 2013 was used for estimating 2012 results and the estimate of 2011 was based on external data available in January 2012.

The estimated values were compared with the actual results of the official FADN survey for this period.

The estimated Farm net income was 20.04 billion CZK in 2011, which is close to the official result of 19.13 billion CZK with just 4.7% difference. Estimation of overall production was almost 100% in line with actual results, see Table 2.

Farm net income was estimated at the level of 17.82 billion CZK in 2012. The final result of the FADN CZ survey calculates it at 18.97 billion CZK. The difference between the estimated and the official result is 6.1%. The difference was mainly due to higher estimated costs, though it can also be partly explained by a change in the weighting method. For the official results the most recent Farm structure survey 2010 was used, while the estimation results have been processed before this upgrade using weights based on Farm structure survey 2007.

Among other indicators involved in the income composition we can mention Farm net value added with a deviation of only 1.2%, the total production (4.8%), operating subsidies (5.0%) and the total cost (6.95%).

The common partial explanation of the variance between actual and projected results is the use of weighting factors for estimated result from the previous year because the weights of the actual year were not known at the time of simulation.

Estimation accuracy - cumulative distribution

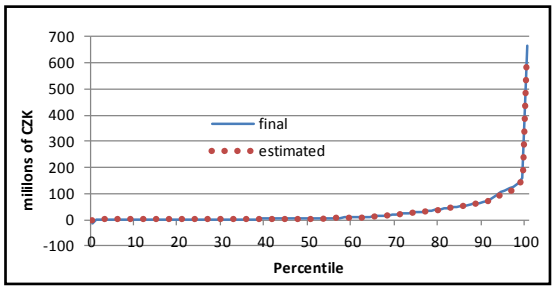
Accuracy of estimation is also confirmed by the comparison of the cumulative distribution (Galbraith, Bakhshi, Kung, Kjaer, 2011) of the chosen indicators with the final FADN results for both tested years in the Czech Republic. The following set of graphs gives evidence of equivalent distribution of estimated indicators and it confirms good performance of the model and method used.

Graphs 3-6, showing comparison of the distribution of 1266 farms in 2012 based on four variables (Total output, Total costs, Farm net value added, Farm net income), prove the proper distribution of the estimated curves for all variables.

Accounting year	2011	2011e	%	2012	2012e	%
Source	FADN final	Estimate FADN	Change	FADN final	Estimate FADN	Change
Date of processing	October 2012	January 2012		November 2013	April 2013	
Farm net income	**19.13**	**20.04**	**4.74**	**18.97**	**17.82**	**-6.08**
Gross farm income	62.44	62.7	0.42	62.29	61.81	-0.78
Farm net value added	48.52	49.94	2.92	48.47	47.88	-1.2
Total output	129.53	129.45	-0.06	125.82	131.84	4.78
Subsidies (ex. on investments)	30.91	29.14	-5.73	30.81	32.35	5.02
Total costs	143.93	137.99	-4.13	139.31	149	6.95
Specific costs	54.78	55.92	2.08	52.9	57.86	9.38
Farming overheads	42.42	39.1	-7.83	40.68	43.72	7.47
External factors	32.81	30.21	-7.93	31.91	33.49	4.97

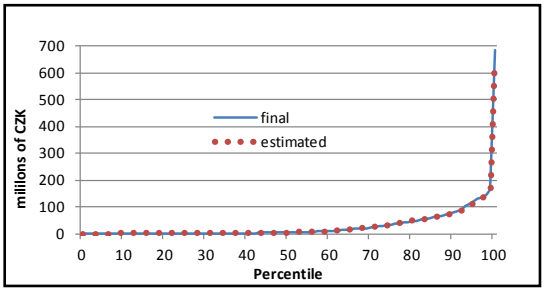
Note: 2011e, 2012e – estimated results
Source: FADN CZ, own processing

Table 2: Comparison of estimated results for 2011 and 2012 to final FADN results (billions of CZK)



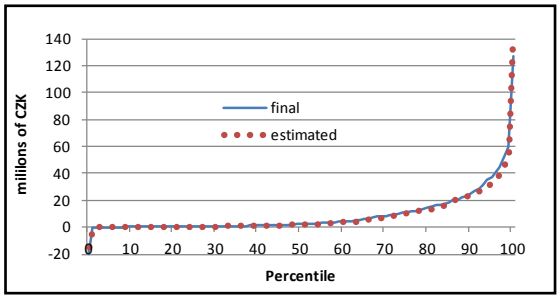
Source: FADN CZ, own processing

Figure 3: Final versus estimated Total output, FADN CZ 2012.



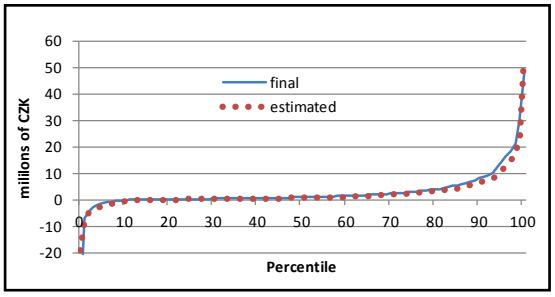
Source: FADN CZ, own processing

Figure 4: Final versus estimated Total costs, FADN CZ 2012.



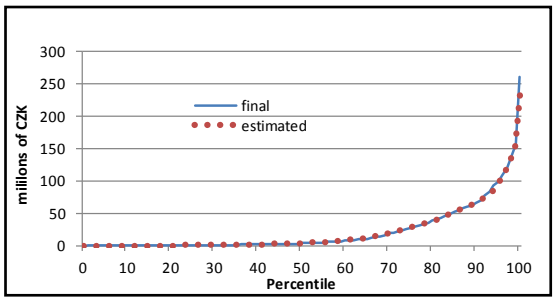
Source: FADN CZ, own processing

Figure 5: Final versus estimated Farm net value added, FADN CZ 2012.



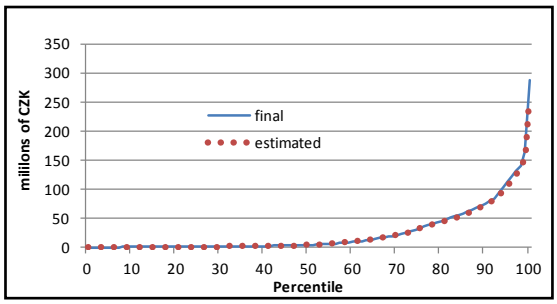
Source: FADN CZ, own processing

Figure 6: Final versus estimated Farm net income, FADN CZ 2012.



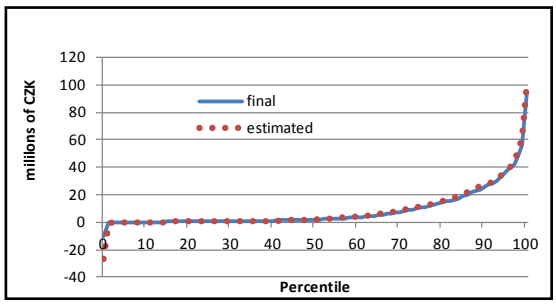
Source: FADN CZ, own processing

Figure 7: Final versus estimated Total output, FADN CZ 2011.



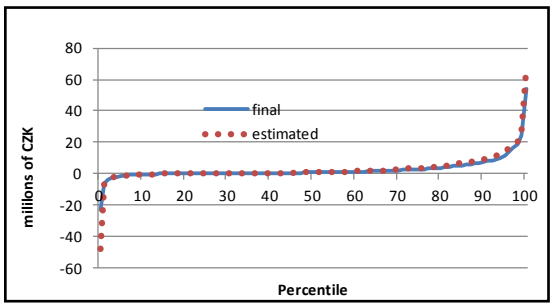
Source: FADN CZ, own processing

Figure 8: Final versus estimated Total costs, FADN CZ 2011.



Source: FADN CZ, own processing

Figure 9: Final versus estimated Farm net value added, FADN CZ 2011.



Source: FADN CZ, own processing

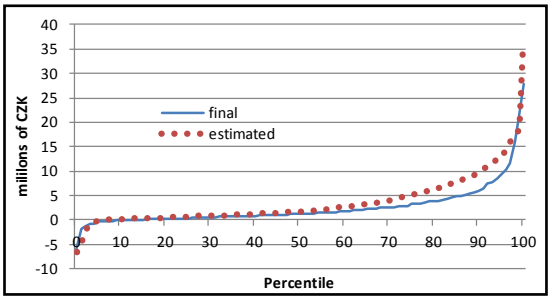
Figure 10: Final versus estimated Farm net income, FADN CZ 2011.

The graphs 7-10 demonstrate overall cumulative comparison of distribution for the chosen indicators of 1323 farms in 2011. Even in this testing period we can notice very

tight shapes between both estimated and actual curves indicating proper method was used for the projection.

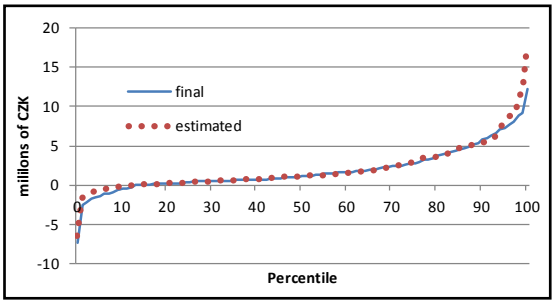
The amounts of production and costs were slightly underestimated for very large agricultural holdings as it can also be noticed in results for 2012. On the other hand Farm net income was overestimated for farms with very poor economic results. This under and over estimation can be explained by changes in farm structure, year-on-year improvement of management of farms or large volatility of prices during the estimated year.

The graphs 11-14 provide an overview of the distribution of Farm net income for the selected types of farming (386 specialists' field crops farms, 136 specialists' dairying farms, 152 grazing livestock – rearing and fattening farms and 421 mixed farms) for actual and projected results for the accounting year 2011. Farm net income for mixed farms and grazing livestock farms was projected with very good results what is confirmed by almost identical shapes of compared curves. The overestimation resulted for dairy farms with large FNI. Apparently the FNI rises less sharply for estimated results of field crops farms. The reasons of the differences are equivalent to those mentioned above.



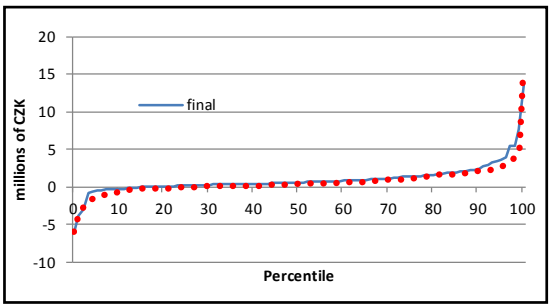
Source: FADN CZ, own processing

Figure 11: Final versus estimated FNI, Specialists' field crops farms, FADN CZ 2011.



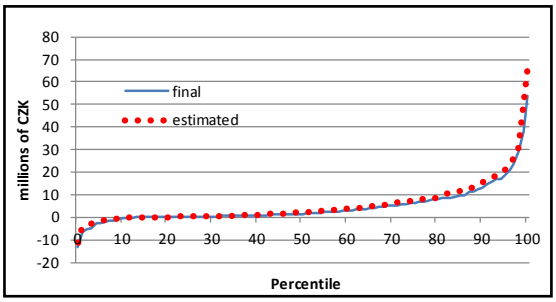
Source: FADN CZ, own processing

Figure 12: Final versus estimated FNI, Specialists' dairying farms, FADN CZ 2011.



Source: FADN CZ, own processing

Figure 13: Final versus estimated FNI, Grazing livestock – rearing and fattening farms, FADN CZ 2011.



Source: FADN CZ, own processing

Figure 14: Final versus estimated FNI, Mixed farms, FADN CZ 2011.

Conclusion

All results produced under the described method are presented in the form of estimates, which carry some risk of distortion or deviation from actual state. Accurate estimate is subject to many external factors that cannot be completely controlled. These are mainly due to extreme weather, high volatility of producer prices or year-on-year structural changes on farms. Also annual change of weighting factors might have some impact on the extrapolated results. First estimate, made in December of the estimated year, may be distorted by missing input information for the fourth quarter of the year, which naturally cannot be available at the time of calculation.

Using the modest techniques of index adjustments of microeconomic data for one-year income estimate does not cause significant impact on the distortion of the results.

Natural factors and the short-term decisions resulting from agricultural policy of the Czech Republic and the EU have an impact on both the production and economic results, which cannot always be predicted impeccably. Nevertheless, taking into account confirmation of the model by comparison of the estimated and final results,

the indicated risk of the distortion can be considered as acceptable.

Taking into account the evidence presented in this paper it can be concluded that the designed model and the methods used for the one year projection of the farm economic results based on FADN database work accordingly and the results can be considered as a usable contribution for the further analyses.

Acknowledgements

The results presented herein refer to the internal research project no. 1281 "Prediction of the Czech agricultural results on the basis of FADN database" conducted by Institute of Agricultural Economics and Information in Prague in 2013.

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Towards a Normalized Economic Mechanism Based on E-services

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Abstract

The article describes the conceptual foundations, architecture and main systems of the normalized economic mechanism based on e-services. This mechanism corresponds to the normalized model of the economy, called **NEc-model**. In this model money is treated as an electronic document that proves the cost of goods and property status of economic agents, and money issue is canceled. The model defines rules for e-banking, e-trade, e-investment, cleaner production and other.

Key words

Normalized economic mechanism, e-service, e-banking, e-trade, e-investment.

Introduction

The mechanism of an economic activity (EM) – one of the most complex organizational-technical systems invented by human beings. Improvement of EM based on e-services is one of the most urgent scientific and technical problems of economics and informatics (Ilyin, 1996).

Methods of doing business depend on the objectives set. The choice of the main goal of economic activity is not the subject of scientific discussion. In any economic model as in a model of human-machine system it is necessary to state the purpose of the model and formulate the objectives that it will help to solve. In the models offered in the famous works on economics (Fisher, 1922; Keynes, 1936; Friedman, 2005; Krugman, Wells, 2009) the default assumption is that the prioritized goal of economic agents is extraterritorial profit. For those seeking extraterritorial profit the main goal is not the economic development of the country. To achieve their goals corporations hire guest workers (Taran, 2011) and seek locations, which offer cheaper labor, land (Meyfroidt et al., 2013), etc. (e.g. in China and other Asian countries). The result – the population of developed countries loses professional qualifications and switch to activities not related to the production of vital commodities (VC production).

The conceptual basis of the EM of extraterritorial profit (PM) is supported by the ideas presented in (Fisher, 1922; Keynes, 1936; Friedman, 2005; Krugman, Wells, 2009). PM is presented as having faults, but having no alternative. The economic troubles inherent in PM are interpreted as the native elements or the unpredictable events like in casinos and racetracks. Not only financial, but also many state leaders, are accustomed to solving their economic problems by reducing the income of producers of real commodities and have a vested interest in the existence of PM.

The inevitable consequences of the use of PM are:

- the growing number of capable people who consume real commodities, but do not produce them;
- an unsustainable pattern in the real economy, including agricultural sector;
- the financial sector dominates the sectors producing real commodities (as money and securities remain highly profitable commodities);
- under the existing rules of the economic activities the state can lose control even over the corporations and farms producing vital commodities (the scheme is well known: enterprises borrow from foreign banks, debts which they are unable to pay back → as a result foreign banks become owners of the property of these enterprises).

Problems of climate change, intensification of pollution, inefficient use of agricultural land

and poorly managed migration of the working population are most obvious harmful consequences of the PM functioning (Taran, 2011; Meyfroidt et al., 2013; Helin, 2013; Skevas, Lansink, 2014; Lwasa et al., 2014). Economists, engineers and environmentalists are looking for approaches to solving the problem of environmentally sound economic growth (Valin, 2014; Lorek, Spangenberg, 2014).

There is also a technological component of the inadequacy of PM: in these days it remains essentially the same as it was before the Internet era. Money is issued and used without legal rules defining any connection with transactions of sale of real commodities. Moreover, different financial instruments (stocks, bonds, etc.) are issued, which are also traded.

The fact that modern banking technologies are provoking fraud proves the professional impropriety of the management of the central banks. Many banks are developing online services as they want to. Surely, the central bank of each technologically advanced country should take the initiative to develop requirements for unified online bank services.

The purpose of this article - to present some results obtained by the authors in studies dedicated to informatization of the economic mechanism (Ilyin, 1996; Ilyin, 2009; Ilyin, 2012; Ilyin, 2013; Ilyin, Ilyin, 2013).

Materials and methods

1. The normalized EM (NEM): general description

The first version of NEM was presented in (Ilyin, 2009), and the latest – in (Ilyin, 2012). A methodology and software for expert resource planning were presented in (Ilyin, 2013) and (Ilyin, Ilyin, 2013).

Economic performance depends on architecture of EM, stocks of resources, technological level and productivity of plants and farms, creativity and earning capacity of those involved in economic activity.

We consider expedient such architecture of NEM that would stimulate the citizens of a country

- to produce the required amount of vital commodities of the appropriate quality (including those necessary for defense) and maintain rational production structure;
- to invent and apply advanced technologies and means of their realization;
- to improve the educational system and the system of scientific research;
- to treat with care the human gene pool and natural resources (water, soil, fossils, etc).

Not all countries can manufacture VC independently. The composition of vital commodities varies from country to country. Joint-stock ventures, mutual investments, international trade unite manufacturers of different countries and make them beneficially interdependent.

We assume that economic well-being of a country (as a participant of global status rivalry) is determined, above all, by its ability to provide itself with a sufficient amount of vital commodities of the appropriate quality (including commodities for military defense), the ability to maintain a rational structure of production and the improvement in the qualifications of the work force.

NEM includes the following complexes:

- production of real commodities (**RC-production**);
- e-trade of real commodities (**RC-trade**);
- stockpiling of vital goods (**VG-stockpiling**);
- contractual money e-investment;
- the state budget, reserves, taxes and duties;
- regional budgets and taxes;
- social security funds;
- documenting the results of economic activity (**EA-documentation**);
- management of economic activity (**EA-management**).

NEM functioning is determined by a **system of obligatory and orienting regulations** (Ilyin, Ilyin, 2013). Obligatory regulations include the ones relevant to the country's laws. Regulations that determine the relations of economic coordination between corporations and citizens of different countries should be referred to as orienting regulations.

RC-production is the transformation of original resources (labor, equipment, materials, etc.) into real commodities of certain types. Manufacturers of real commodities: the systems of water-, heat- and energy supply; plants producing foodstuffs, clothing and footwear; complexes

constructing buildings, bridges, roads; planning and design offices, institutions for scientific research; education, recreational and healthcare facilities. The complex of RC-trade includes wholesale and retails companies (domestic and international) and means of storage and delivery.

The division of labor and specialization of manufacturers have resulted not only in improved products and increased productivity, but also in a number of social problems (including the problems of "single-industry towns"). Job creation for the able-bodied population is one of the goals of EA-management that constantly remains urgent. An acceptable solution to this problem requires a revision of production and distribution technologies.

1.1. Modularity, unification, complexation

The principle of constructing complexes from unified modules does not require an explanation. Modern farms and plants should be built (and those built earlier should be rebuilt) in accordance with this principle. Manufacturing complexes made from unified modules is the key method to solving the problem of unemployment among employable population.

1.2. Ordered production

The higher the cost of a product, the less reasonable it is to produce it without an order and delivery contract. Production to order is an alternative to production "to the warehouse". This mode of production is technologically provided by the modern electronic services (e-services); in particular, by e-services of information portals of modern corporations and farms.

1.3. An alternative to "economic growth"

Energy saving technologies for light and heat cause the reduction of energy consumption, and transition from paper documents to electronic documents will lead to the reduction of paper consumption. The list of examples of inevitable reduction of consumption that has become a consequence of technological advancements is easy to continue. Useful, functionally flexible, reliable and durable commodities should substitute commodities that do not have such characteristics. The popular cult of "economic growth" that is formulated as the total value of commodities bought (INTERNATIONAL MONETARY FUND, 2014) should be replaced by striving for technological rationalization of production of reliable and durable essential commodities. If production of the commodity is cleaner and its environmental safety is higher, then sales tax should be lower. Product specification should include data about the level of cleanliness of the production and environmental safety of the product itself.

1.4. Economic agents

In NEM-system, any capable person or entity has an electronic account of economic agent (EA-account) with unique global identifier (detailed in section 2).

Commercial economic agents can be either individual or corporate enterprises. Individual enterprise (I-enterprise) is set up by one capable person. Corporate enterprise (C-enterprise) is set up by more than one capable person. Regulations of the I-enterprise and Articles of Association of the C-enterprise must be endorsed by digital signatures of their founders and should be drawn up according to the electronic templates approved by law. The Articles of Association should include the amount of money and/or property objects invested by each of the founders, division of powers, conditions of withdrawal of the founders and accession of new members. The documentary proof of a state registration is the assignment of unique global identifier to the C-enterprise that is necessary to open its EA-account. References to relevant sections of the C-enterprise's EA-account are included into private EA-accounts of the founders. At the same time references to private accounts are included into the C-enterprise's account. Material liability of founders of the C-enterprise for its obligations should not be limited by money and property objects referred to in the Articles of Association.

1.5. VG-stockpiling

In addition to the state reserves it is desirable to develop a non-government stockpiling of vital goods. Vital goods in the depositary networks of state and non-government VG-stockpiles are a useful trade buffer (both for consumers and producers and for those engaged in wholesaling). The volume of different types of stockpiled vital goods is to be changed depending on the situation in a country, but in any case such a trade buffer contributes to better predictability of vital goods sales and, as a result, to the greater stability of production. Rational management of VG-stockpiling is an important objective, and the results of its decision influence price stability. It is rational to attract private and corporate investments to construction and exploitation

of the depositary network of non-government VG-stockpiles, and also to purchase of vital goods for them.

1.6. Technologies of resource allocation

Resource allocation problems belong to the main tasks of economic activity planning in NEM. Technologies for resource allocation are designed for implementation in e-services.

Technology of multi-resource allocation

Traditional software for multi-resource allocation does not allow an expert intervention in the search for solution. If given system of constraints is incompatible, programs propose to adjust the input data. To make up for these shortcomings, the authors have proposed the informal statement and method for solving the **general linear problem of resource allocation**, which has been called the **method of target displacement of solution**. This method is implemented in the **technology of interactive resource allocation in accordance with the customizable system of rules**. This technology allows an expert to search for plans in accordance with his knowledge of the applicability and efficiency of the plans. Software implementation of the technology has been developed and tested in a number of applications (Ilyin, 2013).

Expert planner defines rules of resource allocation in the form of requirements on the values of resource functions $F_i(\bar{x})$ – linear forms, whose values depend on vector of allocation $\bar{x}$ and numerical coefficients.

In general case, a simple rule can be written in one of three forms:

$$F_i(\bar{x}) = c_i\ [\xleftarrow{priority} p_i],\ F_i(\bar{x}) \le c_i\ [\xleftarrow{priority} p_i],$$
$$F_i(\bar{x}) \ge c_i\ [\xleftarrow{priority} p_i]$$

where F_i – resource function, c_i – constant, p_i – priority of the rule ($0 < p_i \le \infty$); square brackets denote optionality of priority.

A composite rule is a logical combination of simple rules.

Expert planner performs step-by-step search for solution [in dialogue with specialized software]. At each step he customizes rules that determine the change of solution. (Any rule may remain unchanged during the search).

The rules can be obligatory or orienting. Obligatory rules have an absolute priority ($p_i = \infty$), that is, they cannot be violated. Orienting rules specify the desired values of resource functions, setting the direction for displacement of solution.

Let $\overline{x^0}$ be a given vector of allocation, and

$$\{ F_i(\bar{x}) = F_i(\overline{x^0}) + h_i\ [\xleftarrow{priority} p_i],\ h_i \ne 0 \}$$

– a given composite rule: the simple orienting rules, related by conjunction, are enclosed in curly brackets.

Let say that the vector of allocation $\bar{x}$ satisfies the given orienting rules ($\bar{x}$ is more efficient than $\overline{x^0}$), if

$F_i(\overline{x^0}) < F_i(\bar{x}) \le F_i(\overline{x^0}) + h_i$ is true for each $h_i > 0$, and

$F_i(\overline{x^0}) + h_i \le F_i(\bar{x}) < F_i(\overline{x^0})$ is true for each $h_i < 0$.

The informal statement of general linear problem of resource allocation (Ilyin, Ilyin, 2013) is oriented to the computational experiment mode, which involves the possibilities of changing the input data and system of rules, governing the search for solutions. In general case, the expert planner solves a set of particular problems, having the formal statements and algorithms, and performs comparative analysis of solutions.

The developed technology (Ilyin, Ilyin, 2013) significantly extends the traditional arsenal of facilities for solving resource allocation problems (an expert can formulate and try to solve standard optimization problem at any step during the search for solution).

Technology of cost planning

Income is a variable for millions of individuals and companies. It may depend on the volume of sales, market prices, exchange rates and many other factors. However, even on a state level, expenditures are often planned on the basis of point assumptions about the total income. If such assumptions are wrong, the budget is to be altered. The planning results are also presented by exact value for each expense item, although in practice most of the costs cannot be predicted accurately. To address these shortcomings, authors have proposed formulation of the problem, where expected amount of the resource and requests are given by numerical intervals. The method

for solving this problem (Ilyin, 2013) is implemented in the CP-service (see 5).

1.7. Documenting the results of economic activity

The core of the EA-documentation complex is the **property status system (PS-system)**. Documenting the sale and purchase transactions, e-investments, gifts and donations, and documenting the public dues payments, is done by the **personal electronic banks of economic agents (PEBs)**, where original accounts and other documents of business activity are kept. At the closing of each deal the copies of participating accounts are updated on the servers of **banks-providers** that play the role of certifying centers and depositaries of updatable copies of the EA-accounts and other documents, and the same operations are performed on the servers of central bank once a day (or at another time period set by law). Documenting the corporation's internal operations is carried out using their own resources (on the basis of a form of documents and rules of document flow set by law). All the documenting is carried out in accordance with program-implemented system of rules. Each stage of documenting is done on the basis of advanced information technologies using tested hardware and software of PEBs, the servers of the central bank and the banks-providers. It is rational to implement **e-documenting commodities (EDC)** in the form of **EDC-services**. There should be a specification for every commodity that has a field "Documentation" for hyperlinks to e-documents, which specify all parameters of the commodity.

1.8. Property items and their exchange

Specified property items of a NEM-system (s-items) – are means of RC-production, RC-trade, VG-stockpiling, EA-documentation, EA-management belonging to economic agents and consumer items, registered in the NEM-system. Every s-item corresponds to a unified electronic specification that includes its name, purpose and characteristics. If it is a manufactured item, then a manufacturer and a release date and expiry date are recorded. A reference for sales and delivery regulations is indicted for the item to be sold. The s-item specification is an e-document that presents it as a commodity.

A commodity is a s-item which can be sold. Categories and types of commodities are to be determined by law. Within their categories (food, clothing, etc.) every type of commodity (in the category of food: bakeries, dairies, etc.) must have a unified specification that includes the number of this type according to the priority list of the category of commodities, information about customs duties and on the terms of sale within and outside the NEM-system. The type of commodity, within a certain category, determines the level of duties applicable on domestic and overseas sales.

S-items of refundable property exchange include:

- real commodities (including services of state mechanism);
- savings (money savings and non-monetary savings) of economic agents, reflected in their EA-accounts.

Money savings are used in purchase and sale transactions and in contractual **NEM-money** e-investments. Non-monetary savings, reflected in accounts by hyperlinks to specifications of registered property, are used in sales transactions involving credit (as collateralized property of the customer) and in contractual NEM-money e-investments (as collateralized property of the e-investment recipient). Donations (of real commodities and/or NEM-money savings), contributions and etc. relate to free of charge property exchange (the exhaustive list and terms of fulfillment are to be fixed by law).

1.9. The complex of EA-management:

- sets the goals and objectives for the development and improvement of NEM complexes mentioned above;
- directs and stimulates economic activity through taxes, excise, duties and other means of economic regulation;
- coordinates the fulfillment of the objectives and controls the results achieved.

The complex of EA-management includes state institutions (ministries and the central bank) and commercial institutions (boards of directors, etc).

Results and discussion

These days the approaches to the implementation of the PS-system (see 2), e-banking system (see 3) and multicurrency market (see 4) are discussed the most intensively. E-service for cost planning is already being tested (see 5).

2. The system of property status (PS-system) and NEM-money

The system of property status (PS-system) is the system of e-documentary representation of monetary and non-monetary components that reflect property status of economic agents. Monetary components are represented in NEM-money amounts that are in the currency sections of **unique unified multicurrency accounts of economic agents (EA-accounts)**. Non-monetary components of PS-system are represented by hyperlinks to e-documents proving ownership of land, houses, etc.

NEM-money is an e-document that serves for

- quantify representation of values of commodities and monetary components of EA-accounts;
- payment for commodities, taxes and duties;
- accumulation of wealth in universal form;
- contractual monetary e-investment;
- monetary gifts and donations.

NEM-money is represented by records in EA-accounts, which certify property rights to a share of the commodity value of the NEM-system and property liabilities in relation to other economic agents. Signed real numbers are used to present the sums in EA-accounts (the minus sign is used for those sums that are to be returned, the plus sign for those sums which have been received in accordance with contracts of closed deals). NEM-money has two states: assigned (e.g. a debt due to a commodity purchase; investment; tax, etc.) and non-assigned (sums in the "I own" sections of EA-accounts). Assigned NEM-money may be used only for a certain purpose [e.g. those received from investors can be used in accordance with the investment contract (purchase of new equipment, etc.)]. Non-assigned NEM-money is used according to the self-determination of the owner of EA-account (in any permissible deal). The NEM-money concept excludes money issue and excludes trade in credits and currencies.

A market value of a commodity is expressed by an amount of NEM-money and is a result of trade-off between a buyer and a seller, which depends on supply and demand. The NEM-money savings of an economic agent are reflected in his EA-account in the form of records of the currency sums in the sections "I own" and in subsections "I invested" of the sections "Investment". The values in the sections "I own" imply unbound savings [non-assigned NEM-money sums]; investment accumulation is recorded in subsections "I invested" of the sections "Investment" (an assigned sums that can be used only in accordance with e-investment contracts).

2.1. Purchasing power (tradable capacity) of NEM-money

Let us assume that in some region of NEM-system one can purchase el[A] kilowatt-hours of electric power for A rubles or wa[A] liters of fresh water. Amounts el[A] and wa[A] represent a regional tradable capacity of NEM-money (e.g. in rubles) for electric power and fresh water. The tradable capacity of NEM-money for similar types of commodities (e.g. electric power) can vary significantly in different regions of the NEM-system. It is rational to use the same amount A in all the regions within the NEM-system (to make comparisons of the regional tradable capacities for the chosen type of a commodity). Changes over time in the regional tradable capacity of NEM-money (for commodity types) reflect changes in the supply-and-demand situation (for commodities of these types). Data about these changes play an important role for producers and investors. It is efficient to publish changes in regional tradable capacity of NEM-money (for commodity types) on special web-sites of e-trade and bank portals.

The prevailing continuous decrease of the tradable capacity of money in PM-systems, as a rule, is determined by money emission and loan granting not only for purchases of commodities. The decrease of tradable capacity of money occurs also due to the employment of securities as a means of payment for real commodities. Besides, modern banking technologies do not exclude the possibility of using (for some period of time) money on clients accounts (without letting them know about it). Thus the organized decrease in the tradable capacity of money is fraud to take a part of money belonging to those who produce real commodities and selling them.

2.2. Unique unified multicurrency account of economic agent (EA-account)

EA-account is a unified e-document consisting of currency sections (which are activated by the central bank), each of which has the following basic items: "I own", "Lending", "Investment",

"Taxes and duties", "Gifting", "Donation".

The section "I own" includes an amount of NEM-money that can be used for any permissible deals (purchases, investments, etc.). The section "Lending" has two subsections – "Granted" (a sum of NEM-money lent) and "Received" (a sum of borrowed NEM-money). The section "Investment" includes the subsections "Invested" (a sum of invested NEM-money) and "Received" (a sum of received investments). There are other subsections in other sections also. Having assigned a time period, one can receive detalization for subsections of any section of the EA-account. The set of permissible operations for amounts recorded to EA-account is determined by subsections to which they belong (e. g. an amount from the "Received" subsection of a section "Lending" cannot be used for granting loans).

As far as an EA-account has a multicurrency structure, it can be applied to record the results of internal and overseas economic activities. The application of EA-accounts assumes that every economic agent has his own unique identifier (a conceptually similar project "National Strategy for Trusted Identities in Cyberspace" was published in the USA (The White House, 2011)).

Services of e-banking and the functioning of the EA-accounts are based on programmable sets of rules fixed by law. Access to the EA-account, reading of its content and recording of something are carried out by certified software that is installed on the PEB-device. Any change is registered, and a copy is automatically sent to a bank-provider that serves this PEB. Only results of transactions that are allowed by law may be recorded in EA-accounts [purchase and sale of real commodities (using lending or free from it), contractual investment, registration of real estate and etc].

3. E-banking system

The e-banking system of NEM is the primary means of EA-documentation. It includes **personal electronic banks (PEBs)**, **banks-providers** and **central bank**, which manages all the other banks.

A central bank is a state institution that manages the banking system.

The central bank performs the following functions:

- grants and revokes licenses to carry out banking activity (for owners of PEBs and banks-providers);
- activates and deactivates the currency parts of EA-accounts;
- controls implementation of banking activity rules;
- analyses the financial component of the NEM-system's activity and presents the results of analysis in order set by law;
- develops, modifies and approves tested unified forms of banking documents (including EA-accounts);
- controls the efficiency of monetary state reserve funds and social protection funds allocation, etc.

The central bank possesses a network of servers located on the territory of a country under whose jurisdiction the NEM-system functions.

Bank-provider is a commercial institution established by legal entity (or by associations of legal entities and individuals) which deals with RC-production, RC-trade or VG-stockpiling. The bank-provider produces and sells unified e-services to owners of EA-accounts.

These services include:

- processing queries of EA-accounts owners, which are sent by PEBs when the deal is effected (including queries to certify the state of the EA-account, sent upon authorization of its owner);
- storing of the copies of EA-accounts;
- analysis of investment inquiries of clients (prospective investors and investment recipients) (banks-providers can execute orders of investment recipients to consolidate investments in order to accumulate a desired sum);
- registering signed agreements [for permissible transactions] and maintaining the database of such agreements;
- legal support of deals etc.

Legal support of deals is an important component of bank-provider's services. The bank-provider disposes a consolidated network of servers, designed to process the queries of PEBs owners and to interact with the servers of a central bank.

Personal electronic bank (PEB) is a portable electronic device (like tablet PC) with smartphone functions. PEB stores the original EA-account and documents on deals. The mobile banking software (certified by central bank) is the core of PEB applications. The encrypted database

of an EA-account is stored in the memory of the device, and its copy is stored on the memory card. Only EA-account owner can initiate records in the files of EA-account. The copies of EA-account and documents of serviced deals are kept in the bank-provider's databases (for the period of time, set by law of the given NEM-system).

4. Multicurrency market and e-trade technology

To buy or sell a certain type of commodity any member of multicurrency market may choose a partner from any country with which there is a trade agreement. The choice can be made on e-trade portals where buyers and sellers place their offers. Price of any commodity may be presented in multiple currencies (of the allowed for this type of commodities). Sales tax (in currency that was used in trade deal) goes to the country that issued the license to sell the commodity. Realization of the idea of multicurrency market would reduce the harmful effects of the economic crisis. Krugman (2012) made a similar conclusion when he wrote about the plight of some EU countries.

Market prices are set in deals on twenty-four-hour operating e-trade portals. The beginning of a purchase and sale transaction is the signing of a typical contract (for this type of commodity). Banks-providers of the buyer and seller register the fact of signing the contract (the contract is kept in these banks together with the payment document). The seller does not have any rights to increase the price for this commodity after the moment of the signing (even if there are people who want to buy it at a higher price). The commodity itself does not matter. One of the necessary components of e-trade technology is the legal backing of purchase and sale transactions.

Domestic e-trade is done according to the rules that are set by the laws of the state under whose jurisdiction the NEM-system operates. E-trade deals among economic agents from different NEM-systems should be done following the given obligatory rules:

- the applicable set of currencies is represented by an intersection of the sets of currencies that are activated by central banks of the NEM-systems whose economic agents execute the deal;
- restrictions should be made corresponding to the list of commodities that are allowed for import and export, as defined by law and by international treaties.

Coordinating relations between countries are necessary while developing and implementing of the above rules. Any global regulators that are limiting the freedom of economic choice are not desirable. In particular, WTO rules do not always have a beneficial effect on the processes of competition for markets of agricultural products (Soukup, Brčák, Svoboda, 2014).

5. E-service for cost planning (CP-service)

Widest area of the CP-service usage is the budgeting (although the CP-service allows to plan any resource costs). The CP-service is designed for distribution of expected funds between expense items. Service user downloads and installs a client application for his operating system. With it:

- User specifies an interval for expected funds assuming the worst and the best conditions.
- User specifies a table of expense items, and for each row he enters the lowest and the highest expected costs (or exact value) – the requests of the expense items. Priorities of the requests can be specified and optionally used in calculations.
- User can create a table of details for any expense item. Any item in details can also be detailed, etc. Different data precision can be used for different tables.
- User commands "Allocate" from his application. It connects to the CP-service via Internet and sends it a request for resource planning (request contains only numbers).

The CP-service performs calculations and sends results back to the client application, which shows them to user. The results contain values "Give min." and "Give max." for each expense item. Sums of min. and max. values comply the specified minimum and maximum funds respectively. Subsequently, when user receives or spends a part of the funds, or obtains more precise information on the income and expenditure sides of the budget, he adjusts the input data, commands "Allocate" again, and gets refined results. When user specifies the funds exactly (i.e. minimum = maximum), the received values „Give max." can be treated as exact decision of the cost planning task.

The CP-service and its client applications are presented at **www.res-plan.com**.

Conclusion

The most dangerous trends of the last decades are climate change, intensification of pollution, inefficient land use, poorly managed migration of the working population and the intensive growth of the non-producing but actively consuming part of population (which requires a continuous increase in budgetary expenditure on social assistance). Agricultural sector is most vulnerable to these trends: farms lose not only the necessary human and natural resources, but also a significant part of budget support.

The rules regulating economic activity imposed by the state at each stage should correspond with the objectives of development and protection of the country's potential, and the state regulating impacts (in the spheres of taxation, customs duties, investment and other) should direct activities of economic agents to achievement of these objectives. It should be much more profitable for economic agents to comply with those rules than to break them.

It is advisable to immediately start step-by-step design and implementation of the NEM. Complexes of RC-production, RC-trade and VG-stockpiling have to become highly adaptive to changes in demand for vital goods and to requirements regarding their quality. NEM-money should become a means of e-documenting the results of economic activity. Every economic agent should have unique electronic multicurrency account (EA-account) that reflects monetary and non-monetary components of property. A loan must become a deferred part of payment for purchase, according to a contractual schedule. Contractual e-investment must be targeted at the development of RC-production, VG-stockpiling, RC-trade etc.

The following concepts of the NEM have particular importance for agricultural producers:

- buyer lending by sellers and contractual investment based on technologies of personal and corporate electronic banks
- multicurrency market
- nets of VG-stockpiling
- state regulation of imports and exports in accordance with systems of obligatory and orienting rules

Implementation of unified technologies for multicurrency e-trade and e-investment is especially important for the agricultural sector because many farms are in need of expanding the market, attracting and making investments (Maart-Noelck, Musshoff, 2013).

	Basic NEM principles
EA-management	**RC-production:** modularity, unification, complexation; ordered production
	VG-stockpiling: the state reserves and a non-government stockpiling of vital goods
	Multicurrency market: e-trade, e-investment
	EA-documentation
	- PS-system: NEM-money, EA-acounts
	- E-banking system: central bank, banks-providers, personal electronic banks (PEBs)
	The state budget, reserves, taxes and duties
	Regional budgets and taxes
	Social security funds

These days the concept of normalized economic mechanism is being implemented in the framework of research at the Institute of Informatics Problems of the Russian Academy of Sciences. Online services of cost planning and interactive resource allocation according to the customizable rules have been developed (Ilyin, 2013; Ilyin, Ilyin, 2013).

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Agritourism Farms and the Web. An Exploratory Evaluation of their Websites

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Abstract

In the last few years, the contribution of the agricultural sector to tourism has been increasingly evident. Agritourism provides the possibility to have a green holiday experience and allows farmers to diversify their income. In the tourist sector, communication is decisive in determining consumption choices, and the Web plays an important role. Considering that the Internet can bring potential benefits and reach new customers, it is important that websites are complete and attractive. This paper evaluates agritourism websites in an Italian region (Sicily) to analyse the strategic choices made by farmers. This study uses the eMICA methodological approach to analyse the quality of the websites and a cluster analysis to find homogeneous groups of farms. The results indicate that there is a large group of Sicilian agritourism providers that have been slow in taking advantage of the new opportunities offered by the Web, whereas another group, which is less numerous, makes use of social networking tools, demonstrating web 2.0 communication.

Key words

Agritourism, websites, eMICA model, cluster analysis.

Introduction

Among the activities developed by agricultural farms, tourism is spreading with great speed. Today, agritourism has an international dimension, and it is present in various regions of the world (Van Huylenbroeck et al., 2006). In the European Union, the European Commission has been very supportive of this type of economic activity because it represents local development (Briedenhann, Wickens, 2004; European Commission, 2006; UNWTO, 2000). Agritourism allows the agricultural entrepreneur to diversify their income, and, at the same time, it is part of the activities related to the concept of agriculture multifunctionality (Renting et al., 2009). In Italy, agritourism is well developed. It is an Italian specificity in the panorama of rural tourism in Europe, and this is because of the particular legal order that regulates the matter. Italy's 1985 National Legal Framework for Agritourism states in its second article that agritourism activities "must remain connected and complementary to farming activities" (Sonnino, 2004).

Even if it is linked to agriculture, the hospitality offered by farmers is still a tourist activity, with all that implies. Often termed country hospitality or agritourism, according to several studies, this type of experience is becoming an important component in today's leisure society (Putzel, 1984; Nickerson et. al., 2001; Havlíček et al., 2013). During his holiday, the tourist has the opportunity to live in contact with nature, learn about and appreciate local products (Chinnici et al., 2014; Platania, Privitera, 2006) and learn about rural culture.

Even the way in which the tourist chooses the farm follows the prevailing trends in the tourism sector. Among the „decision places", the virtual place plays a dominant and growing role. More and more frequently in fact, the choices of tourists are made on the basis of the information they collect through the Internet, a place where the potential customer can compare and make more responsible choices (Buhalis, 1998; Wan, 2002). In the last decade, the development of the Internet has been well established and, without a doubt, created a competitive environment in the world of tourism. It has become an important distribution channel and a tool, especially for competition and tourism development (Kim et al., 2007).

To ensure the effectiveness of web pages, it is necessary that the information they contain is able to communicate the local identity and the specific nature that are the basis of the competitive advantage of the farm.

The competitive advantage of a „place“ is not, therefore, only communicated via natural resources but also by the dissemination of information and the image that it is able to project, which also creates a virtual experience for the surfer (Hanna, Millar, 1997). It is obvious that the choice of „how“ and „what“ to communicate are crucial to attracting tourists during trip planning.

The aim of the paper is to analyse how the farms present themselves on the web. The survey and analysis of the data were based on a sample of agritourism farms in the region of Sicily, which, by number can be defined as representative. The methodological point of view that has been adopted, albeit with the necessary adaptations, is an extension of the Internet Business eMICA (extension Model of Internet Commerce Adoption), originally developed by Burgess and Cooper (2000) and taken up by other studies and adapted to the tourism sector (Doolin et. al., 2002). The model was used to analyse the characteristics of the farm websites. On the basis of the scores obtained from the sites identified, a Cluster Analysis was applied that led to the identification of homogeneous groups of farms.

Materials and methods

The evaluation of the websites of Sicilian farmhouses was developed through an exploratory survey through which the data were collected on the characteristics of the sites according to the eMICA model. This model allows analysis of the complexity of a website in which it is possible to perform a commercial transaction, assuming the presence of several „moments“ of interaction with the consumer gradually more evolved from a „static“ site designed based on simple description of the information to a website that is inclusive of information and offers services with high interactivity.

The formulation of the model, which was originally called „MICA“, is related to the contribution of Burgess and Cooper (2000). This methodology describes the adoption of electronic commerce, as applied to the industrial sector, through an evolutionary process of Web sites, depending on the variables of time, complexity and functionality. The model clearly demonstrates how sites evolve, moving from a „static“ state to a „dynamic“ and finally „integrated“ state, and which variables determine their optimal level of functionality.

The methodology is based on three main stages of recognition of the sites: promotion, functionality (in terms of interactivity with the user) and maturity of the process (transactions). Each stage includes variables that allow analysis of the characteristics of the site.

In subsequent years, the MICA model has been integrated into the study of the variables that characterise a website, and the model has been applied in other industries such as tourism (Doolin et al., 2002; Hashim et al., 2009), revealing an alternative to simple exploration sites and aiding analysis of the development of technological applications on the Internet. In particular, Doolin et al. (2002), studying the application of MICA in tourism, have reworked the model (defined eMICA). They have a greater number of „layers“ within the three main stages, with the aim of deepening, in terms of functionality and sophistication, the process by which we come apply electronic commerce (Platania, Privitera 2011).

In fact, the eMICA model, because of its special characteristics, is very useful for evaluating the functionality of a website and allows judgments not only of the commercial function but also of the informative functionality and, in general, an understanding of the type of market strategy the farm is using.

In this study, the eMICA model was adapted for application to the websites of agritourism farms.

The design of the research provided, at an early stage, the development of survey sheet information. In total, 54 variables were defined, and their composition differs from the eMICA model because of the additions, some typical and some functionally related to the agritourism sector (figure 1).

Subsequently, the number of agritourism sites to apply the model to was decided with the application of quota sampling. This is a non-probability sampling technique wherein the sample has the same proportions of individuals as the entire population with respect to known characteristics. Initially, the population analysed should be divided in groups based on some structural variables, and then, based on information available from official sources, the weight percentages of each group should be decided (Marbach 1992). In this study, the overall population was those on a list of farms licensed by the Region of Sicily to engage in agritourism activity (available online at http://pti.regione.sicilia.it/). The population was divided by provinces, and we chose to define a representative sample of 16% of the regional total (Table 1).

eMICA	Examples of functionality
Stage 1 - promotion	
Layer 1 - basic information	Company name, physical address and contact details (links, map, GPS coordinates), product and service images
Layer 2 - rich information	Email contact, information on company activities, news, links to institutional sites of the territory
Stage 2 - provision	
Layer 3 - low interactivity	Basic product catalogue (farms, rooms, restaurant, services), websites in English language
Layer 4 - medium interactivity	Higher-level product catalogues (e.g., tourist trail), customer support (e.g., FAQs, sitemaps, weather)
Layer 5 - high interactivity	Social tools (e.g., vCard, Facebook page), discussion forum, multimedia, RSS feed, accessibility (SSL certificate)
Stage 3 - processing	
Layer 6 - processing	Secure online transactions, interaction with corporate servers, booking

Source: adapted from Burgess and Cooper (2000)

Figure 1: The extended model of Internet Commerce Adoption (eMICA).

Province	Total number of farms authorised by the Region of Sicily (2012)		Sample (16%)	
	n.	%	n.	%
Agrigento	31	5	5	5
Caltanissetta	22	4	4	4
Catania	90	15	14	15
Enna	40	7	6	7
Messina	102	17	16	17
Palermo	90	15	14	15
Ragusa	62	11	10	11
Siracusa	108	18	17	18
Trapani	43	7	7	7
Total	588	100	94	100

Source: own processing based on Region of Sicily data.

Table 1 : Quota sampling counting scheme.

For the identification of the websites, we proceeded using the Internet. In particular, the selection procedure was to type the name of the province into the search engine followed by the Italian word „Agriturismo" (agritourism). The surveys, conducted in May 2014, continued until reaching the quota sampling set for each province.

To process the data, descriptive statistics were used, which allowed detection of the presence/absence of the variables examined. In particular, these were detected according to the three stages. For each detected variable, a progressive score was assigned, the same for each layer, starting with 0.5 (Layer 1 - basic information) up to a maximum score of 3 (Layer 6 - processing). Overall, a database of 5076 results (54 attributes for 94 sites) was prepared.

Subsequently, these data were processed using multivariate analysis techniques for grouping to analyse the behaviour of the agritourism farms in terms of strategic choices and orientation to the tourist market using the characteristics of their websites. In particular, a direct classification algorithm (non-hierarchical) around mobile centres (K-Means algorithm) (Molteni, 1993) was employed, using the Quik clusters present in the statistical package SPSS.

Results and discussion

The website evaluation allowed, first, the verification of the presence and/or absence of the variables included in the eMICA model. Specifically, the analysis of the variables belonging to the first stage, that of „Promotion", clearly indicated a good level presented by the total sites

examined, both within layer 1 (basic information) and in layer 2 (rich information) (Table 2). This first group of variables is essential in the first stage of contact with the Internet user, as it allows him to know with certainty the main references useful for planning any trip or for collecting information on the area.

Layer 1 - basic information	
Media gallery photo	100.0
Phone number	98.9
Owned URL	97.9
Map	91.5
GPS coordinates	42.6
Where to find us: links	39.4
Layer 2 - rich information	
Contact email	100.0
Logo	78.7
Information on the resort	36.2
News section	26.6
Links to the territory	21.3
Music background	8.5

Source: own processing

Table 2: Presence of the variables of Stage 1 „promotion“ divided by layer (val %)

The websites of the selected farms were structured to provide the necessary information to the user, such as the presence of images of places (variable detected in 100% of sites), information relating to the telephone contacts (98.9%) and those of the localisation company through a map (91.5%). Information necessary to movement in the territory was less common, such as variables related to the presence of GPS for satellite navigation and the main links between the agritourism and the localities in the area. Even for „additional information“, the second layer of this first stage, the results indicate good presence of these variables, such as email contacts (100%), a logo (78.7%) and information about the main tourist places in the territory. Other variables related o communication, such as the presence of news and information about the area the farm is located in and the presence of a news section, were scarcely present.

The variables belonging to the second stage of analysis (functionality) are characterised by their explanatory power on the level of interactivity and were the most common. In this group of variables, there are those instruments that seek to emphasise the quality of the tourist places and attempt to decrease the distance between the „real supply“ and „the virtual“. The results indicate a varied presence of the variables examined (only one variable was found to be totally absent from the sites examined) but at lower percentages than in the first stage (Table 3).

Layer 3 - low interactivity	
Information on the building	84.0
Information on additional services	80.9
Information about prices	74.5
information about the rooms	69.1
Website in English	63.8
Information about restaurants	56.4
Information about farm	33.0
Available in a third language (besides English and Italian)	33.0
Links to more information	30.9
Advertising messages coherent	23.4
Layer 4: medium interactivity	
Quality mark issued by the regional government	89.4
Website update	72.3
Quality labels issued by associations of tourism	34.0
Itineraries	30.9
Slider images	24.5
Guest book	7.4
Downloadable brochure	6.4
Skype	4.3
Weather information	3.2
Group Purchase Deals	2.1
Sections: cooking recipes	1.1
Webcam	0.0
Layer 5: high interactivity	
Page on social networks (Facebook, Google+, etc.)	51.1
Write your own review on Tripadvisor or Trivago	28.7
Media gallery movies	28.7
Like button	26.6
Share button	13.8
Booking off-site with credit card	13.8
Mailing list	8.5
Media Gallery: 360 °	6.4
RSS feed	4.3
Booking off-site	4.3
W3C accessibility	4.3
vCard	2.1
Mobile version of the website	2.1

Source: own processing

Table 3: Presence of the variables of Stage 2 „provision“ divided by layer (val %).

The variables of the third layer (low interactivity) were quite commonly present and provide information regarding the journey and, in particular, information on the structure (84%) of the farm and additional services (80.9%), prices (74.5%), rooms (69.1%) and food (56.4%). It is interesting to note that information on the farm was only present in 33.0% of cases. Therefore, it appears that many of these also farmers keep their two activities (the strictly agricultural and tourism) separate in terms of business strategy. In 63.8% of the cases observed, the website also featured a version in a foreign language (English), which thus ensures effective transmission of information for foreign demand, whereas the percentage of sites that provide information in a third language (33.0%) was lower. In addition, there was a low presence of advertising messages coherent with the vocation of the site (23.4%). This variable is very important because its presence is indicative of a website designed in a strategic manner, as coherent advertising, in addition to providing profit, provides services and generates networks with other operators.

Regarding the variables related to medium interactivity (fourth layer), some were quite commonly present and linked to business information, such as the presence of a brand that certifies the quality of the farm, as well as those related to issuances by the regional government (89.4%) and by organisations and associations operating in the tourism sector (34.0%). However, lower values for some instruments of „dialogue“ were recorded, making it more expensive or complex for the user to manage, such as providing information on regional weather (3.2%), the presence of a guest book (7.4%), the possibility of downloading information and advertising material (6.4%) and the availability of a Skype number to use to contact the farm (4.3%).

This section concludes with the second stage variables related to high interactivity (fifth layer).

In this layer, there were variables related to linkages with the major social networks. There were several companies identified that manage their own page on Facebook or Google+ (51.1%), which invite users to click on the buttons, such as social network „like“ (26.6%) or share (13.8%) buttons.

There are also a number of attributes, especially technical, with a low presence, such as more sophisticated website graphics with video (28.7%), RSS feeds (4.3%), and accessibility according to the W3C standards (4.3%). Even lower values were recorded for vCards (2.1%) and mobile versions of the site (2.1%), as well as for the more sophisticated graphical functions (such as a 360° view of some farms).

The last stage observed was „Processing.“ At this stage, it was possible to assess the efficacy of the farm's strategy to approaching the demand (Table 4). In fact, the analysis revealed how the farms are lacking in this aspect. There were few agritourism websites examined that allow a complete transaction of a tour package (1.1%) or the possibility to book online using a credit card (1.1%).

Most of the agritourism sites (67.0%) offer a simple form to fill out, where the tourist provides the necessary information for reservations. In some cases, the website provides only the phone number and email of the farm.

Finally, there are only a few agritourism sites that allow surfers the opportunity to purchase local products from the same farm (1.1%).

Layer 6 – processing	
Availability request (form to be filled in)	67,0
Opportunity to purchase off-line products from company	3,2
Online booking with credit card	1,1
Opportunity to purchase products online from company	1,1
Booking payment online	1,1
Online booking without credit card	0,0

Source: own processing

Table 4: Presence of the variables of the Stage 3 – processing (val %).

The clustering of the agritourism websites

The use of cluster analysis allowed the obtainment of a more thorough analysis of the main strategies pursued by the agritourism farms through their websites. As already explained, the C.A. was applied to the scores obtained from the websites for each layer (Table 5). The identification of the number of groups is a classic problem of Cluster Analysis. Although there are some statistical tests that allow you to estimate the appropriate number (Beale, 1969; Marriot, 1971), the experience of the researcher remains the most appropriate yardstick. Therefore, assuming the risks arising from the subjectivity of the choices, we proceeded in the analysis of classification and eventually identified three groups.

	Stage 1- promotion		Stage 2 - provision			Stage 3 - processing
	Layer 1 - basic information	Layer 2 - rich information	Layer 3 - low interactivity	Layer 4 - medium interactivity	Layer 5 - high interactivity	Layer 6 - processing
First cluster (n. 11). Mean within the first cluster (a)	2.32	2.18	5.45	3.09	10.45	4.09
mean within the remaining sample (b)	2.36	2.78	8.60	4.05	4.13	5.35
PR (c= a/b)	0.98	0.78	0.63	0.76	2.53	0.76
Second cluster (n. 29) mean within the second cluster (a)	2.52	3.17	10.29	5.86	7.67	5.90
mean within the remaining sample (b)	2.28	2.51	7.32	3.08	3.62	4.89
PR (c= a/b)	1.11	1.26	1.41	1.90	2.12	1.21
Third cluster (n. 54) mean within the third cluster (a)	2.27	2.57	7.69	3.07	2.22	5.06
mean within the remaining sample (b)	2.46	2.90	8.96	5.10	8.44	5.40
PR (c= a/b)	0.92	0.89	0.86	0.60	0.26	0.94

Source: adapted from Burgess and Cooper (2000)

Table 5: Descriptive statistics (mean) of variable values within the clusters and corresponding statistics within the remaining population sample, prevalence ratios (PR).

To analyse the characteristics of the clusters, prevalence ratios (PR) were calculated as the ratios between the mean of every value layer in the segment and the mean of the same value layer in the remaining sample. Using the PR, it was possible to conduct an analysis in more detail, allowing demonstration of how it is possible to assume three clusters of strategic behaviour.

The first cluster, consisting of 11 websites, is formed by a set of farms that have given greater importance to the instruments connected to social networks. In fact, in that cluster, agritourism farms presented low PR for almost all levels, with the exception of high interactivity. The farms belonging to this cluster provide users with basic information, considering their presence on social channels more strategic and linking these to their website.

In the second cluster, consisting of 29 websites, the PR value is the highest for all stages, except for high interactivity. The group of farms belonging to this cluster have fairly complete websites from the point of view of information and with discrete levels of interactivity. Their presence on the Internet is based on the transmission of information including the use a variety of quite innovative technological aspects.

Finally, there is the third cluster, to which the majority of the companies (54 websites) belong. This cluster is in an intermediate position. The websites that belong to this cluster are not distinguished in any layer. The understanding of this cluster is quite easy. It identifies the most common strategic behaviour practiced by agritourism providers on the web, namely the presence of minimum technological, informative and commercial content.

Conclusion

Tourism activity can be an instrument to support the income of farms and allow local development. For this to be possible, it is very important that agritourism be presented to markets in an efficient manner, even those that are virtual. In fact, the process of buying the tourist product is completed increasingly more often on the web.

The farms cannot fail in this scenario. They must take advantage of the technological tools in a strategic way to inform the consumer and to bridge the gap between demand and supply.

Therefore, a website is strategically important to obtaining benefits in terms of lowering the asymmetry of information.

The analysis performed on the sample of sites of farms operating in the region of Sicily has highlighted some aspects that affect the choices of Internet use. If, on the one hand, the amount of information available appears to be sufficiently large and easily accessible, the majority of sites, with some exceptions, do not offer a complete online experience. The survey results, in fact, indicate that in terms of a strategic plan, most of the companies surveyed use the Internet only for communication of basic information, which is a web 1.0 communication style. There is also a small group of companies that use the website in a very light manner and have shifted their communication to social channels, which is closer to a web 2.0 communication style.

Overall, the characteristics of the web sites of these farms makes, therefore, very difficult to open in new markets. The simple static site (brochure site) in the medium and long term is certainly not competitive. In addition, openness to social channels should be a loyalty strategy rather than the main mode for transmitting information in the virtual market. We are faced, then, a situation that, with a few interesting exceptions, is still lagging behind in the tourism market online.

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Semantic Network in Information Processing for the Pork Market

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Anotace

Základním cílem příspěvku je zachytit prvky jednotlivých informačních rámů a jejich vzájemné vztahy a vyjádřit ztrátu informací a informační asymetrii v tržním prostředí pomocí sémantické sítě. Preference prvků v síti jsou vyhodnoceny analytickým síťovým procesem (ANP). Přínosem aplikace sémantické sítě v tržním prostředí je zvýšení informovanosti spotřebitelů a snižování informační asymetrie.

Využití sémantických sítí bude ukázáno na analýze informačního rámu výrobce, distributora a spotřebitele na trhu s vepřovým masem. Proces rozhodování v prostředí trhu s vepřovým masem je ovlivněn mnoha faktory. V informačním rámu spotřebitele vyjadřuje spotřebitel svá očekávání a preference, podle nichž se rozhoduje. Výrobce pracuje s větším rozsahem informací o výrobku, než je k dispozici pro spotřebitele. Distributor získává informace jak od výrobce, tak pomocí marketingových nástrojů od spotřebitele, tyto informace však obvykle nesděluje v úplném rozsahu spotřebiteli ani výrobci, čímž vzniká informační asymetrie.

Klíčová slova

Sémantická síť, efekt zarámování, rám výrobce, rám distributora, rám spotřebitele, informační asymetrie, analytický síťový proces.

Abstract

The main aim of this paper is to capture the elements of individual information frames and their relations using semantic network; and to express the loss of information and information asymmetry in the market environment. Preferences of elements in the network are evaluated by the Analytical network process. The benefits of applying semantic networks in the market environment are in increasing consumer information and reducing information asymmetry.

The use of semantic networks will be shown in the analysis of the information frames of the producer, distributor and consumer in the pork market. The consumer's frame expresses expectations and preferences, according to which decisions are made. Producer operates with greater range of information about the product than is available to the consumer. Distributor receives information from both the producer and from the consumer, but this information is not usually fully shared to the consumers or producers. This creates information asymmetry.

Key words

Semantic Network, Framing Effect, Producer's Frame, Distributor´s Frame, Consumer's Frame, Asymmetric Information, Analytic Network Process.

Introduction

The integral part of any decision-making is the information receiving and processing. As Fagley, Coleman and Simon (2010) mention decision-making is influenced by the quality of the information and its processing and by the effect of information distortion (framing effect). Tversky and Kahneman (1981) argue in their studies, that the framing effect included in some information can significantly influence decisions. There are various views on a particular issue in decision-making process. Bishop (2006) believes that if information is not sorted according to its relevance because we cannot properly decide who has the most important view, we may face the problem of being overloaded

with too much information resulting in either poor information acquisition or the whole process is very time consuming and thus very ineffective. Even when we sort information according to our preferences we may lose the information needed for successful decision making. To reduce these negative impact of the frames we need firstly to define and understand them, secondly, as pointed out by Druckman (2001), we need to evaluate them, and thirdly we need to use the appropriate method to limit them. For this kind of evaluation as Fagley, Coleman and Simon (2010) write we need to know the importance of various frames and included points of view.

The typical example of the frame's impact on decision is the information written on the product´s package. As Kozel (2006) detailed analyses, the packaging inevitably influences our purchase decisions. According to Lindsey-Mullikin and Petty (2011) and Vysekalová (2011), the product packaging can attract our attention; affect our emotions, but on the other hand, by its information content it can contribute to the rational purchase decision. Each consumer has his unique view when buying a specific product (his unique way of perceiving the situation) based on his personality. His purchase decision is influenced by the preferences and expectations; this process is represented by the framing effect of the decision situation, which discusses in detail Rydval (2010, 2012). The framing effect is manifested in the same manner in producer's, distributor's, and consumer's decision-making. To define the framing effect, the frames influencing producer's, distributor's, and consumer's behaviour the semantic networks can be used.

The semantic network was developed at the end of 1960s (Sowa, 2000). Semantic networks were originally used to express meanings of various expressions in natural language. However, their present form of directed graph consisting of nodes and edges they became more general graphical tool to represent knowledge, which consist of information about the particular fact (Xia, Bu, 2012, Steyvers, Tenenbaum, 2005).

According to Sowa (2000) semantic networks are used namely because of their ability to provide easily usable system to represent information focused mainly on organisation of large information sources, information integration in distribution and description of complex processes. Semantic networks offer the tool to represent knowledge and they display their connections and relationships.

Semantic network can display individual elements influencing the decisions of producers, distributors and consumers. It provides us with information about relationships in the network between individual elements and how they can influence the decision. However, it does not give us the quantitative information about the importance of individual elements and how much they influence higher level elements.

Therefore we suggest converting semantic network to network consisting of clusters and nodes for the Analytic network process (ANP). The Analytic Network Process is one of the multiple criteria decision-making methods. It decomposes decision problems into a network of smaller parts (sub-problems) that can more easily by analysed and evaluated. It is specific for this method that the human judgment is involved. (Saaty, 2001).Using this method we can determine the cardinal quantitative information evaluating the individual elements influence on other elements in the same or higher level of the semantic network and we can measure the influence of network's elements in decision-making process in the market environment.

The goal of this paper is to map and quantify the distortion of information which occurs in the decision-making. The suggested approach is based on the semantic networks which can capture the basic elements of the information frames and their mutual relationships to express the possible loss of information and its asymmetry. The relevance of the identified elements in the network is then estimated using Analytic Network Process. The practical application of the semantic network and the ANP is demonstrated in the case of the producer's, distributor's and consumer's information frames in the pork market environment.

Materials and methods

In the same situation different decision-makers obviously decide according to the different criteria, frames. The important decision-making information and knowledge for each of them can be included into the semantic networks which describe the basic elements of their information frames and their mutual relationships identified in the decision-making process. The impact and relevance of each element of the semantic network are measured using multi attribute approach ANP. The pairwise comparisons correspond

to the logical connections and relationships of the semantic network.

Semantic Network

Semantic (associative) network can be seen (Sowa, 2000) as a directed graph consisting of nodes and edges. Nodes represent individual objects of described world and edges connecting these nodes represent relationships between these objects. Very often we can meet with following types of the relations:

- IS-AN-INSTANCE-OF (ISA) relationship is used to express the fact that a particular object (an instance of a particular class) belongs to the specified class.
- A-KIND-OF (AKO) relationship can express that a class is a subclass of another class.
- A-PART-OF (APO) relationship serves to express that a certain class of objects is composed of certain parts.

The basic advantage of the semantic network is that it contains information similarly as information is stored in human memory, and it is machine-understandable. This means that it can be machine-processed - is it possible to analyse facts and information included in the semantic network and to acquire new knowledge about represented facts (Xia, Bu, 2012, Steyvers, Tenenbaum, 2005).

Semantic networks have following basic characteristics:

- The network is transparent - the finite number of nodes has only finite number of edges.
- The network allows quick navigation - from any part of the network it can be relatively quickly reaches any other part.
- The network can be structured defining the local sub-networks.
- The network has a natural „entry points“ – starting points for the navigation.

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Analytic Network Process

The Analytic Network Process (ANP) is a multiple criteria decision method considering the dependence across the elements and levels of the hierarchy because many decision problems cannot be structured hierarchically. Therefore, ANP is represented by a network, rather than a hierarchy. (Saaty, 1990, 1996, 2003)

The basic steps of the ANP method are following:

- The first step - definition of a network which describes inner dependence within a set (clusters) of elements, and outer dependence among different sets (clusters).
- The second step – the pairwise comparisons of the elements within and across the clusters are made. The consistency of these comparisons has to be checked.
- The third step - construction of the normalized supermatrix with the preferences derived from the previous pairwise comparisons
- The fourth step - the limiting supermatrix is computed and global preferences of decision elements are obtained (Saaty, 1996, 2001, 2003)

Evaluation of ANP network can have various forms, e.g. personal judgement or surveys. The ANP calculation is than supported by the software SuperDecisions system (SuperDecisions). The program was written by the Creative Decisions Foundation.

Results and discussion

Proposed approach is illustrated in the example of the pork market environment. This case study shows how semantic networks and the ANP help to model the producer’s, distributor’s and consumer’s preferences. Thus it helps to decide what information should be shown on the product packaging and makes the product more attractive for the consumers. Semantic networks and ANP may serve as a supporting tool in the marketing strategy.

Three basic semantic networks were identified (Rydval 2012):

- Semantic network of the producer’s frame - refers to the basic features and links of what affects the producer in selecting the information about his product.
- Semantic network of the consumer’s frame - refers to the basic features and links of what influences consumer demand

in certain product.

- Semantic network of the distributor's frame - refers to the basic features and links of what influences distributor in the selection of published information about the product.

Using structured interviews and analysis information on the packaging of the product the essential elements were identified. These elements are the basic elements of the three basic frames in the pork market. Rydval (2013) wrote the three basic frames are: producer's, distributor's and consumer's decision-making frames.

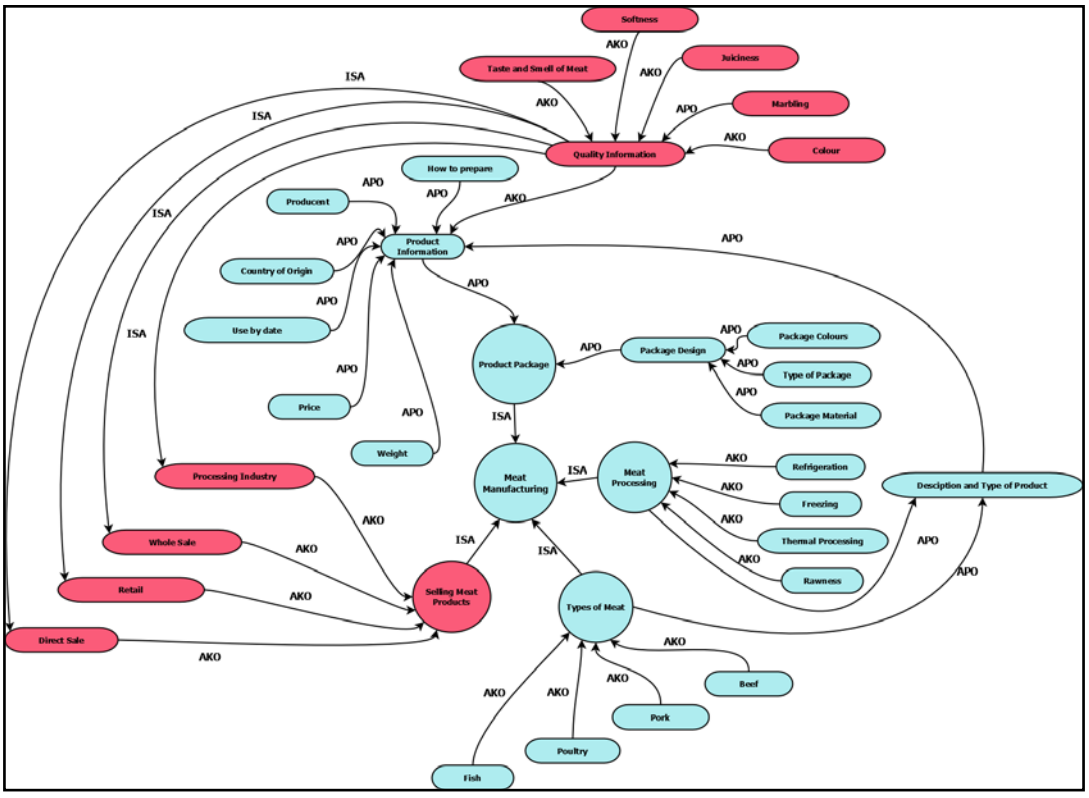
The created producer's and consumer's semantic networks are then integrated into a comprehensive network of distributor (Figure 1, Figure 2, Figure 3). This semantic network gives us the overview of what aspects should be taken by distributor into account when buying pork from producers and distributing pork to consumers.

Producer's frame

Semantic network of the producer's frame shows what affects the decision about information published on product packaging. Figure 1 shows that the Meat manufacturing of the production of pork and its distribution to the consumer consists of four sub-networks (areas of producer's attention), which influence producer's decision. These are:

- T*ypes of meat,*
- *Meat processing,*
- *Selling meat products,*
- *Product package, which consists of two other sub-networks:*
  - *Package design,*
  - *Product information, which include the Quality information sub-network.*

Red elements of semantic network represent information processed by the producer, but often not shared with the consumer or not interesting for the consumer. At the same time this information about the quality of pork is important for producers, which proves Rydval (2012) in the case study. This case study shows that the quality of pork is important for the producer of 43% (calculated using AHP approach).



Source: own processing

Figure 1: Producer's semantic network of Meat manufacturing.

Consumer's frame

Semantic network of the consumer's frame shows what affects the perception of information (published on product packaging) when purchasing the pork. Figure 2 shows that the consumer´s frame Meat Purchase consists of five sub-networks (areas of consumer's attention), which influences his/her decision. These are:

- *Types of meat,*
- *Meat processing,*
- *Recommendations,*
- *Level of need satisfaction,*
- *Product package, which consists of two other sub-networks:*
  - *Package design,*
  - *Product information.*

The product information on the packaging includes: Weight, Price, Expiration date, Manufacturer, Country of origin, Distributor and usually Instructions for preparing the product, or important information about the ongoing marketing campaign.

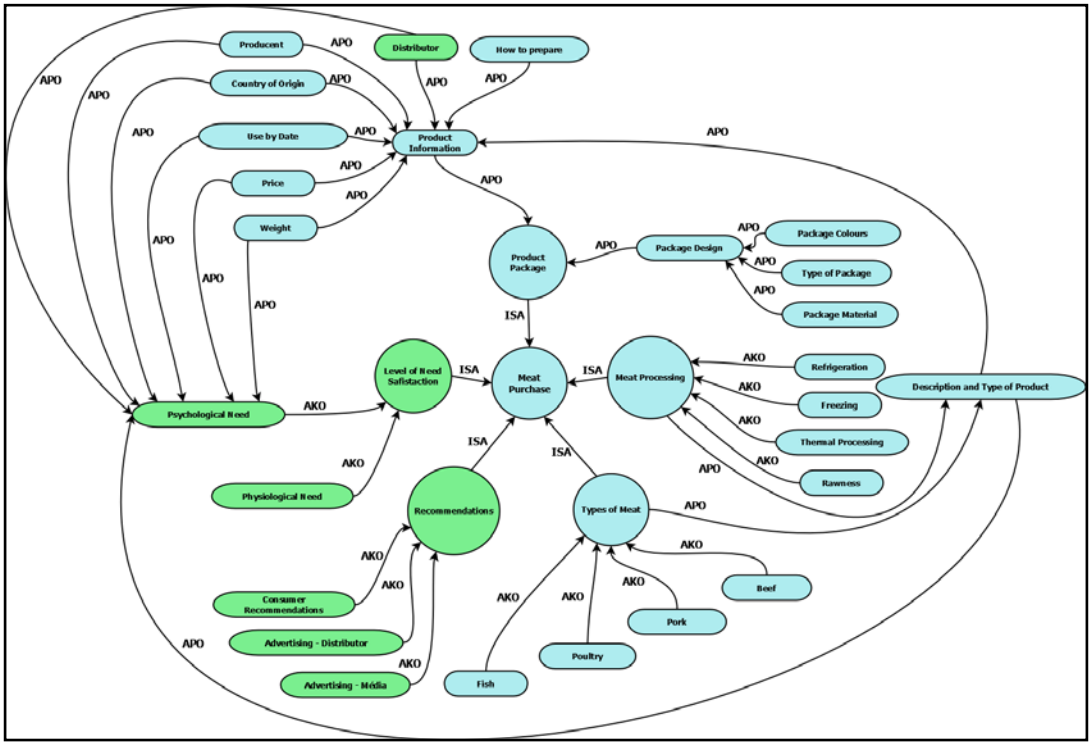
Some of this information (basic elements of semantic network) contributes to the satisfaction of the psychological needs of consumers, which, together with the physiological needs of consumers leads to the customer satisfaction. The semantic network allows clearly display interrelationships of each element in the decision-making process and it can be used for further analysis of consumer behaviour.

Green elements of semantic network represent information processed by the consumer, but often not shared with the producer or not interesting for the producer.

Distributor's frame

Semantic network of the distributor's frame gives the overview of aspects which should be taken into account when distributor buys pork from producers and when distributes pork to consumers. Figure 3 shows that the Meat distribution frame consists of five sub-networks (areas of distributor's attention), which influences distributor's decision. These are:

- *Types of meat,*
- *Meat processing,*
- *Buying meat from distributor,*
- *Selling meat to consumer,*



Source: own processing

Figure 2: Consumer's semantic network of Meat purchase.

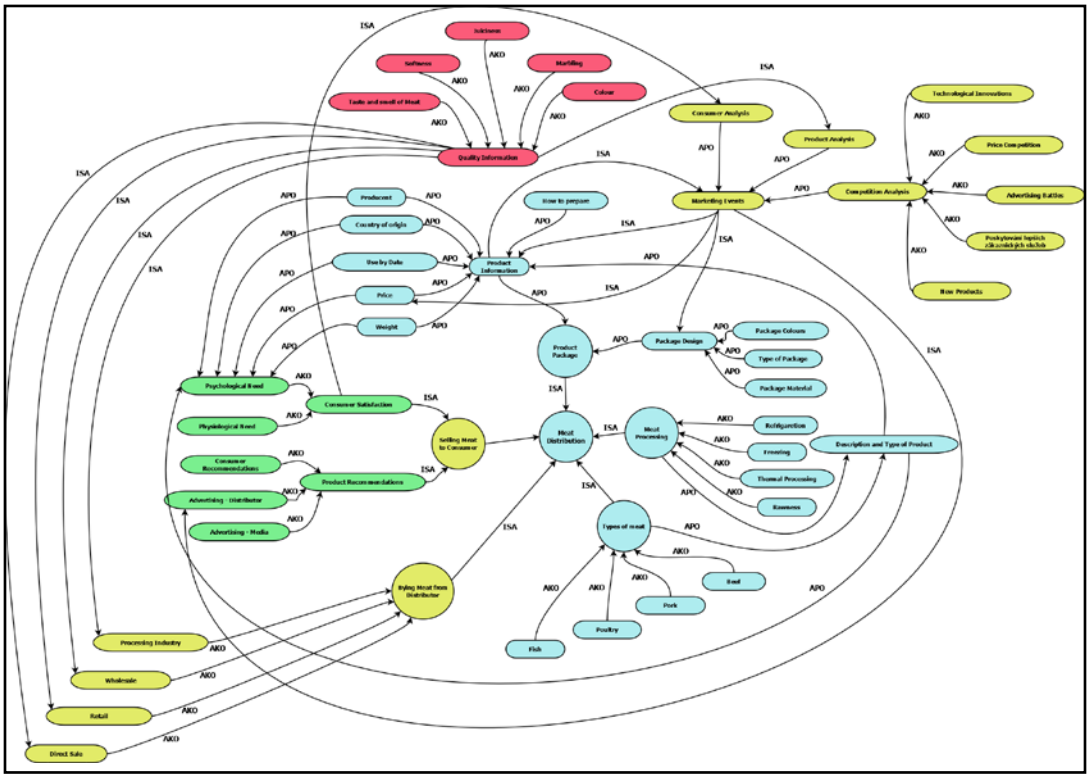
- *Product package, which consists of two other sub-networks:*
  - *Package design,*
  - *Product information.*

The nodes of the semantic network represent the basic elements of the distributor‘s frame and individually oriented arrows between nodes represent connections and relationships between them. As shown in Figure 3, we can see that the distributor receives information about the quality of the pork from the producer. The distributor has information about consumer’s preferences and expectations, and using marketing tools he can affect the consumer’s behaviour. These steps may influence the decision-making process in consumer’s behaviour.

The information on the product packaging includes information that distributor considers as relevant to the attractiveness of the product for the consumer, in particular the Information on quality of meat, Product information and Price.

Information about the way of meat sale is important for producers to choose the form of the product distribution. Meat producer is responsible for publishing the correct information about the quality of the pork and the information is one of his main competitive advantages in the battle for the customers.

Figure 3 points to the fact that the distributor has the greatest amount of information about the product. Distributor has all the quality information from the producer (red in Figure 3) and by using various marketing tools he obtains information on what motivates consumers to buy a product (green in Figure 3). Yellow elements of semantic network represent information (received from marketing research) processed by the distributor, but often not shared with the producer or consumer. Figure 3 also clearly shows the product information asymmetry in the producer-distributor-consumer information chain. Information asymmetry is expressed in different availability of the information sub-networks. Some of them are available to the distributor, but not to the producer or to the consumer. The distributor can use or misuse this information as a competitive advantage in the battle for the customers.



Source: own processing

Figure 3: Distributor’s semantic network of Meat distribution.

Quantification of the semantic networks

As shown in Figure 3, the distributor has the most available information within the pork market environment. The distributor's main problem is how to make his product more attractive to the customer. Some relevant distributor's questions (Vysekalová, 2011) are as follows:

- *What elements of the product design play the most important roll?*
- *What sort of information is important for the marketing events?*
- *What information on the product packaging, customer focused on?*
- *What takes the consumer in to account when buying pork?*

Distributor can get an adequate response for these questions with proper analysis and evaluation of the basic elements of the semantic network.

Field survey in Prague was carried out in the case study and responses from 203 customers and 9 producers of pork were received. The field survey took the form of an opinion poll. There were determined the preferences and expectations of the respondents in the pork market environment. The respondents aged 18-60 years were from Prague.

The impact and relevance of each element of the semantic network are measured using multi attribute approach ANP.

Based on the ANP the importance of the colour, material, and type of packaging in design of product packaging was calculated. As shown in Table 1 the colour is the most important for the design (75.31%), while packaging material (for instance paper used) is less important (only 6.29%).

Design of product packaging	colour of packaging	75.31%
	type of packaging	18.40%
	material of packaging	6.29%

Source: own processing

Table 1: Design of product packaging.

Table 2 shows that the consumer analysis in a successful marketing strategy is the most important (63.70%).

Analysis for marketing events	consumer analysis	63.70%
	product analysis - quality information	25.83%
	competition analysis	10.47%

Source: own processing

Table 2: Analysis for marketing events

In the Table 3 is calculated what kind of product information on product packaging is the most important for the consumer. The most important information is price of product (39.32%).

Product information	consumer analysis	63.70%
	price	39.32%
	marketing events	24.75%
	quantity	12.25%
	date of consumption	10.83%
	description and type of product	5.50%
	country of origin	3.26%
	producer	2.45%
	how to prepare	1.63%

Source: own processing

Table 3: Product information.

Table 4 shows what affects the selling the pork to the consumer.

Meat sale to the consumer	consumer analysis	63.70%
	satisfaction of psychological consumer´s needs	44.32%
	reference of product	38.32%
	advertising	12.17%
	satisfaction of physiological consumer´s needs	5.19%

Source: own processing

Table 4: Meat sale to the consumer.

And in the Table 5 there is calculated what kind of information is the most important for the consumer analysis. That the most important is the satisfaction of consumer´s psychological needs.

Consumer analysis	consumer analysis	63.70%
	satisfaction of psychological consumer´s needs	44.32%
	reference of product	38.32%
	satisfaction of physiological consumer´s needs	12.17%
	advertising	48.52%

Source: own processing

Table 5: Consumer analysis.

Using results of this analysis and evaluation of the basic elements of the semantic network distributor knows what information should be taken into account for preparing new marketing campaigns:

- To attract the product to the customer is necessary to use adequate colour and graphic design of product package.
- In preparing marketing events the distributor should focus his attention on data obtained from the analysis of the customer.
- With it, he learned that the most important information on the product packaging for the customer is the price and any other benefits of running marketing events.
- Distributor should take emphasis on meeting the psychological needs of the customer.

Conclusion

This paper deals with the describing, modelling, and analysis of the factors affecting our rational thinking, our ability to make rational decisions; in particular, with the framing effect in decision-making process and its graphical representation and quantification, using semantic networks and the ANP method.

The described case study shows that semantic network can be used to define the basic information frames of main subject of market environment. To define the frames and the construction of semantic networks can be used structured interviews (opinion poll).

The individual clusters and nodes with their logic consequences are used as the ANP network, and quantitative characteristics of semantic networks can be calculated. The data for this calculation can be received by the questioning of the relevant respondents from the market environment or by the experts' opinion.

By the comparison of semantic networks of individual actors of the market environment, transfer and loss of information in the producer-distributor-consumer chain can be defined. Using the comparison of the created semantic networks we can also identify the information asymmetry of market environment and the possible cause of externalities of the market process.

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Appropriate tools of Marketing Information System for Citrus Crop in the Lattakia Region, R. A. SYRIA

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Anotace

Produkce citrusů představuje jediný zdroj obživy pro mnoho rodin v regionu Lattakia v Sýrii. Zemědělci, kteří citrusy pěstují, nemají dostatek informací o očekávaných cenách na trhu, přičemž tyto informace jsou nezbytné pro jejich rozhodování. Pro farmáře je nutné vzít v potaz rozdíl cen, dle místa a roční doby při arbitrážích citrusů tak, aby mohli omezit vliv překupníků. Cílem článku je verifikovat užití SARIMA modelů jakožto vhodného nástroje pro informační tržní systém a predikci cen na trhu Lattakia v Sýrii.

SARIMA modely byly testovány pro predikci velkoobchodních cen pro trh Lattakia. Data byla získána ze stávajícího tržního informačního systému pro region Lattakia. Na základě výsledků je možné konstatovat, že SARIMA model (2,1,0) $(1,0,1)_{12}$ je vhodný pro predikci cen a může být součástí tržního informačního systému. Data byla zpracována v softwaru Minitab.

Klíčová slova

Tržní informační systém, Lattakia, Sýrie, citrusy, rozhodovací proces, SARIMA model.

Abstract

Citrus production represents the only livelihood source for many families in Lattakia region. Citrus farmers are not informed about expected prices. This information is crucial to make business decisions. For the farmers is necessary to take into account the spatial and temporal arbitrage of citrus harvest and storage, which may improve citrus farmer's position in marketing chain and reduce the influence of intermediaries. The aim of the paper is to verify using of SARIMA models as a tool of Agricultural Marketing Information System for citrus price forecasting in Lattakia region, R. A. Syria.

The SARIMA model were tested for citrus wholesale prices prediction at Lattakia market in the paper. SARIMA model was applied on the empirical data, obtained from the actual Marketing Information System in the Lattakia Region. Results showed that SARIMA model (2,1,0) $(1,0,1)_{12}$ is suitable for seasonal prices prediction. This method is suitable to be part of AMIS. The data was processed in software Minitab.

Keywords

Marketing Information System, Lattakia, Syria, citrus fruits, decision-making, SARIMA model.

Introduction

Syria is a Mediterranean country, where agriculture plays a key role in enhancing the national economy through its multiple contributions to the economic and social development process of the country. Citrus is an important crop in the Syrian Arab Republic, it is consumedboth as fresh fruit and citrus juice. Citrus production provides an important source of income for more than 35, 000 Syrian farm families located in the coastal governorships of Lattakia and Tartous (CBS, 2014).

It is very important to find the way how to provide the services to the farmers. Csótó (2010) says: „information technology is regarded as mediating channels and a vehicle for new services". Shepherd (1997) describes the contribution as follow: „A Market Information Service is seen as providing "transparency," i.e. a full awareness of all parties of prevailing market prices and other

relevant information.This, in turn, can contribute to "arbitrage," i.e. the act of buying at a lower price and selling at a higher price. In theory, when a marketing system functions efficiently prices at different markets are influenced by arbitrage activities of traders, i.e. "spatial arbitrage." takes place. Traders take advantage of price differences until these differences decrease to the level of transaction costs. "Temporal arbitrage" is the storing of products in order to take advantage of expected higher prices later in the season or, in some cases, in subsequent years". In Lattakia region the more profit party of the market chain was intermediaries and farmer suffer from them. Deepak et al. (2007) viewed: ,'marketing intermediaries in developing countries as parasites, taking advantage of farmers weak bargaining power and poor economic conditions" so, Agriculture Marketing Information System (AMIS) may improve farmers market position. To make an AMIS more economically sustainable and effective, one has to provide basic information on prices and market conditions free to all the target participant and the extension services (Dinar, 1996). Therefore the aim of this paper is to develop model which could help to the farmers in the decision making process and improve the income of citrus producers from one side and increase its contribution to the national economy from the other.

In Syria the MIS is arranged by Ministry of Agriculture. The data are collected as daily prices for all main Syrian markets. The collected data are stored in archive. But they are no available in electronic format and they are not published. That's why there is a lack of information for stakeholders.

To find the appropriate way there is necessary to collect and process the data of the farmers. Aker and Mbiti (2010) found that mobile phones have spread from urban centers to rural areas as well as from the wealthy to the poor in developing countries, as a tool for collecting and disseminating of marketing data.Users who implement a MIS should find that they are better able to:

a) make informed marketing decisions;
b) negotiate with others in the marketing chain;
c) organize production and sale; and
d) facilitate group discussion and decision-making (Shepherd, 1997).

Citrus prices in Syria have seasonal Characteristics and more fluctuation between the months and markets, the price fluctuation risk of agricultural products has become one of the main risks faced by agricultural producers (Chuan, Junye, Min, 2010).

Price fluctuation and changes was very important issues to the farmers in Lattakia region, the increased price of the commodity has generated significant discussion on the causes and on making appropriate decision (Timmer, Dawe, 2007, World Bank, 2008, Sugden, 2009).

The analysis of price volatility is necessary to develop bidding strategies or negotiation skills in order to maximize profit (Kuwornu et al., 2011). White and Dawson (2005) indicated that, planting decisions are taken on the basis of expected prices at harvest time; hence forecasting food prices will give farmers the opportunity to take informed decisions regarding planting in the future. Autoregressive integrated moving average (ARIMA) models (Tomek, Myers, 1993) lead to more accurate estimates. One of the most important and widely used time series models is the (ARIMA) model, which serves as a benchmark model for creating linear models because of it theoretical elaborateness and accuracy in short term forecasting (Jhee, Shaw, 1996). Nochai and Nochai (2006) in this paper was forecasting oil palm price of Thailand in three types as farm price, wholesale price and pure oil price for the period of five years, 2000 – 2004. Applying ARIMA model Hossian et al. (2006) forecasted three different varieties of pulse prices namely motor, mash and mung in Bangladesh with monthly data from January 1998 to December 2000; Pargami et al., (2013), in this research showed that SARIMA parametric model enjoys the most power in modeling the time series of monthly retail prices and, the most appropriate model for forecasting the monthly retail price of Privileged Sadri rice. Felipe et al., (2012) based on the daily prices of soybeans of the years 2000 (from January) to 2011 (until October) describe short-term forecasts by using ARIMA model, and it was observed that the ARIMA (5,0,0) or simply AR (5), responded as the best model. Seasonal ARIMA (SARIMA) model is described by Sampson et al. (2013): „Among the seasonal decomposition models of forecasting, Seasonal Autoregressive Integrated Moving average (SARIMA) method could enable producers achieve better market positions by adopting the practice. The SARIMA model is an extension of the ARIMA model into capturing

both seasonal and non-seasonal behavior of a time series data". Adanacioglu and Yercan (2012) this paper analyse the seasonal price variation of tomato crop and to develop a Seasonal ARIMA (SARIMA) model to forecast the monthly tomato prices at wholesale level in Antalya, SARIMA (1, 0, 0) $(1, 1, 1)_{12}$ model was selected as the most suitable model to forecast of tomato prices.

The SARIMA model was used by Cahndran and Pandey (2007) to forecast potato wholessale price of Delhi market. They found that the SARIMA model (1,1,1) $(1,0,0)_{12}$ fits well for short-term seasonal price forecasting. Luo et al., (2013) concluded that SARIMA model (1,0,1) $(1,1,1)_{12}$ as a well fitting for short-term vegetable prices forecasting and warning.

In Syria the MIS is arranged by Ministry of Agriculture. The data are gathered as daily prices for all main Syrian markets. The collected data are stored in archive. But they are no available in electronic format and they are not published. That's why there is a lack of information for stakeholders. Using the SARIMA model as a part of AMIS for citrus crop should help to provide information about expected prices and their seasonal volatility. According these information farmers could decide which market and intermediary provide them the best option to yield the profit. To provide all needed information the AMIS should consist of three parts: database of citrus products (contains the daily prices and quantities traded. This part is working in this moment, but the data are not published.), database of citrus producers and market research database. The last mentioned one should contain predicted (expected) and real minimum and maximum prices, theoretical and real supply and demand for given markets.

The objective of this paper is to verify the Seasonal ARIMA (SARIMA) models as a tools of AMIS topredict future prices of lemon Autochthonin Lattakia region in Syria, R. A. The predicted monthly prices may help farmers in choosing the right time and place for selling their citrus fruits.

Materials and methods

There were stated research question: Are the ARIMA, resp. SARIMA models suitable to be part of the Agricultural Marketing Information System (AMIS)?

The main aim of the paper is to verify using of SARIMA model as tools of Agricultural Marketing Information System (AMIS) for citrus price forecasting in Lattakia region, R. A. Syria. The purpose of the SARIMA model is forecasting the price during the year with the price volatility. The SARIMA model is based on the prices from previous years.

Materials

The market data are gathered by the Ministry of Agriculture, Lattakia Agricultural Economic Directorate and Marketing Department in Syria. The extension officers collect data from main wholesale markets. The data are available for daily maximum and minimum prices and production quantity for each regional wholesale market. These data were obtained by one of the authors (H. Sulaiman) during his visit in Syria. There were available data with daily prices for several varieties of lemon traded at local market. The data were not available in electronic form, so there was necessary to transfer them to the MS Excel. Then the data were transferred to the monthly average prices of lemon Autochton on Lattakia market for years 2010 – 2013. There were 48 observations with an average of 33.31 and the minimum value of 16 recorded in the year 2012 and maximum value 83,7 recorded in the year 2013, and the dispersion of the values of this series for an average by the value of standard deviation of 19,05, which gives an idea about the degree of non-homogeneity of the sample of data. SARIMA model was created in SW Minitab and use monthly data described above.

Lemon Autochton variety is one of the most important varieties for 35,000 familly in Lattakia region. Its annually production in Lattakia is about 50,000 tonnes and lemon Autochton is produced over the whole year, unlike the other varieties (CBS, 2014). But there is also big volatility of prices during the year caused by limited possibilities to time and storage the harvest. It is very important to bring analysis of the prices and find appropriate model providing important information (forecasted prices) for the farmer and all the market chain of lemon Autochton.

Year / Month	2010	2011	2012	2013
January	17.10	17.70	16.00	23.30
February	21.50	19.80	17.00	26.00
March	18.40	19.80	19.60	25.90
April	18.60	20.10	28.10	26.30
May	28.20	22.60	48.00	29.70
June	34.30	37.80	57.70	49.60
July	65.80	42.40	47.80	55.70
August	53.40	63.80	65.50	83.70
September	60.60	57.30	60.10	75.20
October	17.10	16.30	17.10	21.40
November	18.00	18.40	19.30	24.20
December	17.30	17.40	18.30	20.00

Source: Agricultural Directorate in Lattakia

Table 1: Lemon Autochthon monthly prices 2010-2013 (in SYP/Kg).

Seasonal Autoregressive Integrated Moving Average (SARIMA) Model

There is a number of studies using the ARIMA models for prices forecasting. Numerous studies have shown this method is effective compared with the other methods. Mishra and Singh (2013) say that: „the econometric model ARIMA is a time series which was introduced by Box and Jenkins, (1970). The model is one of the most popular methods for forecasting, generally a non-seasonal time series can be modeled as a combination of past values and errors, which can be denoted as ARIMA (p, d, q) which is expressed in the following form:

$$X_t = \theta_0 + \Phi_1 X_{t-1} + \Phi_2 X_{t-2} + \ldots + \Phi_p X_{t-p} + e_t$$
$$- \theta_1 e_{t-1} - \theta_2 e_{t-2} - \ldots - \theta\, e_{t-q} \ldots E_q$$

Where X_t and e_t are the actual values and random error at time t, respectively, Φ_i (i = 1,2,……., p) and θ_j (j = 1,2,……, q) are model parameters, p and q are integers and often referred to as orders of autoregressive and moving average polynomials respectively. The random errors et are assumed to be independently and identically distributed with mean zero and the constant variance, σe2. Similarly a seasonal model is represented by **SARIMAs (p, d, q) x (P, D, Q)** model, where P = number of seasonal autoregressive (SAR) terms, D = number of seasonal differences, Q = number of seasonal moving average (SMA) terms. Basically this method has four phases: model identification, diagnostic, parameter estimation and checking.

Seasonal Autoregressive Integrated Moving Average Model

SARIMA (p.d.q) (P.D.Q)s

$\emptyset_p(B)\Phi p(B^s)(1-B)^d(1-B^S)^D{}_{Zt} = \delta+\theta\_q(B)\ \Theta_Q(B^s)\ a_t$

$\emptyset_p(B) = \{\Phi_1, \Phi_2, \ldots . \Phi_p\}$ Autoregressive parameters

$\emptyset_p(B) = 1 - \Phi_1 B - \Phi_2 B^2 \ldots\ldots\ldots - \Phi_p B^p$

$\theta_q(B) = \theta_1, \theta_2, \ldots\ldots\ldots \theta_q\}$ Moving Average Parameters

$\theta q(B) = 1 - \theta_1 B - \theta_2 B^2 \ldots\ldots\ldots - \theta_p B^q$

B Back displacement parameters where:

$BZ_t = Z_{t-1}$

$B^2 Z_t = B(BZ_t) = BZ_{t-1} = Z_{t-2}$

$B^m Z_t = Z_{t-m}$

this time series $\{Z_t\} = \{\ldots\ldots Z_{-1}, Z_0, Z_1, Z_2 \ldots\ldots\}$
Where the values:

Autoregressive seasonal factor

$\Phi_P(B^s) = 1 + \Phi_1 B^s + \Phi_2 B^{2S} + \ldots\ldots + \Phi_p B^{ps}$

$\Theta_Q(B^s) = 1 + \Theta_1 B^s + \Theta_2 B^{2s} + \ldots\ldots + \Theta_Q B^{Qs}$

$a_t \sim$ WN $(0, \sigma^2)$ White Noise series

It is a series of observations uncorrelated (independent), and have identical distributions with the value of average of zero and a constant variance

$a_t \sim WN\ (0, \sigma^2)\ \ (I.I.D)$ Independent Identically Distributed

$E(a_t) = 0\ \forall\ t$

$$\text{Cov}\ (a_t, a_s) = \begin{cases} \sigma^2 & \forall t, \forall s, t = s \\ 0 & \forall t, \forall s, t \neq s \end{cases}$$

The proposed model for this series is: SARIMA $(2,1,0)\ (1,0,1)_{12}$

$(1-\Phi_1 B - \Phi_2 B^2)(1- \Phi_1 B^{12})(1-B)z_t = (1-\Theta_1 B_{12}$

$a_t(1-\Phi_1 B-\Phi_2 B^2 - B+\Phi_1 B^2+\Phi_2 B^3 - \Phi B^{12}+\Phi_1 \Phi B13 +$

$\Phi_2 \Phi B^{14} + \Phi B^{13} - \Phi_1 \Phi B^{14} - \Phi_2 \Phi B^{15})z_t = (1-\Theta_1 B^{12})a_t$

By calculation was found:

$z_t = (1+\Phi_1)Z_{t-1} + (\Phi_2 - \Phi_1)Z_{t-2} - \Phi_2 Z_{t-3} - \Phi Z_{t-12}$
$- (\Phi_1 \Phi+\Phi)Z_{t-13} + (\Phi_1 \Phi-\Phi_2 \Phi)Z_{t-14} + \Phi_2 \Phi Z_{t-15} + a_t$
$- \Theta a_{t-12}$

Results and discussion

Forecasting prices by using ARIMA model

There are three stages of modeling as suggested by Box and Jenkins to find the fitting ARIMA model. They are identification, diagnostic, estimation and checking.

Model Identification

The time series were analyzed by using the Statistical software (MINITAB). The selected sample is a time series data of the prices of the Citrus Lemon Autochthon. In different seasons of the year over the four years from 2010 to 2013. There are 48 observations based on monthly prices. The seasonal component is illustrated by figure 1, where horizontal axis represents the time and the prices are on vertical axis.

The seasonality which is obvious at the figure 1 is caused by fluctuation of supply of lemon Autochton at Lattakia. These oscillations are repeated regularly and in the same part of each year. The prices decrease after the time of harvest, when there is high saturation of the market and in the opposite before the harvest the prices reach the maximum because the lack of stocks.

The following figure 2 shows the auto-correlation function of the sample to build an appropriate model.

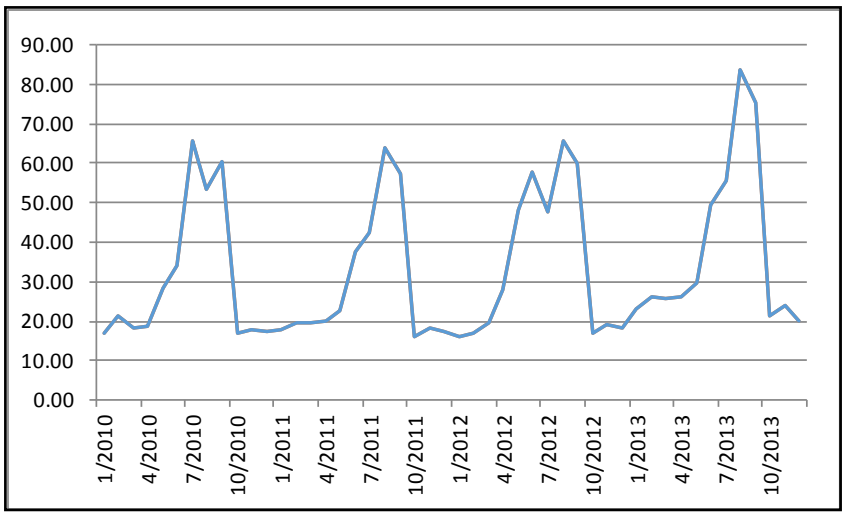
The parameters of the model can be obtained from the figure 2 which shows that the correlation between values and previous values remains within the deviation and this chart can be seen as a model for the sinus damping to find the parameters of the model.

Partial self- correlation is represented by the figure 3.

If the time series was random the large amounts of data would be correlated with each close to zero. If the correlation is not heading toward reasonable rate of zero it indicates instability data. The figure 3 shows that the link between the value and the previous value regardless of changes, so the time series are stable. It is clear that the autocorrelation function geometrically decrease after one slow degree, and this guide for the stability of the time series. The fact that the first delay in the red line cuts the blue line can take advantage of it to build a model.

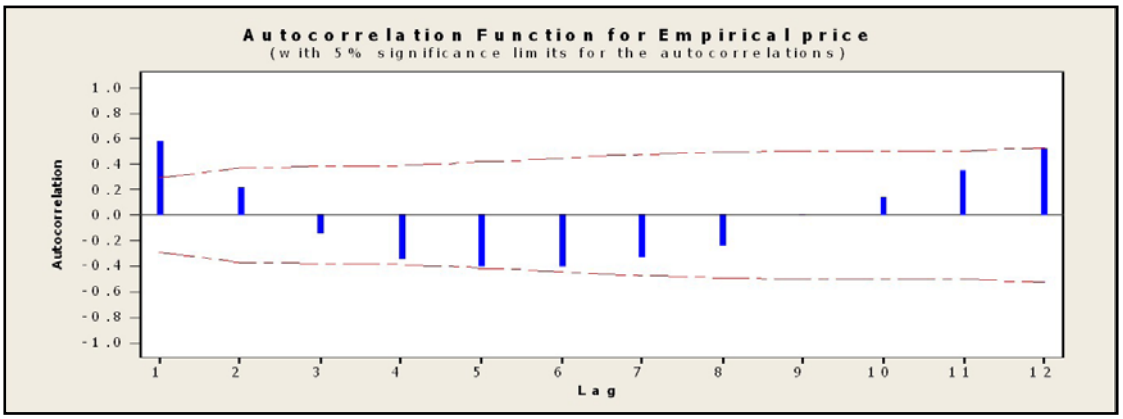
There was made a comparison between the numbers of SARIMA models to choose the best model. The predicted data should be closer to the real values. The values of MSE and MAE are the tools which was adopted to provide information about the most appropriate model.

From the table 2, there was found that the values of MSE and MAE of the SARIMA model (2, 1, 0) * (1, 0, 1) are the smallest compared with the other values. It indicates the most suitable model for the given time series. This model should be able to predict reliable future values.



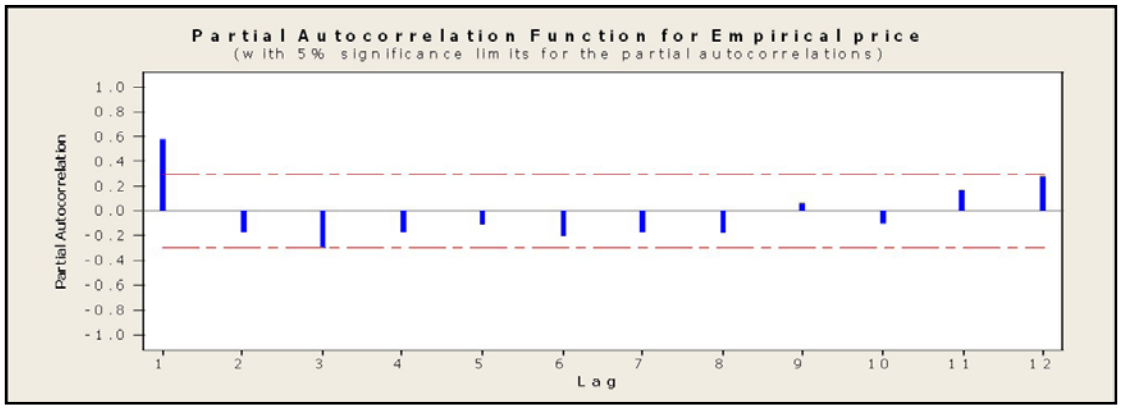
Source: processed in MS Excel, based on data of Agricultural Directorate in Lattakia

Figure 1: Prices of lemon autochton in Latakia 2010 – 2013 in SYP/Kg.



Source: processed in SW Minitab, based on data of Agricultural Directorate in Lattakia

Figure 2: ACF of lemon autochton price.



Source: processed in SW Minitab, based on data of Agricultural Directorate in Lattakia

Figure 3: PCF of lemon autochton price.

MODEL	SARIMA (2,1,0)*(1,0,1)	SARIMA (2,1,1)*(1,0,1)	SARIMA (2,1,0)*(2,0,1)	SARIMA (2,1,0)*(2,1,1)
MSE	69.99	70.23	72.20	70.73
MAE	53.20	55.69	55.98	53.75

Source: processed in SW Minitab, based on data of Agricultural Directorate in Lattakia

Table 2: The value of MSE and MAE for considered SARIMA models.

Estimation of parameters and Model Diagnosis

As the best model was found multiplier seasonal model SARIMA (2,1,0) * $(1,0,1,)_{12}$ The model is based on the rank of the model AR, MA based on the form of the autocorrelation function when matching the values of autocorrelation coefficients and partial autocorrelation for the time series after taking the first and seasonal differences which found in the figures (2), (3) and from the clear that the autocorrelation function (ACF) and partial autocorrelation function (PCF) gradually decreasing (behave like sine function) and through this indicator can be note that the best model is the multiplier Seasonal model from the class SARIMA (2,1,0) * $(1,0,1)_{12}$

Parameters of the modeal are introduced in the Table 3.

The values were equal:

$\Phi_1 = -0.3692$

$\Phi_2 = -0.1607$

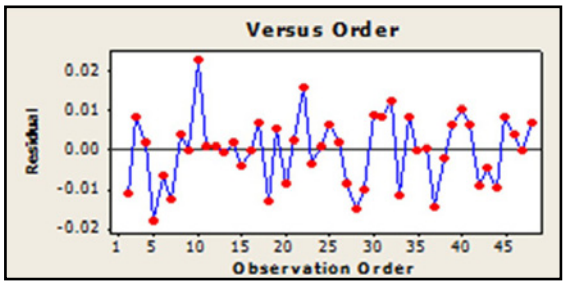
$\Phi = 0.9937$

$\Theta = 0.8248$

Type	Coef	SECoef	T	P
AR 1	-0.3692	0.1532	- 2.41	0.020
AR 2	-0.1607	0.1528	- 1.05	0.299
SAR 12	0.9937	0.0181	54.99	0.000
SMA 12	0.8248	0.1724	4.78	0.000
Constant	-0.0070	0.2933	- 0.02	0.981

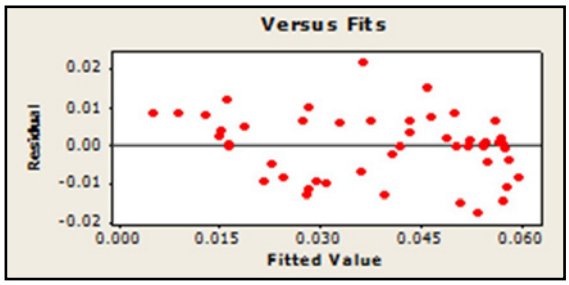
Source: processed in SW Minitab, based on data of Agricultural Directorate in Lattakia

Table 3: Estimated parameters.



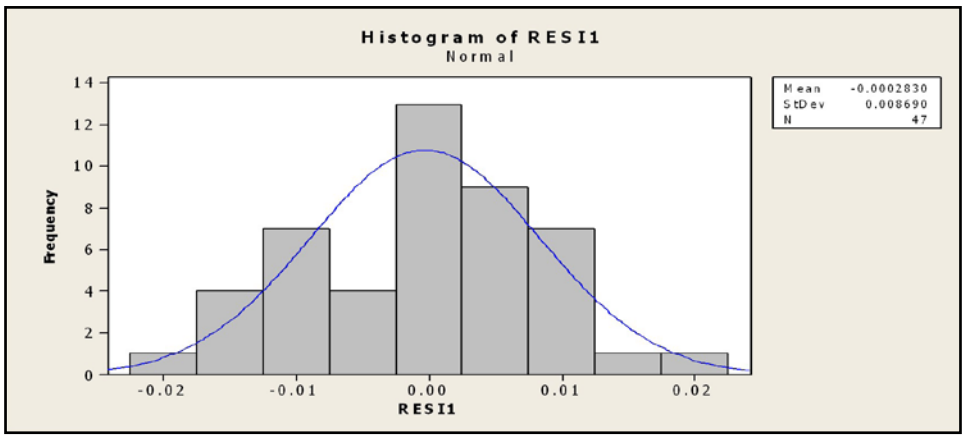
Source: processed in SW Minitab, based on data of Agricultural Directorate in Lattakia

Figure 4: Residuals vs. the order of the data.



Source: processed in SW Minitab, based on data of Agricultural Directorate in Lattakia

Figure 5: Residual vs. the fitted values



Source: processed in SW Minitab, based on data of Agricultural Directorate in Lattakia

Figure 6: Histogram of residuals.

By compensation, we find that the equation of the model are:

$z_t = 0.6308z_{t-1} + 0.2085z_{t-2} + 0.1607z_{t-3} - 0.9937z_{t-12} - 0.6268z_{t-13} - 0.2072z_{t-14} - 0.1597\, z_{t-15} + a_t - 0.8248\, a_{t-12}$

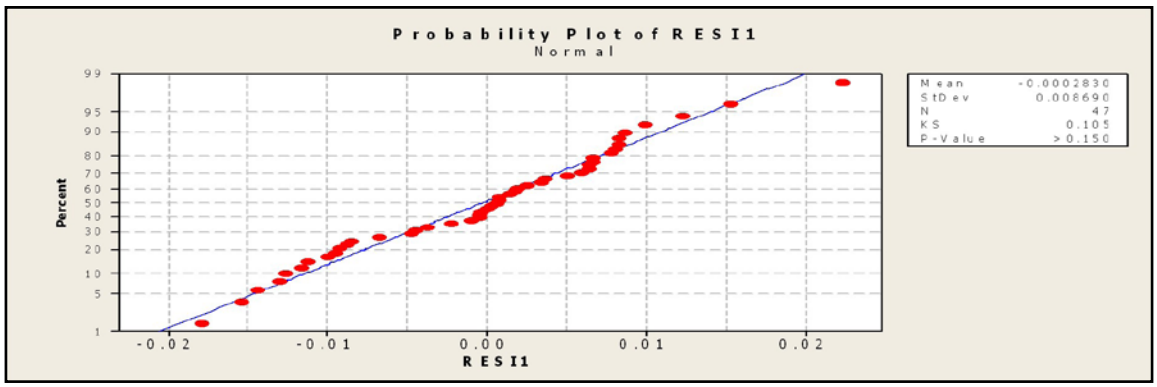
Verification (Checking) of the model

The residual were examined to verify suggested form of the model. The normality of distribution, its independency and homoscedasticity were tested.

The figure 4 shows the residuals versus the appropriate values. There is no trend or a specific oriented residuals. This fact also indicates that there was chosen appropriate model form.

There is no visible orientation of residuals at figure 5 as well, which indicates that the residuals are independent and random.

The figure 6 is the histogram of residuals with the drawing of normal distribution curve and this shows that the residuals have normal distribution.



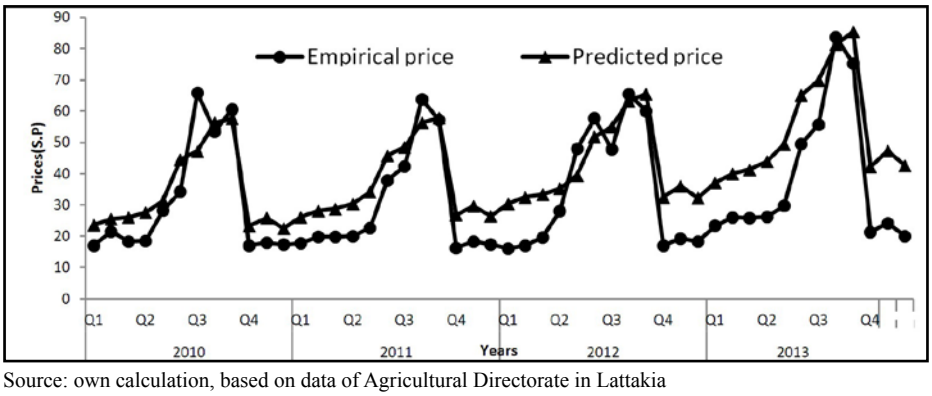
Source: processed in SW Minitab, based on data of Agricultural Directorate in Lattakia

Figure 7: Distribution of residuals.

Year / Month	2010	2011	2012	2013
January	2014	2015	2016	2017
February				
March	23.62	26.16	30.33	37.18
April	25.48	28.11	32.54	40.04
May	26.07	28.80	33.44	41.39
June	27.52	30.33	35.25	43.87
July	31.39	34.13	39.49	49.39
August	44.42	45.85	51.82	65.11
September	47.19	48.51	54.96	69.78
October	56.24	56.25	63.26	81.32
November	57.59	57.85	65.53	85.45
December	23.23	26.85	32.54	42.26

Source: own calculation, based on data of Agricultural Directorate in Lattakia

Table 4: predicted prices by SARIMA model in SYP/Kg.



Source: own calculation, based on data of Agricultural Directorate in Lattakia

Figure 8: Empirical monthly Prices of Lemon Autochton Compared with Predicted one in SYP/Kg for years 2010 - 2013.

Figure 7 shows the normality of distribution of residuals of this model. There are not outliers. And according to Kolmogorov - Smirnov test for the residuals, we find that the P-value greater than 0.05 and therefore accept the null hypothesis that mean residuals are subject to the normal distribution.

According to the developed SARIMA model the prices for Lemon Autochthon for four years, coming from the 2014 until 2017 were predicted. The results are presented in Table 4. The figure 8 shows comparison of predicted (ex post forecasting) and real values for years 2010 – 2013. There is obvious that series for the predicted period follow the same behavior of the original series.

4. Conclusion

The aim of the paper was to verify the SARIMA model as appropriate tool of Agricultural Marketing Information System. According to that there was also stated the research question: Are the ARIMA, resp. SARIMA models suitable to be part of the Agricultural Marketing Information System (AMIS)? To answer this question there was developed model for Lemon Autochton price forecasting. The model was tested, if it is able to predict the price during the year with its seasonal volatility. Data were provided by Munther Kheirbek from Syrian ministry of Agriculture.

The variety of lemon Autochton was chosen because represents most important commodity for local farmers and it is produced during the whole year. Farmers can harvest the yield three times or even four times if there is a good weather.

There is no function AMIS in Lattakia which would help to the farmers and in this situation the intermediaries have the highest profit in the marketing chain.

As the best model was found the multiplier Seasonal model from the class SARIMA (2,1,0) * (1,0,1)12 which has been chosen in order to determine the course of the prices for the next 4 years. It shows that any significant changes will not occur in lemon Autochton prices by the end of 2017 while the increase in real prices of input is taken into account because now Syria suffer from inflation, so in fact the decrease of income of citrus growers may bring out the farmer group who is unwilling to continue to produce citrus.

According to the obtained results can be stated that the SARIMA model is able to predict the prices of citrus on Lattakia market and when the missing Agricultural Marketing Information System is created it should be taken into account.

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Russian Agrarian Foreign Trade Development – the Impact of Selected Factors

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Anotace

Ruský agrární zahraniční obchod se mění. Jeho hodnota, objem a zejména komoditní a teritoriální struktura se neustále formují. Období transformace společně s několika krizemi kompletně změnily charakter ruského agrárního sektoru a potravinářského průmyslu. Aby vůbec Rusko bylo schopné formovat rozvojovou strategii pro příští desetiletí, je nutno identifikovat klíčové trendy a faktory ovlivňující ruský agrární zahraniční obchod. Hlavním cílem tohoto článku je analýza vlivu vybraných proměnných (zemědělská produkce, směnný kurz, světová cena potravin a vládní podpory) na ruský agrární obchod a identifikovat zda-li existuje významný vztah, či nikoliv mezi uvedenými proměnnými. Sekundárním cílem článku je analýza vztahu existujícího mezi cenami potravin na ruském trhu a vývojem cen potravin na trhu světovém. Na základě výsledků vyplývajících z jednotlivých analýz následující závěry mohou být formulovány. Hodnota importů roste mnohem rychleji v porovnání s hodnotou exportů. Výsledkem je neustále se zvyšující záporné saldo ruského agrárního obchodu. Komoditní struktura ruského agrárního exportu je velmi koncentrovaná, na druhou stranu komoditní struktura agrárního importu se stává více heterogenní. Hovoříme-li o jednotlivých hypotézách analyzujících vztah mezi jednotlivými proměnnými, lze konstatovat následující. Lze potvrdit existenci vztahu mezi ruským agrárním obchodem a vývojem hodnoty zemědělské produkce, vládních podpor a vývojem světových cen agrárních a potravinářských produktů. Na druhou stranu existence vztahu mezi směnným kurzem a hodnotou ruského agrárního exportu a importu nebyla prokázána.

Klíčová slova

Rusko, agrární zahraniční obchod, hodnota, vztah, zemědělská produkce, podpora, směnný kurz, cena potravin, vývoj, charakter.

Abstract

Russian agricultural foreign trade is changing. Its value, volume and especially commodity and territorial structures are under the permanent development. The period of transformation together with several crises completely changed the character of Russian agricultural sector and foodstuff industry. To be able to develop the country‘s strategy for the upcoming decades it is necessary to identify the key trends and drivers affecting the Russian agricultural trade performance and development. The main objective of this paper is to analyze the influence of selected key variables (agricultural production, exchange rate, and world food price and government subsidies) on Russian agricultural trade and to identify if there is existing the significant relationship or not. The secondary objective of the paper is the analysis of relationship existence between Russian food price development and World food price development. On the basis of the results coming from the analyses the following can be highlighted. The value of imports was growing much faster comparing to value of exports. The result is constantly increasing negative trade balance. Russian agrarian export commodity structure became more concentrated, on the other hand the commodity structure of agrarian imports became more heterogeneous. Talking about individual hypotheses analyzing the relations between individual variables the following can summarized. There do exist the relationships between Russian foreign trade and agricultural production development, government subsidies development and world food price development. On the other hand the existence of relationship between exchange rate and Russian agrarian export and import performance was not proved.

Key words

Russia, agrarian foreign trade, value, relation, agricultural production, support, exchange rate, food price, development, character.

Introduction

Russia has the largest area in the world, with considerable diversity in natural, economic, and social conditions across regions and a combination of federal and regional policies (Gusev, 2007; OECD, 2011). The process of Russian agri-food sector's integration in the world economy in recent years is accelerating and the country is becoming an active player in a number of food markets (OECD, 2008).

Considering the dynamics of Russia's foreign trade (Table 1) in agricultural products and foodstuffs, the following trends can be revealed. There is the significant growth of foreign trade turnover due to the expansion of both imports and exports (Liefert and Liefert, 2012).

During the 2000s, Russian agricultural import was growing considerably. This import growth has made Russia the second largest agricultural importer among emerging markets, after China (Liefert, 2009).

Russia's agri-food export was growing alongside the increase in imports. Currently, Russia has a significant share in the world markets of certain products, such as wheat and sunflower oil (Liefert, 2009; Nosov and Ivanova, 2009).

There does exist the huge disproportion between Russian agrarian export and import, while the share of agricultural products in Russian total merchandise export is only and import is 2.4%, the share of agrarian and foodstuff products import in total value of merchandise imports is about 14%.

Russian agricultural foreign trade is changing. Its value, volume and especially commodity and territorial structures are under the permanent development (Cooper, 2006). The period of transformation together with several crises completely changed the character of Russian agricultural sector and foodstuff industry. Russian agricultural and foodstuff market also changed significantly (Ellman and Scharrenborg 1998; Robinson, 1999; Feridun, 2004; Stupak, 2012; Ahrend, 2006; Hanson, 2007; Sapir, 2001; Rutland, 2013). All the changes reduced production performance and increased Russian dependency on imports from other countries (Pustovalov, 2004; Gudoshnikov, 2008; Russian presidential administration, 2009) . Changes in production structure significantly affected especially the commodity structure of Russian agrarian export (Graph 1). The reduction of domestic production capacities also affected the commodity structure and value of imports (Graph 2).

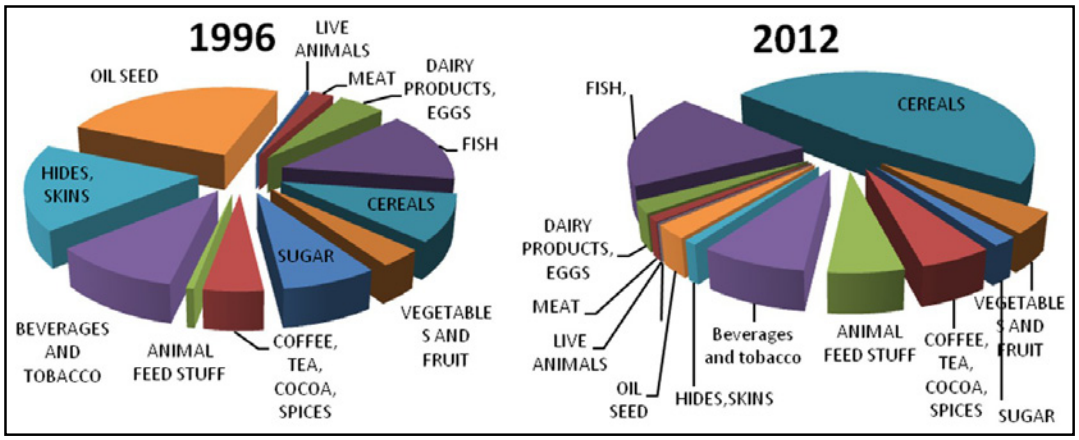
Last two decades development changed also territorial structure of Russian agricultural trade. For details see – Tables 2 and 3. While in 1996 Russian territorial structure of agrarian export was the following CIS (Commonwealth of Independent States) (28.73%), EU (European Union) (25.65%), Asia (25.41%), America 4.8% and Africa 0.41%, in 2012 the situation was the following: Asia 41.32%, CIS 26.96%, Africa 15.21%, EU (10.33%) and America (0.71%).

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	GM
Export	1.2	0.8	1.3	1.5	2.2	2.7	2.5	3.9	4.8	8.3	8.4	9.3	7.6	11.3	16.7	X
Import	10.3	7.7	7.0	8.7	9.8	11.3	12.8	16.3	20.4	26.2	25.2	32.7	22.5	28.9	41.2	X
Balance	-9.1	-6.9	-5.7	-7.3	-7.7	-8.6	-10.3	-12.4	-15.5	-17.9	-25.0	-19.1	-26.1	-27.9	-23.8	X
Normalized trade balance	-79.3	-81.9	-68.6	-71.4	-63.7	-61.6	-67.6	-61.5	-61.6	-52.0	-59.8	-50.7	-63.3	-55.1	-41.6	X
Foreign trade coverage ratio	11.6	10.0	18.6	16.7	22.1	23.8	19.3	23.8	23.8	31.6	25.2	32.7	22.5	28.9	41.2	X
Chain index of export flows	X	64	170	112	149	124	92	157	125	170	102	111	81	150	147	121
Chain index of import flows	X	75	91	125	113	115	113	127	125	128	127	85	119	117	103	110

Source: UN Commodity Trade Statistics Database. author's calculations (2013)

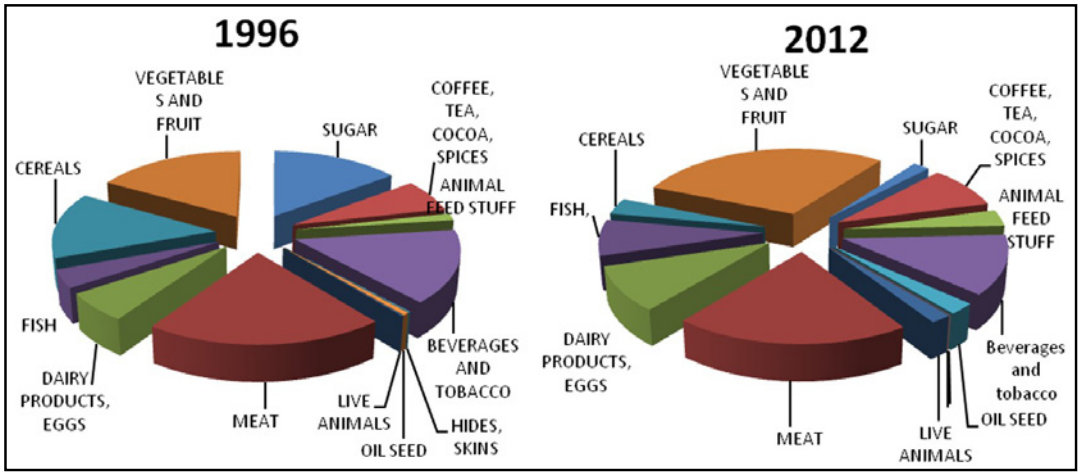
Table 1: Russian foreign trade in agrarian and foodstuff products (billions USD).

The situation in the case of Russian agrarian imports territorial structure also changed very much. While in 1996 the territorial structure was the following one: CIS (30.34%), EU (26.24%), Asia (11.34%), (America 14.1%) and Africa (1.45%), in 2012 the territorial structure reached the following changes: EU (28.81%), America (24.4%), Asia (16.66%), CIS (12.58%) and Africa (3.96%).



Source: UN Commodity Trade Statistics Database, author's calculations (2013)

Graph 1: Product structure of the Russian agricultural export (%).



Source: UN Commodity Trade Statistics Database, author's calculations (2013)

Graph 2: Product structure of the Russian agricultural import (%).

	1996	1998	2000	2002	2004	2006	2007	2008	2009	2010	2011	2012
World	1688	1187	1301	2177	2479	4849	8257	8390	9281	7562	11337	16705
North America	76	54	24	28	33	44	74	64	60	75	67	66
CIS	485	317	418	546	1065	2006	2899	3496	2895	1765	2335	4504
EU	433	223	243	467	304	601	831	910	714	781	1328	1725
Asia	429	448	462	680	633	1384	2351	2498	3986	3448	4701	6902
South America	5	1	0	3	0	1	3	22	32	9	47	51
Africa	7	10	42	298	254	492	1662	1007	1232	1122	2099	2541
Others	253	135	112	156	189	321	438	393	362	363	760	916

Source: Comtrade database, author's calculations (2013)

Table 2: Russian agricultural exports by geographic regions, million USD.

	1996	1998	2000	2002	2004	2006	2007	2008	2009	2010	2011	2012
World	11139	10266	6982	9832	12820	20387	26156	33348	28355	33620	39210	40516
CIS	3380	1620	1669	1221	2463	2309	2855	3587	2844	3407	3281	5097
EU	2923	2919	1841	2919	3480	5692	7511	9264	7622	10040	12013	11674
Asia	1263	1280	855	1389	1714	3124	4129	5494	4811	5868	7137	6751
South America	379	882	683	1729	2142	4763	6029	7179	6233	6803	7505	6928
North America	1193	1289	771	800	803	1326	1693	2686	2124	1770	2296	2950
Africa	162	205	209	388	476	742	1024	1240	1197	1383	1739	1603
Others	1840	2072	955	1386	1742	2430	2913	3897	3523	4349	5238	5511

Source: Comtrade database, author's calculations (2013)

Table 3: Russian agricultural imports by geographic regions, million USD.

To prevent the growth of imports, negative trade balance and food dependency the Russian Federation has employed import-substitution policy in relation to agriculture. In 2010, Russian President approved the Food Security Doctrine of the Russian Federation. The Doctrine sets the following goals regarding the minimum share of domestic production in the total supply of basic food products: grain – 95%, sugar – 80 %, vegetable oil – 80%, meat and meat products – 85 %, milk and dairy products – 90 %, fish products – 80 %, potatoes – 95%, edible salt – 85 %. These goals should be achieved by 2020. (Doctrine of Food Security of RF, 2009)

Furthermore, Russia is seeking not only to achieve a high level of self-sufficiency in basic agricultural products, but also claims to be a major exporter of agricultural products and foodstuffs. To achieve all these goals Russian agricultural products must be competitive both in the domestic and global market (Competitiveness is one of the most serious problems of Russian agrarian trade (Liefert, 2002; Savin and Winker, 2009).). Russian government in nowadays is looking for the most suitable policies to encourage the Russian agricultural trade performance and to improve the position of Russian agricultural and foodstuff sector. There are four key determinants influencing Russian agricultural market (those determinants were identified by the "Food Security Doctrine") – agricultural sector performance, world food price, exchange rate and government subsidies.

To be able to develop the country's strategy for the upcoming decades it is necessary to identify the key trends and drivers affecting the Russian agricultural trade performance and development. The main objective of this paper is to analyze the influence of selected key variables (above mentioned) on Russian agricultural trade and to identify if there is existing the significant relationship or not. The secondary objective of the paper is the analysis of relationship existence between Russian food price development and World food price development (Russian food market is quite isolated from the World market through the Russian government policy and the significant share of all export transactions is realized through the bilateral agreements. It is the reason why one of the objectives is to find out if Russian food prices are influenced by world food prices development or if they are influenced by only regional prices.). The results coming from the analyses are very important especially for the future formation of Russian agricultural trade policy. On the base of hypotheses analyses the paper is identifying the existence of relationship between Russian agricultural trade value (especially export value) on one side and the set of above mentioned variables on the other side.

Materials and methods

In order to achieve the objectives, a number of methods and analytical tools have been used in this paper (time series analysis, trend functions, fixed-base index, chain base index and geometric mean of chain indices – Hindls, 2007).

Regression analysis

In this paper, the Russian foreign trade in agricultural products and foodstuffs is considered to be a dependent variable and other parameters (gross value of agricultural production, government subsidies, exchange rate and world food price) are considered to be independent variables. The regression analysis is conducted as logarithmic regression. The results coming from the analyses can be interpreted also as elasticity existing between endogenous and exogenous variable.

The several hypotheses about the relationship between the value of Russian foreign trade in agricultural products and foodstuffs (as a dependent variable) and studied independent variables are formulated and then the separate simple regression equations for each independent variable in relation to dependent variable is calculated and tested.

Every regression model is tested to see if it is „significant" or not.

Methods of hypothesis testing

Hypothesis testing is the use of statistics to determine the probability that a given hypothesis is true. There is a wide range of statistical tests available, depending on the nature of the investigation.

The P-value Method of Hypothesis Testing

A P-value (or probability value) is the probability of getting a value of the sample test statistic that is at least as extreme as the one found from the sample data, assuming that the null hypothesis is true.

In other words, a small P-value indicates that observation of the test statistic would be unlikely if the null hypothesis is true. Being a probability, P can take any value between 0 and 1. Values close to 0 indicate that the observed difference is unlikely to be due to chance, whereas a P value close to 1 suggests there is no difference between groups other than that due to random variation. The lower the P-value, the more evidence there is in favor of rejecting the null hypothesis. Alpha (α) is a probability threshold for a decision. If $P \leq \alpha$, we will reject the null hypothesis.

The aim of hypothesis testing is not to ‚accept' or ‚reject' the null hypothesis. Rather, it is simply to gauge how likely it is that the observed difference is genuine if the null hypothesis is true (Statistics, 2007).

The F-test in Regression

A significant result for the F statistic means that a relationship exists as described by the straight line model. This test is very important in the regression analysis, and essentially it is a special case of constraint checking.

Accordingly, if the value of this statistic is more than the critical value at a given level of significance, the null hypothesis is rejected, which means the statistical significance of regression. Otherwise, the model was deemed significant. If F-calculated is larger than F-critical thus we have to reject the hypothesis (Statistics, 2007).

The T- test in Regression

The t-statistic is the regression coefficient (of a given independent variable) divided by its standard error. The standard error is essentially one estimated standard deviation of the data set for the relevant variable. To have a very large t-statistic implies that the coefficient was able to be estimated with a fair amount of accuracy.

If the t-stat is more than critical value, it can be concluded that the variable in question has a significant impact on the dependent variable. High t-statistics (over critical value) mean the variable is significant.

The t-tests are used to conduct hypothesis tests on the regression coefficients obtained in simple linear regression. A statistic based on the t distribution is used to test the two-sided hypothesis that the true slope, $\beta 1$ equals some constant value, $\beta_{1,0}$.

If the value of $\beta_{1,0}$ used is zero, then the hypothesis tests for the significance of regression. In other words, the test indicates if the fitted regression model is of value in explaining variations in the observations or if you are trying to impose a regression model when no true relationship exists between X and Y. Failure to reject H_0: $\beta_1 = 0$ implies that no linear relationship exists between X and Y (Statistics, 2007).

The Coefficient of Determination - r-sqrd (Goodness of Fit)

The coefficient of determination (R^2) indicates how well data points fit a line or curve.

The R^2 value is equal to the square of the simple correlation of x and y in simple regression. R^2 can be interpreted as the fraction (or percent if multiplied by 100) of the total variation in the outcome that is "accounted for" by regressing the outcome on the explanatory variable. R^2 -value varies from 0 to 1 (Statistics, 2007).

Results and discussion

We'll start with the formulation of hypotheses and their feasibility study, which will give us a basis for the further construction of the regression model. While many connections among these variable could be hypothesized, in this regression models we considered five hypotheses.

Gross agricultural and food production and foreign trade

The relationship between foreign trade and production of agricultural products is the most logical and the most probable. It is obvious that if country is able to increase its production, it is also able to increase its export performance.

Hypothesis I: Gross agricultural and food production affects country's agricultural export.

The null hypothesis is the gross agricultural and food production does not affect Russian foreign trade in agricultural products.

Value of gross production has been compiled by multiplying gross production in physical terms by output prices at farm gate. Thus, value of production measures production in monetary terms at the farm gate level. Since intermediate uses within the agricultural sector (seed and feed) have not been subtracted from production data, this value of production aggregate refers to the notion of „gross production".

	Gross Production Value	Export Value
1996	41252000	1697976
1997	39689000	1423363
1998	25781000	1034278
1999	22278000	610533
2000	24226000	1076535
2001	29147000	1117711
2002	28388000	1839763
2003	32885000	2339450
2004	41179000	2197106
2005	45741000	3451314
2006	53489000	4367401
2007	67699000	7734804
2008	88709000	7900781
2009	69204000	7530653
2010	69455000	5832416
2011	96202000	9215159

Source: FAOSTAT (2013)

Table 4: Gross Value of Agricultural Production and foreign trade in agricultural products in Russian Federation (1000 USD).

Value of gross production (Table 4) is provided in current term and is expressed in US dollars. The **current** value of production measures value in the prices relating to the period being measured. Thus, it represents the market value of food and agricultural products at the time they were produced.

US dollar figures for value of gross production are converted from local currencies using official exchange rates as prevailing in the respective years. Expressing data series in one uniform currency is useful because it avoids the influence of revaluation in local currency, if any, on value of production.

Government support for agriculture and agricultural exports

In the days of the Soviet Union, the government was inclined to consider the high levels of production as something desired, regardless of cost, and referred to the self-sufficiency as the ultimate goal. Therefore, subsidizing of agricultural enterprises was carried out in large volume, even in relation to the economically inefficient entities.

Large share of industry support was provided by the cheap material and technical resources for agriculture, particularly fertilizer and fuel, leading to inefficient use (overspending and wastage), which did not give a proportional increase in production volume.

These subsidies were sharply reduced after the 1991. Agricultural enterprises were not ready for such changes. The result was a sharp decline in agricultural production, the effects of which we can observe to this day.

In the recent years, funds allocated from the federal budget of the Russian Federation to support agriculture (Table 5), currently do not comply with its contribution to the formation of the gross domestic product (GDP) of the country. The support of agricultural production is a small fraction of the total expenditure budget (about 1-2% of total government expenditures).

Increased government support for agriculture stimulates the development of agricultural production, and therefore potentially has a positive impact on the volume of agricultural exports.

Hypothesis II: Government support for agriculture affects the agricultural exports.

The null hypothesis is the government support for agriculture does not affect Russian foreign trade in agricultural products (Table 5).

Russian government expenditures on agriculture consist of Federal Budget and the budgets

of subjects of the Russian Federation. For the purposes of this analysis only total consolidated budget expenditures are used.

	Consolidated budget	Federal Budget
1996	4921074	1659886
1997	5376127.2	1711372
1998	2503842.5	484282.3
1999	1441923	357434.4
2000	1955265.9	476373.9
2001	2310709.9	812519.7
2002	1907588.3	886805.3
2003	2218817.4	1032842
2004	2727865.1	1207757
2005	2778912.9	669064.4
2006	4074884	960955
2007	5723032.1	1058505
2008	9588427.9	2335407
2009	8793221.5	2619121
2010	8637405.5	1163215
2011	9145594.8	4814087

Sources: Rosstat, World Bank database (2013)

Table 5: Government expenditures on agriculture and rural development in Russian Federation (1000 USD).

Exchange rate and foreign trade

Next hypothesis is addressing the influence of the exchange rate of the ruble on changes in the value of country's foreign trade in agricultural products and foodstuffs.

According to the economic theory, increasing in the real exchange rate is leading to depreciation of domestic currency; thus, it is encouraging exports.

The exchange rate plays an important role in a country's trade performance. The fact that the Russian economy began to grow after the plunge of the ruble in 1998 proves that the strong ruble had been hampering the country's economic growth and made Russian products less competitive.

There is huge number of studies that investigate the impact of exchange rate on foreign trade, including agricultural exports and imports. The most of them investigates the impact of the exchange rate volatility. However, there will be examined only direct relationship between the official ruble/USD exchange rate (Table 6) and the Russian foreign trade (exports and imports separately).

Hypothesis III:

a) There is a relationship between the ruble exchange rate and Russian agricultural exports.

b) There is a relationship between the ruble exchange rate and Russian agricultural imports.

The null hypotheses are the exchange rate does not affect Russian foreign trade in agricultural products.

	Official exchange rate	Import Value	Export Value
1996	5.120833	10934964	1697976
1997	5.784833	12448930	1423363
1998	9.705083	10496568	1034278
1999	24.6199	7913562	610533
2000	28.12917	7233760	1076535
2001	29.16853	8709335	1117711
2002	31.34848	9360263	1839763
2003	30.69203	10993983	2339450
2004	28.81374	12363270	2197106
2005	28.28444	15460680	3451314
2006	27.19096	19304657	4367401
2007	25.58085	24535164	7734804
2008	24.85288	31390865	7900781
2009	31.74036	26682992	7530653
2010	30.36792	31843086	5832416
2011	29.38234	37233201	9215159

Sources: World Bank database, FAOSTAT (2013)

Table 6: Official exchange rate of Russian ruble and country's foreign trade in agricultural products (LCU per US$, period average, 1000 USD).

Official exchange rate refers to the exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (ruble units relative to the U.S. dollar).

World Food Prices and Russian agricultural exports

In order to discuss the relationship between world prices and country's foreign trade it is necessary to explain their relations from an economic point of view.

As the world price level rises, foreign made goods become relatively more expensive so that

the demand for imports decreases. In the same situation, the country‘s exports will grow.

Therefore, we expect the positive correlation between international food prices and country’s agricultural exports.

Hypothesis IV: There is a relationship between World Food Prices and Russian agricultural exports

The null hypothesis is there is no relationship between World Food Prices and Russian agricultural exports.

In this analysis, World Food Price Index was used as an indicator of price changes. World Food Price Index consists of the average of 5 commodity group price indices (Meat, Dairy, Cereals, Oil and Fat and Sugar Price Indices) weighted with the average export shares of each of the groups for 2002-2004: in total 55 commodity quotations considered by FAO commodity specialists as representing the international prices of the food commodities noted are included in the overall index.

World Food Prices and Russia’s export prices

In addition to the analysis of factors affecting the volume of Russian trade in agricultural products and foodstuffs, this paper is examining the relationship between the prices of Russian agricultural exports and World prices of agricultural products (Table 7). It is possible to test to what extent the Russian export prices follow the worldwide prices.

Hypothesis V: there is a relationship between World Food Prices and Russia’s export prices

Data for the analysis are presented in the Table 7 below.

	World Food Price Index	Russia’s export price index
1996	129.1	72.2
1997	118.5	91.6
1998	107.1	67.6
1999	92.4	85.7
2000	90.4	86.6
2001	93.4	68.7
2002	89.9	73.2
2003	97.7	96.1
2004	112.4	76.7
2005	117.3	102.5
2006	126.7	120.9
2007	158.7	110.4
2008	199.8	179.7
2009	156.9	118.5
2010	185.3	119.3
2011	227.6	131.6

Sources: FAO, author’s calculation (2013)

Table 7: World Food Price Index and Russia’s food export price index.

Russia’s Export Price Index is calculated as Laspeyres index for country’s trade in agricultural products according to export unit values of 400 items (4-digit code in Harmonized System) weighted with the average export shares of each of the groups for 2002-2004.

Results of the regression analysis

The following tables (Tables 8, 9, 10, 11, 12 and 13) provides an overview of results coming from individual regressions.

N=16	b*	Std.Err. (of b*)	b	Std.Err. (of b)	t(14)	p-value
Intercept			-2209189	480880.9	-4.59405	0.000417
Var1	0.964083	0.070985	0	0.0	13.58157	0.000000

Regression Summary for Dependent Variable: Var2 (Spreadsheet1), R = .96408322 R^2 = .92945646 Adjusted R^2 = .92441763, F(1.14) =184.46 p<.00000 Std.Error of estimate: 8126E2

Source: author’s calculation (2014)

Table 8: Hypothesis I - Gross Production Value and export value.

N=16	b*	Std.Err. (of b*)	b	Std.Err. (of b)	t(14)	p-value
Intercept			-348242	733442.0	0.000000	0.642247
Var1	0.86614243	0.13357643	0.876342846	0.135149539	6.000000	0.000010

Regression Summary for Dependent Variable: Var2 (Spreadsheet1), R = .86614243 R^2 = .75020271 Adjusted R^2 = .73236005, F(1.14) = 42.045 p<.00001 Std.Error of estimate: 1529E3

Source: author’s calculation (2014)

Table 9: Hypothesis II - Government expenditure for agriculture and export value.

N=16	b*	Std.Err. (of b*)	b	Std.Err. (of b)	t(14)	p-value
Intercept			797819.0	2118820	0.376539	0.712161
Var1	0.36344802	0.24898444	119258.0	81699	1.000000	0.166440

Regression Summary for Dependent Variable: Var2 (Spreadsheet1), R = .36344803 R^2 = .13209447 Adjusted R^2 = .07010122, F(1.14) = 2.1308 p<,16644 Std.Error of estimate: 2850E3

Source: author's calculation (2014)

Table 10: Hypothesis IIIa - Official exchange rate (LCU per US$, period average) and export value.

N=16	b*	Std.Err. (of b*)	b	Std.Err. (of b)	t(14)	p-value
Intercept			9597186	7258617	1.000000	0.2073045
Var1	0.288588838	0.25589011	315649	279884	1.000000	0.2783687

Regression Summary for Dependent Variable: Var2 (Spreadsheet1), R = .28858884 R^2 = .08328352 Adjusted R^2 = .01780377, F(1.14) = 1.2719 p<.27837 Std.Error of estimate: 9764E3

Source: author's calculation (2014)

Table 11: Hypothesis IIIb - Official exchange rate (LCU per US$, period average) and import value.

N=16	b*	Std.Err. (of b*)	B	Std.Err. (of b)	t(14)	p-value
Intercept			-4625980	1051652	-4.39877	0.000606
Var1	0.911765	0.109768	63420	7635	8.30631	0.000001

Regression Summary for Dependent Variable: Var2 (Spreadsheet1), R = .91176461 R^2 = .83131471 Adjusted R^2 = .81926576, F(1,14) = 68.995 p<.00000 Std.Error of estimate: 1257E3

Source: author's calculation (2014)

Table 12: Hypothesis IV - World Food Price Index and export value.

N=16	b*	Std.Err. (of b*)	B	Std.Err. (of b)	t(14)	p-value
Intercept			26.00000	15,00000	1.000000	0.103507
Var1	0.8000757859	0.1603297	0.557578578	0.1117349475	4.000000	0.000200

Regression Summary for Dependent Variable: Var2 (Spreadsheet1), R = .80007579 R^2 = .64012126 Adjusted R^2 = .61441564, F(1.14) = 24.902 p<.00020 Std.Error of estimate: 18.388

Source: author's calculation (2014)

Table 13: Hypothesis V - World Food Price Index and Russia's export price index.

The following text provides the summary of results coming from individual analyses. Individual results are also briefly explained and discussed. At the end of each section there is information related to the results of individual hypotheses analyses.

1) Gross agricultural and food production and exports

On the basis of regression analysis, it is possible to formulate the following conclusions related to the relationship between the value of agricultural and food production in Russia and the value of country's foreign trade in agricultural products and foodstuffs (export).

The p-value of the F-statistic for agricultural production is greater than 0.05, so this term is significant at the 5% significance level given the other terms in the model.

The p-value (p = 0.0000) is greater than the common alpha level of 0.05, which indicates that it is statistically significant. Hence, it is possible to reject the null hypothesis.

F(1.14) = 184.4590, that is more than the critical value (4.6) at a given level of significance. It means that the regression is deemed significant.

Another way to test the regression for significance is to test the b1 term (slope term which shows the effect of X on Y). This is done via a t-test. The t-value is -4.594. The t-value will be negative if the first mean is smaller than the second one. The p-value for a negative t-value is the same as that for the positive version of that t-value. Therefore t = 4.594 is more than t_{crit} = 2.1448. It means that regression is statistically significant. The two tests give the same results.

Adjusted R^2 measures the proportion of the variance in the exchange rate that was explained by variations in the independent variables. In this case, the adjusted $R^2 = 0.82441763$ shows that 82.4% of the variance was explained. The correlation coefficient is 0.864 that is close to 1.

The empirical results directly support the hypothesis I. The results of the analysis show that there exists a relationship between the gross agricultural production value development and agricultural export value development. An increase in the agricultural production value has a significant and positive impact on export trade flows. The hypothesis I can be **accepted**.

2) Government support for agriculture and agricultural exports

Testing the hypothesis about the relationship between government expenditures for agriculture and country's exports of agricultural products provided the following results.

The p-value (0.000014) is greater than the alpha level of 0.05, which indicates that the regression is statistically significant.

F statistic (F = 42.04544) is more than the critical value (F-critical = 4.60) at a given level of significance, the null hypothesis is rejected, which means that the statistical significance of regression.

Adjusted R^2 = 0.73236005 shows that 73.2% of the variance was explained by the regression. R-Square is equal 0.75020 - it means that 75.0% of the variation was explained by the regression. The correlation coefficient is 0.78 and it is close to 1.

According to t-statistic analysis, the value of t = 4.594 is more than critical (2.1448). The t value is in the area of rejection, so that b is enough different from 0 to reject the hypothesis of no relationship between X and Y. It means that regression is statistically significant.

There is evidence, that the relationship between the government's support for agriculture and agricultural exports value. The hypothesis II can be **accepted**. Null hypothesis can be rejected.

3) Exchange rate and foreign trade

The regression analysis of the impact of ruble exchange rate on the Russian foreign trade was conducted both in relation to export and import flows.

Exchange rate and agrarian export value

If we are analyzing the relationship between the exchange rate of the ruble (in relation to USD) on the value of Russian exports of agricultural products and foodstuffs, the following results are coming from the analysis.

The p-value (0.16644) is greater than the common alpha level of 0.05, which indicates that it is not statistically significant.

In regression, the t-stat, coupled with its p-value, indicates the statistical significance of the relationship between the independent and dependent variable. The value of t=0.3222 is less than critical (2.1448) and therefore regression is not statistically significant.

F(1.14) = 2.1308, that is less than the critical value (4.6) at a given level of significance. It means that the regression is deemed insignificant.

The adjusted R2=0.07010118 shows that only 7.0% of the variance was explained. The „R-Square"' provides us the information - that 13.2% of the variation was explained by the regression. The correlation coefficient is very low (less than 0.15).

On the basis of results coming from the analysis the hypothesis IIIa can be **rejected** and the regression can be considered as an insignificant.

Exchange rate and agrarian import value

The analysis of relations between the ruble/USD exchange rate and Russian agricultural import value provides the similar results as in the case of exports.

The p-value (0.2784) is greater than the alpha level of 0.05. It means that it is not statistically significant. The value of t = 1.3222 is less than critical (2.1448) and therefore regression is not statistically significant.

F(1.14) = 1,271897 - that is more than the critical value (4.6) at the level of significance $\alpha = 0.05$. It means that the parameter can be deemed significant. Adjusted R^2 = 0.01780374 shows that only 1.7% of the variance was explained by this parameter. According to the value of R^2, 8.3% of the variation can be explained by the regression. The correlation coefficient is lower than 0.1.

The hypothesis IIIb can be also **rejected** and the regression can be considered also as an insignificant.

4) World Food Prices and Russia's agricultural export

The analysis of relationship between international food prices and Russian agricultural exports provides the following results.

The p-value ($p = 0.000001$) is less than the common alpha level of 0.05, which indicates the significance of the regression.

The F-value of the regression is significant and equals 68.99479. It is much more than critical value (4.6). In this case, the explained variation (due to regression) is 68.99479 times greater than the unexplained (residual) variation. This is why we reject the null hypothesis.

The coefficient of determination, R-Square, is 83.1%. It means that 83.1% of the variation can be explained by the regression. The adjusted $R^2 = 0.81926576$ shows that 81.9% of the variance was explained by the regression. The correlation coefficient is 0.912 that is very close to 1. It means that the relationship between both mentioned parameters is very strong.

Therefore, the results of the analysis support the hypothesis about the relationship between world food prices and Russian agricultural export value development. The hypothesis IV can be **accepted**. Null hypothesis can be rejected.

5) World Food Prices and Russia's export prices

The last hypothesis tested is the one about relationship between World Food Prices and Russia's export prices.

According to results of the regression analysis, p-value is equal 0,000198. This value is greater than the alpha level (0.05). Therefore, the regression is statistically significant.

F statistic ($F = 24.90199$) is more than the critical value at a given level of significance It means that the regression can be considered as the significant one.

However, according to t-statistic analysis, the value of $t = 1.7415$ is less than critical (2.1448). So according to this criterion – the regression is statistically insignificant.

Adjusted $R^2 = 0.61441564$ shows that 61.4% of the variance can be explained by the regression. R-Square is equal 0.64012126. It means that 64.0% of the variation can be explained by the regression. The correlation coefficient is 0.8.

Thus, p-value, f - statistic and high value of correlation coefficient can be considered as evidences of the relationship between world food prices and Russia's agricultural export prices. However, according to t-statistic the regression is statistically insignificant. Nevertheless, the hypothesis V can be **accepted**.

Conclusion

On the basis of above mentioned characteristics related to Russian agricultural foreign trade development and on the basis of results coming from individual regression analyses the following conclusions can formulated. Russian agricultural trade heavily changed during the last two decades (Gaidar et al., 2011). The value of exports and imports increased significantly. The value of imports was growing much faster comparing to value of exports. The result is constantly increasing negative trade balance. The last two decades of transformation changed not only the value of Russian agrarian trade, but also the territorial and commodity structure of Russian agrarian trade changed significantly. Russian agrarian export commodity structure became more concentrated, on the other hand the commodity structure of agrarian imports became more heterogeneous. The negative figure of Russian agrarian trade commodity structure development is the fact that while commodity structure of imports is represented by high share of semi-finalized or finalized products, the commodity structure of Russian export can be characterized by high portion of unprocessed products with very low added value. The territorial structure of Russian agrarian trade also changed significantly. In nowadays Russian exports are focused especially on Asian countries and CIS. On the other hand Russian imports are focused especially on the European Union and America.

Talking about individual hypotheses characterizing the relationships between Russian agricultural foreign trade and selected above mentioned variables the following can be summarized. The empirical results are directly supported by the hypotheses I, II, IV and V. Thus, there is existing a strong relationship between the gross agricultural production value and agricultural export value development. An increase in the agricultural production value has a significant and positive impact on export trade flows. There are also high correlation and statistical significance in relations

between government support for agriculture and agricultural exports. The results of the analysis support the hypothesis about the relationship between world food prices and agricultural exports. There is also the evidence of significant relationship between world food prices and Russia's agricultural export prices development. So it can be said with some certainty, that Russian export prices substantially follow the worldwide prices.

In addition, in the regression analysis two hypotheses were rejected. These are hypotheses about relationships between ruble/USD exchange rate and Russian agricultural export and import value development. In both cases, the regressions were deemed insignificant. From the import side it can be explained by fairly low price elasticity of demand for agricultural products compared to other products. As mentioned earlier, Russia is not self-sufficient in agricultural products. Since agricultural and foodstuff products are products of first priority, the demand for them is less exposed to fluctuations in the exchange rate.

From the export side it is possible to explain the above mentioned results through the specific commodity and territorial structure of Russian agrarian trade (especially agrarian export). It is dominated by unprocessed products. In addition, a large share of Russian agrarian export is realized in relation to CIS countries.

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Age Management Principles in Czech Agrarian Sector

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Anotace

Moderní koncepce Age Managementu se v rámci celé ekonomiky zaměřuje na to, aby každý pracovník měl možnost využít svůj potenciál a nebyl znevýhodněn kvůli svému věku. I když je tato oblast důležitá z hlediska současného demografického vývoje, ne všechny podniky její opatření využívají. Článek se proto zaměřuje na identifikaci a zhodnocení využívání Age Managementu v českých zemědělských podnicích. Analyzovaná data byla získána na základě kvantitativního výzkumu pomocí dotazníkového šetření sběru dat (celkem podniků: n=315, zemědělských podniků: na=60). Z výsledků vyplývá, že v rámci českých zemědělských podniků se opatření Age Managementu ještě v současné době zcela nevyužívají. Jedním ze závěrů článku je, že pomocí opatření Age Managementu lze ze společenského hlediska zlepšovat situaci na trhu práce a produktivitu práce, podprovat mladé lidi, aby pracovali v zemědělství, a v neposlední řadě na organizační úrovni budovat značku zaměstnavatele. Aplikace Age managementu působí na výkon zaměstnanců, ale také na celkové snižování nákladů a zvyšování zisku.

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Klíčová slova

Age Management, vývoj demografie obyvatelstva, zemědělství, náklady, Česká republika, výzkum.

Abstract

Within the frame of the entire economy, the modern conception of Age Management enables each and every employee to use their full potential without being put at a disadvantage for age reasons. Despite the fact that this area is important in terms of current demographic development, there are organisations that do not implement its measures. The article therefore concentrates on the identification and evaluation of Age Management application by Czech agricultural businesses. The data analysed was obtained based on a quantitative survey in which data was collected by means of a questionnaire survey (total companies: n=315, agricultural businesses: na=60). The outcomes show that Czech agricultural businesses are not quite familiar with the application of Age Management measures. One of the conclusions of the article is that from the social point of view Age Management measures may help improve the situation on the labour market, labour productivity, encourage young people to work in the agricultural sector and, last but not least, build, on the organisational level, an employer's brand. Application of Age Management causes on the employees performance but also on the costs reduce and profit increase.

This contribution is a follow-up to the project of University – wide internal grant agency (CIGA), number 20141002 - Human resource branding using of the new strategic trends in organisations in the Czech Republic.

Key words

Age Management, demography development of population, agriculture, cost, the Czech Republic, survey.

Introduction

At present, Age Management represents a method of management that takes into account the age of employees that work in the organisation (Cimbálníková et al., 2012). The main goal of this idea is to support a comprehensive approach to the demographic situation which is not (in the Czech Republic but also elsewhere) very optimistic in any of the economic sectors (Bejkovský, 2012). Čadil et al. (2011) states that the number of young people to be employed in the future will continue to decrease in the Czech Republic while the number of the elderly (50+) will grow significantly (Smrčka, Arltová, 2013). Age Management therefore stresses that employing older people has its advantages and in this context it also deals with demographic changes at the workplace (Ng, Law, 2014). With respect to the above said, it is evident that the conception of Age Management is important not solely at the social level, but also at the organisational level. According to Cimbálníková et al. (2012), the principles on which Age Management is based may be briefly summarized into four preconditions: (1) to have good knowledge of the age structure of employees within the organisation; (2) to place emphasis on fair approaches to ageing; (3) to take into account the individuality of each employee; and (4) to encourage variety or strategic thinking.

Age Manangement is a way of management that is suitable for all economic sectors, i.e. all business fields. In the Czech Republic, one of the areas that has been long characterised by an unfavourable age structure of labour is the agrarian sector. The data issued by the Czech Statistical Office (2014; 2011, hereinafter CSO) reveals that the agrarian sector needs to undergo a speedy generational change and to improve the quality of labour in compliance with the growing demands for the quality of production. According to Fukan (2011) and the CSO (2011), this refers in particular to the low percentage of young employees and, on the other hand, the high percentage of employees at pre-retirement age. The CSO (2011) states that there are significant differences also when compared with the age structure of employees across all sectors of the Czech national economy and, last but not least, when compared with employment in agriculture in some developed EU countries. Statistical data shows that the development is not positive and that the success of the generational change in this sector is jeopardised. The competitiveness of Czech agriculture is also endangered due to the decreasing capacity of the sector to implement the latest knowledge and innovations.

The objective of the article is thus to identify and evaluate the application of Age Management in Czech agricultural businesses. A partial goal is to test dependencies between the preset qualitative features, to summarise the advantages of its application at individual, corporate (agricultural business) and social levels and to propose recommendations for agricultural businesses.

The first part of the article presents the theoretical background together with comparisons of secondary resources. The Results and Discussion chapter includes an analysis and a synthesis of the survey targeted at Age Management in the agrarian sector in the Czech Republic. The chapter also contains a comparison of results with results of similar surveys conducted abroad and draft recommendations.

Theoretical background of the work

According to the European Age Management network (2007) the term "Age Management" is frequently used in today's developed societies, however, no agreement has been reached when it comes to a common definition. This is also due to the fact that it covers a wide range of areas (Cimbálníková et al., 2012).

According to the European Age Management network (2007), the content of the conception observed may be defined at three levels: social and political; corporate; and individual. Kocianová (2012) adds a fourth level – i.e. collective. When it comes to their definition, it may be said that for each of the above-mentioned levels the objective is to define a strategy (procedure) to achieve benefits for each defined group. These levels may be defined as follows:

1. Individual level: strategies at this level concentrate on individual employees and relate to work skills, health and the quality of life, social relationships and benefits that older employees bring to organisations (Ng, Law, 2014; Cimbálníková et al., 2012; European Age Management network, 2007).
2. Collective level: these are strategies built on collective dialogue between trade unions and employers (Kociánová, 2012).
3. Corporate level: strategies are proposed on a corporate level and deal with retaining skills and labour, knowledge transfer, human resources management techniques,

and modifications of organisation of work and working hours (Cimbálníková et al., 2012; European Age Management network, 2007).

4. Social level: these strategies are developed by governments of individual countries within the frame of the following topics: active ageing, health and life quality improvement, reducing pension costs, and health and social care (Cimbálníková et al., 2012; European Age Management network, 2007).

The above shows that the scope of the conception is rather broad and crosses individual pillars of economy, i.e. people who are knowledge carriers and teams that co-operate to create values and contribute to a company's performance and, last but not least, contribute to the well-being of society as a whole.

In compliance with the above said in 2013 the Quality Assurance Authority of the Czech Republic and the Czech Society for Quality (2014) started to encourage organisations to apply, on a permanent basis, the principles of Age Management and therefore introduced the Award for the application of Age Management in businesses in the Czech Republic. This is a response to the activities of the European Union which designated the year 2012 the European Year for Active Ageing and Solidarity between Generations. The competition stresses solidarity between generations and its positive impacts on society, civil life, entrepreneurial environment, and public administration in harmony with the principles of the National Positive Ageing Strategy (Ministry of Labour and Social Affairs, 2013). Although, with respect to current demographic development, employee ageing is a topical issue for all companies, and the article focuses primarily on the corporate level in the area of agriculture, i.e. the application of Age Management conception in the agrarian sector.

According to the National Training Fund (2014) agriculture is one of the sectors of the Czech economy employing people having a higher average age and in the long term has failed to attract young people. The percentage of employees under 30 has decreased by half; on the contrary, the number of employees over 60 years old has increased by 50% in the course of the last 10 years (CSO, 2014). The data also shows that more than two fifths of employees are over 50. At present, agriculture is perceived as an industry with a relatively lower employment perspective and the overall employment in this sector is expected to decrease, according to the CSO (2014), by one third by 2020 compared to the year 2008. Its share with respect to the overall employment in the entire economy is expected to be 2.45 %. According to the CSO (2014) this figure roughly corresponds to the current share of this sector in overall employment in developed West European countries.

Agriculture lacks certain professions and in the coming years the sector is going to undergo a change in qualification structure. New trends will support demand for workers with higher or broader qualifications (e.g. the growth of ecofarms and the development of agrotourism) and the demand for employees with completed secondary or tertiary education is likely to increase (National Training Fund, 2014).

A similar development is expected also in forestry professions. These are still characterised by a large share of manual work, which is going to change due to the development in mechanisation. Forestry, like agriculture, is characterised by lower demands for qualified labour, but this is also likely to change, at least partially, in the future years. Apart from the requirement of having knowledge in forestry combined with the ability to master more modern technological processes, the importance of ecological knowledge is also likely to grow. Professions with such a qualification structure will be increasingly important to maintain environmental stability and forest biodiversity (National Training Fund, 2014, Czech Quality Assurance Authority, 2013).

In compliance with the CSO (2014) Krutílek and Kuchyňková (2006) state that the adverse age structure in agriculture and forestry is a result of a greater number of factors which include the following:

1. The transformation process led to the outflow of unused, but also qualified labour and the production of resources for the development of agricultural businesses was significantly limited. While at present agriculture is witnessing production modernisation, the deficits in qualified labour still persist (Krutílek, Kuchyňková, 2006).
2. One of the most important factors is the prevailing lower income, i.e. wage level which does not correspond to the general demandingness of work

in agriculture (hard manual work, longer working hours, seasonality, conditions and circumstances at workplaces in animal and plant production, etc.). In combination with wage disparity the sector lacks attractiveness or young and qualified people. Lower wages in agriculture have a close connection to financial results of businesses (average monthly wage CZK 18.815 in agriculture in comparison with national average value CZK 24.806, CSO (2014)). On the other hand, the requirements for labour qualification and quality in agriculture continue to grow, primarily due to technical and technological development. Agricultural businesses, however, have difficulties to recruit such employees (National Training Fund, 2009).

3. Agriculture is not undergoing a generational change to a sufficient extent and is characterised by "conservative" behaviour of the older agricultural generation (Krutílek, Kuchyňková, 2006).

In particular these deficits in the area of human capital are a result of an insufficiently innovative approach which manifest themselves, among other things, in an inappropriate ratio of costs and benefits that are revealed by surveys targeted at the identification of the level of diversification of the European agriculture. Surveys focusing on the educational structure of farm owners also disclosed that it is farm owners under 40 who tend to practise more significant diversification, demonstrate the ability to accept and adopt new technologies and practices and also support more environmentally friendly farming and who, in the majority of cases, also have higher education (often including some specialisation) rather than the category of owners over 40 years old (Krutílek, Kychyňková 2006).

With respect to the above said it may be concluded that no major changes for the better can be seen. Agriculture has a significantly more unfavourable age structure than the rest of the national economy. While it employs a much lower number of employees under 30, the number of employees over 60 employed in agriculture amounts to almost double (CSO, 2014; National Training Fund, 2014).

The unfavourable age structure of employees together with low wages in agriculture (average monthly wage CZK 18.815, CSO(2014)) represent a long-term problem which continues to grow with the increasing pressure to speed up the generational change due to the strong representation of employees of higher age categories who are about to retire. Therefore the following assumptions (A) have been defined for the practical part of the article:

- A1: Agricultural businesses in the Czech Republic do not apply Age Management as a management method.
- A2: Agricultural businesses in the Czech Republic do not plan to apply Age Management.

The above assumptions are to be verified in the practical part of the article based on the execution of a primary survey.

Materials and methods

The article has been drawn up using scientific methods, in particular logical methods, such as analysis, synthesis, induction and deduction. The theoretical background was based on analysis of secondary sources, studying the scientific papers and literature about Age Management and Human Resource Management.

The primary data analysed has been obtained by means of a quantitative survey using a questionnaire technique of data collection in organisations in the Czech Republic operating in all economic sectors (according to the CZ-NACE). The selection of organisations was intentional. The sample group consisted of 315 organisations. Companies were contacted based on the following two criteria:

- Sector of economy (15% from the primary, 15% from the secondary and 70% from the tertiary sectors, which reflects the structure of Czech economic entities within industries according to the CSO).
- Size of the business according to the number of employees: 65% of small, 20% of mid-sized and 15% of large organisations (which reflects the structure of business entities according to their size across industries in the Czech Republic according to the CSO).

Only one respondent per business was contacted. On behalf of the organisation, the questionnaire was completed by a respondent who holds a managerial position (has at least one direct subordinate), e.g. human resources manager; a person who

deals with human resources management within the organisation in question; a line manager; company owner; or a person holding a position in the middle or higher management of the organisation.

By 15 May 2014 315 organisations participated in the questionnaire survey:

- Based on economic sector: 19.0% from the primary, 16.5% from the secondary and 64.4% from the tertiary sectors,
- Based on the size of the business according to the number of employees: 55.9% of small, 25.1% of mid-sized and 19.0% of large organisations.

As of 15 May 2014 60 businesses operating in the agricultural sector took part. As regards the size of the business according to the number of employees, the structure was as follows: 63.3% ,of small agricultural businesses (up to 50 employees), 28.3% of mid-sized agricultural businesses (51 to 249 employees), and 8.3% of large agricultural businesses (over 250 employees).

A total of 95% of these businesses were Czech entities, only 5% of the responding businesses were entities with major foreign participation (3 businesses). The majority of contacted agricultural businesses were from the Central Bohemian region (36.7%), Prague (20.0%) and the Ústecký Region (13.3%). Other regions are represented by 2% on average.

To evaluate the outcomes of the survey methods of descriptive statistics (absolute and relative frequency, testing of independency between set qualitative characteristics and power dependency measures) have been applied. The Pearson´s Chi-square test and Cramer´s V have been applied. Authors have based the decision about the test results on the p-value. If the p–value calculated by means of the χ^2 test (Pearson Chi-Square) was lower than the selected level of significance $\alpha = 0.05$, null hypothesis about independency was rejected. The analysis was carried out using the Microsoft Excel 2013 statistical software SPSS 21.

Results

This chapter contains evaluation of the data, their interpretation and recommendations. It is structured into the two sub-sections; the assessment of the current situation of Age Management in the Czech companies in agriculture. The section "Results" is followed by the discussion and conclusions which summarize the most important recommendations from the evaluated results.

The results show that at present only 32.7% of businesses addressed (n=315) undertake Age Management activities, out of which (na = 60) 26.7% (16 businesses) were agricultural businesses. It is therefore possible to state that the majority of agricultural businesses do not implement Age Management. The survey was thus targeted at identifying the reasons for the above said. The reasons determined are shown in Table 1. Respondents were allowed to mark more than one reason.

Reasons	Absolute frequencies
Age Management is not important for us	19
It´s application is difficult	11
We do not have specialists in this area	23
It is not a parto of organizational culture	8
Others	6

Source: own survey

Table 1: The reasons why the agrarian companies do not ensure Age Management

The largest number of representatives of agricultural businesses mentioned they did not dispose of specialists in the given field. This was because they were predominantly small businesses lacking a human resources department or a sufficient number of line managers who would deal with these issues. They also found the application quite difficult which, however, could be solved by studying relevant manuals which had been developed within the frame of the Human Resources and Employment Operational Programme or a consultation with specialists who concentrate on this area. The total of 19 agricultural businesses (out of 60) did not find this area important. The situation, however, might change with the demographic development of the population. Organisational culture was also a limiting factor. If the organisational culture does not support Age Management strategies (employing people aged 55+), it is merely impossible to implement the conception in an agricultural business.

On the other hand, it must be said that 26.7% of agricultural businesses (12 businesses) that do not currently apply Age Management stated that they planned to implement Age Management activities.

This is due to the fact that the demographic development and the National Action Plan or the surveys conducted abroad (Cimbálníková et al., 2012) emphasise the necessity to adapt work processes to the risk group aged 55+ and to support co-operation of young and older employees. The future implementation of Age Management in agricultural businesses according to the organisation's size is shown in Table 2.

Category	Absolute frequencies
up to 50	6
51 - 250	5
251 and over	1
Total	**12**

Source: own survey

Table 2: Application of Age Management in the future (until 2 to 3 years) by the size category

Agricultural businesses that conduct Age Management activities stated that 75% were conducted intuitively since they did not dispose of the set of measures and the systematic approach to follow. In total, 25% of organisations in agriculture apply a set of systematic measures arising from the National Action Plan supporting positive ageing. The responsibility for Age Management activities undertaken in this area falls, in the majority of agricultural businesses, on middle or higher management including the owners of the businesses (62.5%, 10 businesses), the human resources department 31.3% (5 businesses) and line managers 6.3% (1 business). In all large agricultural businesses analysed (having over 250 employees) the responsibility for the given area lies with the department of human resources management, which is in compliance with Koubek (2011), who stresses that even mid-sized businesses, regardless of the industry in which they operate, should have a human resources department established specialising in individual personnel activities.

With regard to the data from the Ministry of Agriculture stating that agriculture employed approximately 141 thousand people in 2004 and that this figure has been decreasing since the 1990s, the age structure of employees in the agricultural business in question (Table 3) has been examined, in particular in the most critical category (55+). Age Management focuses primarily on this category.

Category	Absolute frequencies	Relative frequencies
0 - 5 %	16	26.7
6 - 10 %	6	10.0
11 - 15 %	8	13.3
16 - 20 %	6	10.0
21 - 30 %	9	15.0
31 - 40 %	7	11.7
41 - 50 %	4	6.7
51 % and more	4	6.7
Total	**60**	**100.0%**

Source: own survey

Table 3: Stucture of employees in agrarian companies in category 55+.

Based on the results it may be summarised that the majority of businesses monitored have a low percentage of employees aged 55+, which is also due to the demandingness of work in agriculture, the emphasis on increasing employee qualifications, etc. Since the level of employee turnover is rather high due to the fact that young people leave and agriculture faces a lack of labour, it is necessary to stimulate employees adequately to make them stay in the sector. Employees that leave agricultural businesses the most are workers aged 18 and 30. These results are in line with the statement of Krutílek and Kuchyňková (2006) that there is insufficient generational change in agriculture and the older generation of workers employed in agriculture behaves conservatively. A detailed structure of employee turnover in the given businesses is shown in Table 4.

Category	Absolute frequencies	Relative frequencies
18 - 30 years old	38	63.3
31 - 44 years old	10	16.7
45 - 56 years old	6	10.0
57 years old and older	6	10.0
Total	**60**	**100.0%**

Source: own survey

Table 4: Employee turnover in age employee category.

Employees in agricultural businesses are, according to the Czech-Moravian Confederation of Trade Unions Portal (2014), the most loyal employees in the Czech Republic. Surveys show that the lowest turnover is in agriculture (13.3 years in one position) and public administration (12.4 years). On the contrary, jobs are most frequently changed in fields such as business

(8.7 years) and science or rather research (6.8 years). Agricultural employees who decide to leave are usually graduates and young people under 30 who wish to gain experience in a more attractive industry. One of the most important reasons for leaving is the average salary in agriculture, which is also confirmed by the CSO (2014) and the National Training Fund (2009).

When identifying factors that might influence the application of Age Management in businesses, the following statistical hypotheses have been verified:

1. Age Management application is not dependent on the sector in which the business operates.
2. Age Management application is not dependent on the size of the business.

Contingency tables that show the frequency of combinations of individual categories have been developed for both hypotheses (see Table 5 and Table 6).

Sector	**Age management implemented**		**Total**
	Yes	No	
Primary	16	44	60
Secondary	17	35	52
Terciary	70	133	203
Total	**103**	**212**	**315**

Source: own survey

Table 5: Application of Age Management by sector.

It is evident from Table 5 that roughly one third of responding businesses, regardless of the sector, apply Age Management. When paying more attention to individual sectors, one third of businesses in the secondary and tertiary sectors apply Age Management, and in the primary sector it is only about 27%.

Number of employees	**Age management implemented**		**Total**
	Yes	**No**	
up to 50	55	121	176
51 - 250	21	58	79
251 and over	27	33	60
Total	**103**	**212**	**315**

Source: own survey

Table 6: Application of Age Management by the size category

Table 7 contains the results of dependency testing. It has been verified the dependence of the application of Age Management on the sector in which the business operates and the size of the business measured by the number of employees. In both cases the null hypothesis on independence was tested by means of the Chi-Square test. In neither of the cases the hypothesis was rejected since the p-value in both tests (0.526; resp. 0.060) exceeded the significance level of 5%. It is possible to state that the application of Age Management at the 5% significance level is not dependent on sector or the size of the business.

Tested factor	**Chi-square test criterion**	**Number of degrees of freedom**	**p-value**
Sector	1.286	2	0.526
Size category	5.637	2	0.060

Source: own survey

Table 7: Testing of dependence of Age Management implementation on selected factors.

Based on the results of the test it is possible to summarize that:

- A1: Agricultural businesses in the Czech Republic currently do not apply Age Management as a method of management.
- A2: The majority of agricultural businesses in the Czech Republic which do not apply Age Management want to apply it in the future (within the period of 2 to 3 years) bearing in mind the demographic development of the population.

Based on the survey conducted it is possible to summarize the problems and opportunities of Age Management application for an employee as such, for the given agricultural business and the entire society. Table 8 shows means and possible solutions to achieve the set goals in the given area.

Surveys, for example Bejkovský (2012) or Cimbálníková et al. (2012), state that for organisations in the Czech Republic it is currently rather unattractive to employ people over 50. It is connected with the fact that businesses need to develop special conditions for these employees and not all businesses are ready for this.

Discussion

On the basis of the survey carried out, comparison with similar surveys and the current situation

Interest area	Problems and opportunities	Means and solutions	Goals and results
Individual	Work ability Work motivation Unemployment Competencies	Continuous learning/training, support universities of the third age. Support Age management and knowledge transfer from generation to generation (ensuring knowledge continuity). The use of flexible forms of employment and working hours in companies.	Competitive advantage in the labor market.
Agriculture company	Workforce ability Competetiveness Labour productivity	Change attitudes to aging, effectively use all the workforce to adapt to trends in the organisation of working hours and forms of employment with emphasis and requirements of individuals.	Work efficiency
Society	Work attitude Retirements Age discrimination Costs	Mitigate the negative consequences of demographic development.	Maintaining the competitiveness of the economy. Reducing the rate of employment and increasing qualifications of the staff.

Source: own elaborate

Table 8: Using Age Management in society.

on the labour market, it may be said that the situation is changing rapidly and it is necessary to adapt to these changes. Therefore it is necessary to take into account current trends in lifestyle to which businesses should respond. Current trends include the following:

- Return to alternative ways of life and interest in farming and the countryside. At present the situation on the food market has triggered increased interest (after years of decline) in "self-supply" agricultural activities (CSO, 2011).
- Strengthening of vocational and secondary agricultural education with more emphasis on the needs of agricultural practice.
- Changes in the rural labour market as the worsening of the situation on the labour market may encourage interest in employment in agriculture with a higher share of qualified candidates (National Training Fund, 2013).

With respect to the above said agricultural businesses are recommended to:

- Adapt flexibly the length and content of work to the individual pace of employees, which is in compliance with the surveys conducted by Galea et al. (2014), Ng, Law (2014). In positions and divisions where work time is not strictly defined by shifts or follow-up operations it is advisable to leave the performance of tasks to employees' discretion, and if required, to extend their work break. This measure, however, is conditioned by the completion of all daily tasks. This would be welcomed by those employees who need a longer break due to fatigue. Others will probably not prolong their working hours.
- Not presume that certain work is too exhausting for an older employee; one's opinion needs to be based on an employee's decision and other factors, not only on age. Such a measure will contribute to better employee's self-fulfilment and subsequently will increase their satisfaction.

The advantages of application of measures in the area of Age Management are confirmed by various studies (Štorová, 2013; Bejkovský, 2012; Cimbálníková et al., 2012) and the variety of possible measures is very wide. Proposed measures show that such solutions do not necessarily mean inadequate financial burden. Some measures may be implemented without significant organisational effort and financial demands. Application of these measures and the follow-up change of the business to an organisation respecting age differences will have a positive impact not only on the performance, motivation and satisfaction of employees, but also on the overall cost cutting and profit increase.

This will subsequently lead to the enhancing of the organisation's image, help build the employer's brand and, last but not least, it will contribute to the improvement of quality of life of the entire society.

Conclusion

The results have revealed that the majority of agricultural businesses still fail to implement the Age Management conception (73.3%). However, taking into account the demographic development, organisations' managements are expected to support it and in the future its importance for management will continue to grow. At present, it is mainly large businesses with foreign participation in the secondary sector that deal with these issues; in agricultural businesses Age Management is very seldomly applied. Nevertheless, bearing in mind the demographic development in the Czech Republic according to the CSO (2014), we can expect that the number of employees in the target group at which Age Management is aimed will increase in the following ten years. These issues have already been monitored by the government of the Czech Republic that strives to help entrepreneurs (through background methodological materials) set goals and measures in the area of Age Management. The theoretical contribution of the article lies in the verification of the theoretical assumptions of Age Management application in a specific economic sector, i.e. agriculture. The practical contribution of the article is the presentation of the results obtained from the 60 agricultural businesses monitored, including recommendations for those agricultural businesses that plan to implement Age Management.

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Dimensions and Determinants of Growth in Micro and Small Enterprises: Empirical Evidence from Mekelle City, Ethiopia

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Abstract

This paper aims to investigate the dimensions and determinants of growth in Micro and Small Enterprises (MSEs) based on a survey covering 178 randomly selected MSEs in Mekelle city, northern Ethiopia through the test of four main hypotheses and arguments of Gibrat's law and the learning theory hypothesis. Semi-structured questionnaire and interview were used to collect data, and the binary choice model was used to identify factors that significantly affect the growth of MSEs. Employment size index is used as a proxy to measure firm growth in which about 76.4 percent of MSEs are found survival and the remaining 23.6 percent are growing type. There is also an evidence supporting the law of proportional effect could hold in the MSEs context. Moreover, the logit model result reveals that there is a significant gender difference in growth of MSEs. Furthermore, the start up capital, location and sector in which MSEs operate matter a lot for their growth. Hence, government and non-government organizations that are concerned with the promotion and development of MSEs need to take these factors in to account to accomplish better result and increase the potential contribution of MSEs to the economic growth.

Key words

Determinants, dimensions, growth, MSEs, binary choice model, Tigray, Ethiopia.

Introduction

In developing countries, Micro and Small Enterprises (MSEs) by virtue of their size, location, capital investment and their capacity to generate greater employment have proved their paramount effect on rapid economic growth (MTI, 1997). The sector is also known in bringing structural economic transformation by effectively using the skill and the talent of people without requesting high-level training, much capital and sophisticated technology. As a result the MSE sector is described as the natural home of entrepreneurship since it provides an ideal environment that enable entrepreneurs to exercise their talents to fill and attain their goals. Due to these MSEs are recognized as a real engine of economic growth and technological progress (Carrier, 1994; Mulharn, 1995). Moreover, MSEs exert a very strong influence on the economic growth of all countries over the world (Drillhon and Estime, 1993). These makes MSEs a major area of concern for government and non-government organizations with an objective of unemployment and income inequality reduction, income generation, import substitution, innovation, poverty alleviation etc.

The MSE sector is seen as an essential catalyst for job creation, unemployment reduction and social progress at large since it takes the lion share of fast growing labor force in the world particularly 48% in North Africa, 51% in Latin America, 65% in Asia, and 72% in Sub-Saharan African Countries (ILO, 2002). The study made in five countries of Eastern and Southern Africa (Botswana, Kenya, Malawi, Swizaland and Zimbabwe) by Mead and Liedholm (1998) shows that people engaged in MSEs are nearly twice the level of employment in large scale enterprises and in the public sectors.

In Ethiopia, MSEs are the second largest employment generating sector next to agriculture. A National survey conducted by Central Statistics Agency (CSA) in 2006 indicates that more than 1.3 million people in the country are engaged in MSEs sector. But a large number of MSEs are unable to grow (expand in terms of employment) and remain to be survival (non-growing) type which cannot provide employment. Moreover, out of 1000 MSEs in this country

around 69% of them are found survival types (Gebreeyesus, 2009) and particularly in capital city Addis Ababa majority (75.6%) of the MSEs are unable to grow at all since start up and only 21.9% of the MSEs were added workers (Wasihun and Paul, 2010). Even though MSEs that add workers or seeking to add labor force make a major contribution to the economic growth of the country (Mead and Liedholm, 1998) and helping more of these enterprises to grow (add workers) can make a greater contribution to unemployment reduction and income generation than equal efforts made for the promotion of new MSEs. Besides, the MSEs that add workers are very important mechanism for helping people to move up and out of poverty since increase in size is often associated with an increase in economic efficiency but, most MSEs are subject to different set of dynamic forces which can affect their growth and reduce their potential contribution to the economic growth of the country. Hence, most MSEs remain the same in size of employment since start up as compared to larger enterprises since the factors that influence the growth of MSEs are many, complex and erratic.

The Ethiopian Government in this regard has formulated a National MSEs Development and Promotion Strategy in 1997 with a major objective of creating long-term employment and providing basis for medium and large scale enterprises there by to facilitate economic growth. However, this strategy needs to be supported by detailed studies at every level i.e., country, regional and firm level so as to be easily realized.

While a significant amount of research has been done on the determinants of growth in large firms, much less is known with respect to MSEs (Raymond, Bergeron, & Blili, 2005), specifically in developing countries like Ethiopia, given that MSEs survival, growth and prosperity are more often than not and potentially subjected to different constraints and contingencies related to entrepreneurial, firm, external and inter-firm factors. Hence, most MSEs remain the same in size of employment since start up as compared to larger enterprises since the factors that influence the growth of MSEs are many, complex and erratic. As Ajibefun and Daramola (2003) emphasized that many studies that exist in the developing countries are macro in nature and generally rely on cross-country or multi-country data rather than firm level survey data. Therefore, most problems that are found at firm level were remaining unsolved due to lack of detailed studies in most developing countries including Ethiopia.

So that taking these all in to account, it is very essential to systematically analyze the factors that affect the growth of MSEs. Therefore, this study aims to investigate the dimensions and determinant factors of MSEs growth in Mekelle city, Tigray regional state of Ethiopia. In which major emphasis was given to examine the growth status of MSEs, to identify the key factors affecting they growth of MSEs and to critically analyze the causes and consequences.

Materials and methods

The dimensions and determinants of MSEs growth is vast and complex (Delmar, 1997). However, to examine factors affecting the growth of MSEs, this study draws on empirical evidence from 2012 survey covering 178 randomly selected MSEs from Mekelle city Tigray regional state of Ethiopia. A semi-structured questionnaire and personal interview were used to collect first hand data. The data collected in this way was classified, summarized and presented using text and table, and analyzed using the descriptive statistical tools like percentages, ratios, mean and standard deviation. In addition, the econometric analysis tool that is binary choice logistic regression model was used to test the literature driven hypothesis and to draw conclusions.

The model

The growth of MSEs is subject to different set of interrelated factors (Baldwin, 1995) in order to investigate the factors that determine the growth status of MSEs, the binary logistic regression model is used to examine the relation of each factor with growth of MSEs. These models are often used to approximate the mathematical relationships between explanatory variables and dichotomous dependent variable.

The binary logistic regression model is selected due to the nature of dependent variable, if the dependent variable is categorical variable with only two categories (growing & non-growing/ survival valued as 1 & 0 respectively), binary logistic (logit) regression is appropriate. But when the dependent variable is categorical, OLS regression technique produces parameter estimates that are inefficient and heteroscedastic error structure. As a result, testing hypothesis and construction of confidence interval becomes inaccurate and

misleading. Similarly, a linear probability model may generate predicted value outside 0 - 1 interval which violates the basic principles of probability (Gujarati, 2004). It also creates a problem of non normality, hetroscedasticity of the disturbance term; thereafter leading to lower coefficients of determination (Gujarati, 2004).

Therefore, to alleviate these problems and come up with relevant out put the non-linear specification model is selected i.e., the cumulative distribution functions (CDFs) are commonly chosen to represent the 0-1 response model which are the logit and the probit models.

The logit model assumes cumulative probability distribution function where as the probit model is associated with the cumulative normal distribution (Gujarati, 2004). The logit and the probit model yield similar parameter estimates, but the cumulative logistic regression model is preferred because of its comparative mathematical simplicity and more meaningful interpretation of odds ratio (Gujarati, 2004).

In this study MSEs are assumed to be either growing or survival (not growing). Hence the binary choice logistic regression model that assumes dichotomous dependent variable which takes either 1 or 0 value depending on Y^* is used, this is specified as:

$$Y = \begin{cases} 1 \; if \; Y^* > 0 \\ 0 \; if \; Y^* \leq 0 \end{cases} \quad (1)$$

In a qualitative response model, the probability that Y=1 is given by the sign of the latent variable that is the probability that the latent variable becomes positive.

$$P(Y^* > 0) = P(\beta' X + \varepsilon > 0) = P(\varepsilon > -\beta' X) = P(\varepsilon < \beta' X) = F(\beta' X) \quad (2)$$

The finally employed model becomes:

$$P(Y = 1) = \alpha + \beta_1(genow) + \log\beta_2(iis) + \beta_3(entloc) + \beta_4(entsec) + \varepsilon \quad (3)$$

Where α the intercept, $\beta_{1\text{-}4}$ is is is the coefficient to be estimated, genow is the gender of enterprise owner, iis is initial investment size, entloc is the enterprise operation location, entsec is the enterprise sector of operation and ε is the error term that has a logistic distribution with mean 0 and variance 1. In this binary choice model, each observation is treated as a single draw that is binomial with one draw. The model with growing probability *(Y=1)* of *F(ß'X)* and independent individual observations leads to the joint likelihood function, given by the sum-product of the probabilities of growing and survival.

The model can be written as a multiplicative function by taking the exponential form of both sides: *Odds (growing) =P/ (1-P) = exp {α + $\beta_i X_i$} = e^{α} $e^{\beta ixi}$*. This is a model for Odds. Odds change multiplicatively with X_i. A one unit increase in X_i leads to a change (increase or decrease) of $e^{\beta i}$ in the odds that a MSE would be growing type. The logarithm of the odds changes linearly with X_i; however, the logarithm of *Odds* is not an intuitively easy or natural scale to interpret.

Alternatively, it can be expressed in terms of probability as:

$$P = exp\{\alpha + \beta_i X_i / \{1 + exp(\alpha + \beta_i X_i)\}. \; Or, \; p = Odds / (1 + odds) \quad (4)$$

Where:

exp = e = 2.71828 = base of natural logarithm,

P /1-P = odds of MSE growth

X_i = independent variables

X_i*'s* can be categorical or continuous, but *Y* is always categorical (qualitative), *Growing* or survival in this case. The *Logistic Regression* is a powerful tool in its ability to estimate the individual effects of continuous or categorical independent variables on categorical dependent variables (Wright, 1995).

Specifying dependent and independent variable

The dependent variable is a dichotomous variable that represent the growth of MSE that is measured in terms of change in employment size. Taking the calculated growth in employment, MSEs are classified in to two categories i.e., growing (if gr > 0) and survival (if gr ≤ 0) following Cheng (2006) growth classification and represented in the model by 1 for the growing and 0 for survival MSEs. The independent variables that that are critically examined in this study are gender of the owner, initial investment size, location and sectors the MSEs are engaged. Taking this, the following hypotheses were driven.

Gender of owner versus MSEs growth

In most countries, majority of MSEs are owned and operated by women (Mead & Liedholm, 1998). The new start rates for female owned MSEs are substantially higher as compared to male headed MSEs but women owned Micro and small enterprise (WMSE) grow less rapidly than those male owned

MSEs. The studies made by Gebreyesus (2009) and Liedholm (2001) show that male owned MSEs grow more than double as compared to WMSEs. This gender difference on the growth of MSEs is hypothesized in this study as follow.

Hypothesis 1: Male owned MSEs are more likely to grow faster as compared to women owned MSEs.

Initial investment size versus MSEs growth

Resource endowment, capabilities and competitive advantages are major determinants of firm growth as per resource-based view since resources are basis for profitability and growth (Grant, 1991). MSEs that are started operation with higher initial investment are more likely to grow than their counter parts that are started operation with relatively smaller initial investment (Barney, 1991). Thus, the following hypothesis is formulated in this regard.

Hypothesis 2: Relatively the higher the initial investment sizes of the MSEs, the higher the chance of the MSEs growth.

Location versus MSEs growth

MSEs located at main road side exhibit higher growth compared to MSEs located out of town (Eshetu & Mammo, 2009; Gebreyesus, 2009). Moreover, the MSEs operating in commercial districts reveals strong tendency of growth than those which operate at distant areas (McPherson, 1996). Thus, this study formulates this hypothesis.

Hypothesis 3: The MSEs that are operating at main roadside (busy street) have higher probability of growth as compared to those MSEs that are operating at out of town (distant area).

Sector versus MSEs growth

MSEs operating in manufacturing and service sector grow faster than those in trade/service (Mead & Leidholm, 1998; Gebreyesus, 2009). MSEs in the construction sector grow more rapidly than enterprises in retailing business (McPherson, 1996). Hence, the following hypothesis is formulated.

Hypothesis 4: MSEs that are engaged in manufacturing sectors have higher chance of growth than those MSEs that are engaged in other sectors.

Research findings and discussions

To determine the status of MSEs, information on the growth measure has to be collected and an appropriate measure of aggregate growth has to be used. As a result, from the available alternatives of aggregate growth measures (capital, sales, profit, employment and etc) (Holmes, Zimmer, 1994), this study used employment size as an objective measure of firm growth since the data used in this study rely on a recall basis as a result other measures are susceptible to measurement errors (Story, 1994). Accordingly, MSEs growth rate is computed by taking the natural logarithm of change in employment size over the life of the firm [i.e., $MGR = \left(\frac{\ln S_{t'} - \ln S_t}{Ea}\right)$] following Evans (1987) model. Taking the calculated growth rate, the MSEs are classified in to two broad categories i.e., growing (if growth rate > 0) and survival (if growth rate ≤ 0) following Cheng (2006) growth classification. Thus, out of the total sample 23.6 percent are found growing type (42 MSEs) and the remaining 76.4 percent are found survival type (136 MSEs).

MSEs category	*Number of MSEs*	*Percent (%)*
Growing	42	23.6
Survival (non-growing)	136	76.4
Total	178	100

Source: Stata result from survey data (2012)

Table 1: Status of MSEs.

As table 1 shows majority (76.4%) of MSEs are found survival type and only 23.6 percent are found growing type. This result is consistent with the findings of Wasihun and Paul (2010) whose found that majority (75.6%) of MSEs in Addis Ababa are survival type. Moreover, Gebreeyesus (2009) also found that majority (69%) of MSEs in Ethiopia are non-growing type. This confirm that about three-forth of the MSEs are survival type and one-forth or less of MSEs are growing type in this country though the growing MSEs percentage is higher as compared to other African countries (Botswana, Malawi, Swaziland and Zimbabwe except Kenya) in which the growing MSEs ranges from 19.3 – 22.8 percent while it is 34.8 percent for Kenya (Liedholm, 2001).

As the following table 2 shows that out of the total respondents (178 MSEs), 66 percent are male owned MSEs and the rest 34 percent are female owned MSEs. The growing female owned

MSEs are accounted for 20 percent of the total female owned MSEs. On the other hand, growing male owned MSEs are accounted for 25 percent of the total male owned MSEs.

Whereas the survival female owned MSEs are accounted for 80 percent of the total female owned MSEs and the survival male owned MSEs are accounted for 75 percent of the total male owned MSEs. In addition there is a difference in the average growth rate between the female owned MSEs and the male owned MSEs i.e., the WMSEs reveals a smaller mean growth rate (16.1%) where as the mean growth rate of male owned MSEs is higher (19.2%). As a result, the WMSEs have a smaller tendency of growth and are more of survival type as compared to male owned MSEs.

Table 3 shows about 74 percent of the growing and 76 percent of the survival MSEs operates in separate business house (out of home) whereas only 26 percent of the growing MSEs and 24 percent of the survival MSEs operates in their residential house (in home).

Table 4 show majority (28%) of the growing MSEs start operation with an initial investment size that ranges from birr 10,000–50,000 while majority (37%) of the survival MSEs start operation with an initial investment size that ranges from birr 1000-5000. But most (72%) MSEs in this study start operation with an initial investment size that ranges from birr 100 – 10,000 since all most all MSEs have no access to formal credit or discriminated by the formal financial institutions (banks/MFIs).

The minimum initial investment size for all MSEs is birr 100 where as the maximum initial investment size is birr 800,000 and the average initial investment size is birr 25,719.10. The initial investment size for the growing MSEs is more variable and diverse as compared to the survival MSEs as the SD of the initial investment shows in the above table (4.6). Similarly, the average initial investment size is higher for the growing MSEs (birr 51,547.62) compared to the survival MSEs average initial investment size (birr 17,742.65).

The average growth rate is higher for those MSEs that are started operation with an initial investment size that ranges from birr 5001-10,000 and decrease for those that start operation with an initial investment size that is over birr 10,000.

The average initial investment size is substantially higher for the growing MSEs (birr 51,547.62)

Variable		***Growing MSEs***		***Growth Rate****			***Survival MSEs***		***Total***	
		No	*Percent*	*Min.*	*Max.*	*Mean*	*No*	*Percent*	*No*	*Percent*
Gender	*Female*	12	29	0.05	0.23	0.161	48	35	60	34
	Male	30	71	0.04	0.65	0.192	88	65	118	66
	Total	42	100	0.04	0.65	0.183	136	100	178	100

Note: * Indicates growth rate is for growing MSEs only
Source: Stata result from survey data (2012)

Table 2: Status of MSEs by gender owners.

Variable		***Growing MSEs***		***Growth Rate***			***Survival MSEs***		***Total***	
		No	*Percent*	*Min.*	*Max.*	*Mean*	*No*	*Percent*	*No*	*Percent*
Operation condition	*In-home*	11	26	0.05	0.31	0.185	32	24	43	24
	Out of home	31	74	0.04	0.65	0.182	104	76	135	76
	Total	42	100	0.04	0.65	0.183	136	100	178	100
Location	*Down town*	17	40	0.05	0.65	0.199	48	35.2	65	36.5
	Main road side	18	43	0.07	0.28	0.187	55	40.3	73	41
	Traditional Mkt	-	-	-	-		16	12	16	9
	Out of town	7	17	0.04	0.22	0.132	17	12.5	24	13.5
	Total	42	100	0.04	0.65	0.183	136	100	178	100

Source: Stata result from survey data (2012)

Table 3: Status of MSEs by areas of operation.

Variable	Range (ETB)	Growing MSEs		Growth Rate			Survival MSEs		Total	
		No	Percent	Min.	Max.	Mean	No	Percent	No	Percent
Initial investment size	100-1000	5	0.17	0.17	0.170	0.170	12	9	14	8
	1001-5000	17	0.05	0.23	0.108	0.108	50	37	57	32
	5001-10000	26	0.07	0.65	0.244	0.244	46	34	57	32
	10001-50000	28	0.09	0.35	0.233	0.233	22	16	34	19
	50001-100000	12	0.04	0.22	0.152	0.152	2	1	7	4
	100000-500000	10	0.07	0.09	0.079	0.079	4	3	8	4.5
	500001-1000000	2	0.04	0.04	0.04	0.04	-	-	1	0.5
	Total	42	100	0.04	0.65	0.183	136	100	178	100
	Mean	51547.62		0.183			17742.65		25719.1	
	SD	126952		0.138			46707.4		74862.41	
	Minimum	1000		0.041			100		100	
	Maximum	800000		0.65			300000		800000	

Note: ETB indicates Ethiopian Birr
Source: Stata result from survey data (2012)

Table 4: Status of MSEs by the initial investment size.

Variable	Growing MSEs		Growth Rate			Survival MSEs		Total	
	No	Percent	Min.	Max.	Mean	No	Percent	No	Percent
Construction	2	5	0.09	0.09	0.09	-	-	2	1
Hotel & Tourism	-	-	-	-	-	2	1.5	2	1
Manufacturing	14	33	0.08	0.65	0.268	7	5	21	12
Service	14	33	0.04	0.34	0.146	29	21	43	24
Trade	12	29	0.05	0.23	0.146	96	71	108	61
Ur. agriculture	-	-	-	-	-	2	1.5	2	1
Total	42	100	0.04	0.65	0.183	136	100	178	100

Source: Stata result from survey data (2012)

Table 5: Status of MSEs by the sector.

compared to the survival MSEs average initial investment size (birr 17,742.65) and overall initial investment size. The average growth rate is higher for those MSEs that are started operation with an initial investment size that ranges from birr 5001-10,000.

As table 5 reveals, in this survey, different variety of activities found in the samples which are categorized under urban agriculture, construction, hotel & tourism, manufacturing, service and trade sectors. Accordingly, urban agriculture takes 1 percent (2 MSEs), construction 1 percent (2 MSEs), hotel and tourism 1 percent (2 MSEs), manufacturing 12 percent (21 MSEs), service 24 percent (43 MSEs), and trade takes 61 percent (108 MSEs). The following table (4.7) shows details about the sectors that are found in the study.

From those MSEs that are engaged in manufacturing sectors (21 MSEs), 14 MSEs are growing type and the remaining 7 MSEs are survival type. In addition, the manufacturing sector growth rate is very high (26.8%) as compared to other sectors. Whereas from the MSEs that are engaged in service sectors, only 14 MSEs are growing and the remaining 29 MSEs are survival. Besides, this sector shows the highest growth rate next to manufacturing sector.

Concerning the test of Gibrats law and the learning hypotheses, the age of MSEs result shows that most MSEs (72.4%) that are included in this study have an age that ranges from 3-6 years and 12 percent of the MSEs are found within the age ranges

of 7-10 years. The remaining 7.2 and 8.4 percent have an age of 11-14 and over 15 years from the total respondent respectively. From those MSEs that are found survival type, 73 percent have an age of 3-6 years, 12 percent have an age of 7-10 years, 7 percent have an age of 11-14 years and only 8 percent of them have an age of more than 15 years.

Similarly, 71.5 percent of the growing MSEs have an age that ranges from 3-6 years and the remaining 28.5 percent have an age that ranges from 7-10, 11-14 and over 15 years which constitutes 9.5 percent each. The growing types of MSEs age is more variable and diverse than the survival MSEs age. Since the SD of age for the growing MSEs (7.12) is greater than the SD of the survival MSEs (4.64) and the growing MSEs average age is higher (7.33) than the survival MSEs average age (6.48). The minimum and maximum age for growing MSEs is 3 and 34 years respectively where as it is 3 and 24 for non-growing/survival MSEs respectively. The following table 6 shows details of the survey result regarding age of MSEs.

As it can be shown in table 6, 72.4 percent of the respondents are found in the age range of between 3-6 years. This indicates that most MS Es are found at the early stage as the other study also found (Wasihun, Paul, 2010). This may be associated with the recent favorable condition created and attention given by the government to the sector i.e., 1997 onwards the government of Ethiopia has formulated and implementing an enabling legal framework for the development and expansion of MSEs through facilitating their access to finance, appropriate technology, market, education, training, information and advice (BDS), and access to physical infrastructure (MTI, 1997). Whereas the remaining 27.6 percent have an age of over 7 years, as compared to those MSEs which are found at the early stage, their average growth rate is further declining and becomes flat. This indicates that there is an agitated negative relationship between the age and growth status of MSEs as the growth rate of MSEs contrary to finding of Chow and Fung (1996). The average growth rate decreases by increasing rate as age increases and then decreases by decreasing rate as age further increases. It shows there is a tendency of becoming flat or growing at constant growth rate. Moreover, it is consistent with the Gibrat's law since it shows that growth is subjective (idiosyncratic). The ups and downs in growth rate may be consistent with the law of proportional effect that state growth is the result of up and downs (shocks) in the size of the MSEs in previous years i.e., growth in employment may increase/decrease following previous year growth in employment.

The initial employment size of the MSEs in this study ranges from 1-10 with an average 1.5 employees i.e., owner and one occasional helper. Besides, most MSEs (72.4%) start business with one employee (owner alone). Similarly, 79.4 percent of the survival MSEs and 50 percent of the growing MSEs start operation by owner (one employee) alone. The MSEs that start operation with 2-5 employment size constitutes 25.3 percent. Only 2.3 percent of the respondent start operations with an employment size of over 5 employees

Variable name	***Range***	***Growing MSEs***		***Growth Rate***			***Survival MSEs***		***Total***	
		No	*Percent*	*Min.*	*Max.*	*Mean*	*No*	*Percent*	*No*	*Percent*
MSEs age	*3-6*	30	71.5	0.05	0.65	0.228	99	73	129	72.4
	7-10	4	9.5	0.05	0.15	0.096	17	12	21	12
	11-14	4	9.5	0.05	0.07	0.059	9	7	13	7.2
	Over 15	4	9.5	0.04	0.07	0.055	11	8	15	8.4
	Total	42	100	0.04	0.65	0.183	136	100	178	100
	Mean	7.33			0.183		6.48		6.68	
	SD	7.12			0.138		4.64		1.29	
	Minimum	3			0.041		3		3	
	Maximum	34			0.65		24		34	

Source: Stata result from survey data (2012)

Table 6: Status of MSEs by age of MSEs.

and all MSEs in this category are growing type. The SD of the employment size for the growing MSEs (2.25) is greater than the SD of employment size in survival MSEs (0.66) which implies the growing type MSEs initial employment size is more variable and diverse than the survival MSEs size (Penrose, 1995). The average employment size is also higher (2.24) for the growing MSEs as compared to non growing MSEs (1.3). The following table 7 summarizes details of initial employment size. As it is shown the average growth rate decreases as initial employment size increases to the extent of some employment size and then after there is a tendency of showing constant growth rate. This supports that growth of MSEs is subjective or idiosyncratic since the growth of MSEs was high/low no matter what the initial employment size is.

The average annual employment growth rate since startup is 18.3 percent. This growth rate is two times higher than the MSEs employment growth in five African countries, except Kenya. The annual average growth rate of employment size since start-up for Botswana, Malawi, Swaziland and Zimbabwe ranges from 6.3 - 9 percent where as it is 24 percent for Kenya which is the greatest (Liedholm, 2001).

Moreover, finding the factors that significantly contribute to the growth of MSEs goes beyond the descriptive analysis and requires employing econometric analysis. Hence, multivariate econometric analysis helps us to identify factors that significantly influence the extent of growth. As it was discussed in materials and methods part of this study, a binary logitistic regression model was used to identify the key determinants of MSEs growth and to test the hypotheses. The variables described in the descriptive analysis are used as explanatory variables in the logistic model.

Using the MSEs growth status as a dependent variable where by a value of 1 is given to growing MSE and 0 to non growing MSE taking the employment growth rate in to account, the output of the model shown in table 8 reveals, most influential variables that significantly determine the growth of MSEs are gender of owner (GEO) with an estimated odds ratio of 3.74 ($p < 0.10$), initial investment size (start-up capital) (EIIS) with an odds ratio of 2.05 ($p < 0.05$), location (EOL) with an odd ratio of 8.14 ($p < 0.05$) for out of town (distant area) located and sector (ESC) with an odd ratio of 0.23 ($p < 0.10$) for service and 0.035 ($p < 0.01$) for trade sectors respectively, holding all other factors remains constant. Moreover, male owned MSEs was found to have positive relation with growth status of MSEs and statistically significant at 10 percent. The odds ratio of the variable "gender of owner" indicates the probability of growth of MSEs that are owned by male operators is 3.74 times higher than the female owned counterparts.

The marginal effect of this variable shows that the probability of growth for male owned MSEs increase by 15.86 % as compared to female owned MSEs. Therefore, the first hypothesis that is "Male owned MSEs are more likely to grow faster as compared to women owned MSEs." is accepted and it is consistent with previous studies of Mead

Variable name	*Range*	*Growing MSEs*		*Growth Rate*			*Survival MSEs*		*Total*	
		No	*Percent*	*Min.*	*Max.*	*Mean*	*No*	*Percent*	*No*	*Percent*
MSEs age	*1*	21	50	0.05	0.65	0.205	108	79.4	129	72.4
	2-3	16	38	0.07	0.31	0.191	26	19	42	23.6
	4-5	1	2.4	0.07	0.07	0.070	2	1.5	3	1.7
	Over 5	4	9.5	0.04	0.09	0.064	-	-	4	2.3
	Total	42	100	0.04	0.65	0.183	136	100	178	100
	Mean	2.24		0.183			1.3		1.52	
	SD	2.25		0.138			0.66		1.29	
	Minimum	1		0.041			1		1	
	Maximum	10		0.65			4		10	

Source: Stata result from survey data (2012)

Table 7: Status of MSEs by the employment size.

MSEs growth status	Odds ratio	P>|z|	Marginal effects (dy/dx)
Gender of MSEs head	3.736918	0.097***	.1586903
Age of MSEs	.929372	0.223	-.0102632
Initial size of MSEs	1.197916	0.582	.0253034
Initial investment size of MSEs	2.047728	0.027**	.1004287
Market linkage	.808429	0.203	-.0297984
Location (reference main roadside			
Down town	3.306261	0.118	
Out of town	8.141648	0.043	
Sector (reference Manufacturing)			
Service	.232882	0.060	-.1670204
Trade	.035697	0.000	-.5081790

Note: *, **, *** represent the level of significance at 1%, 5%, and 10% respectively
Source: Stata result from survey data (2012)

Table 8: Output of the model (logistic).

and Liedholm (1998) and Gebreeyesus (2009). Considering this a number of justifications have been given as to why the female owned MSEs grow slowly than male owned MSEs. In this study, women's are more concentrated in least growing sectors such as trading. As the survey data shows, out of the total female owned MSEs around 67 percent of them are engaged in trade sector. In addition, around 85 percent of women owned MSEs (WMSEs) start business with an initial capital of below 10,000 birr and as compared to male and the minimum startup capital is birr 100 for women while it is 1000 birr for male counterparts. The WMSES startup capital ranges from 100 – 270,000 birr where as the startup capital for male owned MSEs ranges from 1000 – 800,000 birr. Moreover, women have dual (domestic and productive) responsibility than men, thus the business objective of women is different from men. As a result, women is risk averse than male to maintain their welfare and survival of the household (Mead and Liedholm, 1998; Gebreeyesus, 2009).

Similarly, the initial investment size has a positive effect on the probability of being growing as the odd ratio show the probability of being growing increase by 2.05 times as the initial investment size increases by one percent. In addition, the marginal effect (0.10) of implies that, ceteris paribus, the probability of being growth increases by 10 percent as initial investment increases by one percent. As a result, the fourth hypothesis which states "Relatively the higher the initial investment sizes of the MSEs, the higher the chance of the MSEs growth." is accepted. Moreover, in this study as the initial investment increase there is a tendency of shifting from least growing sector such as trading to higher growing sectors such as manufacturing. Besides, the initial investment size ranges from birr 1000-800,000 for growing MSEs but it ranges from birr 100-300,000 for the survival MSEs. Therefore, as the initial investment size of MSEs increases, the probability of becoming graduated from being survival MSEs increases (Barney, 1991).

Further, the logistic regression results predict that holding other factors constant, the probability of being growing for MSEs that operates at out of town (distant areas) is 8.14 times ($p<0.05$) higher than those which operates in busy streets (main road side). As the marginal effect shows the probability of being growth increases by 41.8 percent for those MSEs that are operated at out of town as compared to those MSEs that operates at main road side. As a result, the hypothesis that assumes "MSEs that are operating at main roadside has higher probability of growth as compared to those MSEs that are operating at out of town/distant area" is rejected. This is due to the fact that MSEs that are operating at out of town are engaged in higher growing sectors, particularly in manufacturing sector and this MSEs have an easy access for input while those MSEs that are operating at main road side are engaged mostly in least growing sectors

	Hypotheses	*Significance level*	*Decision*
H_1	Male owned MSEs are more likely to grow faster as compared to women owned	$p < 0.1$	Accepted
H_2	Relatively the higher the initial investment sizes of the MSEs, the higher the chance of the MSEs growth.	$p < 0.05$	Accepted
H_3	MSEs that are operating at main roadside has higher probability of growth as compared to those MSEs that are operating at out of town/distant area	$p < 0.05$	Rejected
H_4	MSEs that are engaged in manufacturing sector have higher chance of growth than others	$p < 0.01$	Accepted

Source: Stata result & researcher's own analysis (2012)

Table 9: Summary of hypotheses tests.

like trading. In addition, as the MSEs location get out from the center the copycat strategy is reduced which imply that the MSEs that are located at out of town mostly produce differentiated product. As a result they have more and loyal customers than those which operate at main road side.

Assuming all other factors remains constant, the probability of growth for MSEs that engaged in service sector decreases by 16.7 percent ($p<0.10$) compared to MSEs that operates in manufacturing sector. Similarly, the probability of growth for MSEs that operate in trade sector decreases by 50.8 percent ($p<0.01$) than manufacturing sector. Therefore, the sixth hypothesis in this case "MSEs that are engaged in manufacturing sector have higher chance of growth than others" is accepted at 1% level of significance since most manufacturing sector MSEs in this study start business with higher initial investment size as compared to MSEs that operate in other sector. The minimum initial investment size for manufacturing sector is birr 5,000 where as it is birr 100 for trade and service sectors. Further most manufacturing sector MSEs are owned by male. The hypotheses that are tested in this study are summarized in table 9.

Conclusion

Taking the findings, the study concludes that over three-fourth of the MSEs that are found in Mekelle city are survival MSEs and about one fourth of them are growing MSEs. The MSEs that are owned by male grow at relatively higher rate of growth as compared to the WMSEs. There is a slight difference in the growth rate between MSEs that are operating in home and out of home but there is a big difference in growth rate among the MSEs that are operating at down town (commercial center), main road side (busy street) and out of town (distant areas). MSEs that start operation with an initial investment size that ranges from birr 5000-10,000 shows the highest growth rate as compared to those which start operation with an initial investment size that exceed 10,000 birr. Manufacturing sectors MSEs grow faster than those in service/ trade sectors. In addition, Female headed MSEs grow slowly than male headed MSEs.

The dimensions and determinants of MSEs growth are vast and complex. The growth of MSEs has a recognized effect on unemployment reduction and poverty alleviation since MSEs have massive contribution in employment creation and income generation than big enterprises but change in employment size in MSEs is subject to different constraints such as financial, working premises and other socio-economic conditions. Thus, proper understanding of these factors and conditions constitutes an essential starting point and is a key to the formulation of policies, designing of appropriate intervention strategies and practical steps by the government, non-government organizations and other stake holders in order to reduce poverty, unemployment and income inequality as well as to promote sustainable growth at micro and macro levels. Furthermore, one of the millennium development goals is reduction of poverty. And currently, unemployment is global agenda. Thus, the government and the NGOs, particularly operating at the local levels should design an awareness creation program to put the already endorsed and existing MSEs development policy and strategy (promotion of existing MSEs than establishment of new MSEs) in to effect. To this end, more emphasis should be given to make the formal financial institutions (banks &MFIs) affirmative to support MSEs particularly WMSEs through financial services provision and an integrated BDS provision that make the MSEs to be engaged in manufacturing (other growing sector), that reduce the practice

of copycat strategy and mass operation in the same sector must catch the attention of the government and non-government organizations in this regard at every level.

Further research directions

The MSEs take a central position in today's poverty alleviation and unemployment reduction strategy. As a result, much theoretical work has been done on the dynamics of MSEs. However, empirical work lags far behind the dynamics of MSEs. But, because of the limits in time and resources, considerable issues remain unresolved and need further research, particularly, in the specific areas considered.

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