Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Statistics

Diploma Thesis

Statistical analysis of farm economy in the Czech Less Favoured Areas

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Faculty of Economics and Management

DIPLOMA THESIS ASSIGNMENT

Bc. Daria Chervonaya

Economics and Management

Thesis title

Statistical analysis of farm economy in the Czech Less Favoured Areas

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Objectives of thesis

Diploma thesis deals with evaluation of farm economy of agricultural enterprises in the Czech Less Favoured Areas. The main goal is to evaluate economic performance and related indicators.

Methodology

The evaluation of farm economy and the impact of LFA policy changes on selected economic indicators will be carried out by statistical analysis, such us exploratory data analysis, distribution analysis, hypothesis testing and regression analysis.

The proposed extent of the thesis

60 – 80 pages

Keywords

Less favoured areas, Common Agricultural Policy, payment, current subsidies, statistical analysis

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Recommended information sources

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Declaration

I declare that I have worked on my diploma thesis titled "Statistical analysis of farm economy in the Czech Less Favoured Areas" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 29.03.2017 _____

Acknowledgement

I would first like to thank my thesis supervisor Ing. Tomáš Hlavsa, Ph.D. of the department of statistics at Czech University of life Sciences Prague. The door to Prof. Hlavsa office was always open whenever I had a question about my research or writing. He consistently allowed this paper to be my own work, but steered me in the right the direction.

I would also like to express my very profound gratitude to my family for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this thesis. This accomplishment would not have been possible without them.

Statistical analysis of farm economy in the Czech Less Favoured Areas

Abstract

Diploma thesis deals with statistical analysis of economic indicators of farms in Czech Republic and in EU. Firstly, short overview on situation in agriculture was provided in order to describe reasons to support agriculture, CAP and used tools. Types of LFA's were described in the same chapter. Secondly, due to recent reform in CAP, comparison of two budgetary periods was provided for changes concerning LFA.

In next chapter evaluation of Czech Republic's agriculture was done in comparison with other EU Member States using such indicators as FNVA, assets, liabilities, ROA, solvency, etc.

Statistical analysis was conducted for three indicators (FNVA, ROA and Cost/Income ratio) in two sets. Firstly, the differences among LFA groups were analysed for each indicator and dependency of subsidies was tested for each group. Secondly, farms were divided into six groups based on utilized agricultural area and the same analysis was done for the same indicators.

Keywords: Less favoured areas, Common Agricultural Policy, payment, current subsidies, statistical analysis, ANOVA, FNVA, ROA, Cost/Income ratio

Statistická analýza zemědělského hospodářství v méně příznivých oblastech Česka

Abstrakt

Diplomová práce se zabývá statistickou analýzou ekonomických ukazatelů zemědělských podniků v České republice a v EU. Na začátku práce je uveden krátký přehled o situaci v zemědělství s cílem popsat důvody na podporu zemědělství, dále SZP a použité nástroje. Druhy LFA jsou popsány v téže kapitole. Kvůli nedávné reformě CAP byly porovnány dvě účetní periody.

V dalším kapitole bylo porovnáno zemědělství ČR ve srovnání s ostatními členskými státy EU za použití takových ukazatelů, jako FNVA, aktiva, ROA, solventnost, atd.

Statistická analýza byla provedena na třech ukazatelech (FNVA, ROA a poměr náklady / výnosy) ve dvou sadách. Za prvé, rozdíly mezi LFA skupinami byly analyzovány pro každý ukazatel a závislost na dotacích byla testována za každou skupinu. Za druhé, farmy byly rozděleny do šesti skupin podle využité zemědělské plochy a analýza byla provedena stejným způsobem.

Klíčová slova: Méně příznivé oblasti, Společná zemědělská politika, platba, dotace, statistická analýza, ANOVA, FNVA, ROA, poměr náklady / výnosy

Table of content

1 Introduction

In the European Union, less-favoured area (LFA) is a term used to describe an area with natural handicaps (lack of water, climate, short crop season and tendencies of depopulation), or that is mountainous or hilly, as defined by its altitude and slope.

While in the whole EU 58% of total utilized agricultural area is classified as less favoured (Baourakis, Kalaitzis and Mattas, 2014) in the Czech Republic, 50.8% of the total agricultural land is currently defined as LFA, of which the mountain areas account for 15% of agricultural land and "Other LFA" for 28.8% of agricultural land and the areas affected by specific handicaps represent 6.6% of agricultural land (Štolbová and Hlavsa, 2008).

That is why there is Less Favoured Area Support Scheme which is provided for EC Rural Development Regulations. The objectives are to:

- ensure continued agricultural land use in order to contribute to the maintenance of a viable rural community
- maintain the countryside, and
- maintain and promote sustainable farming systems

The thesis will focus on agriculture in general and particularly on LFA. To link the policy and economic outcome for farms in Czech Republic it is important to have a clear vision of where it stands among other EU countries. As follows, comparison of main economic indicators must be done in order to understand specifics of Czech farming.

As stated by European Parliament the CAP for the period 2014-2020 maintains the existence of two pillars but tightens up the links between them, thus offering a more holistic and integrated approach to policy support. Specifically, it introduces a new architecture for direct payments that is better targeted, fairer and greener (Europarl.europa.eu, 2017). As the latest data available is only until 2012-2013 it is important to finalize outcome of previous budgetary period and to find out what reform can bring from 2014.

Since thesis focuses deeply on policy, many sources of literature will come from EU organizations, such as reports and press releases of European commission. Books were used for better understanding of economics of agriculture and for correct implementation of statistical

methods. Additionally, knowledge gained from course “Introduction to ANOVA, Regression, and Logistic Regression” provided by SAS and organized by Faculty of Economics and Management (CULS) was implemented in practical part of thesis. Data was taken mostly from FADN, Eurostat and Albertina.

Thesis will cover such topics as reasons to support agriculture, tools used to support LFA, types of LFA, comparison of two budgetary periods regarding LFA. Practical part will include comparison of economic indicators for Czech Republic with other EU member states, trends by country groups. Also statistical analysis will be peformd for three indicators (FNVA, ROA and Cost/Income ratio).

2 Objectives and Methodology

This part will describe aim of diploma thesis, objectives that are necessary to achieve it and methodology used.

2.1 Objectives

Diploma thesis deals with evaluation of farm economy of agricultural enterprises in Czech Less Favoured Areas. The main aim is to evaluate its economic performance and related indicators of Czech LFA.

To achieve the aim of thesis several objectives were set up:

- To identify the changes in EU legislation between periods 2007-2013 and 2014-2020
- To evaluate position of Czech Republic in EU agriculture in year 2013 (latest available data) by such indicators as farm income, total assets and liabilities, development of farm net worth, solvency, remuneration of farm workers, etc.
- To analyze performance of Czech farms in LFA in years 2007-2012 using such indicators as farm net value added, return on assets and cost to income ratio.
- To analyze influence of subsidies on FNVA, ROA and Cost/Income ratio for farms in Czech LFA in 2012

Research question: what is the impact of policy changes on farms in Czech LFA and how FNVA, ROA and Cost/Income ratio vary across different farm groups?

2.2 Methodology

Research will be carried out by both qualitative and quantitative approach. The main aspects of CAP, reasons to support agriculture, tools that CAP uses (particularly in LFA) and changes in EU policy will be described by qualitative approach, while position of Czech Republic in EU, performance of Czech farms in LFA and its influence by subsidies will be analyzed by quantitative approach. Using quantitative approach thesis will identify position of Czech farms in EU viewed from different indicators presented by Farm Accountancy Data Network (FADN) – public database of EU Commission. Main methodological tool that will be applied in this

research is statistical analysis, such as exploratory data analysis, distribution analysis, hypothesis testing and regression analysis.

The source of data is database “Albertina” access to which is be provided by thesis supervisor. Database “Albertina” consists of representative sample of more than 6500 agricultural enterprises, 4500 of which receive LFA payments. Data will be processed and outcome will be given by means of statistical software “Gretl” and “SAS”.

3 EU regulations

This chapter will introduce into Common Agriculture Policy, describe reasons to support agriculture and tools that are used in EU to support agriculture. Also this chapter will define types of less favoured areas and analyze changes of CAP reform in 2014.

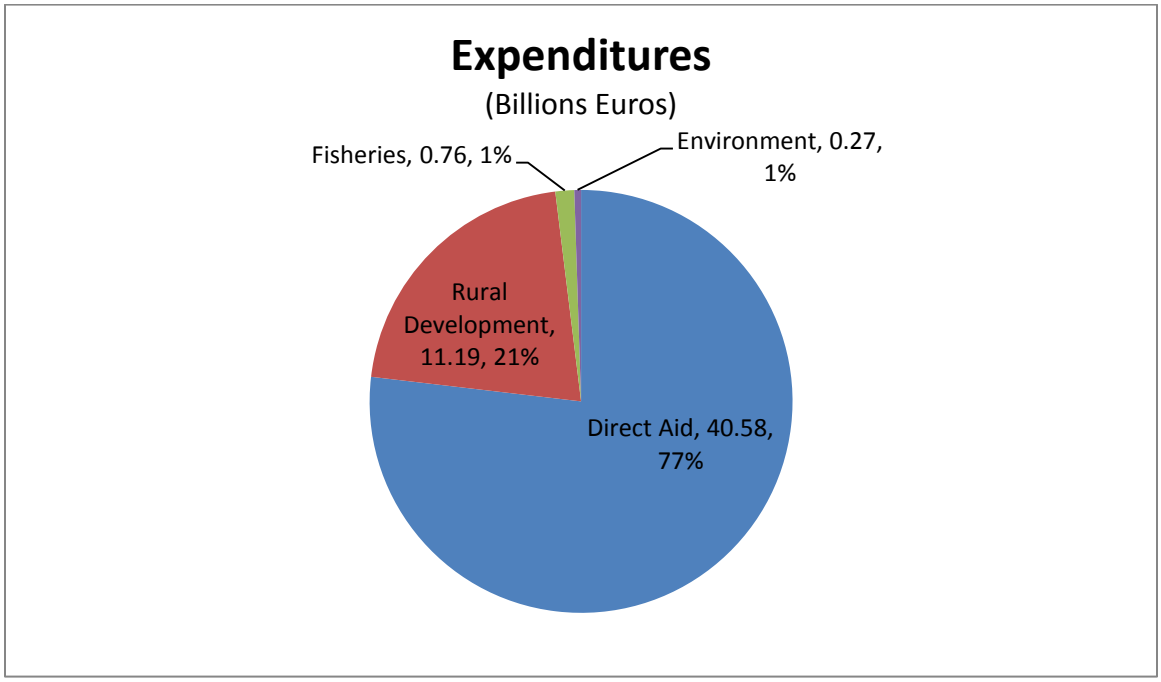
3.1 The Common Agricultural Policy

To provide more than 500 million population of EU (Ec.europa.eu, 2017) with food its government needs market intervention to ensure stable supply and fair income for European farmers. For that purpose in 1965 with Treaty of Rome government created Common Agricultural policy (CAP).

European farmers receive CAP subsidies of around €50-60 billion each year during past two decades (Agriculture and rural development - European Commission, 2017), and these subsidies account for around 35% of the entire EU spending budget.

As shown on the **Ошибка! Источник ссылки не найден.** the most of money goes to farmers as a direct aid.

Figure 1 EU expenditures on agriculture



Source: EU Commission 2014

3.1.1 Reasons to support agriculture

Farmers suffer from three potential problems:

1. Decrease of farms' incomes due to increase in food production on the global market and increasing yields as a result of new technology application in the developing world.
2. Farm prices are very unstable, mostly because of random supply shocks, such as poor weather and disease.
3. Farmers and growers have lost power to the large supermarket chains, which can exert their monopsony power in pushing farm prices down (Norton, Alwang and Masters, 2010).

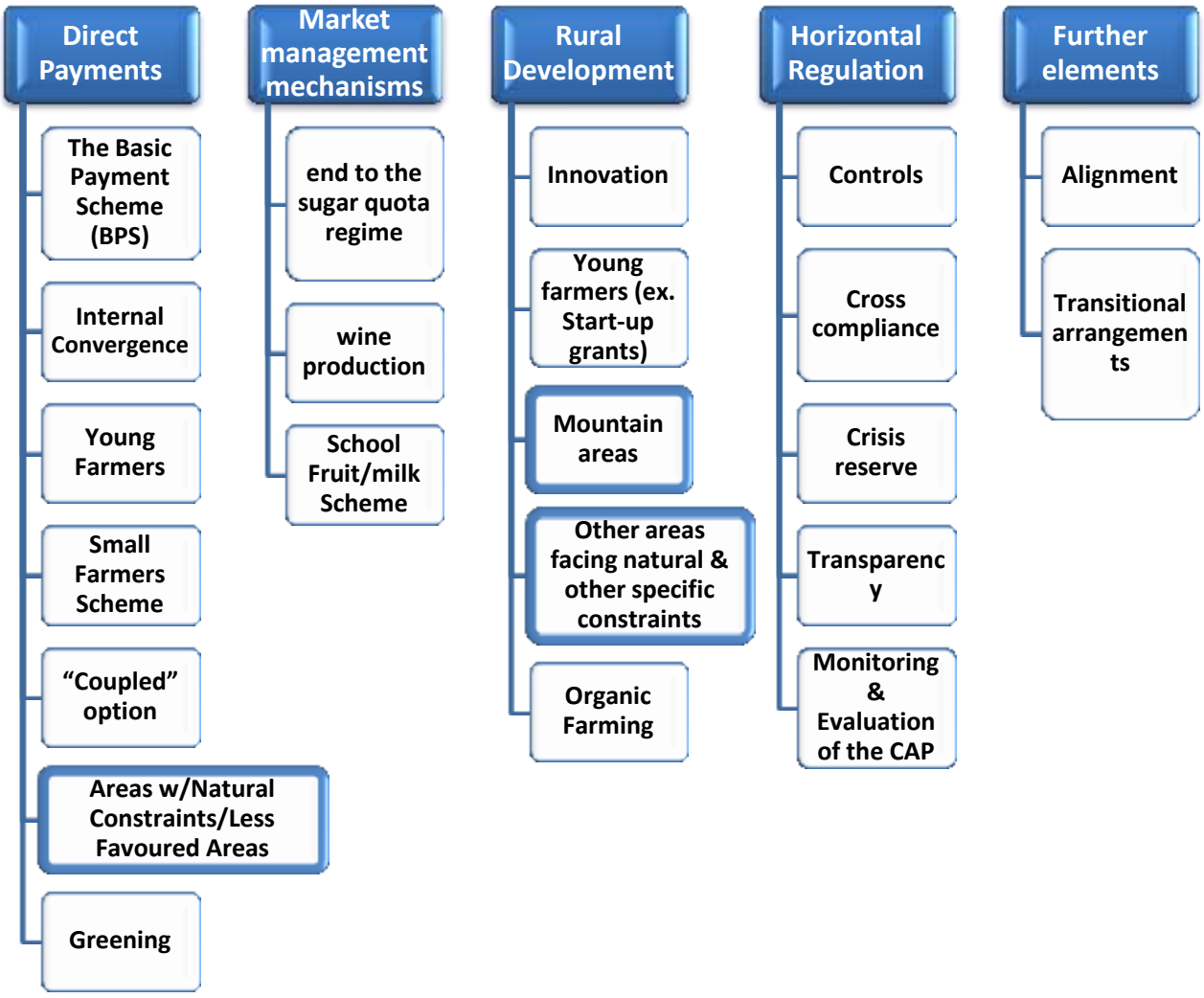
As a result, farmers are often regarded as a special case for government support. Food is a strategic good, and governments around the world often view food security as a key economic objective. The introduction of CAP, in Europe, was seen as an important step in establishing food security for Europe. Price support schemes, such as guaranteed prices, were first introduced in 1962, and became the main means of supporting European farmers (Economicsonline.co.uk, 2017).

3.1.2 Tools

Common agricultural policy support farmers in various ways. The graph below shows selected tools that are divided into five groups and valid for 2014-2020 budgetary period:

- Direct Payments
- Market management mechanisms
- Rural Development
- Horizontal Regulation
- Further elements

Figure 2 CAP tools used in budgetary period 2014-2020



Source: European Commission, 2013, own creation

The widest attention goes to the first three of them.

Direct payments – farmers receive annual payments to help stabilize farm revenues in the face of volatile market prices, unpredictable weather conditions and variable input costs. To benefit from these payments, farmers must respect rules and practices concerning environmental standards, animal welfare, food safety and traceability. Many of these requirements are stricter than those facing our global competitors. This is also what EU consumers and taxpayers want from the CAP.

To avoid distorting markets, payments are not based on how much a farmer produces, but on how much land he uses and how he uses it.

The most interesting tool for this thesis is called "Areas with Natural Constraints (ANCs) /Less Favoured Areas (LFAs)" which states that Member States (or regions) may grant an additional payment for areas with natural constraints (as defined under Rural Development rules) of up to 5% of the national envelope. This is optional and does not affect the ANC/LFA options available under Rural Development (European Commission, 2013).

Rural development programs provide co-funding for projects with economic, environmental or social objectives, primarily targeting farms and SMEs in rural areas. The budget is spent via tailor-made plans designed nationally or regionally to match local challenges and opportunities. Spending is linked to a performance framework with target indicators and monitoring, which effectively requires Member States and regions to deliver clearly defined results in order to keep the full budget allocation. On top of the additional public funding from national and regional administrations, rural development programs also raise significant amounts of private capital, in particular for investments related to business development.

There are two programs that support LFA's directly: mountain areas and other areas facing natural & other specific constraints.

For mountain areas and farmland above 62º N, aid amounts can be up to 450 €/ha (increased from 250 €/ha);

New delimitation for Areas with Natural Constraints (ANC) – with effect from 2018 at the latest - based on 8 biophysical criteria; Member States retain flexibility to define up to 10% of their agricultural area for specific constraints to preserve or improve the environment (European Commission, 2013).

Market measures – ad hoc measures linked to specific market situations, as well as support for trade promotion, the school milk and fruit schemes, and producer organizations, which help farmers get a better deal when negotiating prices and conditions with processors and supermarkets (European Commission, 2015).

3.2 Less Favoured Areas

In areas designated as "**less-favoured**", agricultural production or activity is more difficult because of natural handicaps, e.g. difficult climatic conditions, steep slopes in mountain areas, or low soil productivity in other less favoured areas.

Due to the handicap to farming there is a significant risk of agricultural land abandonment and thus a possibility of loss of biodiversity, desertification, forest fires and the loss of highly valuable rural landscape (Drummond and Goodwin, 2011).

To mitigate these risks, the Less Favoured Areas (LFA) payment scheme is an important tool, implemented by all the Member States although it is not a compulsory measure.

Preserving the farmed landscape and forests is one of the key actions identified by the Community strategic guidelines for Rural Development for 2007-2013:

"Appropriate farming systems help to preserve landscapes and habitats ranging from wetlands to dry meadows and mountain pastures. In many areas, this is an important part of the cultural heritage and of the overall attractiveness of rural areas as places in which to live and work…."

The LFA scheme is part of Axis 2 of the Rural Development Policy for 2007-2013, which aims at improving the environment and the countryside by supporting sustainable land management. Council Regulation (EC) No 1698/2005 describes the objective of the LFA scheme as follows (Recital 33):

"Natural handicap payments in mountain areas and payments in other areas with handicaps should contribute, through continued use of agricultural land, to maintaining the countryside, as well as to maintaining and promoting sustainable farming systems."

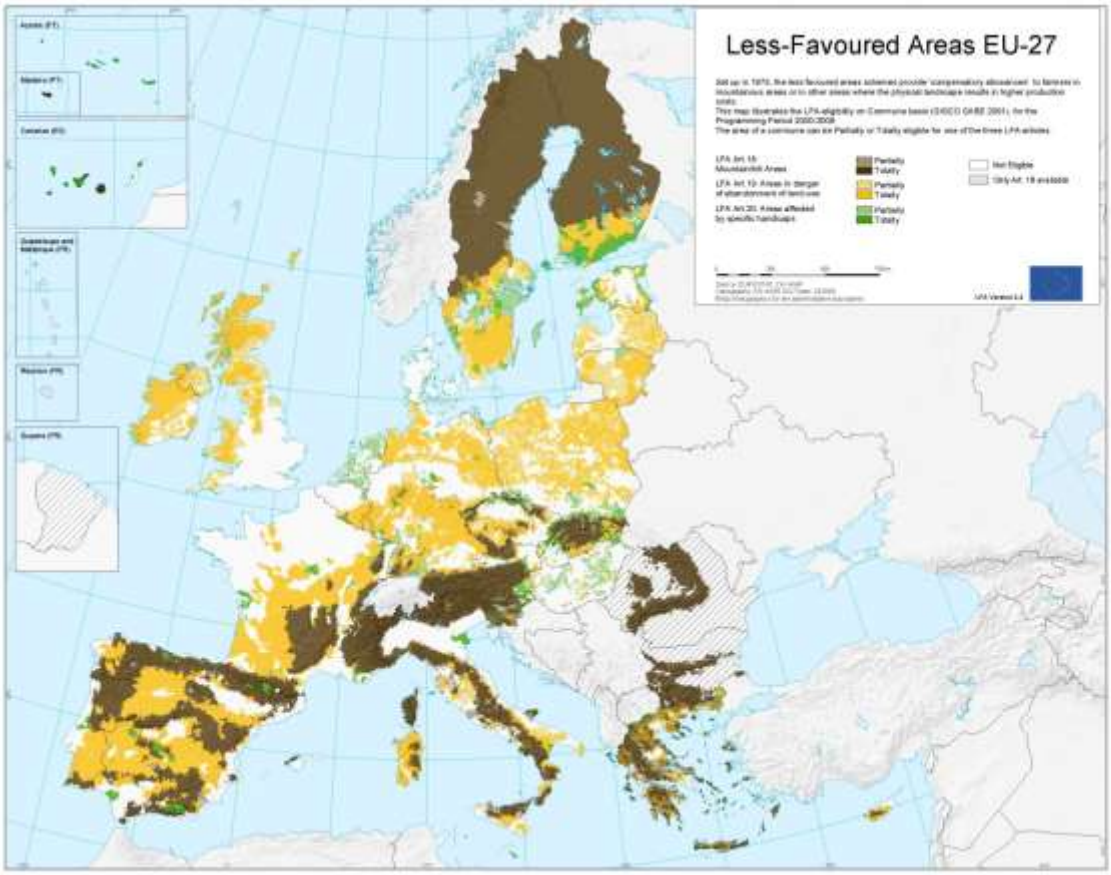
3.2.1 Types of less favoured areas

Under the Articles of Council Regulation (EC) 1257/1999 still in force, an area may be classified as less favoured according to one of three categories. Each category characterizes a specific cluster of handicaps, common to certain areas of agricultural land across Europe, and which threaten the continuation of agricultural land use:

1. Under Article 18, Mountain Areas are characterized as those areas handicapped by a short growing season because of a high altitude, or by steep slopes at a lower altitude, or by a combination of the two. Areas north of the 62nd parallel are also delimited as Mountains.
2. Under Article 19, 'Intermediate' Less Favoured Areas are those areas in danger of abandonment of agricultural land-use and where the conservation of the countryside is necessary. They exhibit all of the following handicaps:
    - land of poor productivity;
    - production which results from low productivity of the natural environment;
    - and a low or dwindling population predominantly dependent on agricultural activity.
3. Under Article 20, Areas Affected by Specific Handicaps are areas where farming should be continued in order to:
    - conserve or improve the environment;
    - maintain the countryside;
    - preserve the tourist potential of the areas;
    - protect the coastline.

The map below shows the three existing categories of LFAs in the EU 27.

Figure 3 Map of less favoured areas in EU



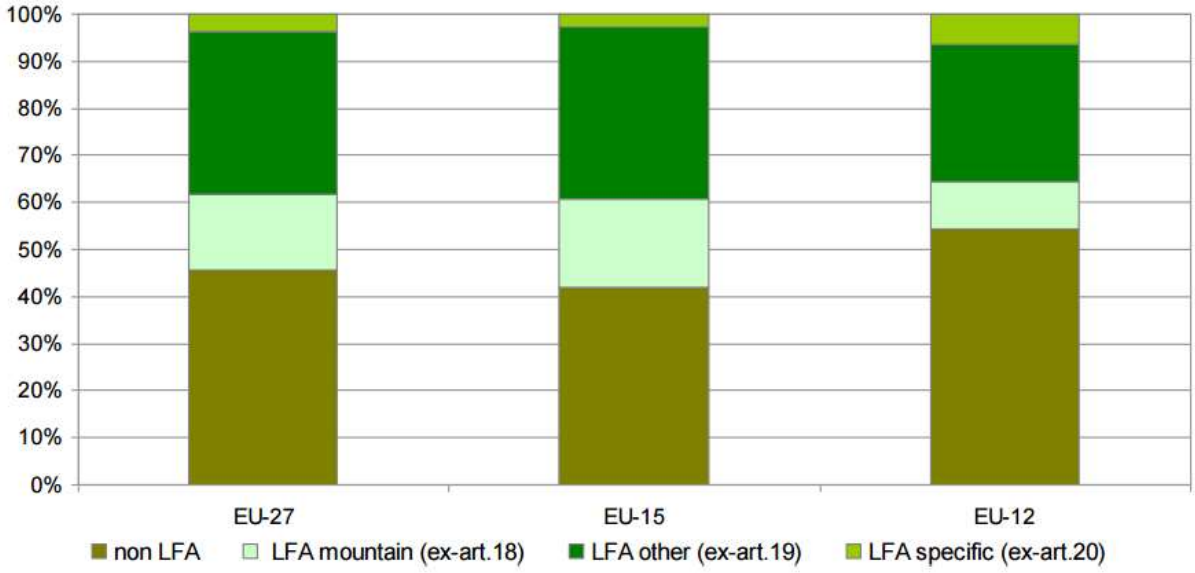
Source: DG AGRI EU- FADN

Not all farms within an LFA receive a compensatory allowance. LFA beneficiaries are required to undertake to farm for at least five years from the first payment and to farm a minimum area fixed at the Member State level. In addition, Member States apply a range of specific eligibility criteria.

LFA payments are granted annually per hectare of utilised agricultural area. The level of the payment can vary between a minimum of 25 €/hectare and a maximum of 200 €/hectare (European Commision, 2011).

57 % of the overall Utilized Agricultural Area in the EU is classified as Less Favoured Area. As it could be seen on graph below, the share of LFA is higher in the EU-15 than in the EU-N12

Figure 4 Share of LFA in total UAA by EU regions



Source: European Commission report, 2012

3.2.2 Comparison of budgetary periods 2007-2013 and 2014-2020

The three categories for areas facing natural or other specific constraints that are "mountain areas", "areas affected by significant natural handicaps" and "areas affected by specific handicaps" remain also during the period 2014-2020 although they are not called LFA's anymore.

The changes made in the Rural Development Regulation for the period 2014-2020 come from a long debate between the Commission and the Member States.

In 2003, the European Court of Auditors concluded that the delimitation of the intermediate less favoured areas could involve unequal treatment because it was based on some *140 national criteria*, all very different from each other. However, the revision of the system was delayed due to several factors. Finally, in 2011, the Commission communicated to the Member States *eight biophysical criteria* as a way of delimitation of intermediate areas. This delimitation is credible, transparent, objective and comparable across all Member States. The method is based on scientific evidence and has been elaborated by the European Commission's Joint Research Centre.

Meanwhile, some policy changes were already introduced in the Regulation 1698/2005, as concerns the Programming period 2007-2013: payments were made degressive above a threshold

level of area per holding, the calculation of the payments was based on income loss and additional costs, etc., however, the entry into force of these new provisions was delayed until the new parameters of the delimitation were agreed on. Effectively, this step did not take place during the 2007 – 2013 programming period and the legal provisions of the 2000 – 2006 programming therefore remained in force.

• Maximum and minimum compensations

Now, in the period 2014-2020, the maximum amount of payment has been increased from € 250 to € 450 per hectare in mountain areas and from € 150 to € 250 per hectare in areas of other natural or specific constraints. These amounts can be increased in case of specific circumstances, and have to be justified in the Rural Development Programme.

The minimum amount of € 25 per hectare remains the same also during the new period 2014-2020.

• Active farmers concept

In the period 2014-2020 the beneficiaries must comply with the definition of "active farmer", as defined in article 9 of Regulation (EU) No 1307/2013 [DP].

• Payments under the 1st pillar

The new period 2014-2020 brings along also a possibility for an additional income support to farmers in constrained areas in the form of a decoupled area-based payment as a complement to basic payment under Pillar I. This is a voluntary payment (up to 5% of annual national ceiling) for farmers in areas facing natural constraints, as delimited in the Rural Development Regulation covering all three categories of constrained areas. However, Member States may decide to restrict this payment to some of these areas on the basis of objective and non-discriminatory criteria. Member States may also apply the payment at regional level, provided that they identified the regions concerned in accordance with objective and non-discriminatory criteria and, in particular, their natural constraint characteristics, and their agronomic conditions.

The new payment for farms in areas with natural constraints in Pillar I should not be a duplication of the scheme in rural development. The main purpose of the new Pillar I scheme for

areas with natural constraints is to allow Member States to achieve a more equitable distribution of income throughout their agricultural area by targeting a part of income support to farmers whose farming activity and the income derived from it is permanently limited by natural constraints.

The support scheme is optional in both pillars. The interaction between the pillars is secured by the condition that any payment for natural constraints received in the first pillar is taken into account in the payment in the second pillar.

• New delimitation method for areas facing natural constraints

A new, credible, transparent and objective delimitation of areas with significant constraints (previously called intermediate LFAs) is put in place. This new delimitation is based on eight biophysical criteria, covering climate, poor soil productivity and steep slopes. Each (sub)criterion has a predefined threshold, e.g. slopes with a gradient of 15% (or more) which identifies the trigger for the area to be considered as severely constrained from the agricultural production point of view. A methodology for measuring is also available to Member States.

The constraint(s) is measured at local administrative unit 2 (which corresponds to a municipality level in most Member States) or at the level of clearly delineated local unit. This economic area shall have a definable economic and administrative identity. The definition says that all agricultural area in the respective local unit can be considered as constrained, if one or more constraints are present on at least 60 % of the local unit's agricultural area (Regione Campania Assessorato Agricoltura, 2014).

• Fine-tuning

Those areas in which a constraint has been documented but it has been overcome by investments (e.g. irrigation in dry areas) or by economic activity (e.g. wine production on stony soils) should be excluded from the support under the ANCs. This exercise is called fine-tuning and the Member States are free to develop their own approach so that the final delimitation is as accurate as possible.

Due to technical progress and human intervention, the natural handicaps have been managed to overcome successfully and profitable agriculture can be carried out in areas where the natural

conditions were at the origin quite unfavourable. In such cases, the intrinsic natural characteristics of the area remain unchanged, so on the pure basis of the biophysical criteria the area would be designated as severely constrained for agriculture. However, the handicap has been offset by human intervention and technological progress and does not impact on agricultural productivity. Therefore, there is no justification for classifying the area as affected by natural handicaps (Regione Campania Assessorato Agricoltura, 2014).

• Additional delimitation possibilities for areas under other specific constraints

The delimitation criteria for the areas under other specific constraints are not restricted to certain specific criteria following the principle of the Programming period 2007-2013. The Member States continue to have a certain degree of flexibility in defining these areas. Nevertheless, the Rural Development Regulation for the period 2014-2020 stipulates that areas with specific constraints are "where land management should be continued in order to conserve or improve the environment, maintain the countryside and preserve the tourist potential of the area or in order to protect the coastline." The extent of these areas is limited by a ceiling of 10% of the total area of the respective Member States.

Member States have a good degree of flexibility in delimiting these areas. However, in order to follow the principle of credible delimitation of areas with constraints in general (provided by a transparent delimitation of mountain areas and the use of biophysical criteria for the intermediate areas), there must be clarity on how the areas with specific constraints have been delimited and how the payments have been established.

The Member States may also use the delimitation criteria for the areas with specific constraints by following the "cumulative" criteria, as stipulated in Article 33 (4) of the Rural Development Regulation. According to this rule, the areas may be considered as areas facing specific constraints if at least two of the "biophysical criteria" as used in defining the areas facing natural constraints within a margin of 20 % are met in a given local unit covering at least 60 % of the agricultural area. This means that each of these criteria may be vary from the threshold up to 20 %. The presence of such cumulation and existence of additional costs/income foregone allows an area to enter directly into this category of specific constraints.

• Phasing out scheme for areas losing the status of being constraint

Those areas eligible under the LFA-payments during the period 2007-2013 but excluded from the ANC payments in 2014-2020 due to the new delimitation criteria or fine-tuning may be granted "phasing out" support. The Member State may choose this arrangement in order to facilitate the adaptation of farmers in given areas to the new situation. Article 31 (5) of the new Rural Development Regulation foresees that "…Member States may grant payments under this measure between 2014 and 2020 to beneficiaries in areas which were eligible under Article 36(a)(ii) of Regulation (EC) No 1698/2005 during the 2007-2013 programming period". The sentence under Article 31(5) concerns the fact that Member States may continue to pay for farmers in areas under the "old" delimitation" until the new delimitation comes into force (at latest 2018). Once the new delimitation is in force, the Member States may then continue to pay to farmers who operate in areas that are confirmed as being under constraint by the new delimitation method. For the farmers in areas which can no longer be considered as under constraint according to the new delimitation method a "phasing out period" starts at the latest in 2018. For these farmers, payments may also continue for a maximum 4-year period . However, these payments have to be degressive as stipulated in Article 31(5).

As regards a question on granting ANC phasing out payments to farmers in areas delimited as facing specific constraints during the period 2007-2013, it should be taken into account that Article 31(5) of the new RD Regulation refers to beneficiaries in areas who were eligible for support under 36(a)(ii) of the RD Regulation 1698/2005 but are no longer eligible following the new delimitation referred to in Article 32(3) of the RD regulation 1305/2013. The article 32(3) concerns only natural constraints - as specific constraints are dealt with in 32(4). Given that a farmer who was eligible under 36(a)(ii) 1698/2005 as being located in an area with specific constraints is not concerned by the new delimitation required by Article 32(3). Therefore, the phasing out period does not apply to farmers in that area, and it is not possible to apply the phasing out provisions of Article 31(5) of 1305/2013 to farmers in areas with specific constraints where the Member State opts to amend the relevant delimitation (Regione Campania Assessorato Agricoltura, 2014).

• Conditions of payments

The obligation to pursue farming for five years after the first payment has been abandoned for the period 2014 – 2020. Nevertheless, payments can only be granted to those farmers who

undertake to pursue their farming activity in the delimited area (this payment aims to prevent land abandonment). Farmer must be identified as active farmer (Regione Campania Assessorato Agricoltura, 2014).

4 EU farm economic overview

According to report published in October 2016 after the sharp decline in farm income in 2009, recovery continued until 2012. In 2013 income decreased by 5.8% to approximately the 2010 level. This decrease was due to higher input costs and a slight decline in the value of agricultural output. The latter is mostly linked to the performance of crop production (-6.2% per farm in the EU-28) since the total output of livestock and livestock products increased by +4.4% per farm in the EU-28. The decline in the value of crop production is due to a drop in real prices (-3.7%) which is partly offset by an increase in volumes (+2.7%), (Directorate-General for Agriculture and Rural Development, 2013). However, while most of the Member States reported similar levels of total output figures between 2012 and 2013, significant income differences were observed across European regions and types of farming. Intermediate consumption increased by 1.4 % from 2012 to 2013. Despite high input prices such as the cost of animal feed and of plant protection in 2013, farms specialised in granivores (pigs and poultry) and field crop farms generated the highest income per person. From 2012 to 2013, the average income per labour unit increased most significantly for dairy farms but only slightly for farms specialized in permanent crops other than wine. The income increase per annual work unit (AWU) in dairy farms correlates with the increase in dairy herds in Europe but also with higher milk prices in 2013 which were above the level of previous years. The biggest decrease in income per AWU (by 14.7%) was recorded for farms specialised in field crops. The decrease was less significant in farms specialised in granivores, wine, horticulture and in mixed farms.

The income gap (farm net value (FNVA) per AWU) between the EU-N13 and EU-15 began to narrow again in 2013, after a widening gap in 2012. Nevertheless, the average FNVA/AWU per farm was nearly four times higher in the EU-15 than in the EU-N13, while the remuneration of family labour in the EU-15 even exceeded this fourfold difference.

Finally, the proportion of direct payments to total receipts (total output + balance of current subsidies & taxes) in the EU-28 remained stable at 10.3%, which is consistent with 2012. This trend is in line with the nearly unchanged value of agricultural output (in real terms) in Europe from 2012 to 2013.

4.1 Income developments

The EU-28 average farm net value added (FNVA)[1] decreased by 5.8% from 2012 to 2013, due mainly to the increase in agricultural input costs (linked mainly to the increased costs of feeding stuffs and crop protection) while output value remained nearly unchanged (-1.3%). FNVA fell back close to the 2010 level, having started to recover from the low point reached in 2009. Average FNVA per annual work unit (FNVA/AWU) decreased by 4.6%, from EUR 19000 in 2012 to EUR 18100 in 2013.

This decline was driven by the decrease in FNVA, with labour input remaining nearly stable. It was primarily influenced by a drop in agricultural real prices, which was partly offset by an increase in volumes. Producer prices for crops declined as well in real terms in 2013 as compared to 2012. Remuneration per family work unit[2] stood at around EUR 11400 in 2013, down from EUR 12900 in 2012.

The drop in income masked substantial differences across Member States, regions and types of farming. Holdings in Denmark, north-western Germany and northern France generated the highest FNVA/AWU in 2013. Denmark and the Sachsen-Anhalt region in Germany had the highest average FNVA/AWU in the EU. The regions with low FNVA/AWU (i.e. below EUR 10000) were mostly situated in the EU-N13. The lowest average FNVA/AWU per farm was recorded in the Jadranska Hrvatska region, in Croatia. Only two regions in the EU-15, namely Norte e Centro (Portugal) and Sterea Ellas-Nissi Egaeou-Kriti (Greece) had an average FNVA/AWU below EUR10000. There is a 40-fold difference between the highest income per AWU (Denmark) and the lowest (Jadranska Hrvatska).

On average, farms specialised in granivores, field crops, wine, milk and horticulture had the highest FNVA/AWU, while the FNVA/AWU of farms specialised in other permanent crops, grazing livestock (other than milk) and mixed activities remained below the EU-28 average.

[1] Farm net value added (FNVA) is used to remunerate the fixed factors of production (labour, land and capital) whether they be external or family factors. In order to obtain a better measurement of the productivity of the agricultural workforce and to take into account the diversity of farms, FNVA is also calculated by annual work unit (AWU, work of one person occupied full time on a farm). This is one of the FADN's main income indicators

[2] Remuneration of family labour is equal to: FNVA + balance of subsidies and taxes – wages paid – paid rent – estimated costs of own land and own capital. The value is given per family work unit (FWU).

In 2013, FNVA/AWU increased for dairy farms but only insignificantly for farms specialized in other permanent crops. All other types of farming such as farms specialised in field crops, granivores, wine, mixed farming and horticulture recorded lower income than in 2012. The significant income increase for dairy farms from 2012 to 2013 was mainly due to higher milk prices, an increase in the European dairy herd and a higher average yield per dairy cow. As for the distribution of FNVA/AWU in the EU-N13, the average income per worker in these countries remained significantly below the EU-15 level. In the EU-N13, average FNVA/AWU stood at around EUR 7600, but was under EUR 3200 in more than 50% of farms (median income).

4.2 Role of direct payments

In 2013, direct payments on average accounted for nearly 33% of FNVA in the EU-28, an increase on 2012 (31%). This slight increase was the result of a marginal decrease in FNVA while direct payments remained stable in 2013. The proportion of direct payments to FNVA was highest in Finland (79%) and second-highest in Slovakia (77%).

By contrast, direct payments accounted for only 10% of FNVA in the Netherlands. This shows that Dutch agriculture is more focused on the more profitable sectors that are less dependent on direct payments, such as horticulture and pig and poultry production.

The proportion of direct payments to agricultural income also fluctuated markedly with the type of farming. In particular, direct payments represent a contribution to FNVA (54-44%) of grazing livestock, mixed and field crop farms due to the historical orientation of the common agricultural policy (CAP). On the other hand, subsidies account for only a very limited part of total receipts (total output + balance of subsidies and taxes) of wine and horticulture holdings (7-3%).

Direct payments helped to even out the variability in EU farm income. The average amount of direct payments received in 2013 was EUR8360 per farm covered by the FADN survey.[3]

4.3 Characteristics of farms

The structure of European farms covered by the FADN varies markedly in several ways:

[3] The FADN covers the farms that account for over 90% of agricultural production in the EU. It does not cover the smallest farms with low production.

- Asset value. The average farm size in terms of asset value was highest in Denmark and in the Netherlands (EUR2 520000 and EUR2 290000, respectively). This reflects the very high values for land (average rent paid per hectare) and the importance of sectors which typically need considerable investment (such as milk, granivores and horticulture). In contrast, farms in Romania had the lowest total asset value (below EUR40000) due to low land prices, small farm sizes and less capital-intensive types of farming. Bulgaria doubled the asset value of its farms from 2007 to 2013. The value of land in Romania and Bulgaria remains well below the EU-28 average. Land value (based on the closing valuation of land) in the Netherlands was 35 times higher than in Romania.
- Labour input. In the FADN survey, the average number of workers employed per farm in the EU-28 stood at 1.5 AWU in 2013. However, the figure varied significantly across Member States, ranging from 15.5 AWU in Slovakia to 1.1 AWU in Greece. The average number of workers per farm in horticulture (the sector with the highest labour input) was approximately 2.5 times higher than in permanent crops other than wine holdings (the sector with the lowest labour input).The share of unpaid labour (expressed as family labour hours) accounted for 77% of the total labour force in the EU-28 and was the most prevalent form of labour in most Member States except for Slovakia, the Czech Republic, Hungary, Estonia, Denmark and Bulgaria. In these Member States, the proportion of family labour of the total labour force was below 50%. The average hourly wage of farm workers stood at EUR 7.4 in the EU-28 in 2013, up 1.7% on the previous year. This nominal wage increase more than compensated for the general increase in prices (EU-28 HICP[4] inflation stood at 1.4% in 2013).
- Land use. The average size of farms covered by the FADN survey was 33 ha in 2013. However, it varied considerably across Member States, ranging from 595 ha per farm in Slovakia to 3 ha per farm in Malta. Rented land accounted for 54% of total agricultural area in the EU-28 in 2013. Land rents in the EU-28 have increased by 16 % since 2009, from EUR 143 per ha to EUR167 per ha in 2013. They were particularly high in the Canary Islands (EUR 1310 per ha) and in the Netherlands (EUR 970 per ha), but remained under EUR30 per ha in the Baltic countries (Latvia, Estonia). They also varied markedly across types of farming: the level of rent

[4] The harmonised index of consumer prices (HICP) is an economic indicator constructed to measure the changes over time in the prices of consumer goods and services acquired by households. It is the official measure of consumer price inflation in the euro zone for the purposes of monetary policy in the euro area and for assessing inflation convergence as required under the Maastricht criteria.

per hectare in horticulture and the wine sector was 8 times higher than the rental price paid by grazing livestock farms.

4.3.1 Farm income

Farm income could be measured by few indicators such as farm net value added, farm net income and remuneration of family labour.

Farm net value added (FNVA) is equal to gross farm income minus depreciation costs. It is used to remunerate the fixed factors of production (labour, land and capital), whether they be external or family factors. As a result, agricultural holdings can be compared regardless of whether family or non-family factors of production used.

FNVA = output + Pillar I and Pillar II payments + any national subsidies + VAT balance — intermediate consumption — farm taxes (income taxes are not included) — depreciation. The value is calculated per annual work unit (AWU) to take into account the differences in the scale of farms and to obtain a better measure of the productivity of the agricultural workforce.

Farm net income (FNI): comprises the remuneration of family labour, own land and own capital. It is calculated by deducting the external factors of production[5] from the farm net value added and by adding the balance of subsidies and taxes on investments.

FNI = FNVA — total external factors + balance of subsidies and taxes on investments.

Remuneration of family labour: In the agricultural sector, the bulk of the workforce consists of family members who do not receive a salary but have to be remunerated from farm income. As the FNVA is required to finance not only family labour but all fixed production factors, remuneration of family labour is another way of estimating income. It is calculated as follows:

Remuneration of family labour = FNVA + balance of subsidies and taxes — total external production factors — opportunity costs of own land — opportunity costs of own capital. Or starting from the previous indicator: farm net income — opportunity cost of own land — opportunity cost of own capital.

[5] External factors of production are the remuneration of inputs such as work, land and capital which are not the property of the holder (e.g. wages, rent, interest paid).

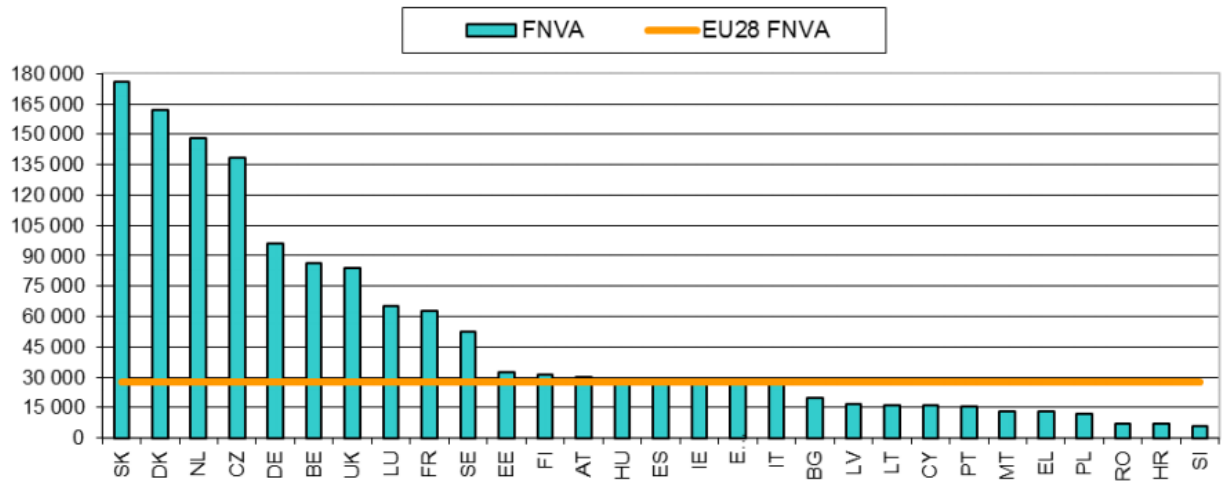
The value is calculated per family work unit (FWU). Only farms that use unpaid labour (which in most cases means family members) are included in the calculation.

Results by member state

FNVA varied significantly across the EU in 2013. It was highest in Slovakia, at EUR 176100 per farm. This is almost 30 times higher than in Slovenia, the country with the lowest value. Denmark, the Netherlands and the Czech Republic also had high values. The EU-28 average was around EUR 27900 (Figure 5). The main advantage of the average FNVA/farm lies in its relative simplicity but it fails to reveal the differences in farm size, type of farming or structural decreases in the labour force employed in agriculture. To overcome this, FNVA is usually expressed per AWU, which can be seen as a measure of partial labour productivity.

It is also worth noting that, of the EU-15 countries, only Portugal and Greece — which are characterised by a large number of small farms — had an FNVA per AWU below the EU-28 average. Except for Hungary and the Czech Republic, EU-N13 Member States had an average income (FNVA/AWU) below the EU-28 average (EUR 18 100).

Figure 5 Farm net value added by Member State in 2013 (average per farm in EUR)



Source: Directorate General for Agriculture and Rural Development (DG AGRI) EU-FADN

Farm net value added is an indicator that measures the remuneration of all fixed production factors, whether they are external or family factors. In order to distinguish between them with respect to income, we have to exclude the external factors of production from the calculation. By doing this we arrive at farm net income (FNI). Using this indicator changes the profitability in

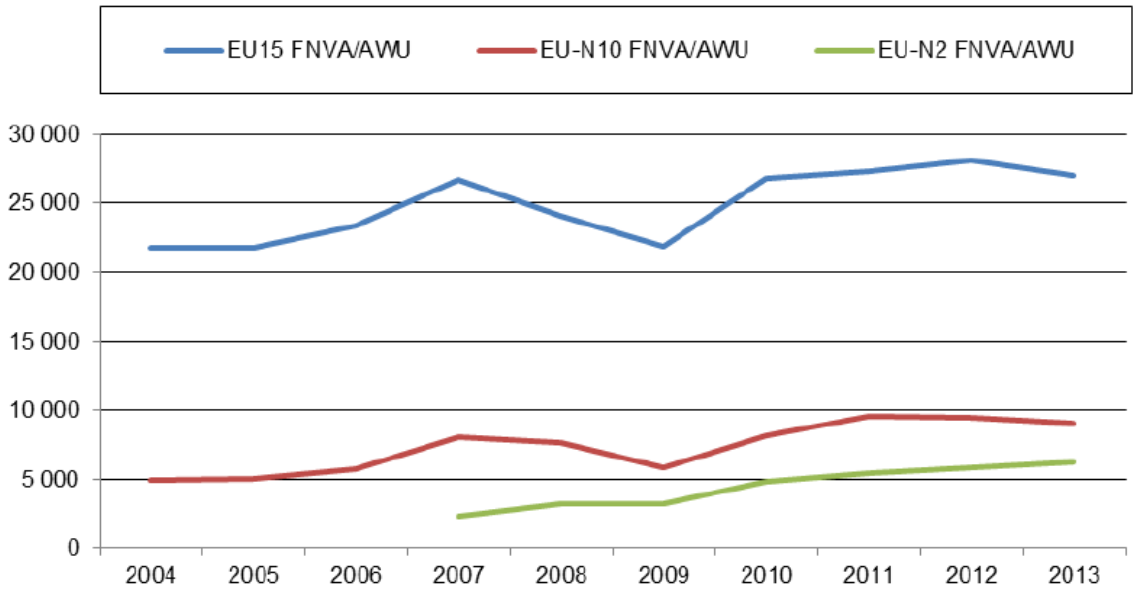
Member States changes. It is noteworthy that Slovakia's FNI was the lowest out of all countries in 2013 while its FNVA was the highest.

Results by EU group

Building on the high annual agricultural income (EUR 41 700) in 2011 in the EU-15, the average NVA per farm continued increasing to EUR 42 700 in 2012 (+2.4 %) but decreased again in 2013 to the 2010 income level (-5.2% compared to 2012). In 2013 the decrease in the EU-28 value of agricultural output (down by -1.3%) was linked to the performance of the crop production (down by -6.2% per farm on average) since the total output of livestock and livestock products were increased by 4.4% per farm on average. While total labour input remained stable in the EU-N13, FNVA per farm decreased slightly from EUR 12 500 to EUR 12 000, which also resulted in a decrease in the FNVA/AWU (by -2.4%). The remuneration of family labour per FWU in the EU-N13 decreased more visibly, from EUR 4 900 to EUR 4 400 (by -11.8%). It should be noted that there was a break in the time series between 2006 and 2007 due to the accession of Romania and Bulgaria to the EU. Especially Romania, with its more than 1 million farms represented in the FADN sample had a big impact on the sample and also on the income development.

In absolute terms, FNVA per AWU increased by EUR 5 200 or 24% in the EU-15 between 2004 and 2013, and by EUR 2 600 or 52% in the EU-N13 — a stronger increase in relative terms, but a widening gap as income in the EU-15 grew more in absolute terms. Looking at the 2004-2013 period and taking into account the changes in the composition of the EU groups, a convergence in nominal farm income can be observed between EU-15 and the two other groups of Member States who joined to the EU in 2004 (EU- N10) and 2007 (EU-N2). While in 2004, FNVA per AWU of EU-N10 was 23% of EU-15's income per AWU, the same was 34% in 2013. In case of EU-N2, FNVA per AWU was 9% of EU-15's FNVA per AWU in 2007, while it has increased to 23% of EU-15's income per labour unit (Figure 6).

Figure 6 Long-term developments in FNVA per AWU in the EU groups (average per farm in EUR)



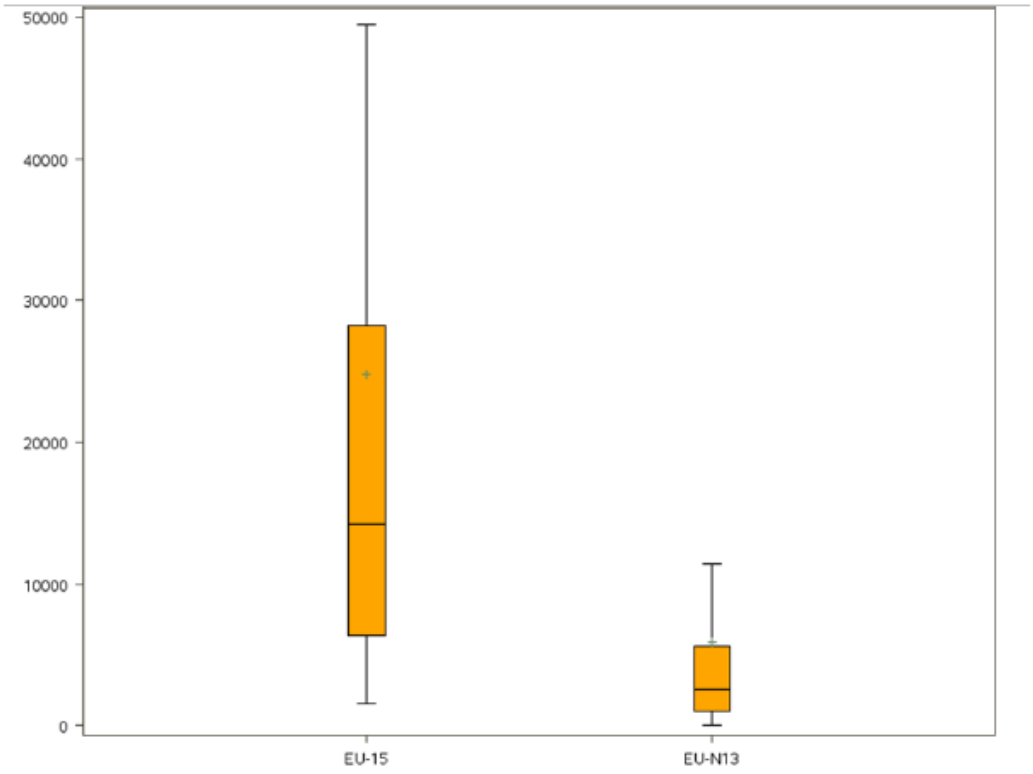
Source: DG AGRI EU-FADN

4.3.2 Distribution of income

Results by group

Agricultural income varies considerably across farms as depicted by the 'box-plots'12 in Figure 7. The general pattern shows that a high proportion of farms have a relatively low income level per worker, while a small proportion of holdings have a very high income level per worker. For instance, the average FNVA per AWU in the EU-15 stood at around EUR 27000 in 2013. However, while 10% of farms had an income per worker of more than EUR 53400, 50% recorded an FNVA per AWU below EUR 14800. Average income per worker in the EU-N13 remained significantly below the EU-15 level. The mean value of EU-N13 is in the upper 25% of data, which means that these box-plots are also skewed to the top (towards higher values). While EU-N13 average income per worker stood at around EUR 7600, 50% of holdings had an income per worker of less than EUR 3200.

Figure 7 Distribution of FNVA per AWU by EU group in 2013 (in EUR/AWU)



Source: DG AGRI EU-FADN.

To look closer to the statistical distribution of income let's look at the Gini index, which can be between 0 and 1.

Ошибка! Источник ссылки не найден. shows income distribution by mean on Gini index[6]. Income concentration in the EU-15 is typically lower than in the EU-N13. Although comparisons between groups should be made with caution, the observed differences partly reflect differences in the structure of the farm sector. For instance, due to generally higher thresholds in the EU-15, the field of observation in the FADN does not include the lower economic size classes as it does in the most EU-N13 countries.

Looking at the development of the coefficient over time within each EU group, income concentration has increased in the EU-15 from 2004 to 2011. It reached its peak in 2011 and was very close to this value also in 2009 too. Income inequality fell slightly in 2012, but intensified again in 2013, reaching the 2009 level.

[6] A coefficient of 0 expresses perfect equality of income in the labour force, while a coefficient of 1 reflects maximum concentration or inequality (with one work unit capturing all the income in a sector).

In the EU-N13, there were minor fluctuations in income distribution over the reference period. The economic crisis in 2009 seems to have increased income concentration in all EU groups, but the EU-N13 was particularly affected by unequal income distribution. The highest income concentration was seen in 2007 and 2009. With the economic recovery, income inequality narrowed in 2010, however there was still a slight concentration in 2011. Income distribution has remained at the same from 2011 to 2013.

Table 1 Development of the Gini coefficient of FNVA per AWU by EU group

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
EU15	0.55	0.55	0.54	0.55	0.59	0.62	0.6	0.63	0.6	0.62
EU-N13	0.68	0.69	0.63	0.72	0.69	0.72	0.67	0.68	0.68	0.68

Source: DG AGRI EU-FADN

4.3.3 Income components

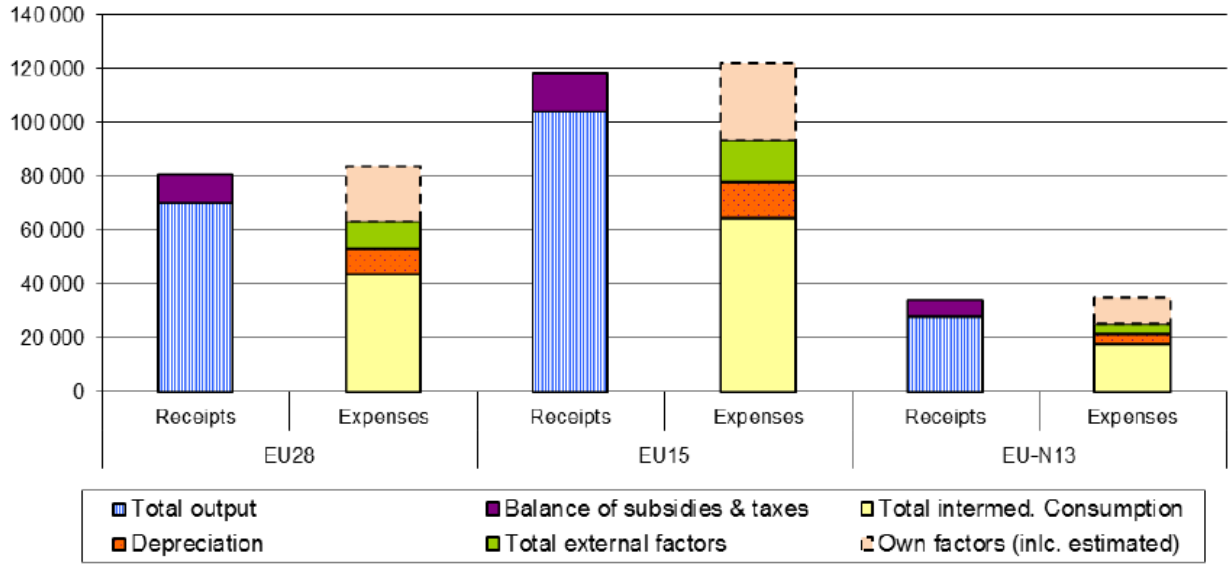
Results for income components will be represented by EU groups in this sub chapter.

Figure 8 shows the composition of farm receipts and expenses by EU group in 2013. In our calculation total receipts represent the income received from the total output and from the balance of subsidies (current operations and on investments) and taxes. When calculating the expenses, the estimated remuneration of own production factors are also taken into account, which means that by comparing farm receipts with expenses including the cost of own resources, we talk about farms' profit. In the previous chapters the cost of own production factors was not taken into account.

On average, expenses were higher than receipts for both farms in the EU-15 and in the EU-N13. On the income side, average receipts per farm in the EU-28 stood at EUR 81 000, of which total output represented EUR 70 300 (87%) and subsidies[7] EUR 10 800 (13%). These aggregated figures hide large differences between the EU groups, both in absolute and relative terms: the average farm receipt in the EU-N13 was roughly four times lower than in the EU-15 and 2.5 times lower than in the EU-28. In relative terms, subsidies accounted for more than 17% of average farm receipts in the EU-N13, compared to roughly 12% in the EU-15.

[7] Subsidies include the sum of net current and investment subsidies. They include EU coupled and decoupled payments less favoured area (LFA) payments, rural development payments and national aid. Net means the balance of current subsidies and taxes plus the balance of subsidies and taxes on investment.

Figure 8 Income components per farm by EU group in 2013 (average per farm in EUR)



Source: DG AGRI EU-FADN

4.3.4 Return on assets

Return on assets (ROA) measures the effectiveness of a company's assets in generating income. It is defined as the ratio of net income over total assets, where the net income is defined as the sum of FNVA and investment subsidies minus wage costs, rent paid and the opportunity costs of own labour (Figure 9).

Figure 9 Formula for calculating ROA

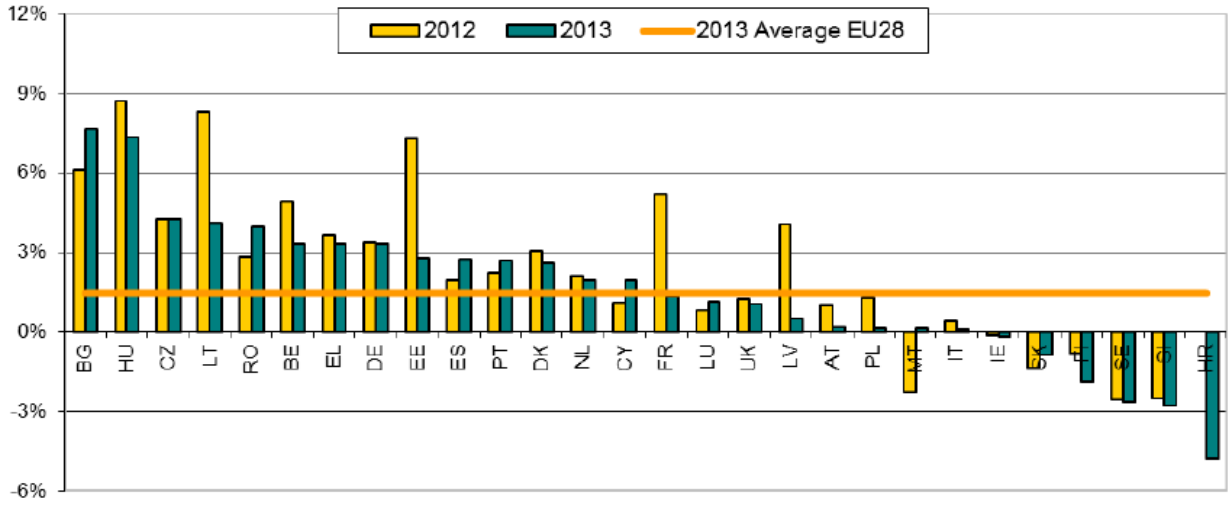
$$ROA = \frac{FNVA + \text{Balance of investment subsidies and taxes} - \text{Wages paid} - \text{Paid rent} - \text{Capital costs} - \text{Opportunity costs of family labour}}{\text{Total assets}}$$

Results by Member State

The ROA of an average farm in the EU-28 in 2013 was 2.0%. This was similar to 2012 and up from 1.8% in 2010 and 0.4% in 2009. Holdings in Bulgaria, Hungary and the **Czech Republic** had the highest ROAs (Figure 10), mainly due to the relatively low levels of opportunity costs of

own labour (except for the Czech Republic) and fixed asset values (such as land and quotas). In 2013, six Member States registered a negative ROA, with the lowest value was recorded in Croatia (-4.8%). In 2013, Slovenia, Sweden, Finland, Slovakia and Ireland had the lowest ROAs in the EU.

Figure 10 Rate of return on assets by Member State in 2012-13 (average per farm in EUR)



Source: DG AGRI EU-FADN

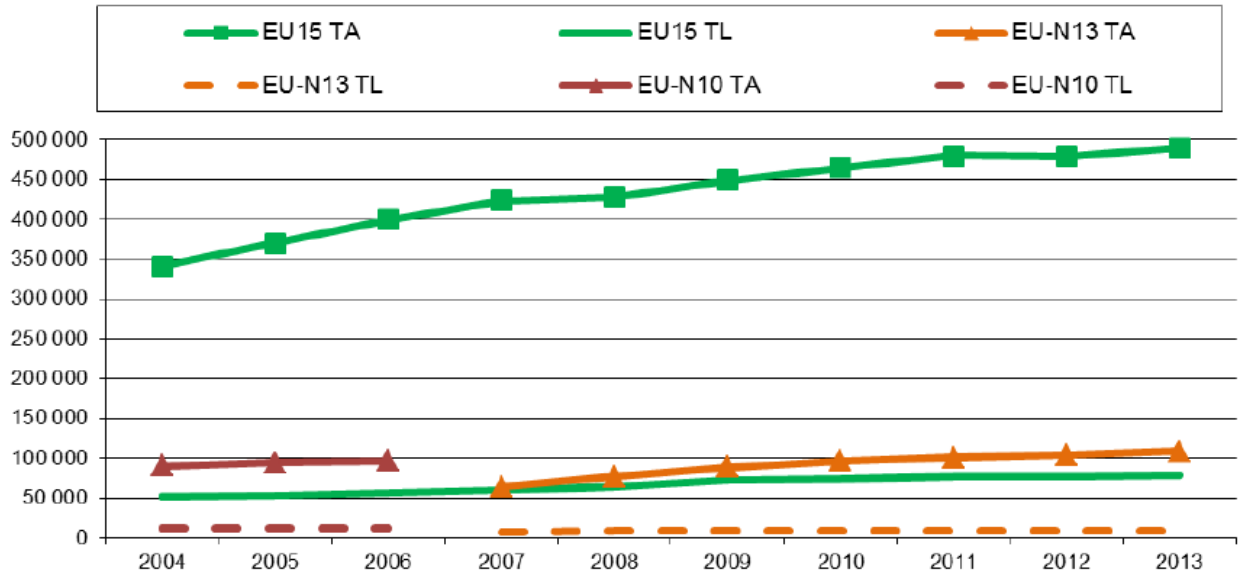
4.3.5 Total asset value

Total assets are the property of the agricultural holding and comprise current and fixed assets. Current assets in the FADN include non-breeding livestock, stock of agricultural products and other circulating capital, holdings of agricultural shares, and amounts receivable in the short term or cash balances in hand or in the bank. Fixed assets are agricultural land, permanent crops, farm and other buildings, forest capital, machinery and equipment, and breeding livestock.

Long-term developments by EU group

Figure 11 shows that the value of total assets has been increasing in both the EU-15 and the EU-N13. In the EU-15, the average value of total assets rose by more than 43% in the 2004-2013 period and by 20% in the EU-N13. However it should be emphasized, that here was a break in the time series between 2006 and 2007 due to the accession of Romania and Bulgaria. This had an impact on FADN farms and caused a temporary decline in the average total asset value and in the liabilities for the EU-N13.

Figure 11 Long-term developments in the value of total assets (TA) and total liabilities (TL) (average per farm in EUR)



Source: DG AGRI EU-FADN

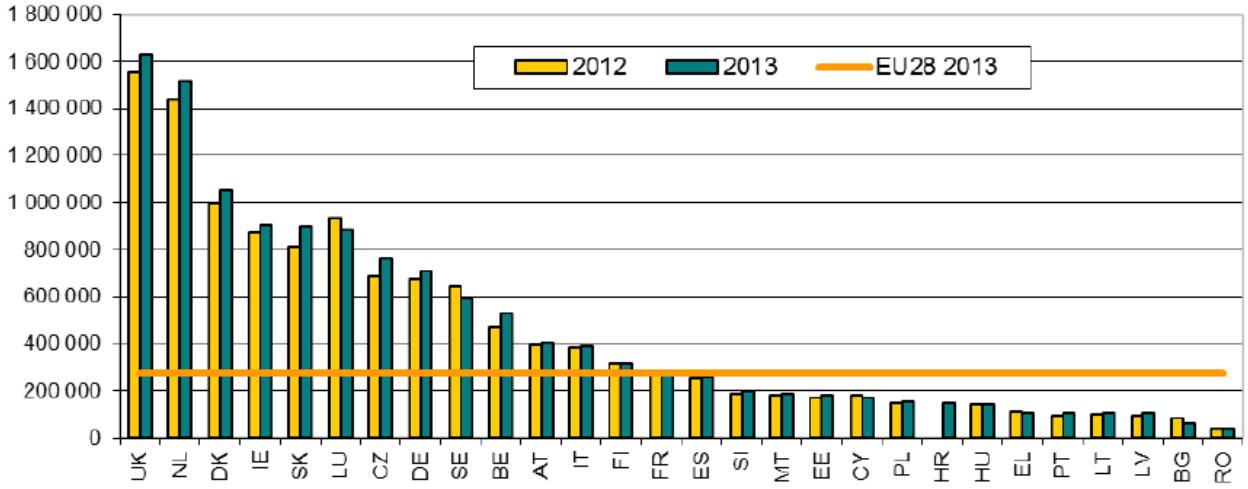
4.3.6 Total liabilities

In line with the general trend for total asset values, total liabilities have also increased. In the EU-15, the average value of total liabilities increased by 51% in the 2004-2013 period, while in the EU-N13 it decreased by 22%, what however reflected mainly a changing composition of this country grouping. In the new Member States total liabilities were higher until 2009 and then subsequently, stagnating until 2013. It should be noted that since 2007 three new countries joined the EU – Bulgaria, Romania and Croatia. In the surveyed farm population of these countries liabilities were very low and at the same time especially in Romania the weight of farms were high influencing significantly the level of liabilities in EU-N13. Without these three new Member States the total liabilities would have increased by 51% for EU-N10 from 2004 to 2013. Consequently this decreasing tendency in total liabilities for EU-N13 is influenced by including the 3 new Member States to those 10 that joined in 2004 to the EU.

4.3.7 Development of farm net worth

Farm net worth is defined as the difference between total assets and total liabilities at the end of the accounting year. In 2013, the average farm net worth stood at approximately EUR 272 900 in the EU-28 (+2% compared to 2012). The average net worth per agricultural holding was highest in the UK (EUR 1 554 000), the Netherlands (EUR 1 437 100) and Denmark (EUR 995 600) (Figure 12).

Figure 12 Farm net worth by EU group and Member State in 2012 and 2013 (average per farm in EUR)

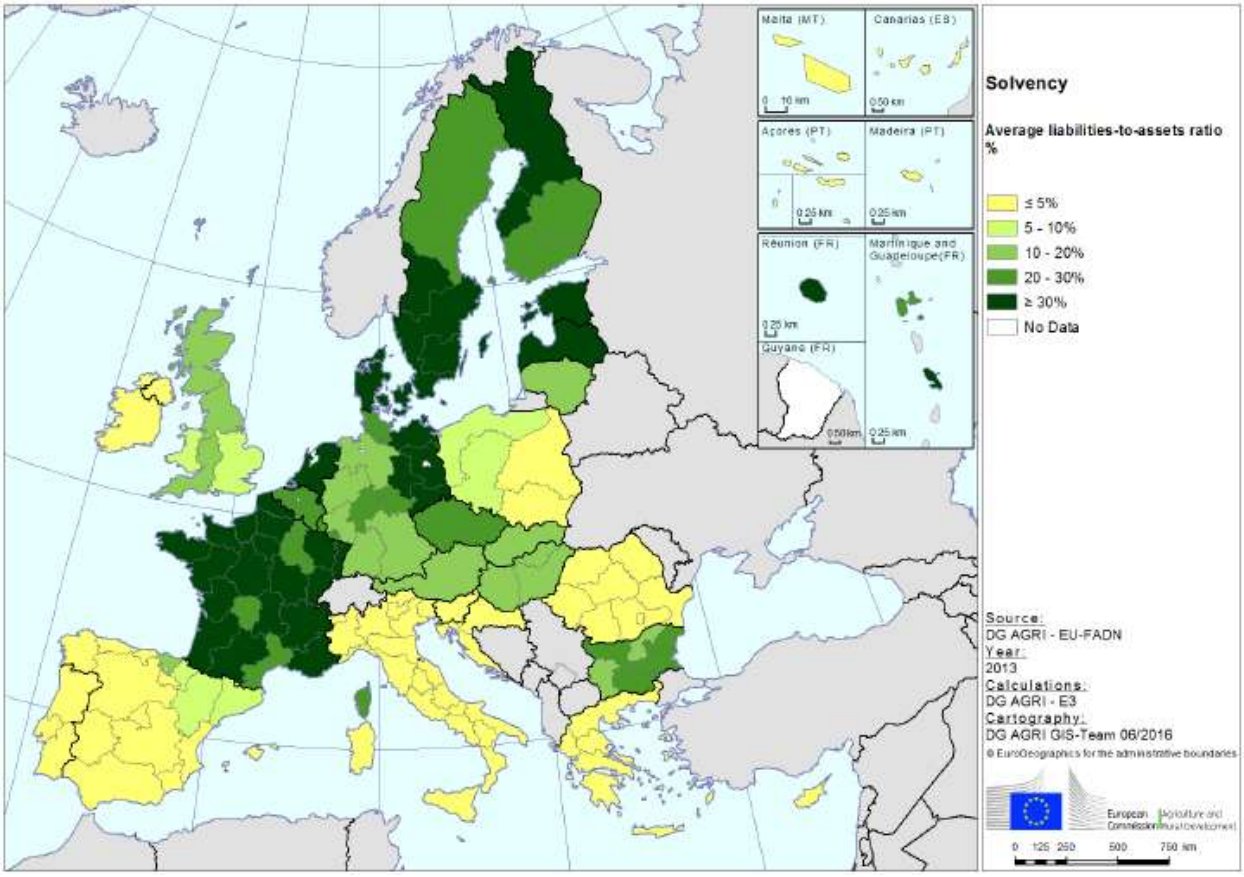


Source: DG AGRI EU-FADN.

4.3.7 Solvency

In this diploma thesis, solvency is measured using the liabilities-to-assets ratio, which shows the percentage of an agricultural holding's assets that are financed through debt. This gives an indication of a farm's ability to meet its obligations in the long term (or its capacity to repay liabilities if all assets are sold). The results should be interpreted with caution as a high liabilities-to-assets ratio is not necessarily a sign of a financially vulnerable position. In fact, a high ratio could also be an indication of a farm's economic viability (i.e. its ability to access outside financing), though there is certainly a threshold beyond which indebtedness will compromise a farm's financial health.

Figure 13 Average liabilities-to-assets ratio per farm by FADN region in 2013



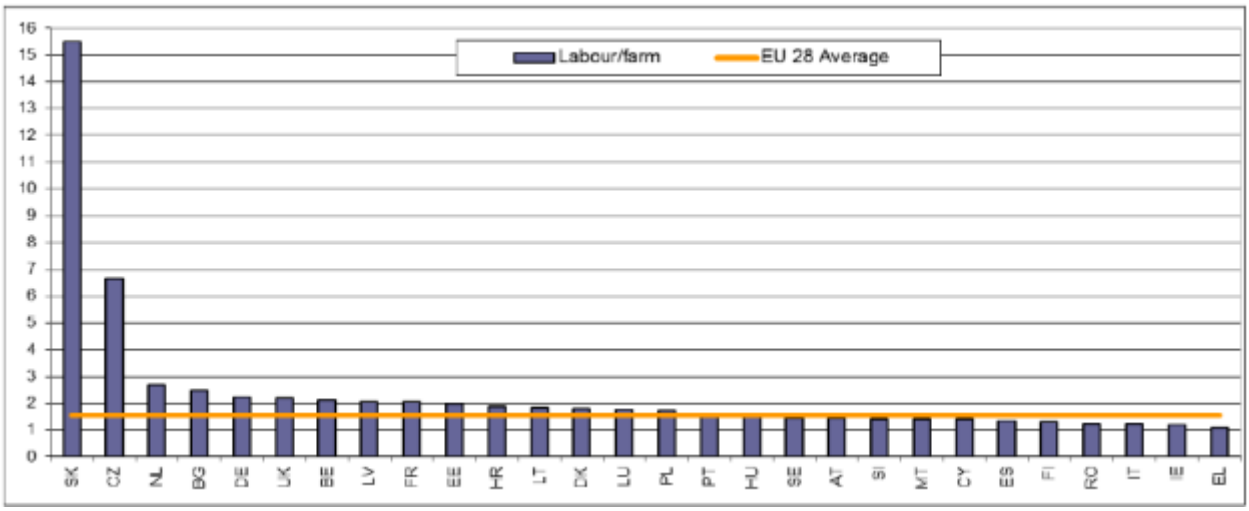
Source: DG AGRI EU-FADN.

4.3.8 Labour force

Results for labour force will be represented by member states in this sub chapter.

The average total labour input of holdings stood at 1.5 AWU in 2013 in the EU-28. This was virtually the same as the previous two years, although it has decreased (by -14 %) compared to 2007. The labour input in Romania has almost halved from 2007 to 2013. As shown in Figure 14, it varied considerably across countries, ranging from 15.5 AWU in Slovakia to 1.1 AWU in Greece. Labour input on Slovak (15.5 AWU) and Czech (6.6 AWU) farms was significantly higher than on farms in the remainder of the EU, reflecting the predominance of very large non-family agricultural holdings in their agriculture sectors.

Figure 14 Labour input per farm (in AWU) by Member State in 2013



Source: DG AGRI EU-FADN.

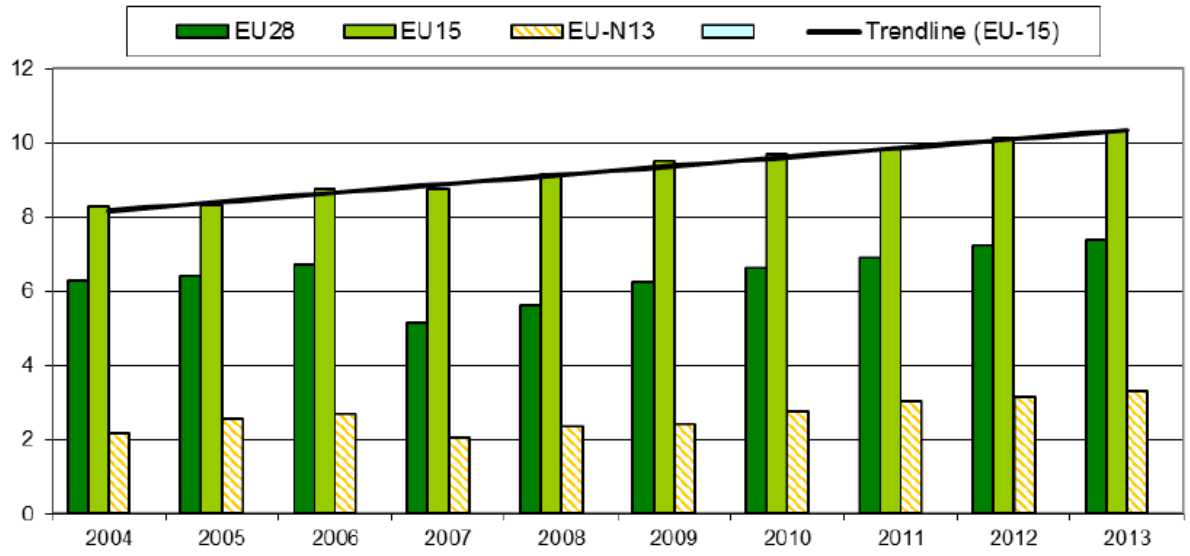
Traditionally, a significant part of the labour force employed in agriculture is family labour. Family labour represents a proportion of total labour force represents the prevalent form of labour in most Member States, with the exception of Slovakia, the Czech Republic, Hungary, Estonia and Bulgaria where the proportion of paid labour in the total labour force was higher than 50 % in 2013.

4.3.9 Remuneration of farm workers

Results for remuneration of farm workers will be represented by EU groups in this sub chapter.

As shown in Figure 15, the nominal hourly wage increased in both EU-15 and the EU-N13. In the EU-15, the average nominal hourly wage rose by 25 % between 2004 and 2013, from EUR 8.2 to EUR 10.3. In the EU-N13, it stood at EUR 3.3 in 2013, up from EUR 2.2 in 2004 (an increase of some 52 %) despite including Romania and Bulgaria in 2007. The average EU-28 nominal hourly wage stood at EUR 7.4 in 2013, compared to EUR 7.3 in 2012 an increase of about 1.7 % over this period. The average nominal hourly wage in the EU-15 was approximately three times higher than in the EU-N13 in 2013. Changes in the nominal wage compensated for price increases over this period, so that the real hourly wage rose by around 0.3 % between 2012 and 2013 (EU-28 HICP inflation stood at around 1.4% during this time).

Figure 15 Long-term developments in average nominal wages (average per farm in EUR)



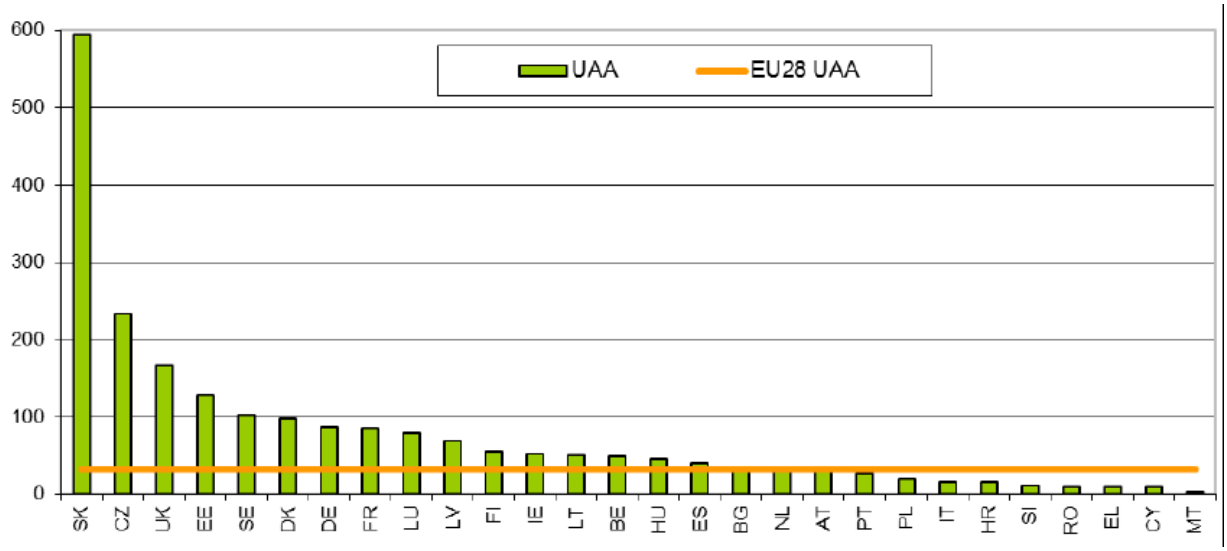
Source: DG AGRI EU-FADN.

4.3.10 Farm size

While it is already clear from this report that the structure of farms varies significantly across Member States, one of the most telling indicators of these differences is the physical size of farms, measured by the average amount of agricultural land per farm. As shown in Figure 16, farms represented in the FADN are on average largest in Slovakia (595 ha), followed by the Czech Republic (233 ha) and the UK (166 ha). Farms are smallest in Greece, Cyprus (9 ha) and Malta (3 ha). The EU average was 32.8 ha in 2013, little changed from the previous year. It should be noted that this average farm size is based on the FADN survey, which does not cover all agricultural holdings in the EU but only those which due to their size could be considered commercial. Thus the interpretation and the use of the above-mentioned average farm size should be treated with caution (see the methodology chapter for more information).

The average farm size was mostly below the EU-28 average in some of the Mediterranean countries, in Austria and in some of the Eastern European countries such as Poland and Romania.

Figure 16 Total farm UAA by Member State in 2013



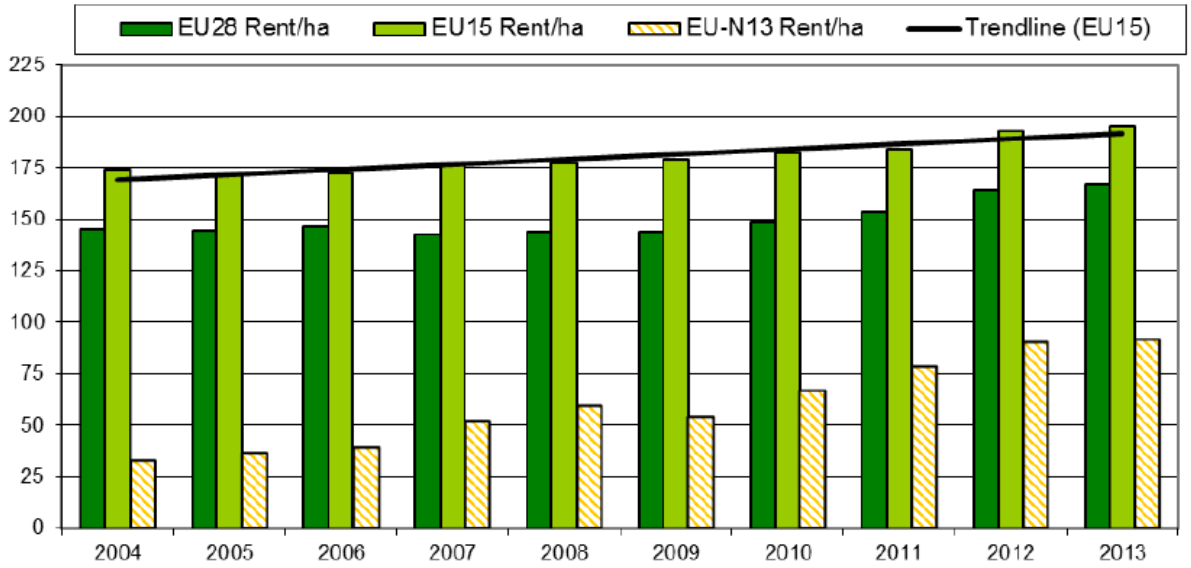
Source: DG AGRI EU- FADN

4.3.11 Level of land rents

This sub chapter will describe developments in land rent levels by EU group.

As shown in **Ошибка! Источник ссылки не найден.**, the level of land rents in the EU-15 increased very gradually over 2004-2013, from EUR 174 per ha to EUR 195 per ha. However, this trend was more pronounced in the EU-N13, despite a small decrease in 2009: average land rent per hectare nearly tripled during this period, from around EUR 32 to EUR 92. All in all, average land rents have gradually increased in the EU since 2007 and stood at around EUR 167 per hectare in 2013 (+15 %). It should be noted that the land rent figures discussed in this subsection are averages and do not necessarily reflect prices in new rental contracts (which may be well above the average level observed in the FADN).

Figure 17 Long-term developments in land rent levels (in EUR per ha)



Source: DG AGRI EU- FADN.

5 Analysis of selected indicators by LFA types

This chapter will describe the relationships between groups of farms by LFA type. Indicators that are going to be analyzed are: ROA, FNVA and Cost/Earnings ratio. After describing the data ANOVA and regression will be performed (Carlson and Winquist, 2014).

Dataset contains over thousand agricultural holdings from 22860 that were registered in agricultural census in Czech Republic in 2010 (Ec.europa.eu, 2012). Years that will be used are from 2007 to 2012 which coves almost all budgetary period.

5.1 FNVA

Description of variables:

- LFA_type is a grouping variable that takes values from 1 to 4 representing Czech farms in mountain, other, specific areas and LFA accordingly
- FNVA is farm net value added per farm in Czech Republic, thsd. CZK
- SUBS is variable for current (operational) subsidies per farm in Czech Republic, thsd. CZK

5.1.1 Descriptive statistics of FNVA

While analyzing the data several the most influential outliers have been identified and excluded from data.

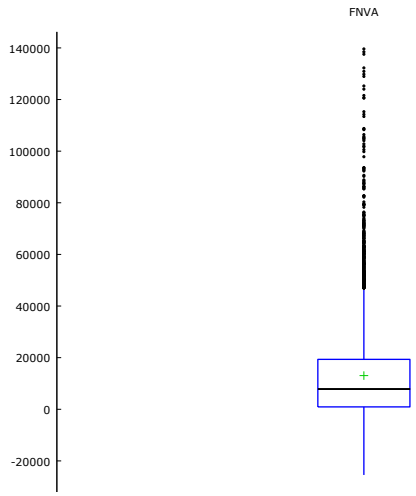
- Vojenské lesy a statky ČR, s.p.
- Zemědělské družstvo Dolní Újezd
- AGRODRUŽSTVO JEVIŠOVICE
- KARSIT, s. r. o.

Box plot for FNVA shows that there are still many outliers left that are located mostly above the upper whisker what makes mean move significantly higher that median. The average for values ranging from -25446 thsd CZK to 139606 thsd CZK is standing at 13053 thsd CZK level which is 5202 thsd CZK higher than median. Considering that mean is highly influenced by outliers (because they are included in calculation) it is better to use median as a measure of central tendency (Larson and Farber, 2012).

Mean is not the only measure that is highly affected by outliers. If there are outliers in the data then the interquartile range 18412 thsd. CZK is more reliable measure of spread than the overall range 165052 thsd. CZK.

Standard deviation 17508,4 thsd CZK indicates how much variation there is from the mean 13053,3 thsd. CZK thereby measuring how spread out the data is.

Figure 18 Box plot for FNVA of Czech farms in thsd. CZK (2007-2012)

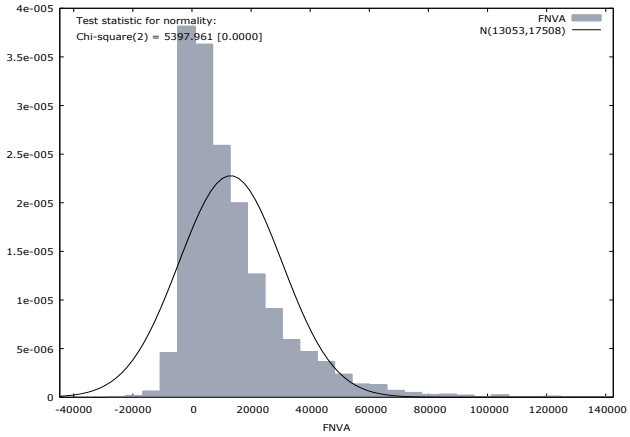


Source: Database Albertina, own creation

Positive value of skewness for distribution shows that the data is concentrated more from the left side of the mean making the distribution right skewed.

Positive kurtosis statistic which represents measure of peakedness explains that data is concentrated more towards the center rather than tails and also could be referred to leptokurtic distribution. Data on the right tail extends well beyond two standard deviations.

Figure 19 Hystogram for FNVA of Czech farms in thsd. CZK (2007-2012)



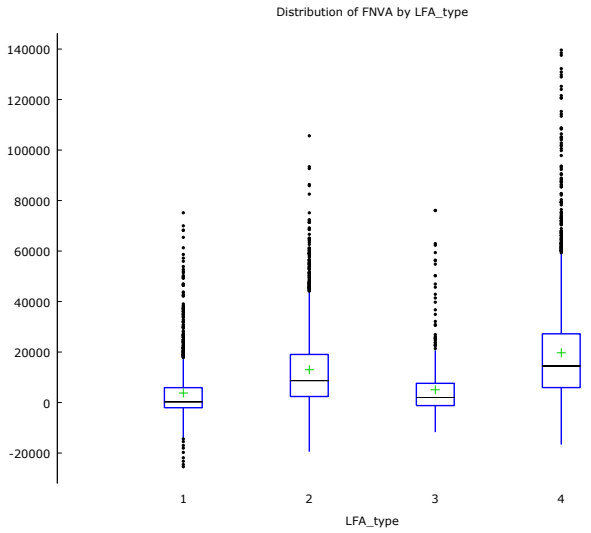
Source: Database Albertina, own creation

Although the original data is not normally distributed it is important to mention that outliers that were left in data have a great influence on distribution. If all of outliers would be dropped, the skewness and kurtosis would show the normality of distribution.

Considering that sample consists of different LFA types it is possible to assume that FNVA statistics vary from group to group. To see that assumption is correct or not, the box plots were separated by four types of area:

- 1 – Mountain areas
- 2 – Other or "Intermediate" LFA's
- 3 – Specific LFA's or Areas Affected by Specific Handicaps
- 4 – non-LFA's.

Figure 20 Boxplot factorized by LFA type for FNVA of Czech farms in thsd. CZK (2007-2012)



Source: Database Albertina, own creation

On above factorized box-plots it is clearly visible that mountain specific areas have on average lower FNVA than non-LFA group. Hence it is recommended to analyze these differences with ANOVA to see whether they are significant or not.

Since it is quite clear that FNVA and subsidies have positive relationship, it is more interesting to see the difference of these dependencies by group.

Table 2 Correlation of FNVA and subsidies by LFA groups for Czech farms in 2007-2012

Type of area	**Correlation (r)**
Mountain	0.6109
Other	0.8061
Specific	0.3178
Non-LFA	0.7872

Source: Database Albertina, own creation

The strongest correlation exists between subsidies and FNVA in other areas and non-LFA areas. But firstly it is good to run ANOVA.

5.1.2 ANOVA for FNVA by LFA groups

There are three assumptions for ANOVA that needs to be verified before doing the actual analysis. The data should contain independent observations, the distribution of all populations

should be normal and the variances in these two distributions should be equal. So the next step is to examine the data and verify these assumptions.

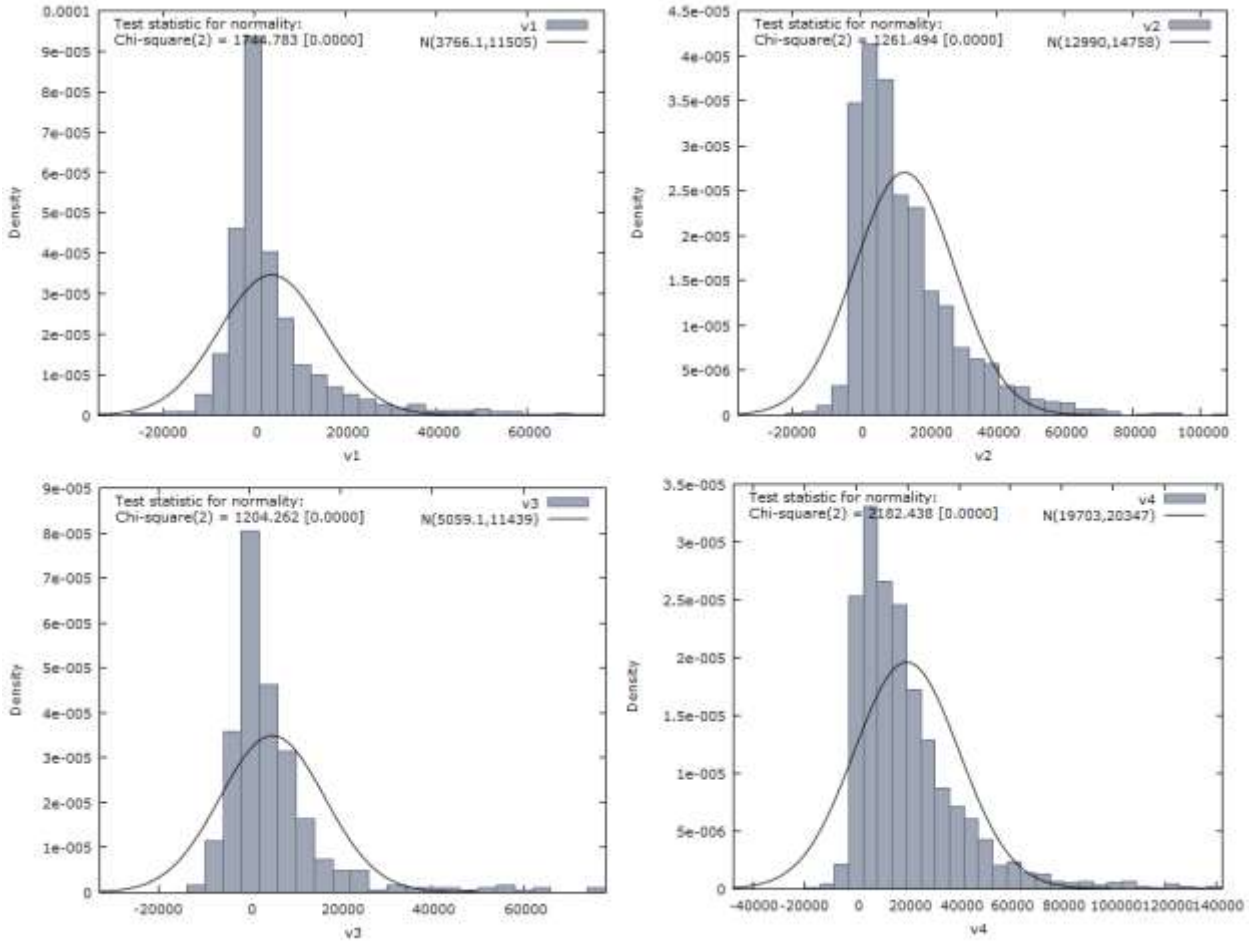
5.1.2.1 Verification of ANOVA assumption

1. Independent observations in data. In used dataset one observation does not affect another observation meaning that no observation provides information about another observation. With this statement, assumption could be considered as verified.

2. Normality of distribution

Below is the distribution of each LFA group plotted in histograms.

Figure 21 FNVA distribution for each LFA type for Czech farms 2007-2012



Source: Database Albertina, own creation

If the distributions look neither normal, nor approximately normal, it is possible to verify assumption using central limit theorem. The theorem states that the distribution of sample means is approximately normal regardless of the population distribution's shape, if the sample size is large enough.

3. Homogeneity of variance

Using Levene's test for homogeneity it is possible to formally identify equality of variances (σ_n^2).

H_0: $\sigma_1^2=\sigma_2^2=\sigma_3^2=\sigma_4^2$, variances across groups are equal

H_A: $\sigma_1^2\neq\sigma_2^2\neq\sigma_3^2\neq\sigma_4^2$, variances are not equal meaning that last assumption is not verified.

Table 3 Levene's test results from SAS for FNVA grouped by LFA type

Levene's Test for Homogeneity of FNVA Variance ANOVA of Squared Deviations from Group Means					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
LFA_typeF	3	9.174E19	3.058E19	46.62	<.0001
Error	6533	4.285E21	6.559E17		

Source: Database Albertina, own creation

Based on the small p-value H_0 needs to be rejected meaning that variances across groups are not equal and assumption is not verified (O'Rourke, Hatcher and Stepanski, 2005).

5.1.2.2 ANOVA hypothesis testing

H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$ – FNVA means are the same for all LFA types

H_a: $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4$ – FNVA means significantly differ across groups

Regular ANOVA test from SAS showed small p-value and that means LFA groups have significantly different FNVA. But since Levene's test confirmed that ANOVA assumption is not verified, it is better to confirm with Welch's ANOVA test that is designed for groups with unequal variances.

Table 4 Welch's ANOVA results from SAS, response = FNVA, treatment = LFA_type

Welch's ANOVA for FNVA			
Source	DF	F Value	Pr > F
LFA_typeF	3.0000	376.12	<.0001
Error	2187.0		

Source: Database Albertina, own creation

Welch's ANOVA results show that p-value is very low as well which means rejecting null hypothesis and accepting that means of at least two groups are different from each other. To determine which ones are significantly different it is important to make post hoc test.

Table 5 FNVA means and standard deviations grouped by LFA types

Level of LFA_typeF	N	FNVA	
		Mean	Std Dev
1	1307	3766.1117	11504.7717
2	2260	12989.8876	14757.7568
3	510	5059.1078	11439.0304
4	2460	19703.2093	20346.7994

Source: Database Albertina, own creation

Based on Tukey method results all pairwise comparisons are significantly different from each other except Mountain and Specific less favoured areas. Based on above table it is possible to conclude that FNVA of all LFA groups are significantly lower than FNVA for farms in non-LFA. Among three LFA groups the best situation based on FNVA indicator is in other less favoured areas. Mountain and specific areas have equally low FNVA.

5.1.3 SLR analysis

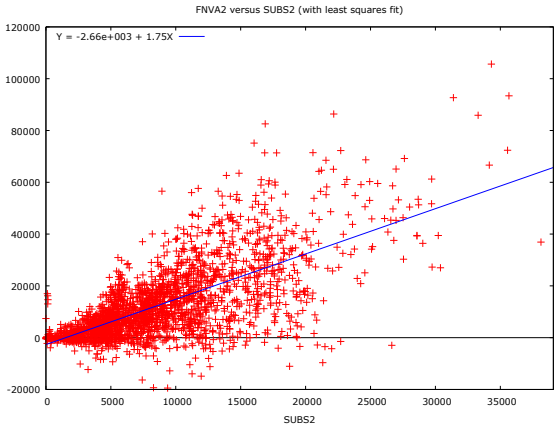
To conduct simple linear regression analysis measuring influence of subsidies on FNVA observations were divided by LFA groups. As was said before, linear relationship exists between FNVA and subsidies in other LFA and non-LFA.

5.1.3.1 SLR for other less favoured areas

Strong positive linear relationship is visible on the graph below. To find statistical relationship simple linear regression method can be used.

Model: $y = \beta_0 + \beta_1 x_1 + \varepsilon$

Figure 22 Scatter plot for subsidies (independent) and FNVA (dependent) in other LFA



Source: Database Albertina, own creation

After running analysis in Gretl we were able to get the final equation of regression.

Final equation: $y = -2656.85 + 1.74915x_1 + e$

To verify model statistically, the p-value needs to be compared to α-level. Since p-value is very low and less than 0,05, we can say that parameter 1,74915 is statistically significant.

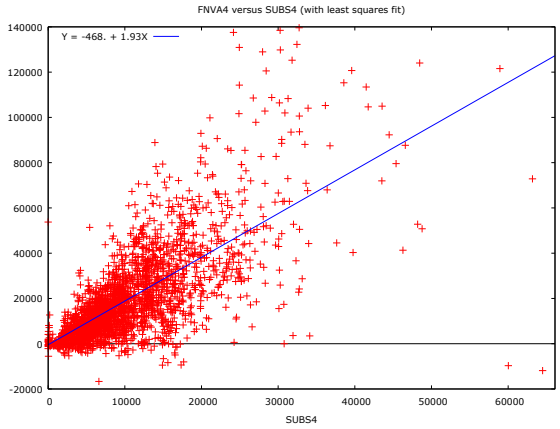
Another important value in the results is R^2 that allows verifying goodness of fit. Value of 0,47 means that subsidies explain FNVA by 47%.

The interpretation of the model is the following: If current subsidies increase by 1000 CZK/farm , FNVA per farm in other LFA will increase by 1749 CZK.

Dependency of FNVA by subsidies in non LFA will be also estimated by OLS method since there is positive linear relationship (see graph below).

Model: $y = \beta_0 + \beta_1 x_1 + \varepsilon$

Figure 23 Scatter plot for subsidies (independent) and FNVA (dependent) in non-LFA



Source: Database Albertina, own creation

After running analysis in Gretl we were able to get the final equation of regression.

Final equation: $y = -467.602 + 1.93215x_1 + e$

P-value for parameter β_1 shows it is significant; goodness of fit is 50,5%, which is slightly higher than in other LFA.

The interpretation of the model is the following: If current subsidies increase by 1000 CZK/farm, FNVA per farm in non-LFA will increase by 1932 CZK.

Here it is important to note that share of LFA payments is very low in non-LFA areas.

5.2 ROA

For this thesis indicator return on assets was calculated as total earnings minus total cost over total assets.

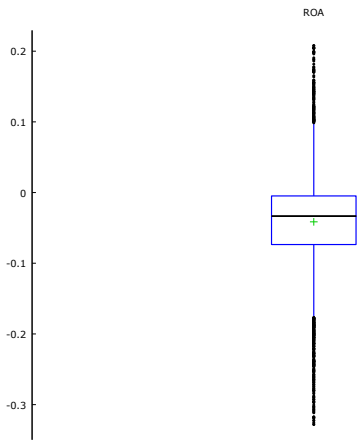
Description of variables:

- LFA_type is a grouping variable that takes values from 1 to 4 representing mountain, other, specific areas and non-LFA accordingly
- ROA is return on assets per farm in Czech Republic, %
- SUBS is variable for current (operational) subsidies per farm in Czech Republic, thsd. CZK

5.2.1 Descriptive statistics of ROA

Before starting the analysis it was discovered that data has several significant outliers that would affect results. For that reason outliers of lowest 1% of data (-33% ROA) and furthest 1% of data (21% ROA) were removed from sample. Hence the box plot has been drawn as below.

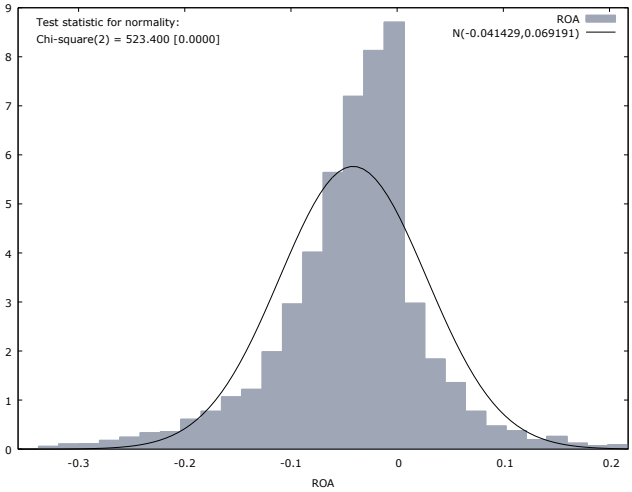
Figure 24 Box plot of ROA of Czech farms 2007-2012



Source: Database Albertina, own creation

After removing the lowest and the highest outliers, the data is ranging from -32,8% to 20,8% while original range was from -118,5% to 61,4%. The box represents middle 50% of the data or interquartile range which fully lies below 0. The mean represented by “plus” sign and median represented by horizontal line inside the box are close to each other showing that the data is symmetric.

Figure 25 Distribution of ROA of Czech farms 2007-2012

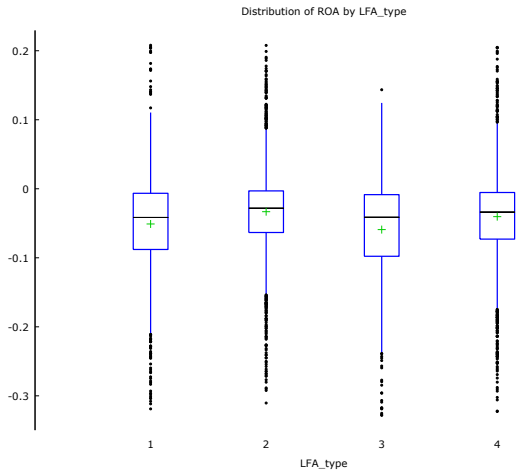


Source: Database Albertina, own creation

Histogram of ROA plotted above shows that distribution is approximately normal. Skewness statistic of -0,5 supports that conclusion, while kurtosis has slightly high value. Nevertheless, if all outliers would be removed from sample, then kurtosis would become much lower and very close to zero. In this case distribution can still be called normal.

Factorized box plot below shows that there are some differences between the groups but it is not really clear whether they are significant. ANOVA test will be run again to test this assumption.

Figure 26 Boxplot factorized by LFA type for ROA of Czech farms in thsd. CZK (2007-2012)



Source: Database Albertina, own creation

As was done before with FNVA it is also interesting to see whether there is any relationship between subsidies and ROA.

Correlation between ROA and subsidies by LFA type

Table 6 Correlation of ROA and subsidies by LFA groups for Czech farms in 2007-2012

Type of area	Correlation (r)
Mountain	-0.1524
Other	-0.2074
Specific	-0.0904
Non-LFA	-0.0913

Source: Database Albertina, own creation

Table shows that the correlation is very low so there is no need to analyze it further.

5.2.2 ANOVA for ROA by LFA groups

As well as in previous part, firstly assumptions have to be verified and then ANOVA can be performed for ROA.

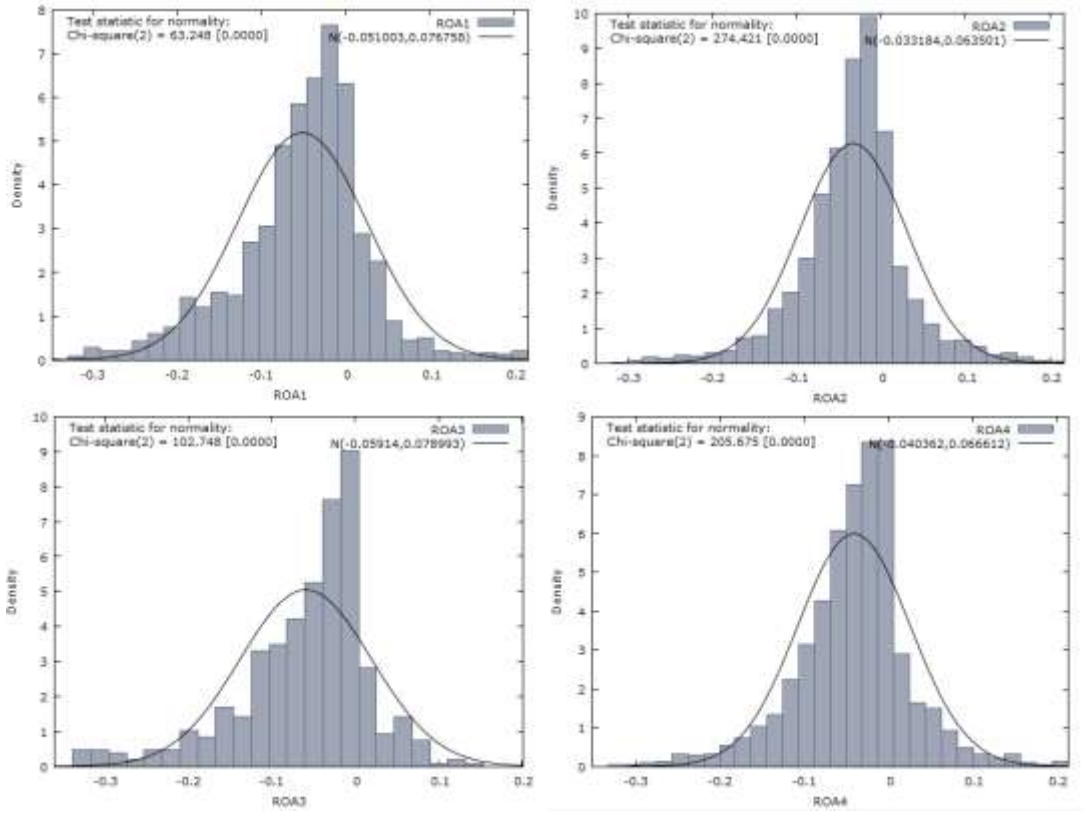
5.2.2.1 Verification of ANOVA assumption

1. Independent observations in data. In used dataset one observation does not affect another observation meaning that no observation provides information about another observation. With this statement, assumption could be considered as verified.

2. Normality of distribution

The histogram below shows that distribution for all groups look approximately normal which is enough to satisfy the assumption.

Figure 27 Distribution of ROA by FA type for Czech farms 2007-2012



Source: Database Albertina, own creation

3. Homogeneity of variance

Using Levene's test for homogeneity it is possible to formally identify equality of variances (σ_n^2).

H_0: $\sigma_1^2=\sigma_2^2=\sigma_3^2=\sigma_4^2$, variances across groups are equal

H_A: $\sigma_1^2 \neq \sigma_2^2 \neq \sigma_3^2 \neq \sigma_4^2$, variances are not equal meaning that last assumption is not verified.

Table 7 Levene's test results from SAS for ROA groupped by LFA type

Levene's Test for Homogeneity of ROA Variance ANOVA of Squared Deviations from Group Means					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
LFA_typeR	3	0.00411	0.00137	15.54	<.0001
Error	6419	0.5659	0.000088		

Source: Database Albertina, own creation

Based on results above H0 is rejected which means that variances across groups are not equal and assumption is not verified.

5.2.2.2 ANOVA hypothesis testing

H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$ – ROA means are the same for all LFA types

H_a: $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4$ – ROA means significantly differ across groups

Table 8 Welch's ANOVA results from SAS, response = ROA, treatment = LFA_type

Welch's ANOVA for ROA			
Source	DF	F Value	Pr > F
LFA_typeR	3.0000	26.92	<.0001
Error	1868.3		

Source: Database Albertina, own creation

Welch's ANOVA results show that p-value is much less than 0.05 which means rejecting null hypothesis and accepting that means of at least two groups are different from each other. To determine which ones are significantly different it is important to make post hoc test.

Table 9 ROA means and standard deviations grouped by LFA type

Level of LFA_typeR	N	ROA	
		Mean	Std Dev
1	1269	-0.05100257	0.07675776
2	2224	-0.03318406	0.06350061
3	496	-0.05914000	0.07899283
4	2434	-0.04036226	0.06661188

Source: Database Albertina, own creation

Tukey's test showed the same results for ROA as previously for FNVA (see Annex); all groups are different from each other except mountain and specific areas. But what makes difference here is that non-LFA farms do not have higher or lower ROA than LFA, but it stands in the middle. Interesting note is that mountain and specific areas generate significantly greater ROA than non LFA farms. Considering that ROA measures the effectiveness of a company's assets in generating income we can conclude that mountain and specific areas are more effective in using their assets that non-LFA and other areas.

5.3 Cost/Income ratio

Description of variables:

- LFA_type is a grouping variable that takes values from 1 to 4 representing Czech farms in mountain, other, specific areas and LFA accordingly
- COST/INC is ratio calculated as total costs per farm over total earnings per farm
- SUBS is variable for current (operational) subsidies to Czech farms, thsd. CZK

5.3.1 Descriptive statistics of Cost/Income ratio

During the initial analysis of data, many outliers have been detected. To get more precise result lowest 0,5% and highest 0,5% of data have been removed from Cost/Income ratio analysis. Additionally data contained 18 missing values that have also been removed. The names of the most influential farms are:

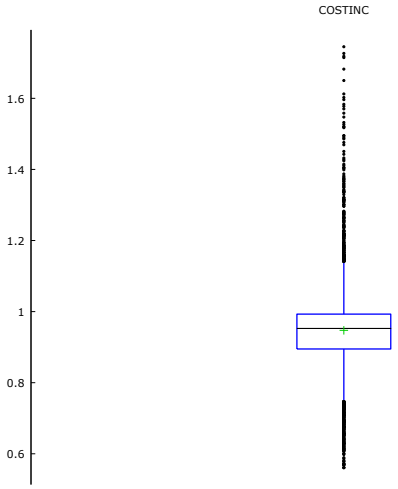
- BONAGRO, a.s.
- Vesa Velhartice, a. s.
- R - YARD spol. s r.o.
- Biochov s.r.o.
- AGROPOL-POČERNY spol. s r.o.
- Družstvo Džbány
- A.T. OSTROV spol. s r.o.
- ART CLUB, s.r.o.
- ZemýdýlskÚ dru×stvo Bzovß - Krhov
- Maňovická zemědělská, a.s.
- BEAVER s.r.o.
- Zelená farma s.r.o.
- AGRONOVA M & P, spol. s r.o.

Box plot shows that there are still many outliers. Cost/Income ratio is now ranging from 0,561 to 1,745, original data spreads between 0,01 to 38. With a small difference between mean 0,947 and

median0,952 it is possible to conclude that remaining outliers do not affect mean much and that the data will probably look symmetric on histogram.

Standard deviation 0,11 indicates how much variation there is from the mean 0,947 thereby measuring how spread out the data is.

Figure 28 Box plot for Cost/Income ratio of Czech farms in thsd. CZK (2007-2012)

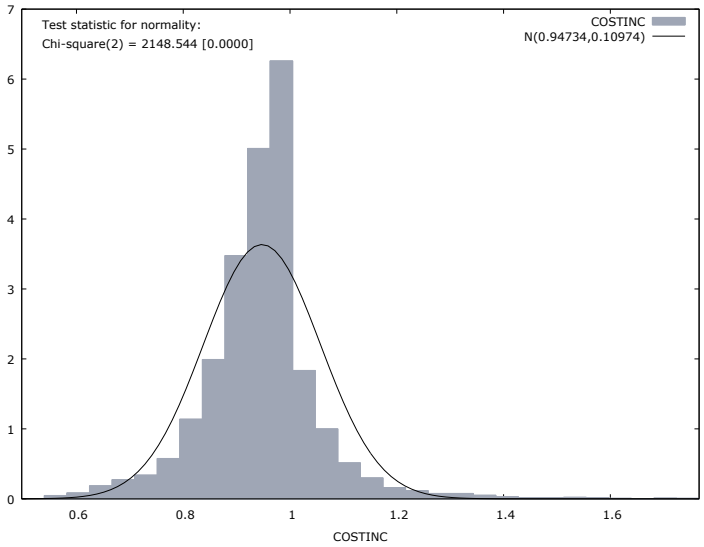


Source: Database Albertina, own creation

Skewness for distribution of Cost/Income ratio of 0,8 shows that the data is spread quite equally on the left and right side.

Positive kurtosis statistic which represents measure of peakedness explains that data is concentrated more towards the center rather than tails and also could be referred to leptokurtic distribution.

Figure 29 Distribution of Cost/Income ratio of Czech farms 2007-2012



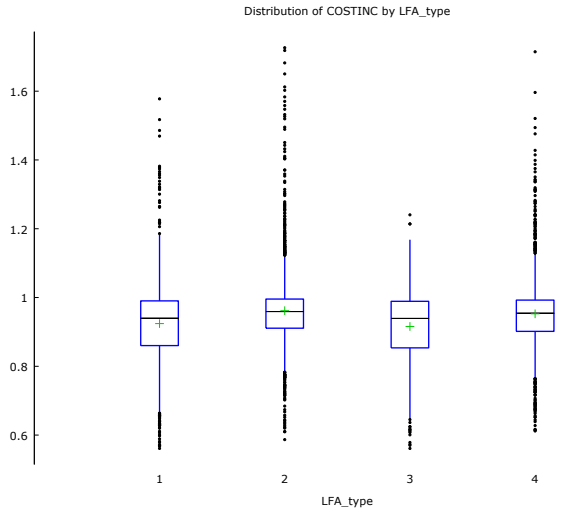
Source: Database Albertina, own creation

Distribution of Cost/Income ratio looks approximately normal which is also confirmed by Chi-square test: α is very close to 0 meaning that H_0 is rejected and H_A says that the data do not follow the specified distribution or that distribution is normal.

As well as with previous indicators it is possible to assume that Cost/Income ratio varies from one LFA group to another. To see whether assumption is correct or not, the box plots were separated by four types of area:

- 1 – Mountain areas
- 2 – Other or "Intermediate" LFA's
- 3 – Specific LFA's or Areas Affected by Specific Handicaps
- 4 – non-LFA's.

Figure 30 Boxplot factorized by LFA type for Cost/Income ratio of Czech farms in thsd. CZK (2007-2012)



Source: Database Albertina, own creation

Above boxplot shows that means and medians of mountain and specific areas are a little lower than specific LFA's and non-LFA's. To see whether such difference between group is significant or not ANOVA test will be run.

Below let's see whether correlation exists between Cost/Income ratio and subsidies within the groups.

Table 10 Correlation of Cost/Income ratio and subsidies by LFA groups for Czech farms in 2007-2012

Type of area	Correlation (r)
Mountain	-0.0867
Other	-0.2026
Specific	-0.1137
Non-LFA	-0.1013

Source: Database Albertina, own creation

Table above shows that correlation between subsidies and Cost/Income ratio is negative but very small and not significant enough for future research.

5.3.2 ANOVA for Cost/Income ratio by LFA types

In this sub chapter three ANOVA assumptions will be verified otherwise it is not possible to continue analysis of variance. The data should contain independent observations, the distribution

of all populations should be normal and the variances in these two distributions should be equal. So the next step is to examine the data and verify these assumptions.

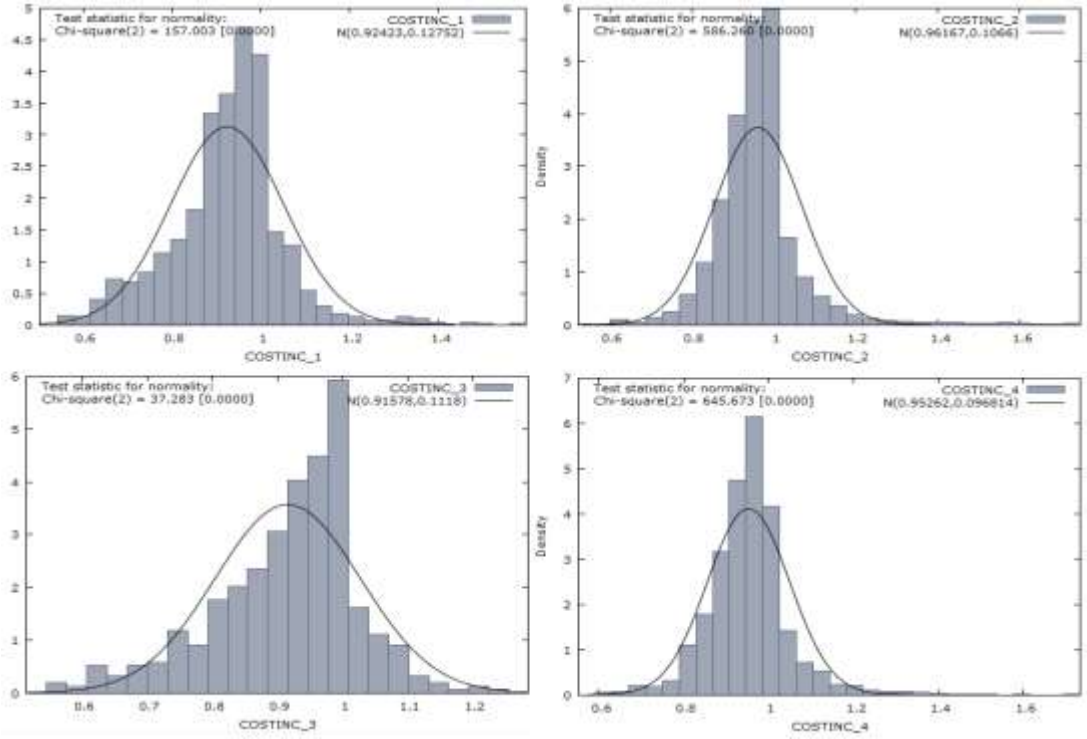
5.3.2.1 Verification of ANOVA assumption

1. Independent observations in data. In used dataset one observation does not affect another observation meaning that no observation provides information about another observation. With this statement, assumption could be considered as verified.

2. Normality of distribution

Below is the distribution Cost/Income ratio by each LFA group plotted in histograms.

Figure 31 Distribution of Cost/Income ratio by LFA type for Czech farms 2007-2012



Source: Database Albertina, own creation

The graph for each group shows that distribution of Cost/Income ratio is approximately normal hence this assumption is successfully verified.

3. Homogeneity of variance

Using Levene's test for homogeneity it is possible to formally identify equality of variances (σ_n^2).

H_0: $\sigma_1^2=\sigma_2^2=\sigma_3^2=\sigma_4^2$, variances across groups are equal

H_A: $\sigma_1^2\neq\sigma_2^2\neq\sigma_3^2\neq\sigma_4^2$, variances are not equal meaning that last assumption is not verified.

Table 11 Levene's test results from SAS for Cost/Income ratio by LFA type

Levene's Test for Homogeneity of COSTINC Variance ANOVA of Squared Deviations from Group Means					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
LFA_typeC	3	0.0405	0.0135	12.92	<.0001
Error	6476	6.7730	0.00105		

Source: Database Albertina, own creation

Based on the small p-value H_0 needs to be rejected meaning that variances across groups are not equal and assumption is not verified. Nevertheless, ANOVA can be continued using Welch's test instead of regular one.

5.3.2.2 ANOVA hypothesis testing

H_0: $\mu_1=\mu_2=\mu_3=\mu_4$ – Cost/Income ratio's means are the same for all LFA types

H_a: $\mu_1\neq\mu_2\neq\mu_3\neq\mu_4$ – Cost/Income ratio's means significantly differ across groups

Table 12 Welch's ANOVA results from SAS, response = Cost/Income ratio, treatment = LFA_type

Welch's ANOVA for COSTINC			
Source	DF	F Value	Pr > F
LFA_typeC	3.0000	42.47	<.0001
Error	1893.9		

Source: Database Albertina, own creation

Welch's ANOVA results show that p-value is very low which means rejecting null hypothesis and accepting that means of at least two groups are different from each other. To determine which ones are significantly different it is important to make post hoc test.

Table 13 ROA means and standard deviations grouped by LFA type

Level of LFA_typeC	N	COSTINC	
		Mean	Std Dev
1	1286	0.92422820	0.12752342
2	2237	0.96167050	0.10659841
3	498	0.91577655	0.11180451
4	2459	0.95262312	0.09681406

Source: Database Albertina, own creation

Again two insignificant differences belong to mountain and specific groups while all other pairwise comparisons showed significance in mean differentiations. The situation with Cost/Income indicator is similar to ROA. Mountain and specific areas have significantly lower Costs/Income then other and non-LFA areas. The highest value stands for other LFA which means that farms in these areas are struggling the most.

6. Analysis of selected indicators by UAA groups

As it was shown in previous chapter, Czech Republic is very specific country in agricultural business. It shows one of the highest results per farm in such indicators as FNVA, ROA, farm net worth, etc. The reason for this is presence of very big farms. In fact, more than 98% of Czech farms in analyzed representative sample has greater size than EU average in 2013 of 32,8 ha.

EU uses classes to divide farms by UAA. The same division will be used for analysis in this thesis.

Table 14 UAA size groups used for analysis

Farm size	Group No
Up to 300 ha	1
From 300 ha to 500 ha	2
From 500 ha to 900 ha	3
From 900 ha to 1800 ha	4
From 1800 ha to 2500 ha	5
Over 2500 ha	6

Source: own creation

6.1 FNVA/ha

It is obvious statement that the farms with higher agricultural land will be able to generate higher FNVA. Because of that it is necessary to recalculate FNVA per ha to conduct a fair and logical research. Moreover, diploma thesis is focused on LFA, hence non LFA areas are excluded from data.

Description of variables:

- UAA_group is a grouping variable that takes values from 1 to 6 representing size group of those Czech farm, that have status of LFA
- FNVA is farm net value added of Czech farms in LFA, thsd. CZK per ha
- SUBS is variable for current (operational) subsidies to Czech farms in LFA, thsd. CZK

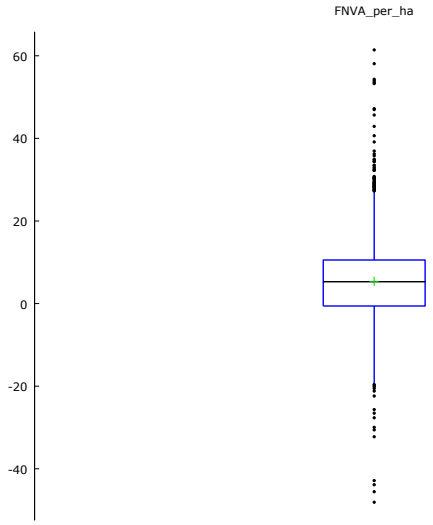
6.1.1 Descriptive statistics of FNVA/ha

As in previous chapter, outliers make a great influence on studied data. Below are businesses that will be excluded from data and described separately:

- AGRODRUŽSTVO JEVIŠOVICE
- FARMA Bolka Polívky, spol. s r.o.
- JASNO, spol. s r. o.
- Lesní společnost Teplá, a. s.
- PODHORAN LUKOV a.s.
- TRIOS, spol. s r.o.
- Aiva zemědělské obchody, a. s.
- Farma Blaník s.r.o.
- Holoubek & pravnuci s.r.o. – missing data
- ITALPE s.r.o.
- TAURUS, družstvo
- BEAVER s.r.o.
- Agrofruct a.s. Dolní Ředice

Boxplot below shows that the distribution of data is approximately symmetric because mean 5374 CZK/ha is almost equal to median 5292 CZK/ha. Analyzed data ranges from -48095 CZK/ha to 61416 CZK/ha but if all farms were included then it would range from -160927 CZK/ha to 971617 CZK/ha.

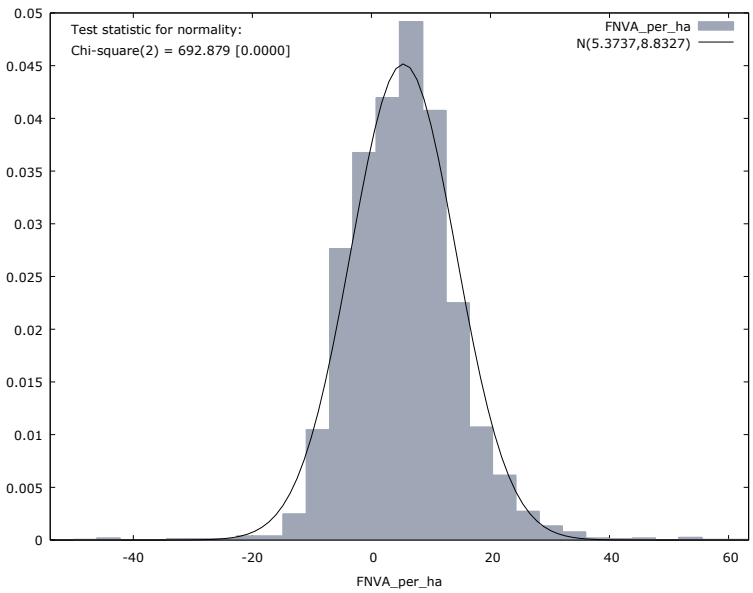
Figure 32 Box plot of FNVA of Czech farms 2007-2012



Source: Database Albertina, own creation

Distribution of data looks approximately normal according to the histogram below. X-axis corresponds to FNVA per ha and shows where the most sample values are located.

Figure 33 Distribution of FNVA/ha for Czech farms in 2007-2012

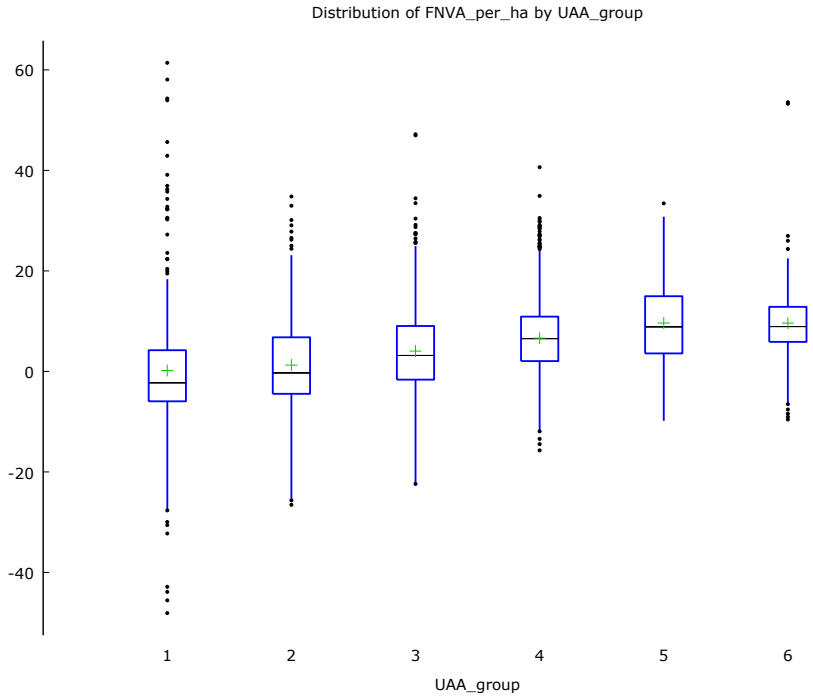


Source: Database Albertina, own creation

Skewness 0,37 confirms that data is symmetric and not spread out more on one side than on another. Positive kurtosis value 3,07 shows that data tends to concentrate more towards the center. Overall, analyzed sample has approximetely normal distribution.

To see whether there is dependency between UAA and FNVA per ha as a first step we can create a factorized box plot. It is visible that the bigger the farm is the higher is FNVA per ha but to confirm that statement ANOVA needs to be done.

Figure 34 Boxplot factorized by UAA group for FNVA per ha of Czech farms in thsd. CZK (2007-2012)



Source: Database Albertina, own creation

Correlation coefficient between FNVA per ha and subsidies by groups is less than 0,7 for each group so it is possible to make a conclusion that there is no dependency between these two variables within farm size groups.

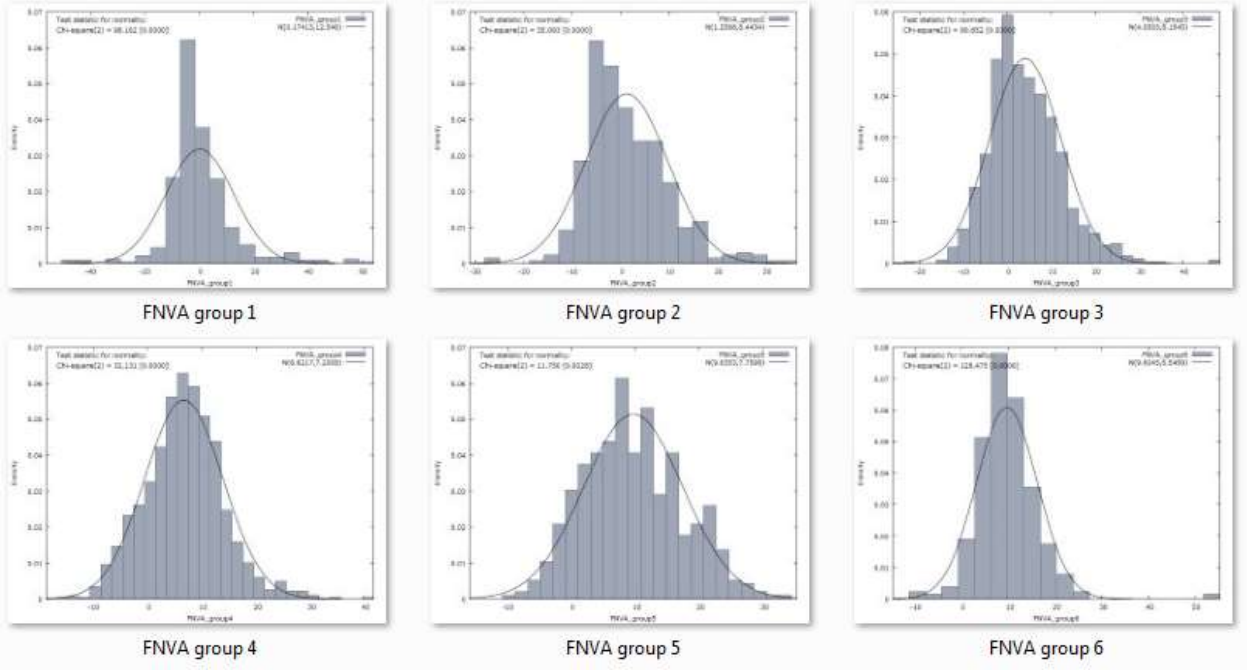
6.1.2 ANOVA for FNVA/ha by UAA groups

Once more the first step before running this statistical analysis is to verify ANOVA assumptions that were already mentioned before.

6.1.2.1 Verification of ANOVA assumption

1. Independent observations in data. In used dataset one observation does not affect another observation meaning that no observation provides information about another observation. With this statement, assumption could be considered as verified.
2. Normality of distribution.

Figure 35 Distributuin of FNVA/ha for each UAA group (2007-2012)



Source: Database Albertina, own creation

3. Using Levene's test for homogeneity it is possible to formally identify equality of variances (σ_n^2).

   H_0: $\sigma_1^2=\sigma_2^2=\sigma_3^2=\sigma_4^2=\sigma_5^2=\sigma_6^2$, variances across groups are equal

   H_A: $\sigma_1^2\neq\sigma_2^2\neq\sigma_3^2\neq\sigma_4^2\neq\sigma_5^2\neq\sigma_6^2$, variances are not equal meaning that last assumption is not verified.

Table 15 Levene's test results from SAS for FNVA/ha by UAA group

Levene's Test for Homogeneity of FNVAHA Variance ANOVA of Squared Deviations from Group Means					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
GROUPf	5	3942420	788484	25.31	<.0001
Error	4028	1.2548E8	31152.3		

Source: Database Albertina, own creation

Based on the small p-value H_0 needs to be rejected meaning that variances across groups are not equal and assumption is not verified. Nevertheless, analysis can be continued using Welch's test instead of regular ANOVA.

6.1.2.2 ANOVA hypothesis testing

H_0: $\mu_1=\mu_2=\mu_3=\mu_4=\mu_5=\mu_6$ – FNVA means are the same for all UAA groups

H_a: $\mu_1\neq\mu_2\neq\mu_3\neq\mu_4\neq\mu_5\neq\mu_6$ – FNVA means significantly differ across groups

The p-value for ANOVA test is less than 0,0001 which means that means vary significantly across groups, but considering that assumption of variances homogeneity is not verified it is better to confirm results by running Welch's test for groups with unequal variances.

Table 16 Welch's ANOVA test results for FNVA/ha by UAA group

Welch's ANOVA for FNVAHA			
Source	**DF**	**F Value**	**Pr > F**
GROUPf	5.0000	101.36	<.0001
Error	1336.5		

Source: Database Albertina, own creation

To find the solution we again need to look at p-value which is very small. If p-value is less than α=0,05, then H_0 is rejected. Welch's ANOVA also confirm that means of FNVA per ha across groups are significantly different. To find out which groups exactly differ from each other post hoc analysis needs to be done.

Table 17 FNVA/ha means and standard deviations grouped by UAA

Level of GROUPf	N	FNVAHA	
		Mean	Std Dev
1	420	0.17412657	12.5463687
2	421	1.25680386	8.4434125
3	1017	4.05025797	8.1545429
4	1327	6.62166507	7.2008384
5	488	9.63533243	7.7598070
6	361	9.60445000	6.5489426

Source: Database Albertina, own creation

After analyzing data by Tukey's method outcome shows that groups 1 and two are not significantly different from each other as well as group 5 and 6. For All other comparisons the difference is significant. It is possible to conclude from results that the bigger the farm is, the higher the FNVA per ha. Moreover, for the smallest group of farms with UAA less than 300 ha FNVA is more than 50 times lower than for the group with biggest UAA of more than 2500 ha.

6.2 ROA

As UAA and SUBS variables are not changing since the last paragraph, there is only one additional variable to declare:

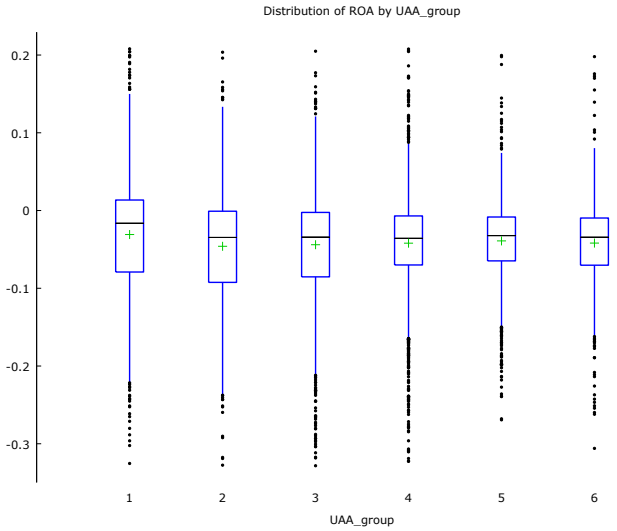
- ROA is return on assets for Czech farms, %

6.2.1 Descriptive statistics of ROA

Descriptive statistics for ROA was provided in part "Analysis of selected indicators by LFA type" and is applicable for this analysis because the same modification of data was applied. Therefore, it is sufficient just to find out necessity for ANOVA test and for simple linear regression.

There is a slight difference between groups though group with UAA up to 300 ha might have significantly higher ROA which is possible to test.

Figure 36 Boxplot factorized by UAA group for ROA per ha of Czech farms in thsd. CZK (2007-2012)



Source: Database Albertina, own creation

To check whether there is dependency between subsidies and ROA within UAA groups, correlation statistics were calculated. To state that correlation exists between variables, "r" should be greater than |0,7|. None of the coefficients crossed |0,6| value so conclusion is that there is no dependency.

6.2.2 ANOVA for ROA by UAA

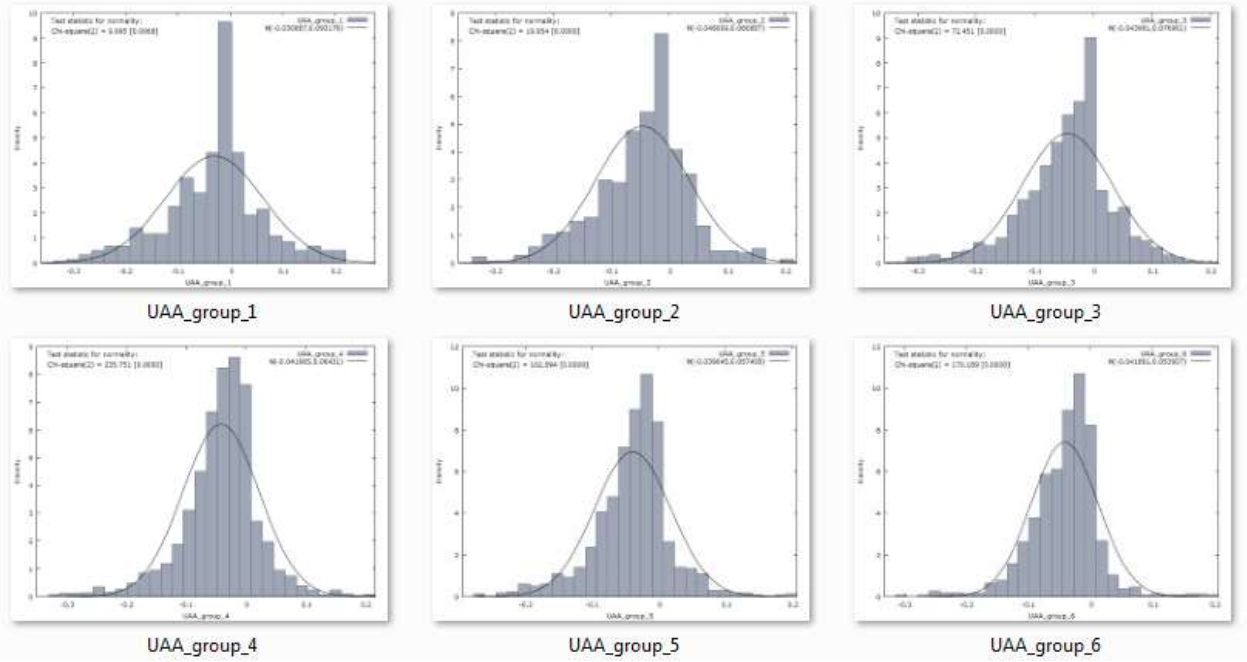
This paragraph will be focused on analysis of variances where dependent variable is ROA and treatment is UAA.

6.2.2.1 Verification of ANOVA assumption

1. Independent observations in data. In used dataset one observation does not affect another observation meaning that no observation provides information about another observation. With this statement, assumption could be considered as verified.
2. Normality of distribution.

As shown on the graph below the distribution for each group is approximately normal.

Figure 37 Distribution in ROA for each UAA grou



Source: Database Albertina, own creation

3. Using Levene's test for homogeneity it is possible to formally identify equality of variances (σ_n^2).

H_0: $\sigma_1^2=\sigma_2^2=\sigma_3^2=\sigma_4^2=\sigma_5^2=\sigma_6^2$, variances across groups are equal

H_A: $\sigma_1^2\neq\sigma_2^2\neq\sigma_3^2\neq\sigma_4^2\neq\sigma_5^2\neq\sigma_6^2$, variances are not equal meaning that last assumption is not verified.

Table 18 Levene's test results from SAS for ROA by UAA group

Levene's Test for Homogeneity of ROA_0001 Variance ANOVA of Squared Deviations from Group Means					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
GROUPr	5	0.0170	0.00341	37.80	<.0001
Error	6417	0.5783	0.000090		

Source: Database Albertina, own creation

Based on the small p-value H_0 needs to be rejected meaning that variances across groups are not equal and assumption is not verified. Nevertheless, analysis can be continued using Welch's test instead of regular ANOVA.

6.2.2.2 ANOVA hypothesis testing

H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$ – ROA means are the same for all UAA groups

H_a: $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4$ – ROA means significantly differ across groups

In ANOVA test produced by SAS program p-value equals to 0.0042 that leads to H_0 rejection. In this case ROA in at least two groups significantly differ from each other but considering the fact that variances across groups are not equal it is important to support result by Welch's ANOVA test.

Table 19 Welch's ANOVA test results for ROA by UAA group

Welch's ANOVA for ROA_0001			
Source	DF	F Value	Pr > F
GROUPr	5.0000	Feb-30	0.0425
Error	2083.6		

Source: Database Albertina, own creation

Based on Welch's ANOVA p-value looks greater but with significance level of 0,05 test still confirms that means are different, which could not be done at level 0,01 though.

To find out differences of which groups are significant the Tukey's method was applied below.

Table 20 ROA means and standard deviations grouped by UAA

Level of GROUPr	N	ROA_0001	
		Mean	Std Dev
1	496	-0.03088707	0.09317596
2	557	-0.04600930	0.08088716
3	1348	-0.04398131	0.07696079
4	2186	-0.04198487	0.06430996
5	984	-0.03904542	0.05740794
6	852	-0.04186057	0.05390700

Source: Database Albertina, own creation

Three groups with the highest ROA 2, 3 and 4 do not vary significantly from each other. The only group that makes difference is 1 which stands for less than 300 ha and has significantly lower ROA then groups 2, 3 and 4 (from 300 ha to 1800 ha). Moreover, Dunnet's test that controls the Type I error for comparisons of all treatments against only one control group shows that group 6 is also significantly different from group 1.

6.3 Cost/Income ratio

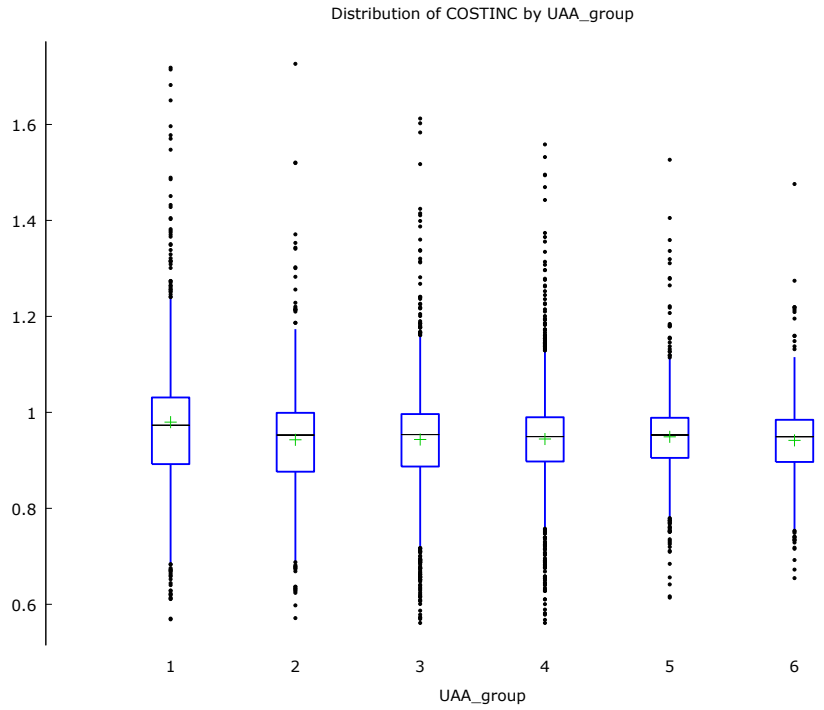
This sub chapter will be focused on analysis of Cost/Income ratio in connection to UAA. Firstly, it necessary to look at data and find out whether ANOVA or regression analysis is applicable and then based on this to analyze data in Gretl or SAS.

6.3.1 Descriptive statistics for Cost/Income ratio

In descriptive statistics for Cost/Income ratio in chapter "Analysis of selected indicators by LFA type" it was stated that dataset has several outliers and lowest and highest 0,5% of them were removed to smooth range and results as some of outliers laid far-far beyond two standard deviations. Small difference between mean and median showed that dataset is symmetric, and Chi-square test showed that distribution is normal.

As in the previous chapter it is also interesting to know whether Cost/Income ratio varies between groups.

Figure 38 Boxplot factorized by UAA group for Cost/Income ratio of Czech farms in thsd. CZK (2007-2012)



Source: Database Albertina, own creation

From factorized boxplot it is not clear whether the difference exists among groups although group with the smallest UAA seems to have a little bit higher Cost/Income ratio.

To check whether there is dependency between subsidies and Cost/Income ratio within UAA groups, correlation statistics were calculated. To state that correlation exists between variables, "r" should be greater than |0,7|. None of the coefficients crossed this threshold so conclusion is that there is no dependency.

6.3.2 ANOVA for Cost/Income ratio

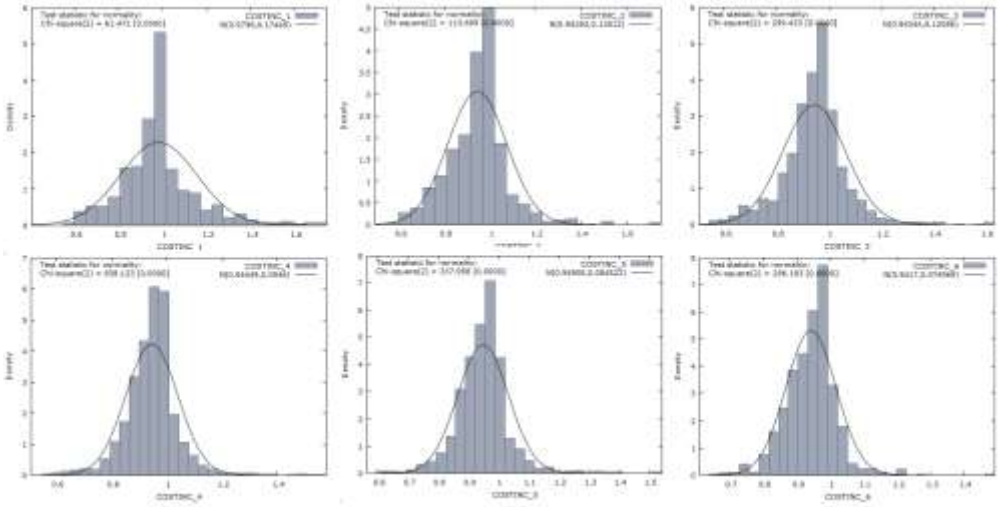
Since there is some visible difference in means shown on box plots, this paragraph will focus on analysis of variances which will consist of two parts.

6.3.2.1 Verification of ANOVA assumption

1. Independent observations in data. In used dataset one observation does not affect another observation meaning that no observation provides information about another observation. With this statement, assumption could be considered as verified.
2. Normality of distribution.

As shown on the graph below the distribution for each group is approximately normal.

Figure 39 Distribution of Cost/Income ratio for each UAA group



Source: Database Albertina, own creation

3. Using Levene's test for homogeneity it is possible to formally identify equality of variances (σ_n^2).

H_0: $\sigma_1^2=\sigma_2^2=\sigma_3^2=\sigma_4^2=\sigma_5^2=\sigma_6^2$, variances across groups are equal

H_A: $\sigma_1^2\neq\sigma_2^2\neq\sigma_3^2\neq\sigma_4^2\neq\sigma_5^2\neq\sigma_6^2$, variances are not equal meaning that last assumption is not verified.

Table 21 Levene's test results from SAS for Cost/Income ratio by UAA

Levene's Test for Homogeneity of COSTINC_0001 Variance ANOVA of Squared Deviations from Group Means					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
GROUPc	5	0.2775	0.0555	54.77	<.0001
Error	6474	6.5593	0.00101		

Source: Database Albertina, own creation

Based on the small p-value H_0 needs to be rejected meaning that variances across groups are not equal and assumption is not verified. Nevertheless, analysis can be continued using Welch's test instead of regular ANOVA.

6.3.2.2 ANOVA hypothesis testing

H_0: $\mu_1=\mu_2=\mu_3=\mu_4$ – Income/Cost ratio's means are the same for all UAA groups

H_a: $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4$ – Income/Cost ratio's means significantly differ across groups

Regular ANOVA test from SAS showed small p-value and that means UAA groups have significantly different Cost/Income indicator. But since Levene's test confirmed that ANOVA assumption is not verified, it is better to confirm with Welch's ANOVA test that is designed for groups with unequal variances.

Table 22 Welch's ANOVA test results for Cost/Income ratio by UAA group

Welch's ANOVA for COSTINC_0001			
Source	**DF**	**F Value**	**Pr > F**
GROUPc	5.0000		0.0002
Error	2114.3		

Source: Database Albertina, own creation

Welch's ANOVA results show that p-value is 0.0002 which also means rejecting null hypothesis and accepting that means of at least two groups are different from each other. To determine which ones are significantly different it is important to make post hoc test.

Table 23 Cost/Income ratio means and stndard deviations by UAA type

Level of GROUPc	N	COSTINC_0001	
		Mean	Std Dev
1	521	0.97960046	0.17449494
2	563	0.94282573	0.13011865
3	1357	0.94343579	0.12086097
4	2194	0.94449059	0.09460013
5	989	0.94907586	0.08452207
6	856	0.94170313	0.07496922

Source: Database Albertina, own creation

It is easy to say which group is different from others just by looking at the means; the average of Cost/Income indicator is higher for the smallest farms by more than 0,03 while differences between other groups do not even reach 0,01. Tukey's test (see annex) confirms that mean of group 1 is significantly different from all other size groups.

7 Conclusion

Summing up the results of the work, it is important to distinguish the most important changes that came with the CAP reform in 2014.

- Less favoured areas are now officially called **areas with natural constraints** and the types were renamed as well to "mountain areas", "areas affected by significant natural handicaps" and "areas affected by specific handicaps“. Nevertheless, definition is still the same.

- **New delimitation** of the intermediate less favoured areas replaced 140 national criteria by eight biophysical criteria that brings credible, transparent, objective and comparable delimitation across all Member States

- **Maximum compensations** have been increased:

    - € 250 → € 450 per hectare in mountain areas

    - € 150 → € 250 per hectare in areas of other natural or specific constraints

- Beneficiaries must comply with the definition of **“active farmer”**

- **“Phasing out” scheme** for areas losing the status of being constraint due to new delimitation criteria

    - The obligation to do farming for five years after the first payment has been canceled, instead payments can only be granted to those farmers who **guarantee** to do farming activity in the delimited area in order to prevent land abandonment.

It is also important to emphasize the special place of Czech Republic in EU agriculture. As per year 2013 Czech Republic had 4th highest FNVA per AWU in EU-28, 3rd highest ROA and after Slovakia employed largest amount of labor force. The reason for this is the size structure of businesses that differs greatly from the structure of businesses in member states of the EU-28. Businesses with more than 50 hectares of agricultural land occupy more than 90% of the total area of the agricultural land farmed, while the EU-28 average is only 33 ha per farm.

This specific structure was formed by Czech history when land that had been confiscated after World War II to form large state-controlled farms.

Agriculture is no longer for the production of food only, but now occupies an important social and environmental function. Agricultural activity is an inherent, essential element of the rural environment that deserves care and support. Farmers are encouraged to carry out this type of work, work which is of such importance to the public and the environment, by a whole range of national or European subsidy instruments.

Based on data from Czech database Albertina several indicators were picked and analyzed in division by LFA type and utilized agricultural land size group. The outcome showed interesting results.

FNVA of all LFA groups were significantly lower than FNVA for farms in non-LFA. Among three LFA groups the best situation based on FNVA indicator is in other less favoured areas. Mountain and specific areas have equally low FNVA.

ROA analysis of variances showed slightly different result. The difference here is that non-LFA farms do not have higher or lower ROA than LFA, but it stands in the middle. Interesting note is that mountain and specific areas generate significantly greater ROA than non LFA farms. Considering that ROA measures the effectiveness of a company's assets in generating income we can conclude that mountain and specific areas are more effective in using their assets that non-LFA and other areas.

All pairwise comparisons except mountain and specific groups showed significance in mean differentiations. The situation with Cost/Income indicator is similar to ROA. Mountain and specific areas have significantly lower Costs/Income then other and non-LFA areas. The highest value stands for other LFA which means that farms in these areas struggle the most.

After analyzing FNVA per ha outcome shows that groups one and two are not significantly different from each other as well as group 5 and 6. For All other comparisons the difference is significant. It is possible to conclude from results that the bigger the farm is, the higher the FNVA per ha. Moreover, for the smallest group of farms with UAA less than 300 ha FNVA is more than 50 times lower than for the group with biggest UAA of more than 2500 ha.

After separating farms by UAA into groups and analyzing ROA we could see that three groups with the highest ROA 2, 3 and 4 do not vary significantly from each other. The only group that makes difference is 1 which stands for less than 300 ha and has significantly lower ROA then groups 2, 3 and 4 (from 300 ha to 1800 ha). Moreover, Dunnet's test that controls the Type I error for comparisons of all treatments against only one control group shows that group 6 is also significantly different from group 1.

Interesting results were found in analysis of variances for Cost/Income ratio. The only one group that has significantly higher Cost/Income ratio is the group with the smallest farms less than 300 ha.

For regression analysis, correlation of current subsidies and selected indicators (FNVA, ROA and Cost/Income ratio) was tested separately for each group but the only strong correlation was found between subsidies and FNVA in specific and non-LFA groups. Regression model showed that if current subsidies increase by 1000 CZK/farm, FNVA per farm in other LFA will increase by 1749 CZK. Otherwise, analysis showed that current subsidies do not play a big role in analyzed indicators.

There are several topics related to research but that were not covered here. Some of outliers, that were removed from analysis due to extremely high values, were not studied. In depth analysis could bring interesting results and explain the nature of Czech agriculture better that is why it is recommended to analyze extreme results of Czech farms in another work.

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9. Appendix

Supplement 1 Summary Statistics for Farm Net Value Added, (6537 valid observations)

Mean	Median	Minimum	Maximum
13053.3	7851.00	-25446.0	139606.
Std. Dev.	**C.V.**	**Skewness**	**Ex. kurtosis**
17508.4	1.34130	2.10377	6.96002
5% Perc.	**95% Perc.**	**IQ range**	**Missing obs.**
-3520.70	46834.4	18412.0	0

Supplement 2 Post hoc analysis of ANOVA for FNVA, treatment - LFA type, Tukey's HSD

Comparisons significant at the 0.05 level are indicated by ***.

LFA_typeF Comparison	Difference Between Means	Simultaneous 95% Confidence Limits		
4 - 2	6713.3	5488.1	7938.6	***
4 - 3	14644.1	12598.1	16690.1	***
4 - 1	15937.1	14497.7	17376.5	***
2 - 4	-6713.3	-7938.6	-5488.1	***
2 - 3	7930.8	5869.3	9992.2	***
2 - 1	9223.8	7762.5	10685.1	***
3 - 4	-14644.1	-16690.1	-12598.1	***
3 - 2	-7930.8	-9992.2	-5869.3	***
3 - 1	1293.0	-902.5	3488.5	
1 - 4	-15937.1	-17376.5	-14497.7	***
1 - 2	-9223.8	-10685.1	-7762.5	***
1 - 3	-1293.0	-3488.5	902.5	

Supplement 3 Summary Statistics for ROA (6423 valid observations)

Mean	Median	Minimum	Maximum
-0.0414290	-0.0332801	-0.328262	0.207951
Std. Dev.	**C.V.**	**Skewness**	**Ex. kurtosis**
0.0691911	1.67011	-0.505454	2.07782
5% Perc.	**95% Perc.**	**IQ range**	**Missing obs.**
-0.168090	0.0602910	0.0687768	0

Supplement 4 Post hoc analysis of ANOVA for ROA , treatment - LFA type, Tukey's HSD

Comparisons significant at the 0.05 level are indicated by ***.				
LFA_typeR Comparison	Difference Between Means	Simultaneous 95% Confidence Limits		
2 - 4	0.007178	0.001998	0.012359	***
2 - 1	0.017819	0.011605	0.024032	***
2 - 3	0.025956	0.017186	0.034726	***
4 - 2	-0.007178	-0.012359	-0.001998	***
4 - 1	0.010640	0.004525	0.016755	***
4 - 3	0.018778	0.010077	0.027478	***
1 - 2	-0.017819	-0.024032	-0.011605	***
1 - 4	-0.010640	-0.016755	-0.004525	***
1 - 3	0.008137	-0.001215	0.017489	
3 - 2	-0.025956	-0.034726	-0.017186	***
3 - 4	-0.018778	-0.027478	-0.010077	***
3 - 1	-0.008137	-0.017489	0.001215	

Supplement 5 Summary Statistics for Cost/Income ratio (6482 valid observations)

Mean	Median	Minimum	Maximum
0.947343	0.952591	0.560870	1.74511
Std. Dev.	**C.V.**	**Skewness**	**Ex. kurtosis**
0.109742	0.115842	0.807423	6.13726
5% Perc.	**95% Perc.**	**IQ range**	**Missing obs.**
0.770668	1.10921	0.0980914	0

Supplement 6 Post hoc analysis of ANOVA for Cost/Income ratio , treatment - LFA type, Tukey's HSD

Comparisons significant at the 0.05 level are indicated by ***.				
LFA_typeC Comparison	Difference Between Means	Simultaneous 95% Confidence Limits		
2 - 4	0.009047	0.000938	0.017157	***
2 - 1	0.037442	0.027729	0.047156	***
2 - 3	0.045894	0.032141	0.059647	***
4 - 2	-0.009047	-0.017157	-0.000938	***
4 - 1	0.028395	0.018843	0.037947	***
4 - 3	0.036847	0.023207	0.050486	***
1 - 2	-0.037442	-0.047156	-0.027729	***
1 - 4	-0.028395	-0.037947	-0.018843	***
1 - 3	0.008452	-0.006198	0.023101	
3 - 2	-0.045894	-0.059647	-0.032141	***
3 - 4	-0.036847	-0.050486	-0.023207	***
3 - 1	-0.008452	-0.023101	0.006198	

Supplement 7 Summary Statistics for FNVA/ha (4034 valid observations)

Mean	Median	Minimum	Maximum
5.37371	5.29165	-48.0952	61.4158
Std. Dev.	**C.V.**	**Skewness**	**Ex. kurtosis**
8.83271	1.64369	0.374029	3.07340
5% Perc.	**95% Perc.**	**IQ range**	**Missing obs.**
-7.41078	19.8817	11.1320	0

Supplement 8 Post hoc analysis of ANOVA for FNVA/ha , treatment - UAA group, Tukey's HSD

Comparisons significant at the 0.05 level are indicated by ***.				
GROUPf Comparison	Difference Between Means	Simultaneous 95% Confidence Limits		
5 - 6	0.0309	-1.6104	1.6721	
5 - 4	3.0137	1.7620	4.2653	***
5 - 3	5.5851	4.2832	6.8870	***
5 - 2	8.3785	6.8059	9.9511	***
5 - 1	9.4612	7.8876	11.0348	***
6 - 5	-0.0309	-1.6721	1.6104	
6 - 4	2.9828	1.5794	4.3862	***
6 - 3	5.5542	4.1058	7.0026	***
6 - 2	8.3476	6.6518	10.0435	***
6 - 1	9.4303	7.7335	11.1271	***
4 - 5	-3.0137	-4.2653	-1.7620	***
4 - 6	-2.9828	-4.3862	-1.5794	***
4 - 3	2.5714	1.5861	3.5567	***
4 - 2	5.3649	4.0424	6.6873	***
4 - 1	6.4475	5.1239	7.7712	***
3 - 5	-5.5851	-6.8870	-4.2832	***
3 - 6	-5.5542	-7.0026	-4.1058	***
3 - 4	-2.5714	-3.5567	-1.5861	***
3 - 2	2.7935	1.4233	4.1636	***
3 - 1	3.8761	2.5048	5.2474	***
2 - 5	-8.3785	-9.9511	-6.8059	***
2 - 6	-8.3476	-10.0435	-6.6518	***
2 - 4	-5.3649	-6.6873	-4.0424	***
2 - 3	-2.7935	-4.1636	-1.4233	***
2 - 1	1.0827	-0.5478	2.7132	
1 - 5	-9.4612	-11.0348	-7.8876	***
1 - 6	-9.4303	-11.1271	-7.7335	***
1 - 4	-6.4475	-7.7712	-5.1239	***
1 - 3	-3.8761	-5.2474	-2.5048	***

Supplement 9 Post hoc analysis of ANOVA for ROA, treatment - UAA group, Tukey's HSD

Comparisons significant at the 0.05 level are indicated by ***.				
GROUPr Comparison	Difference Between Means	Simultaneous 95% Confidence Limits		
1 - 5	0.008158	-0.002692	0.019009	
1 - 6	0.010974	-0.000155	0.022102	
1 - 4	0.011098	0.001298	0.020898	***
1 - 3	0.013094	0.002746	0.023442	***
1 - 2	0.015122	0.002957	0.027287	***
5 - 1	-0.008158	-0.019009	0.002692	
5 - 6	0.002815	-0.006406	0.012036	
5 - 4	0.002939	-0.004625	0.010504	
5 - 3	0.004936	-0.003326	0.013198	
5 - 2	0.006964	-0.003484	0.017412	
6 - 1	-0.010974	-0.022102	0.000155	
6 - 5	-0.002815	-0.012036	0.006406	
6 - 4	0.000124	-0.007834	0.008083	
6 - 3	0.002121	-0.006503	0.010745	
6 - 2	0.004149	-0.006588	0.014886	
4 - 1	-0.011098	-0.020898	-0.001298	***
4 - 5	-0.002939	-0.010504	0.004625	
4 - 6	-0.000124	-0.008083	0.007834	
4 - 3	0.001996	-0.004827	0.008820	
4 - 2	0.004024	-0.005328	0.013377	
3 - 1	-0.013094	-0.023442	-0.002746	***
3 - 5	-0.004936	-0.013198	0.003326	
3 - 6	-0.002121	-0.010745	0.006503	
3 - 4	-0.001996	-0.008820	0.004827	
3 - 2	0.002028	-0.007897	0.011953	
2 - 1	-0.015122	-0.027287	-0.002957	***
2 - 5	-0.006964	-0.017412	0.003484	
2 - 6	-0.004149	-0.014886	0.006588	
2 - 4	-0.004024	-0.013377	0.005328	

Supplement 10 Post hoc analysis of ANOVA for ROA, treatment - UAA group, Dunnett's method

Comparisons significant at the 0.05 level are indicated by ***.				
GROUPr Comparison	Difference Between Means	Simultaneous 95% Confidence Limits		
5 - 1	-0.008158	-0.017477	0.001160	
6 - 1	-0.010974	-0.020531	-0.001416	***
4 - 1	-0.011098	-0.019514	-0.002681	***
3 - 1	-0.013094	-0.021981	-0.004207	***
2 - 1	-0.015122	-0.025570	-0.004675	***

Supplement 11 Post hoc analysis of ANOVA for Cost/Income ratio , treatment - UAA group, Tukey's HSD

Comparisons significant at the 0.05 level are indicated by ***.				
GROUPc Comparison	Difference Between Means	Simultaneous 95% Confidence Limits		
1 - 5	0.030525	0.013734	0.047315	***
1 - 4	0.035110	0.019994	0.050226	***
1 - 3	0.036165	0.020179	0.052150	***
1 - 2	0.036775	0.017920	0.055630	***
1 - 6	0.037897	0.020663	0.055132	***
5 - 1	-0.030525	-0.047315	-0.013734	***
5 - 4	0.004585	-0.007294	0.016465	
5 - 3	0.005640	-0.007328	0.018608	
5 - 2	0.006250	-0.010125	0.022625	
5 - 6	0.007373	-0.007107	0.021852	
4 - 1	-0.035110	-0.050226	-0.019994	***
4 - 5	-0.004585	-0.016465	0.007294	
4 - 3	0.001055	-0.009657	0.011766	
4 - 2	0.001665	-0.012988	0.016318	
4 - 6	0.002787	-0.009712	0.015287	
3 - 1	-0.036165	-0.052150	-0.020179	***
3 - 5	-0.005640	-0.018608	0.007328	
3 - 4	-0.001055	-0.011766	0.009657	
3 - 2	0.000610	-0.014939	0.016159	
3 - 6	0.001733	-0.011805	0.015271	
2 - 1	-0.036775	-0.055630	-0.017920	***
2 - 5	-0.006250	-0.022625	0.010125	
2 - 4	-0.001665	-0.016318	0.012988	
2 - 3	-0.000610	-0.016159	0.014939	
2 - 6	0.001123	-0.015707	0.017953	
6 - 1	-0.037897	-0.055132	-0.020663	***
6 - 5	-0.007373	-0.021852	0.007107	
6 - 4	-0.002787	-0.015287	0.009712	
6 - 3	-0.001733	-0.015271	0.011805	

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List of acronyms and abbreviations

CAP Common Agricultural Policy

EAFRD European Agricultural Fund for Rural Development

EU European Union

EU-15 country group which includes EU Member States in 2003: Belgium (BE), Denmark (DK), Germany (DE), Ireland (IE), Greece (EL), Spain (ES), France (FR), Italy (IT), Luxembourg (LU), the Netherlands (NL), Austria (AT), Portugal (PT), Finland (FI), Sweden (SE) and the United Kingdom (UK)

EU-N12 country group which includes the Members States that joined the EU in 2004: the Czech Republic (CZ), Estonia (EE), Cyprus (CY), Latvia (LV), Lithuania (LT), Hungary (HU), Malta (MT), Poland (PL), Slovenia (SI) and Slovakia (SK), and in 2007: Bulgaria (BG) and Romania (RO)

EU-N13 includes the 10 Member States that joined the EU in 2004, Romania and Bulgaria from 2007 and Croatia for 2013 only.

EU-27 country group which includes EU-15 plus EU-N12 countries, i.e. the European Union between 2007 and 2013

FADN Farm Accountancy Data Network

FNVA Farm Net Value Added

AWU Annual Work Unit, corresponds to the work performed by one person who is occupied on an agricultural holding on a full-time basis

FNI Farm Net Income

UAA utilised agricultural area

WTO World Trade Organization