Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Economics

Diploma Thesis

Determinants of agricultural land price in the Czech Republic

Ludmila Šplíchalová

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

DIPLOMA THESIS ASSIGNMENT

Ludmila Šplíchalová

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Thesis title

Determinants of agricultural land price in the Czech Republic

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Objectives of thesis

The aim of the diploma thesis is to evalate the development of agricultural land market prices in the Czech Republic. To determine and evaluate factors affecting agricultural land market prices.

Methodology

In the theoretical part will be provided characteristics of Agricultural Land Fund and approaches of land valuation. In own work will be done analysis of selected factors affecting agricultural land market price. Econometric model will used to explain variability of agricultural market prices. In diploma thesis will be used methods of collection secondary data, document analysis, synthesis, description and comparsion.

The proposed extent of the thesis

60 pages

Keywords

Agricultural Land Fund, land market, Common Agricultural Policy, agricultural land market price, classification code of soils

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Recommended information sources

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The Diploma Thesis Supervisor

Ing. Petr Procházka, Ph.D., MSc

Supervising department

Department of Economics

Electronic approval: 14. 11. 2016

prof. Ing. Miroslav Svatoš, CSc.

Head of department

Electronic approval: 14. 11. 2016

Ing. Martin Pelikán, Ph.D.

Dean

Prague on 29. 11. 2016

Declaration

I declare that I have worked on my diploma thesis titled "Determinants of agricultural land price in the Czech Republic" 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 third person.

In Prague on 30.11.2016 _____

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Faktory ovlivňující vývoj cen zemědělské půdy v České Republice

Summary

The agricultural land market has gradually accelerated since the Czech Republic joined to European Union. The development of the land market was significantly influenced by different types of support from the EU, unanticipated legislative changes concerning transfers of state-owned land, and state support for purchase agricultural from private owners. At present agricultural entrepreneurs, as well as non-agricultural investors, are major players on the agricultural land market. The prices of agricultural plots increased by 77% between the years 2005 and 2011 and an increasing trend is expected in the long term, but it still cannot compete with the average prices realized in the EU15.

The thesis deals with the determinants affecting the development of land market prices in the Czech Republic between the years 2003 and 2015. In the practical part those factors that it is possible to quantify for the purpose of applying the method of linear regression and correlation are selected. The results of the econometric model will be verified with hypothesis that will be given on the basis of knowledge gained by studying literature sources. After verification the results with hypothesis it was found that the price of agricultural land is mainly influenced by increasing rental prices, resulting in gradual rise of the Single Area Payment Scheme. Other selected determinants influence the price with low intensity or they are not appropriate for this form of the model.

Keywords: Agricultural Land Fund, Common Agricultural Policy, Single Payment Area Scheme, agricultural land market prices, land market, Classification code of soils

Determinants of agricultural land price in the Czech Republic

Souhrn

Prodej státní půdy je již téměř u konce. Zvyšující se zájem o koupi zemědělské půdy v České republice v posledních výrazně vzrostl a to nejen v důsledku stabilizujících se ekonomických podmínek v zemědělství, ale také zvyšující se poptávkou po zemědělské půdě ze strany nezemědělských investorů. Ceny zemědělských pozemků vzrostly až o 77% mezi roky 2005 - 2011 a rostou i nadále, přesto však nemohou konkurovat průměrným tržním cenám zemí EU 15.

V praktické části této práce jsou zkoumány faktory mající vliv na rozvoj trhu s půdou v České republice v letech 2003-2015. Pro použití lineární regrese a korelace byla vybrána data, která lze kvantifikovat. Výsledky ekonometrického modelu budou ověřeny s hypotézami stanovenými na základě znalostí získaných studiem literatury. Pomocí modelu se podařilo dokázat, že na cenu zemědělské půdy má vliv cena pachtovného, jehož nárůst je rovněž způsoben rostoucími sazbami dotací na plochu. Ostatní zvolené determinanty mají nepatrný vliv na růst ceny půdy a některé z nich dokonce nelze uvažovat pro daný typ modelu.

Klíčová slova: zemědělský půdní fond, společná zemědělská politika, Jednotná platba na plochu, tržní ceny zemědělské půdy, trh s půdou, bonitovaná půdně ekologická jednotka

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List of abbreviations

BPEJ - Classification code of soils

CUZK - Czech Office for Land Survey and Cadastre

LFA - Less Favoured Areas

MZE - Ministry of Agriculture

CAP - Common Agricultural Policy

UZEI - Institute of Agricultural Economics and Information

CSO - Czech Statistical Office

LPIS - Land Parcel Identification System

EU - European Union

FADN - Farm Accountancy Data Network

LPIS - Land Parcel Identification System

SZIF - State Agricultural Intervention Fund

PGRLF - Support Guarantee Farm and Forest Fund

CNB - Czech National Bank

1 Introduction

The world population is estimated to reach 9 billion before 2050, and food is pressing economic, social, political, and moral issue. Agriculture is the most important for the global population and as an investment vehicle for pension funds and other financial institutions (Geman, 2015).

Land generally and the agricultural land especially has a value – adding productive capacity of its own. Throughout history, agriculture land had always been a source of basic human needs, and also a major financial income for nations. The greatest value for agricultural production has fertile soil or soil able to give suitable conditions for plant cultivation enabling the human food production.

As common in every country with market economy, the land in the Czech Republic has become a commodity since the year 1989. As a subject of supply and demand, it has to be valued by a monetary price. The land has some specifics. It is a limited resource, for its total supply is naturally restricted. It is an irreplaceable commodity; it is always associated with a specific locality which is unique as far as its production capabilities are concerned.

The transfers of state land to the private ownership significantly contributed to the market development of agricultural land in the Czech Republic since 1990s. The state ownership formed prevailing part of agricultural land market offer up to the year 2012.

Less land had been sold during the last decade on national level, however, the average market price surged over 160 000 CZK/ha in 2015. Moreover, the observed growth in agricultural land price fostered the investment purchases. The agricultural land has become attractive also for many non-agricultural investors, because land is considered as a hedge against inflation. The value of agricultural land significantly affects the viability of agriculture. In view of some land market analysts, low prices of agricultural land are not favourable for agricultures because cheap land is not traded as credible loan security.

Given the importance of an objective valuation of land, the question arises, what determinants have been affecting the formation of agricultural land market price in the Czech Republic.

2 Objectives and Methodology

2.1 Objectives

The diploma thesis aims to analyse the development of the agricultural land market and to determine the factors affecting agricultural land market prices in the Czech Republic.
The aim will be fulfilled by accomplishing these research objectives:

- the characteristics of the Agricultural Land Fund in the Czech Republic,
- examining land valuation methods,
- examining the effects of the Common Agricultural Policy on the development of the land market,
- identifying main factors affecting the price of agricultural land,
- drawing conclusion about the results reached.

2.2 Methodology

A deductive method will navigate the entire process in the theoretical part. This issue is particularly devoted to authors such as Němec, Medonos and Hruška.

Determinants influencing land market prices will be formulated on the basis of literature review. The data required for the analytical part was gathered from publicly accessible sources such as the Czech Statistical Office, reports issued by the Ministry of Agriculture, and other sources concerning to the information relating to the agricultural land market. Descriptive statistics will be provided for the average agricultural land market prices. A linear function will be applied for the simple regression and correlation analysis, which examine the dependence between each factor and average agricultural land market prices. The factors that are examined will be included into Single - Equation Econometric model, which shows the influences on the agricultural land market price. Econometric model will be verified economically, statistically and econometrically. All the calculations will be performed using the Gretl program and MS Excel. The results achieved will be summarized in Results and Discussion chapter.

An econometric model must contain basic assumptions (Čechura et al.,2009):

- the mean value of a stochastic variable is zero,
- the variance of stochastic variables is constant and finite,
- no autocorrelation of residuals,
- no presence of correlation of random variables and exogenous variables – estimates are unbiased,
- normal distribution of stochastic variables,
- specific assumptions (excluding irrelevant variables, right function form, only substantial variables are included, etc.).

The model is necessarily verified and compared with the economic hypothesis. The process of verification includes the following parts:

Economic verification – comparison of the predicted hypothesis with the results reached. The direction and intensity of the explanatory variables in relation to the variables that are explained is evaluated.

Statistic verification – evaluation of the statistical significance of individual parameters and the whole model.

Econometric verification – includes different tests for the verification of the assumptions of the econometric model (Čechura et al., 2009).

3 Literature Review

3.1 Land Fund in the Czech Republic

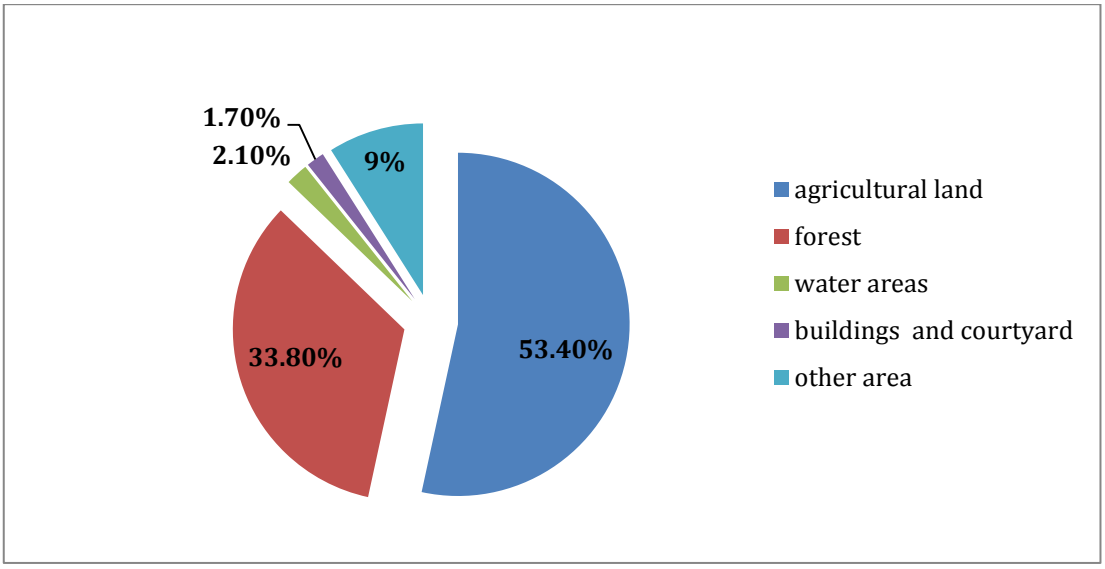
Land is a specific production factor. It´s area is limited and it is irreplaceable therefore it is possible to manage it only in a certain locality with such climatic conditions which are current specific locality. The term "Land Fund" is used interchangeably with the term "agricultural land". Agricultural Land Fund consists of farmed plots, e.g. arable land, grasslands, orchards, vineyards, hop fields and gardens. Another part of Agricultural Land Fund is created by fish breeding ponds. Agricultural land includes plots determined for agricultural activities that are registered in the land Register and each of them has own parcel number. Agricultural Land Fund contains not only cultivated land but also land required for managing these lands (access roads, drainage ditches, irrigation land, etc.)

3.1.1 Structure of Agricultural Land Fund

Land Fund is the important production factor that enables production of agricultural commodities. The total area of Land Fund in the Czech Republic was 7887 ths. ha. The Land Fund is divided into ten categories where arable land represents 2 978 898 ha (i.e. 38% of the total area of Land Fund). The second largest share of the land area belongs to forest areas (34% of the total area of Land Fund) and then hop-gardens (10 276 ha), gardens (163 601 ha), orchards 45 920, permanent grasslands (989 293ha), water surfaces (163 421ha), built-up areas and courtyards (132 192 ha), other areas (70 775ha) (MZE, 2015).

Agricultural Land Fund is located in rugged arable-climatic conditions, which has an impact on extreme weather events such as floods or a long-term drought. Areas with higher altitude can be considered as less favoured areas for the sector of intensive crop management. More than 20% of Agricultural Land Fund is comprised of mountain areas (MZE, 2015).

Graph 1: The allocation of land according to type in the Czech Republic (2015)

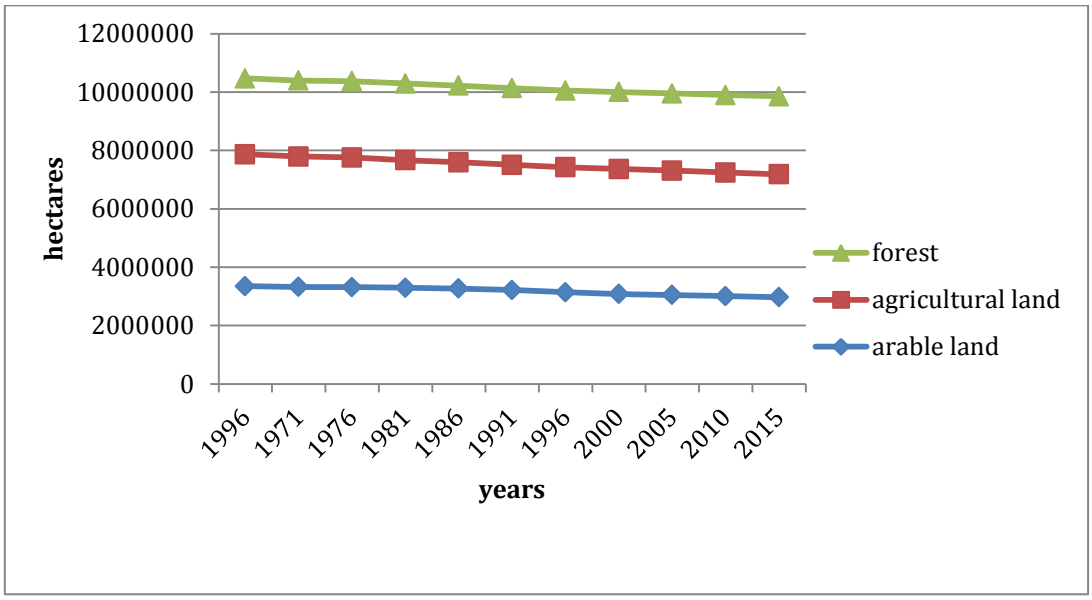


Source: CUZK (2016)

The chart 1 shows the percentage share of agricultural and non-agricultural land according to their main categories. The territory of our country is made up of approximately from 53.5% of agricultural land and 46.5% of non-agricultural land.

Following chart 2 shows that the area of agricultural land is constantly decreasing. Arable land creates 38% of the total area of Land Fund. Over the last decade the percentage of arable land has decreased only slowly, in 2005 it was 70.6% and in 2015 it decreased to 70.7 %. However, in the years 1997 and 1998 there was the growth in agricultural land of more than 4000 hectares. This increase was due to the specification of records of land, especially converting areas that were previously recorded as other land changed into agricultural land (Němec, 2004).

Graph 2: Development of agricultural land, arable land and forest 1966-2015



Source: CUZK (2015)

3.2 Quality of Agricultural Land Fund

Agricultural Land Fund is characteristic of multifunctional for agriculture and for the whole society. The primary function of agricultural land is a production function that creates its value in terms of economic relations given by supply and demand for agricultural products. In the context of societal interests are getting through more and more non-productive functions of soil, resulting from the role of agricultural land as a landscape maintenance. This role takes on particular significance in relation to the declining profitability of primary agricultural commodities, the productivity of crops on the basis of production costs and sales prices and rising levels of social support. In this context grassland plays an important role because of the ecological character of production (Voltr, 2011).

The protection role of soil against various degradation factors is also increasingly required. Soil degradation decreases suitability for intensive production increases its productions costs.

In our country soil and climatic conditions are less favourable – in comparison with other EU member states belong to the mountain areas. The most fertile soils are located in the lowlands (e.g southern Moravia, Central Bohemia) although in recent years the crop yields have fluctuated due to lack of rainfall in these areas. Based on the land valuation, it has been found out that 40% of Agricultural Land Fund is exceptionally fertile, 54% of land surface is at average soil fertility or below average and the rest of 6% of land areas are completely unsuitable for farming (Bukovský, 2012).

Agricultural production areas

In the Czech Republic the agricultural production areas were developed from the beginning of the 20th century and primarily were used for evaluation of agricultural production. The present categorization of production areas has been valid since 2003 and is divided according to areas with similar climatic conditions. At present these agricultural production areas are used not only for the categorization of cadastre areas for statistical purposes but also for the assessment of business entities and their performance. Agricultural production areas are divided in terms of economic and agro ecological assumptions into **4 types and 11 subtypes** (MZE, 2012):

1) Corn production area (K) – 3 subtypes (K1-K3)
2) Beet production area (Ř) – 3 subtypes (Ř1-Ř3)
3) Potatoes production area (B) – 3 subtypes (B1-B3)
4) Mountain production area (H) – 2 subtypes (H1-H2)

Less Favoured Areas

Less Favoured Areas (LFA) are those areas where agricultural production is more difficult and less profitable because of natural handicaps, e.g. difficult climatic conditions, low soil productivity, steep slopes in mountain areas. The aid to farmers within the LFA is to ensure that they still use agricultural land in these areas and to thereby maintain viable rural communities.

Rural Development Programme for the period 2014 - 2020 has following regulations for providing payments:

- Government Regulation no. 72/2015 Coll.
- Government Regulation no. 73/2015 Coll., on conditions for the provision of payments in areas

Natural or legal persons who manage at least 1 ha in less-favoured areas or in Natura 2000 and undertake in writing that they will operate in the field of agricultural activities at least for 5 years can submit a request for support. Bird Areas in the territory of the first zone of the national parks or protected landscape areas are included among Natura 2000 (MZE, 2015)

Furthermore, the significant locations are included in the national list in the territory of first zone of the national parks and protected landscape areas. LFA are recognized in three main categories (mountain areas, other less favourable areas, areas with specific limitations).

3.2.1 Classification code of soils

Classification code of soils evaluates the quality of land; it expresses the degree of ability or suitability of soil for crops cultivation. It assesses production capability, because it compares the productive capacity of different soils (NĚMEC, 2001).

The first mention regarding the evaluation of soils dates back to the 17th century, where the primary objective of this survey was to record the owners of individual plots. A new valuation system took place in the years 1973 - 1978 based on a comprehensive survey of soil from the 1960s. After analysing all methodological approaches and evaluation of information from abroad this valuation system was found to be satisfactory, therefore it became the basis for the determination of the official price (REJFEK et al., 1990).

The Czech Republic, in comparison with other European countries, has mapped land resources in more detail.

Classification code of soils (BPEJ) is considered as a basic mapping and evaluating unit. BPEJ determinates the quality of soil used for farming in different climatic conditions in the Czech Republic. The system of BPEJ was created on the basis of the parameterized natural yields of 13 most common agricultural plants that are categorized into the valuation type structure on arable land.

BPEJ allows the evaluation of the efficiency of agricultural production in different natural conditions and respects the basic factors of production.

The definition according to NĚMEC (2006): "BPEJ is a specific territorial unit (regardless of delimitation of ownership), which as a result of an interactive influence of components of environment, especially land, matrix, climate, and relief has specific site features expressed by specific value of production potential ".

BPEJ is determined by a five-digit code where each number has its specific significance. The picture 1 shows what each number of the five-digit code expresses. The number 1 determinates affiliation to specific climatic regions. The number 2 and 3 determinates affiliation to so called main soil unit. The number 4 expresses the combination of details about slope and exposure to cardinal. The number 5 is the combination of details about stoniness and depth of the soil profile (Maštát et al. 2002).

Picture 1: Significance of BPEJ numbers

Source: own computation, Němec (2006)

The system totally includes 2 199 BPEJs. This classification system is applied in the whole country and it forms the basis of legal measures and decrees. Thanks to these data our country belongs to those countries with the most specific and exact information about land. Němec (2001) highlights the need of actualisation of BPEJ evaluation according to the current development of agricultural economic conditions which arises from the change of production parameters:

- the development of yields,
- the development of costs,
- the development of sowing areas,

- the change of the support system of agricultural production,
- the change of macroeconomic indicators of tax burden and interest rates,
- the accordance with environmental conditions of production.

Usage of BPEJ

The usage of BPEJ for economic purposes is reflected in the law on prices and its implementing regulations. Administrative prices of agricultural parcels are used in all cases where an individual market price cannot be applied, especially for:

- determination of the minimum price of agricultural land,
- determining the basis of property taxes,
- determining the basis of all inheritance taxes,
- determination of average minimum prices of agricultural plots belonging to the cadastral area,
- evaluation of agricultural plots for determination of rights in proceedings of land consolidation with using minimum prices of agricultural land,
- selling price determination of agricultural land owned by a state,
- purposes of Common Agricultural Policy (Štolbová, 2005).

3.2.2 Official land price

The administrative price of agricultural land (the price according to the price regulation) is governed by Act no. 151/1997 Coll., on Property Valuation, as amended by Act no. 303/2013 Coll. (With effect from 1 January 2014) and is calculated in accordance with Decree no. 441/2013 Coll., As amended by Decree no. 199/2014 Coll., Implementing the Act on property valuation and issued by the Ministry of Finance of the Czech Republic. The specific wording of the measure is applied to the current condition of the property for

a specific valuation date (the date of transfer of ownership). The base price of $1m^2$ of land is determined by BPEJ.

The determination of the official price was a fundamental prerequisite for the development of the land market in 1991. It was assumed that in the developed market economies the official rates would be replaced by market prices, which are the result of supply and demand (Němec, 2006).

It is not possible to replace the official market price in the Czech Republic completely, since the official prices are used to determine the general tax rate.

Administrative prices of agricultural land perform following functions:

- the real estate tax, tax of transfers, inheritance and gifts of real estate,
- determination of land rental,
- to determine the value of property,
- expropriation of land,
- land consolidation,
- providing certain types of subsidies (MZE, 2012).

The current official price is the normatively fixed price based on the capitalization of rent effect (net revenue) indicated for each of 2 199 BPEJs according to the selected 13 crops. BPEJs are valued separately at the rate of CZK/m2.

Gross Annual Rent Effect (HRRE) is the difference between the parametric yields of crops valuation and normative costs expended on their production. The current method of determining revenues and expenses is based on economic indicators of the classification code of land. To indicate the production capacity of the soil, BPEJs are used in for determination of HRRE yields of the most common agricultural crops grown in the country. The composition of cultivated crops on arable land used for HRRE yields determination are wheat, rye, barley, oats, and corn for grain / silage, sugar beet, potatoes, canola and perennial forage crops. These plants represent an area of more than 90% of arable land in the Czech Republic (Štolbová, 2005).

Calculation of HRRE

The calculation of HRRE for an individual BPEJ is calculated according to the following illustrated by Němec et al. (2006):

$$HRRE_{BPEJ} = \sum_{i=1}^{i=n} [CPP - (NPP + Z_n)] \times K_{OTS}$$

CPP = price of parameterized produce crop of the plant production in CZK/ha

NPP = normative cos of parameterized produce in CZK/ha

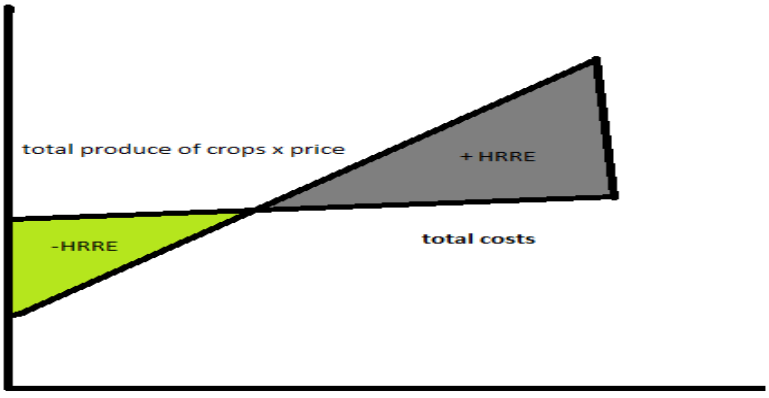
Kots = scalar number stemming from the share of individual pricing crops in specific appraisal structure for individual BPEJ

Zn = normative profit expressed by scalar number in relation to normative costs

In the best land-climatic conditions, HRRE is as much as + 9785 CZK/ha. In the worst land climatic conditions it can even reach the negative value – 2576 CZK/ha.

The schematic course of HRRE in dependence on yields and costs is shown in the following picture 2.

Picture 2: The progress of total costs and revenues



Source: VUZE (1997)

The calculation of the official agricultural land price

The calculation of the official agricultural land prices were established on the basis of calculated gross annual rent effects for BPEJ with positive values of HRRE to the equation:

$$ÚCZP_{BPEJ} = BCZP + \frac{HRRE \times D}{U}$$

$ÚCZP_{BPEJ}$ = *official agricultural land price - individual ecologic units in CZK/ha*
BCZP = *base agricultural land price 20 000 CZK/ha*
HRRE = *gross annual rent effect*
D = *total share of non taxed plant production*

where

D= (100-DP): 100
DP = *income tax*
U = *income tax = interest rate*

The assumed share of non-taxed crop production in 2001 was considered to be at 0.65 under the assumption that taxation by land tax and income tax was 35% of the total income. Capitalisation rate was established at 5% (Němec et al. 2006).

The calculation of the official agricultural land price with negative values of HRRE follows the equation of the second degree polynomial in such a way that the price of the land smoothly connects with UCZP values established for BPEJ with a positive HRRE value.

$$\mathbf{ÚCZP_{BPEJ} = BCZP + A + HRRE + B + HRRE^2}$$

where:

A = *constant valued at 10.1*
B = *constant valued at 0.00177*

In a market economy no commodity can have a negative value, therefore it has been decided that at negative values of HRRE the lowest UCZP will be valued at 7000 CZK/ha and the highest price with the zero value of HRRE will be 20 000 CZK/ha (Němec et al., 2006).

3.2.3 Land tax

In the Czech Republic the land tax is a part of the property tax. This tax is governed by Act no. 338/1992 Coll., on Real Estate Tax, as amended. According to the Czech law, a plot means that part of the earth's surface is separated from adjacent portions of the boundary of territorial administrative unit or limit the ownership, possession limit, limit land use or limit of a cadastral area. It means that it may exist one plot with one parcel number and each of these plots will be subjected to a different tax rate. The subject of the land tax is an area located on the territory of the Czech Republic and registered in the Cadastre of Real Estate. Taxpayer of the land is always the owner of the land. Regarding to the leased land the tax usually pay the person who use the land. The base of the taxation of agricultural land (arable land, hop-fields, vineyards, gardens, orchards meadows and pastures) is the price of the land in CZK/m2, co-ordinated with individual cadastral areas by derivation from BPEJ.

Tax rates according to the type of plots in 2016:

- arable land, hop-fields, vineyards, gardens and fruit orchards 0.75%,
- permanent grasslands, production forests and fish ponds with intensive industrial fish breeding 0.25%.

In the Czech Republic, the Ministry of Agriculture publishes a list of cadastral areas with coordinated prices of agricultural land derived as weighted average from the prices of classification code of soils (NĚMEC, 2006).

3.3 Land Registr

The Czech Office for Surveying, Mapping and Cadastre (ČÚZK) provides state administration of the Cadastre of Real Estate and ensures performance of surveying activities in the public interest given by the law. ČÚZK governs 14 regional cadastral offices, which have 94 cadastral branch offices in larger towns and execute state administration of the cadastre of real estate, it further manages 7 survey and cadastral inspectorates that control cadastral offices and supervise some commercial activities, whose results of which are applied to the cadastre of real estate and state documentation funds.

The current Czech cadastre of real estate was established in 1993 and integrates the function of Land Registry Book (registration of rights) and the former Cadastre of Lands (records of real estate) into one tool. On 1.1.2014 the Act No. 256/2013 Coll., on the Cadastre of Real Estate (Cadastral Act) came into force, having replaced not only the Cadastral Act No. 344/1992 Coll., but also the Act No. 265/1992 Coll., on Registration of Rights into the Cadastre of Real Estate. The both issues - cadastre of real estate and registration of rights to the cadastre of real estate - are now regulated in one Act (CZUK, 2015).

3.3.1 Land consolidation

Although in terms of social life twenty years are a short period of time, the changes happened in the Czech society from 1989 to 2011 were crucial and ground-breaking. In terms of land ownership, land reform was carried out, which was a political decision. Shortly after the renewal of the ownership of land agricultural property was transformed, the partial privatization of state-owned land and buildings used for agriculture and the reform of the property tax were performed (BURIAN, 2011).

Land offices were primarily tasked with restoring the land to its original owners – this restitution allowed farmers to begin farming through land consolidation. The purpose of land consolidation was defined in the section 2 of the Act no. 139/2002 collection, about how to modify the ownership of land and other agricultural property as amended and how to organize plots in the public interest spatially and functionally in order to ensure their good accessibility. Land consolidation have a positive impact on the sustainable

development of the territory, helping to implement plans of spatial planning and enabling the usage of financial support from EU funds (MZE, 2015).

Land consolidation can be implemented in a period of economic and social development, when there are not means and conditions for investments in landscape, and land but also the quality of people´s life. Land consolidation is financed from the state budget as well as from the EU funds (e.g. Rural Development Program).

According to the law 2 forms of land consolidations are recognized:

- simple land consolidation,
- complex land consolidation.

Simple landscaping has limited range and is used mostly to resolve only some of the economic needs (e.g. to expedite the consolidation of land, access to land) or specific environmental needs in the landscape (e.g. local erosion and flood control) or when the landscaping should cover only a part of the cadastral territory (MZE, 2015).

In the mid-1990s implementation of complex land consolidation began involving the exchange of ownership rights to land, especially a new road network but also conservation. Its scope must meet all requirements defined by law, i.0e. Decree No. 13/ 2014 Sb., on progress in the implementation of landscaping and landscaping essentials. For the last 20 years of land consolidation approximately 25% of the total area of Land Fund of the Czech Republic have been completed. The total costs of realization of simple and complex land consolidation reached 26,9billions CZK (MZE, 2015).

3.3.2 Digitization of real estate

Digitization of the real estate registry is a vital step for effective operation and administration of the cadastre of real estate and for users having an access to cadastral information. Cadastral maps in a digital form serve not only for overview of the territorial range of material rights, but they are also important as a reference basis for creation of further maps, for information systems and applications related to the territory as digital technical maps, price maps etc.

Table 1: Development of Digitization of Cadastral Maps 2003 -2015

Year	Till 2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Digitalization Completed	3807	314	279	263	313	763	1106	1094	1127	1074	910	877
Total in Digital Form	3807	4121	4400	4663	4976	5739	6845	7939	9064	10166	11121	11990
% from the Total Number	29	32	34	36	38	44	52.2	61	69.6	77.9	84.9	91.6

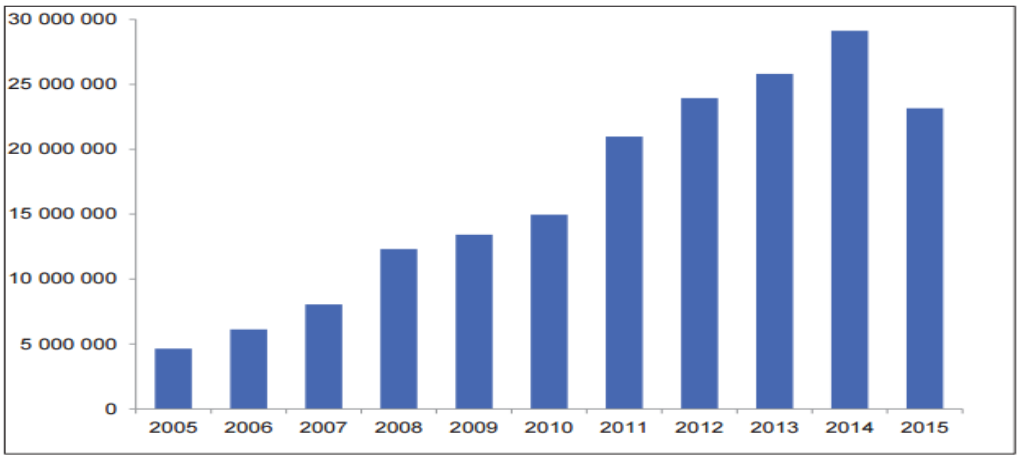
Source: CUZK (2015)

The table 1 shows that by the end of 2008 only 2 to 3 % of the total cadastral territories in the Czech Republic were transformed into a digital form. In the following year 2009, thanks to the provisions for acceleration of the digitization, the number of cadastre units covered by the digital form of map exceeded 8 % of the territory. Because of forthcoming end of digitization of cadastral maps the increase of the number of cadastre units covered by the digitized cadastral map has been step by step decreasing and in 2015 it reached 6.7 %.

By the end of 2015 the cadastral map was in digital form for11 990 cadastral units, which means 91.6 % of the total number in the Czech Republic by the end of 2015 (13 091 cadastral units). The total increase in the number of cadastral units with the digital map was therefore 877 in 2015 in comparison to the end of 2014. In accordance with the long-term frame schedule for the year 2015 the tasks of digitization of cadastral maps were successfully fulfilled (CUZK, 2015).

Probably the best-known eGovernment service, operated in the CUZK, is viewing the cadastre. This on-line service has been made available since 2005, it allows to gain selected technical data and data concerning ownership of parcels, buildings and flats. By means of viewing it is possible to find information on the state of proceedings for the purposes of registering property and other rights to real estate or other data recorded in the cadastre of real estate of the Czech Republic. As it shows the chart 3 the viewing application is very intensively used by a wide range of users and has contributed in a significant way to the increasing transparency of the course of individual administrative proceedings.

Graph 3 : Development of the number of accesses via viewing the cadastre



Source: CUZK, 2015

One of the most visited websites of Czech state administration is viewing the cadastre. From 2005 to 2014 the application was achieving a constant growth in the number of users; in 2015 the number of accesses was more than 23 million, which means a mild decrease after many years of growth.

3.4 Agricultural land market

A market is a place that allows buyers and sellers of specific goods to interact and to facilitate an exchange. The process which forms the supply and demand in relation to each other at given prices is called a market mechanism. Land is a natural resource quantity of which in each country is constant regardless of the amount of payment for the land use (Brčák et al. 2010).

An important prerequisite for the development of land market was the year 1989 when the ownership rights to land and agricultural property was restored. Despite the ongoing process of property restitution and legislative measures, the land market is still underdeveloped. The reasons for backward land market are mentioned by Němec (2001), who states that Land Fund ownership is fragmented, there is a small number of potential buyers and rent of leased land is too low. He sees reasons not only economic but also technical and organizational:

- the low profitability of agricultural production,
- corporate debt and the lack of funds,
- the banking sector is not interested in providing loans for purchases of agricultural land,
- fragmented plots of land in terms of ownership, slow landscaping,
- simplified management of the land register in the Cadastre,
- unfinished restitution –the lack of sense of land ownership,
- slow sales of the state land.

The land market should be significantly affected by the land consolidation, the sale of state land and also by preparation of legislation in the field of real estate and land protection and establishing the bank that would specialised at lending money to farmers investing to agricultural land. Many of proposals as described Němec (2001) have been met.

At present, the land market is more developed. According to the Situation and Outlook Report "Půda" 2015, the volume of purchased land has exceeded 100 thousand hectares annually since 2004, which represents about 2.5% of farmlands. Since 2004 the dynamic development of the agricultural land market was influenced by a mass sale of agricultural land owned by the state and partly by the sale of private land within the program PGRLF "Půda". In the coming years the range of traded land will be likely to decline especially in connection with the end of the transfer of the state land to private persons.

The establishment of the Land Law was an important step for the functioning land market. The Land Law solves legal relationships to real estate and land. It includes the categorization of land, urban planning, protection of agricultural land fund, the ownership and use of land according type of plot. It was also necessary to protect transforming agricultural entities against buying up of land by foreign investors with greater purchasing power than they had our farmers who farmed the land. Legislation that restricts the sale of farmland to foreign investors is regulated by Law no. 229/1991 (Restitution Act), law no. 219/1995 (Foreign Exchange Act) Law no. 95/1999 (the Act concerning the conditions of transfers of agricultural and forest land from state ownership to other people).

The ban on the sale of land to foreigners was abolished in 2011 by the amendment to Act no. 206/2011. According to the data of the Czech Statistical Office at present the foreigners farm at 230 ths. ha representing 6.4% of the agricultural land.

The state ownership of the agriculture land formed prevailing part of the market offer up to 2012. State agriculture land has been transferred to the private ownership by the Land Fund of the Czech Republic. Because this process is actually almost finished, private market subjects dominate the agricultural land market.

Since the adoption of Act no. 503/2012 Coll. of the State Land Office and amendments to certain related laws, the land market has been fully liberalized. Every citizen of the Czech Republic, the EU and the world countries can freely participate in the agricultural land market.

The largest single landowner in the Czech Republic is the state, which from 1999 to 2014 transferred about 562 thousands hectares into private ownership. Currently the state owns approximately 170 thousands hectares of agricultural land, which are managed by the State Land Office (Hruška, 2015)

3.4.1 Market price

The market price of land is defined as the value that is most likely to be achieved at the time and in specific conditions in the property market between voluntarily and legally acting buyers and sellers excluding the effects of special factors, therefore without consideration of individual or other interests, deviating from the common practice. It is expected that subject of a commercial transaction is publicly placed on the market and therefore both parties are aware of all relevant facts about the subject of the transaction. Parties act with the knowledge of the matter, prudently and without compulsion. The market value of the property can evaluate the property at any stage of its life cycle (Kartěna, 2004).

The agreed price of the purchased land is indicated in sales contracts and then reported to the financial authorities. Tax Office registers the purchase price due to the assessment of the income tax and the seller's real estate transfer tax. The buyer has to register the purchase agreement at the Real Estate Cadastre (Němec, 2004).

The market price of agricultural land is influenced by many factors influencing agreed price. The soil ecological unit has decreasing importance when an area of less then 5 hectares is purchased. The following factors play a significant role sale and purchase of plots:

- a position in relation to recreational areas and urban zones,
- unpredictable circumstances on the market (e.g. natural calamities),
- speculative influences (e.g. purchase for resale),
- personal relations between the seller and the buyer (Němec, 2004).

Other factors that have an impact on the land value are:

- size and shape of land,
- the type of soil and soil fertility,
- the susceptibility of areas to flooding,
- availability of electrical energy for the operation of pumps and machines,
- easements recorded on the certificate of ownership (Singh,2001).

Development of market price of agricultural land before 2004

After the year 1989 the land market was monitored by the Research Institute of Agricultural Economy. Data was gained from purchase contracts registered in tax offices due to the assessment of income tax. Until the year 2007 the prices were categorized according to the acreage of land for sale.

The development of average prices from 1993 to 2003 was irregular although the average price increased. The value of the average price was influenced mostly by the market price of sales with the land area no bigger than 1 hectare.

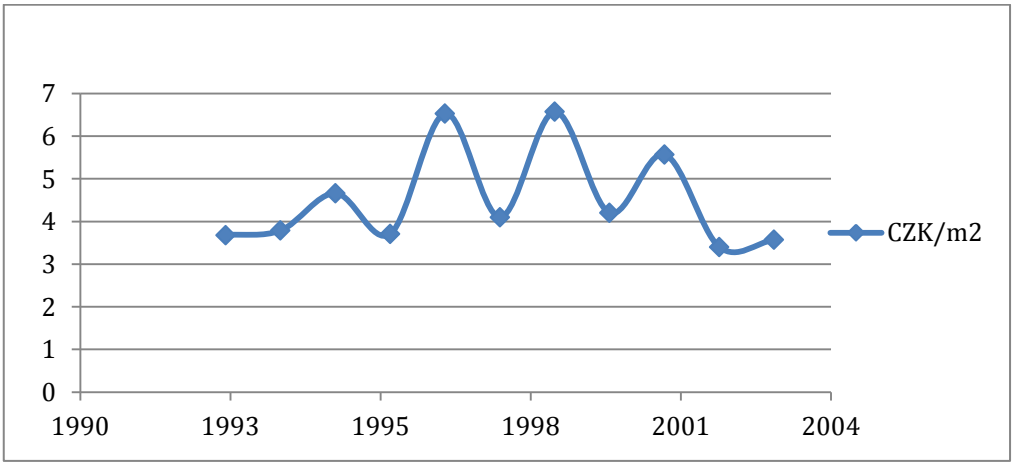
Table 2: Development of the agricultural land market price according to the size of plots CZK/m2

Year/land area	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
>1ha	27.5	34.7	54.4	4.5	124.9	101.9	79.5	92.1	108.8	97.1	116.7
1-5ha	13	16.2	14.1	15.3	14.64	17.42	9.6	13.6	19.95	12.9	13.23
<5ha	3.68	3.79	4.66	3.71	6.53	4.1	6.57	4.2	5.57	3.4	3.57
Average	13.5	16.5	18.3	28.01	31.84	25.4	27.1	34.85	21.2	23.9	23.9

Soruce: Situační a výhledová zpráva Půda (2006)

The table 2 shows the development of the land market price in the period 1993 – 2003. The prices are divided according to the acreage of land plots. The most significant increase was recorded at parcels smaller than 1 hectare which are mainly used for other purposes than agricultural ones. Several times higher price of these plots influenced the average price of land.

Graph 4: Graphical representation of the development of market prices for traded agricultural land areas of over 5 ha 1993-2003



Source: own computation, Situační a výhledová zpráva Půda (2006)

In contrast to areas smaller than 1 ha, the price of land the land with an area of 5 ha used for agricultural purposes oscillates still around basic official prices without much rise and no clear trend. The average annual relative increase is 6%. The market price shows a slight upward trend.

Development of agricultural land market price after 2004

After the accession the EU, potential buyers of land feared the sharp rise in prices of agricultural land due to the increased interest from foreign investors with greater purchasing power, who would be interested in buying land at a significantly lower price compared to the old member countries of the EU. As it can be seen in the following table, this idea has not been fulfilled (Bukovský, et al. 2012).

Table 3: Development of agricultural land market prices according to the size of plots CZK/m^2

Year/area of land	2003	2004	2005	2006	2007
>1ha	27.5	104.24	95.77	147.7	159.49
1-5ha	13	13.63	10.76	20.47	21.56
<5ha	3.68	3.75	3.71	3.61	3.59
Average	13.5	19.59	18.89	26.99	24.58

Source: Situační a výhledovázpráva Půda (2009)

Since 2004 the development of agricultural land market prices has been studied in three categories, as it has been since 1989. The methodology of the monitoring of market prices according to size categories of the sold land was completed in 2007. Since then the ÚZEI has been watching only market prices of land agricultural purposes which are carefully selected according to purchased areas - large areas and areas without the assumption of use for building purposes in the foreseeable future are favoured.

The agricultural land was purchased in 2015 usually for the market price in the range of 13-23 CZK/m2. The most fertile agricultural parcels of arable land were purchased for prices higher than 30 CZK/m2 in localities with high competition.

The increase in the prices negotiated in closed sales agreements to be further added the effect of the gradual transfer of tax liability from the acquisition of immovable property from the transferor to the transferee. Current legislation allows buyers and sellers to agree who will pay the tax. The tax from the acquisition of immovable property in the amount of 4% of the sale price that was paid in 2015 by the acquirer was approximately one quarter of the trades.

In 2015 the demand for acreages of medium size (5-50 hectares) was still prevalent. Agreements of medium-size purchase areas achieved the highest market price. While the average market price for transactions of land with the total area of 2 ha amounted to 14.6 CZK/m2 and for purchases of land with the area of 2-5 ha 14.9 CZK, the average market price for purchase of land with are of more than five hectares was 16.8 / m2. This is due to the fact that the offers of land with the area of 5-50 hectares are still very interesting for all groups of investors. Deals with larger areas reflect decline of buyers with regard to the

amount of the total investment required. Generally higher acreage (more than 100 ha) brings a lower price per square meter (Farmy.cz).

From a regional perspective, the highest market prices were achieved in the most fertile areas of Haná and the area between the cities of Olomouc, Přerov and Prostějov. Above-average prices were also achieved in the border areas, because of an influence of candidates from Germany (Western Bohemia) and Austria (South Bohemia). Localities with the high concentration of biogas stations contribute to strong competition on the demand side and then lead to above average land prices. This relates especially to regions where it is assumed interest of sufficient quantities of essential raw materials for the operation of biogas plants (Farmy.cz, 2015).

3.4.1 Ownership and use of agricultural land

Land Fund of the Czech Republic is highly fragmented as far as to its ownership structure. The Cadastre of Real Estate is divided into 23 081 258 parcels and includes a total of 6 124 625 sheets of ownership. The average size of agricultural parcels is 0.41 ha of land. The agricultural land is owned by more than 3800 thousands private individuals or different types of companies. Currently the Register of Real Estate administrates 177 ths. ha and about 146 ths. ha of this area is created by leased land.

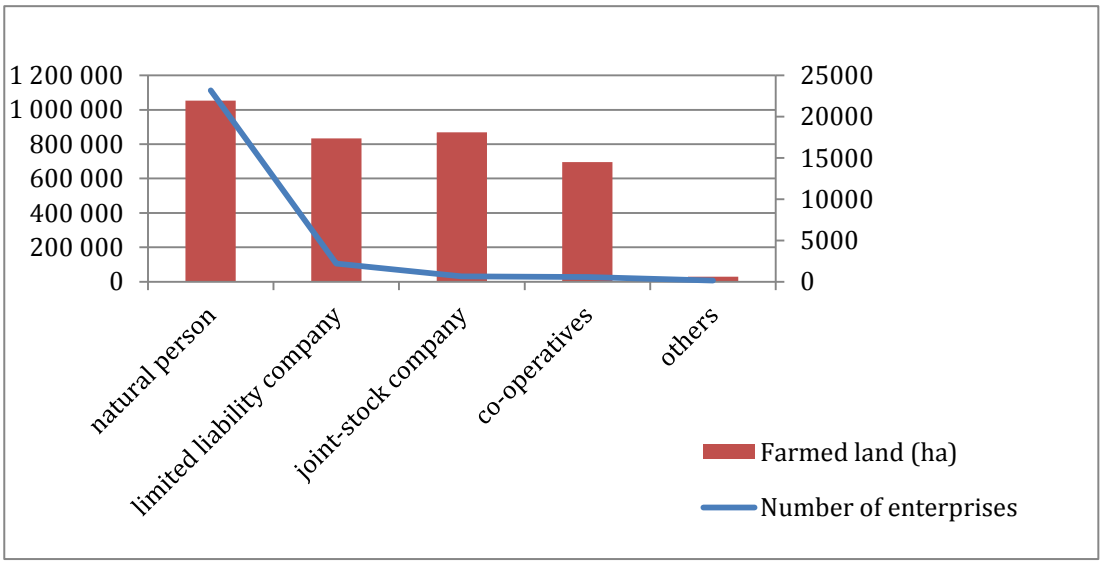
Land Parcel Identification System (LPIS) is the public register of agricultural land under the Agriculture Act no.252 / 1997 Coll ., as amended. Towards the end of 2015, the LPIS registered the total area of 3 559 ths. ha, the registered land area was about 5143 ha greater compared with the previous year.

Agricultural Land Fund with the total area of 3 522 268 ha of agricultural land was managed by 48 554 entities in 2014. Natural persons farmed approximately 30.6 % of the area of agricultural land. Other 69.4% of agricultural land was managed by legal persons such as:

- joint stock companies 24.7 % of agricultural land,
- limited liability company 23.7% of agricultural land,
- cooperatives 19.8% of agricultural land,
- other legal entities 0.8% of agricultural land (MZE,2015).

The following chart shows structure of business entities farming on the area of more than 3 hectares of agricultural land shows following chart number 5.

Graph 5: Structure of agricultural entities and the total farmed area in 2014



Source: MZE (2015)

Since 2000 the area of agricultural land farmed by agricultural entrepreneurs (natural persons) has increased by more than 30%, average area of these enterprises increased to 45.4 ha in 2014. The share of legal entities, by contrast, decreased and average area of farmland managed by legal persons has declined from 1036 ha in 2000 to 684 hectares of agricultural land in 2014. The reason for decline of the area size of legal persons is due to the fact that many of the natural persons were transformed to legal persons (MZE, 2015).

3.4.3 Investing in agricultural land

Reasons for agricultural land investment

Author of the book Agricultural Finance Geman (2015) observes that farmland is going to be one of the best investments in coming future. Capital invested to this type of asset is being attracted by a combination of drivers including:

- Population growth

By 2050, there will be about 9.2 billion people in our planet; a dramatic increase is caused by the highest growth in developing countries. Another reason is worldwide targets in production of bio energy.

- Loss of arable land

In 1950 there were 0.5 hectares of arable land per person in the world, this number has already fallen to just 0.2 hectares. Future estimations signalized that global food production needs to rise in the year 2050 by more than 70% above the 2005-2007 levels to cope with rising food demand.

- Slowing improvement of crop yields

Over the past 40 years, yield per acre increased 2.1% per year, but since 2000 the increase in yield per acre was less than 1% per year and seems to have stagnated.
The rationale for such investment has typically these reasons:

- Farmland linked to food and energy production is considered as a hedge against inflation.
- Farmland as diversifying source of return.
- Farmland as production factor ensuring food and energy safety in the world.

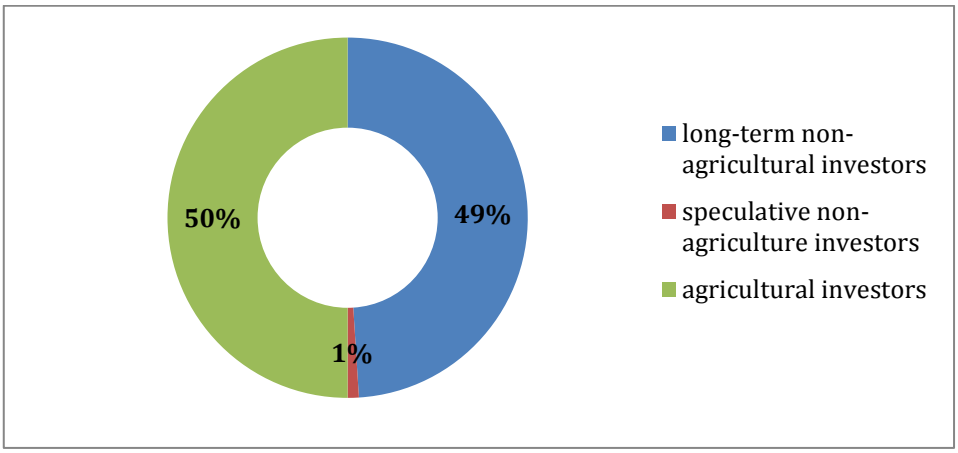
Investors in Czech land market

The land market in the Czech Republic is affected by supply and demand of investors that may be divided based on their intensions into three main groups:

- agricultural investors - farmers and agricultural companies, whose motivation is to possess land as means of production,
- non-agricultural long-term investors – they buy land for the purposes of medium and long-term tenure and their main motivation is a reasonable long-term return on investment which is expected safety,
- non-agricultural speculative investors – they buy the land with the intention to sell it again within a short period of time.

The chart 6 shows that in the previous year the agricultural land was purchased in the same proportion by farmers as well as non-agricultural long-term investors.

Graph 6: Structure of buyers for transfers at market price in 2015



Source: Farmy. cz (2015)

The share of agricultural investors in transactions executed at market prices increased from 44% in 2014 to 50% in 2015. Farmers have been the largest group of demanders on the agricultural land market for a long time. In the past, however, farmers were not willing to offer the market price to landowners. This situation in last five years has changed and many prosperous farmers are ready to offer a fair price for the land purchase.

The group of long-term non-agricultural investors including utility companies owned by churches contributed to the sales of land at market prices with 49% in 2015. On the basis of the act on property settlement with churches, churches are paid compensations for vacant properties. These funds are used by them to invest in land. If a purchase of land to non-agricultural entities will not be legally complicated, the churches would be a major player in the market of agricultural land. The interest of foreign investors is concentrated in rather larger ownership units (area larger than 5 hectares) and agricultural companies. Foreign investors come from Germany, Austria and the Netherlands the most often. Even among these foreign investors, the interest in the long term ownership of land and active land management is evident (Farmy.cz, 2015).

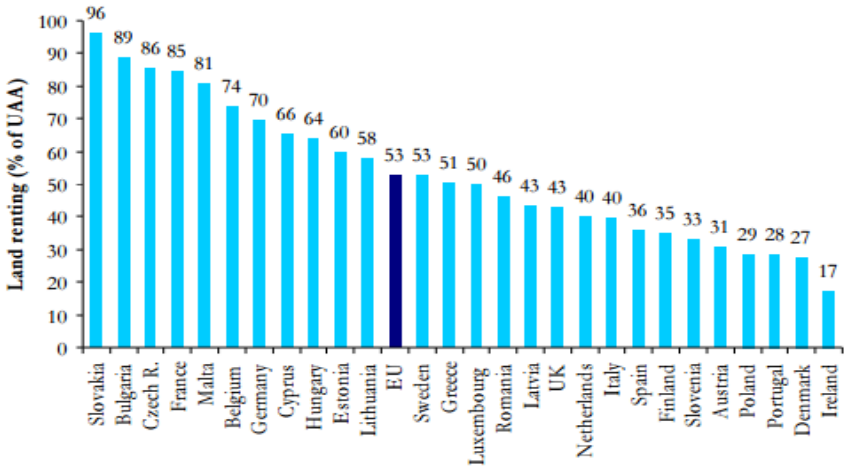
3.4.4 Agricultural land market in the EU

Rental market

There is a huge difference in the EU – 27 land market with respect to the share of rented land in the total utilized agricultural area. The EU average share of rented land of total utilized agricultural area (UAA) is 53%. The prevalence of land renting varies significantly among the EU countries, ranging from 17% in Ireland up to 96% in Slovakia. Farms in Belgium, France, Northern Ireland and Germany are more likely to rent land (more than 65% of the used land). In the rest of the countries farms rent between 34% and 43% of the used land of the total utilized agricultural area. The graph 7 shows the share of rented land of total UAA in selected EU countries.

There are also wide variations in the nature of rental contracts among the EU member states. The average duration differs substantially. The most common contract duration is 1 year in Sweden, 5 years in Romania, 5 – 10 years in Slovakia and Poland, and 9- 12 years in Germany. In countries such as Belgium and France, the length of contracts is of even regulated (Swinnen and Ciaian, 2013).

Graph 7: Land renting in the EU (2009)



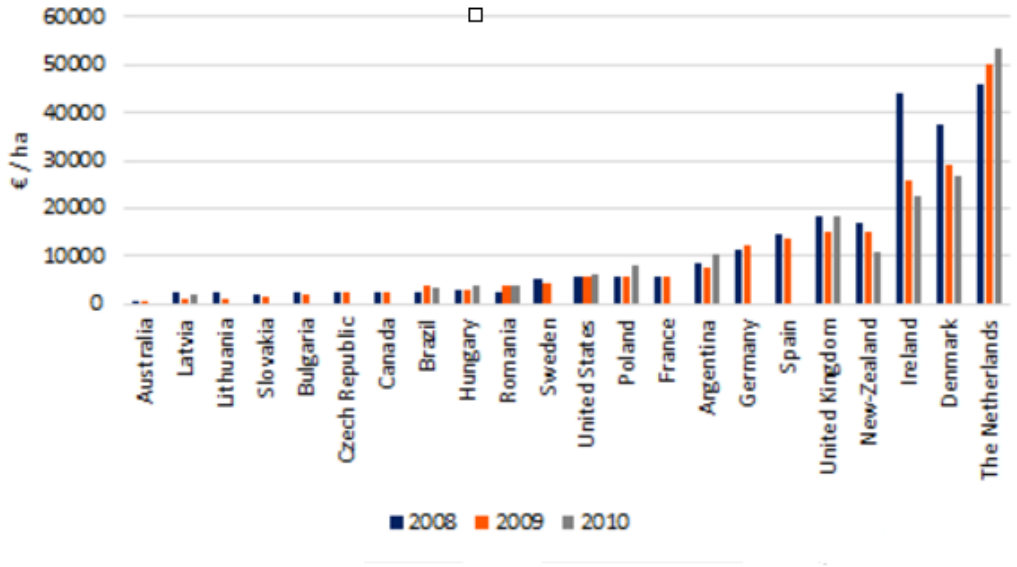
Source: FADN (2008)

Market prices

Agricultural land prices also vary widely across the EU countries. In the peak years, the gaps between the most and least expensive countries exceeded 2% – ranging from around €2 000/ha in parts of Sweden to over €40 000/ha in parts of the Netherlands. In Belgium and the Netherlands, there is an increasing trend in real land sales prices, yearly price variation is larger in these two countries compared to the others. This cross-country heterogeneity in agricultural land markets suggests that farmers and landowners in these various land markets may be affected differently by changes in the CAP.

The following figure contains the land market price data from the member states and also compares the market prices in non-European countries (Canada, Brazil, the United States, Argentina and New Zeeland) According to the available data, it can be stated that in the years 2008 - 2010 the highest prices were reached by EU countries (Denmark, Ireland, and the Netherlands).

Graph 8 : Market prices of agricultural land in the world in 2008- 2010



Source: CIBUS, 2016

3.5 Drivers of land price in the land market of the Czech Republic

Ciaian et al. (2010) researched in their study various factors influencing the price of agricultural land. Farmland is a key factor linked to the agricultural production, such as agricultural commodity prices and productivity; political instruments of CAP subsidies appear to affect land sales prices in the EU countries.

For the analysis of potential determinants of the agricultural land market, factors enabling quantifications have been selected for this work. These factors reflect the economic situation of agriculture, the subsidy policy and the macroeconomic situation in the Czech Republic.

The selected economic factors for the analysis:

- Common Agricultural Policy,
- agricultural commodity prices,
- interest rate
- inflation,
- sold state land,
- land rental,
- Gross Domestic Product,
- non- agricultural land.

3.5.1 Common Agricultural Policy

The Common Agriculture Policy is the core instrument for influencing agricultural production in the EUs countries. The main objectives of the policy are; to ensure a fair income for farmers, high quality food production, to guarantee product safety and to protect the environment and animal welfare.

The CAP has changed significantly since its launch in 1962. The reform in 2003 introduced a new system of Single Area Payments (income support) and cut the link between support and production (decoupling). This Single Area Payment Scheme facilitates the application procedure for farmers on the one hand and requires farmers to

implement environmental protection, food safety, phytosanitary and animal welfare standards (a system called "cross compliance") on the other hand. Farmers who fail to comply with these requirements face reductions in their direct payments.

For the administration of the funds provided under the CAP in the Czech Republic the State Agricultural Intervention Fund (SZIF) has been established. The SZIF has the status of the paying agency and the intermediary financial support that is provided by the EU under the Common Agricultural Policy.

Single Area Payment Scheme (SAPS)

The most significant source of income provided to the Czech farmers after EU accession represents direct payments. Direct payments belong to the first pillar of the EU Common Agricultural Policy.

The Czech Republic has for the period 2014 – 2020 the fixed amount of 5,2 billion EUR of which more than 55% is going to be distributed in the form of Single Area Payment Scheme. In this programme period the applicants must follow new rules for SAPS payment. Unlike to the previous period the farmers must be registered as agricultural entrepreneurs under the law on agriculture. The full amount of direct payment farmers can receive in case that they meet requirements of environmentally-friendly practices so called "greening":

- crop diversification,
- if applicant has more than 15 ha registered in LPIS then it must be maintained 5% of permanent grassland as a so called– Ecological Focus Area (EFA).

For such a kind of subsidies the farmers must register at least 1 hectare of agricultural land according to Land Parcel Identification System. LPIS records the use of land for agricultural subsidies. Applications must be submitted to May 15 and the land on which the grant is requested must be registered in LPIS at least from the date of August 31 of the calendar year. Grants can be applied to agricultural crops cultivated on arable land, grassland, vineyards and hop gardens etc. (SZIF, 2015).

National supplementary payments

National supplementary payments (Top Up) from 2015 called Transitional National Aid are the additional payment provided to the payment SAPS and is fully covered from the national budget of the Czech Republic. These payments are provided only for specified commodities that have been disadvantaged compared to the full system of direct support indigenous, so-called the old EU countries. The table 2 shows the amount of financial means of national supplementary payments for supported categories of agricultural commodities provided in 2014.

Table 4: TOP-UP payments in 2014

Top-Up	2014
Agricultural land	185.06 CZK
Ruminants	96.64 CZK
Hoops	4937. 65 CZK
Cows	131.5 CZK
Sheeps, goats	61.15 CZK
Starch	1681.86 CZK

Source: SZIF, 2014

Land purchase supported by PGRLF

Another type of support is the aid from the Support and Guarantee Farming and Forestry Fund (PGRLF), which existed prior to the entry into the EU and is mainly focused on the partial support of loans for the purchase of tangible fixed assets (e.g. land, machinery) and the partially coverage of the costs of agricultural insurance for crops, machinery etc.

From 2004 PGRLF supported purchases of private land by means of interest subsidies, the program continued until the year 2011.In 2013, first inauguration of a new programme called "Support for the purchase of land" was launched. This programme is rated to purchases of non-governmental land. In 2014 the PGRLF annual report shows 588 applications for the purchase of agricultural land in the total area 7 725 hectares within the programme, while the total amount of supported loans amounted to 873,039 thousand,

which represents an amount of 113 015 CZK / ha. The total costs of purchased farmland from supported loans are the minimum amount of these loans (MZE, 2015).

The overview of the private land purchase support within PGRLF programme "Půda" in different years is presented in the table 5.

Table 5: PGRLF support of private land purchases

Year	Number of applications	The area of purchased land (ha)	Loan per 1ha (CZK/ha)
2004	113	3943	34634
2005	279	9913	39153
2006	258	10475	38424
2007	247	9338	47469
2008	250	14069	42166
2009	401	6014	76287
2010	134	2754	86859
2011	169	2420	105844
2012	0	0	0
2013	42	719	105058
2014	588	7725	113015
Total	**2481**	**67370**	**57244**

Source: MZE (2015)

Since 2004 PGRLF has encouraged purchases of more than 67,000 hectares of non-state agricultural land. Average loan for purchase of private agricultural land was about 57 000 CZK/ ha.

3.5.2 Agricultural commodity prices

Agricultural commodity prices are expected to affect land values substantially. In competitive markets, the agricultural land price is determined by the amount of agricultural income that land can generate. The agricultural commodity prices has growing tendency in general but there are fluctuations in dependence on weather (Ciaian et al. 2010).

Market prices of agricultural outputs of the produced commodities can change farmer's decisions about whether to invest in more land. Rising commodity prices can make farms

more profitable. Prices for arable crop products have increased more than those for livestock products or fruit and vegetables have.

The largest share on arable land belongs to cereals that are the most convenient regarding to the soil and climatic conditions of the Czech Republic. These kinds of cereals are especially produced: wheat, wheat, malting barley, barley, rye, oats and corn. The annual average agricultural producer prices are published in the "Zelená zpráva" issued by the Ministry of Agriculture.

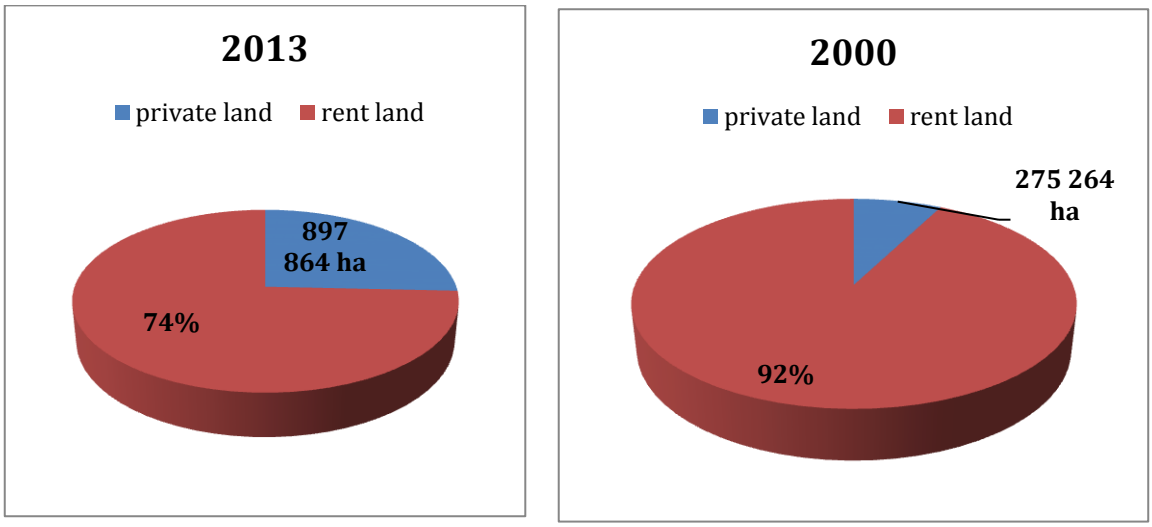
3.5.3 Land Rental

Under the new Civil Code and Law no. 89/2012 of February in the Czech Republic are recognized two meanings of the word land rental because the word can expresses different economic functions. In one case land lease gives a tenant temporary right to use the leased land and in second case the land rental is the lease of land that brings revenues to landlords or tenants and according to the law they must take care of that matter (soil) in right way.

The amount of rent is determined by Act no. 229/1991 on the land and was fixed at 1% of the land by a decree of the Ministry of Agriculture of the Czech Republic no. 613/1992 Coll. if the tenant and the owner agree otherwise. This provision is no longer valid, and in October 2013, this paragraph regulating rents was cancelled. The amount of rents currently depends only on the agreement between the owner of land and user of land. The amount paid for land rental grows twice as fast compared with its market price. This growth is partly due to the transfer of the obligation to pay the land tax from users to owners in those cases where the leased land plots are recorded in a digitized cadastre. The competition among farmers as tenants has caused upward pressure on rents. Before the Czech Republic joined the EU, the average rent was about 1% of official land prices, whereas currently it represents about 3%. In areas with fertility soil and nearby urban zones average rents can be more than 5% of the leased land (Hruška and Vilhem, 2015).

Structural survey of CSO shows that a favourable economic situation in agriculture in last 4 years has reflected on a relatively fast growing share of private land management, which amounted to 26% in 2013 and for 2015 it had been estimated to reach nearly 30%.

Graph 9: Share of own and rented land in the Czech Republic



Source: Hruška, Vilhem (2015)

The chart 9 above shows the growth in the proportion of private land to leased land. In 2000, agricultural entrepreneurs managed 8% of own land while in 2013, this ratio increased to 26%.

3.5.4 Sale of public land

Transfers of agricultural land owned by a state to private ownership may affect the land price positively. The sale of state land to private ownership started in 1999. Total area transferred from 1999 to 2008 represents 75% of total supply (app. 600ths.hectares). Around 2% of the total area of state land was transferred free of charge to schools, public universities and research institutions. At the end of 2015, the State Land Office possessed approximately 139 thousand hectares. Generally it can be said that regardless of a rise in sales of agricultural land during 2015, the pace of de-nationalization of agricultural land has been decreasing consistently in the recent years. The decline was mainly the result of the decreasing acreage available state land. The share of the sold state land to the total of converted farmland owned by the state accounted for 84.8% in 2015 and represented a surface area of 1 204 hectares. In terms of acreage, the volume of transfers in 2015 was less than half compared with the previous transfers of 2014. The average area of sold plots was 0.23 ha. The purchase price per 1 m^2 in this market segment nearly doubled, from 13.4

CZK / m^2 to 24.2 CZK / m^2 in 2015. The noticeable trend is the decline of the average area of transferred land and simultaneously the increase in the price per unit of transferred land (MZE, 2015).

3.5.5 Mortgage rates

A mortgage loan can be a way for individuals and legal entities how to finance investments in real estate (not applicable to the purchase of cooperative apartments). Mortgage must be secured by a lien on real estate in the Czech Republic. This is usually the real estate financing, but it is not a requirement.

Interest rates are determined annually by the Czech National Bank and in the recent years, they have been reaching historic lows. Signing a credit contract is determined by the current interest rate and banks offer the choice between fixed and floating rates. Interest may be held for 1-10 years and during this period banks guarantee the agreed rate, but it is not possible make any changes during the agreed period of time. Banks can claim a penalty fee even for early repayments. Given the expected development of the economy today, it is advantageous to fix a loan for five years, as the scope for further significant reduction in rates is not assumed (it is expected that interest rates will tend to rise). If a floating rate is chosen the interest rate stipulated in the contract can be changed depending on the increase or decrease in interest rate announced by the CNB.

Arranging a mortgage can even bring savings on taxes. The amount paid for the interest on a mortgage loan can be reduced from the tax base of the income tax, up to 300 000 CZK annually. Business clients include depreciation box of deductible expenses in their tax return (Finexpert, 2015).

3.5.6 Inflation

The primary objective of our central bank - Czech National Bank shall be to maintain stability of consumer prices. This central bank conducts its monetary policy within an inflation targeting regime. Inflation is generally taken to mean persistent increases in the majority of prices in a whole economy. In practice, inflation in the consumer price area is

measured as the increase in the consumer price index. In the Czech Republic, inflation is measured by the Czech Statistical Office (Czech National Bank, 2016)

Supply of land is fixed as the general population increases the price of land shall raise proportionately. Unfortunately the demand for land does not grow proportionately. In fact there are correlations between inflation and any good with a limited supply. From the perspective of investors land purchasing is one of the investment that is protected against inflation. The economist Todd Kuethe (2014) explains that farmland bought in the 1980s, if held as a long-term investment; it still operated as a hedge against inflation.

3.5.7 Gross Domestic Product

Jelínek, Medonos and Voltr (2009) in their analysis research macroeconomic indicators. They predefined the level of land market prices based on GDP and GVA.

The gross domestic product (GDP) is one of the primary indicators used to measure the health of economy in the country. It represents total value of goods and services produce over a specific time period. GDP is more often expressed as a comparison to the previous year. For example, if the year to year GDP is up to 4 % , this is thought that economy has grown by 4%. Generally are used three approaches of measuring GDP. Income approach is calculated by adding up what everyone earned in the year and expenditure method sum of what everyone spent in the year. Both methods should drive same results (Investopedia, 2015).

4 Analytical part

This chapter of diploma thesis will provide analysis of selected factors, which aims to estimate positive or negative effects of chosen determinants on agricultural land market price development. Descriptive statistics will be done for dependent variable - average agricultural land market price. First will be applied Simple Linear Regression which determines the relations between the price of agricultural land and each determinant. One – Equation econometric model will be done base on annually data gathered for the period 2003 – 2015. Results will be statistically and economically verified. All calculations will be done using software Gretl and Microsoft Excel.

Data introduction

In this analysis are taken into consideration factors that are quantifiable. There is many institutions gathering data about land. Although there exist many other sources of data for this research were used data from Ministry of Agriculture, Czech National Bank and Farma.cz.

The model uses annually observations from 2003 to 2015. The basic data time –series is presented in Appendix 1 and includes all eight variables that are summarized in following table 6. These shortened names (abbreviations) will be used in following analysis.

Table 6: Variables summary for econometric model

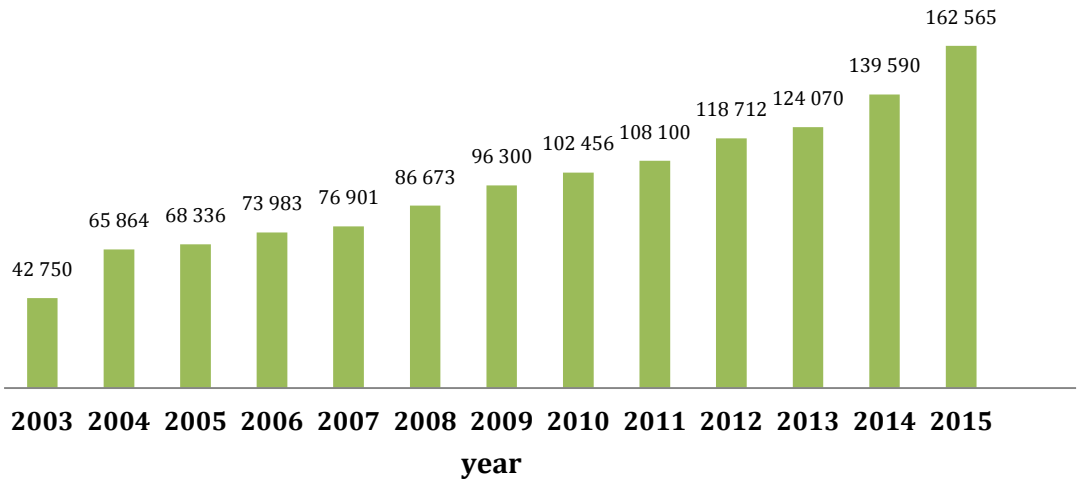
Variable name	Units	Abbreviation
Agricultural land market price	CZK/ha	ALMP
Rental price	CZK/ha	RC
SAPS	CZK/ha	SAPS
Crops prices	CZK/ha	CP
Sold state land	ha	SSL
Interest rate	%	IR
Inflation	%	IF
Non-agricultural land	ha	NAL

Source: own computation

4.1 Summary statistics of agricultural land market price

The following chart shows the average agricultural land market price in the Czech Republic from 2003 to 2015. Market prices are in CZK/ha.

Graph 10: Average market price of agricultural land (2003-2015)



Source: Farmy.cz, (2016)

Maximum and minimum

Minimum specifies the minimum value of selected time series. The minimum value of agricultural land market price time series is 42 750 CZK/ha. This minimum value is in the first year 2003. In contrast the maximum of agricultural land market price was 162 565 CZK/ha. The maximum value was measured in the last year of observation. This time series has growing character.

Median

The median is a middle score between the lowest and the highest value. The ordered data are divided into two same groups. The advantage of this indicator is that it is not influenced by extreme values as it is the mean. In this time series the median is 96 300 CZK/ha.

Mean

Mean or simple arithmetic average determinates the average level of data in whole period. It is average value of time series interval. It is calculated as the sum of the values y divided by number of values. The average of agricultural land market price in selected period is 97 408 CZK/ ha.

Standard deviation

The standard deviation is a measure of the spread of scores within a set of data. It is commonly used matter of dispersion. The square root of the variance, measures the dispersion around the mean. The standard deviation for time series of agricultural market price is 33 220 CZK/ ha.

Variance

Variance is defined as average of the squared differences of observed variable from the mean. As a measure of variability, the variance is useful. If the scores in data set are spread out, the variance will be a larger number. Conversely, if the scores are spread closely around the mean, the variance will be a lower number. Variance is not in the same units as the scores in our data set, the variance is measured in units squared. The variance of agricultural market price

Normality test

The normality test examines whether the data set has normal distribution. If it would not have normal distribution, this fact must be taken in consideration in regression and correlation analysis. In case of normal distribution it is used the Pearson correlation coefficient. If the data set does not have normal distribution it is usually used Spearman coefficient.

In relation to the size of data set (which is smaller than 2000 observations) will be used Shapiro – Wilk test. The normality test examines two hypothesis: the null hypothesis H_0 basic data set has normal distribution is confirmed in case of the p-value o Sharpi- Wilk test is bigger than the level of significance α (0.05). Alternative hypothesis H_1 is confirmed when the p-value is smaller, it means that time series has not normal distribution.

Average absolute increase

The average absolute increase is expressed as a difference between two observations and is measured in same units as observed indicator. Average absolute increase specifies the average changes of the indicator in observed period.

Average coefficient of growth

This coefficient is calculated as the ratio of two adjacent values. It determinates changes in variable between two time periods in relative expression. The average coefficient of growth is geometric mean of individual coefficients of growth.

The overview of the calculated values of average agricultural land market price is in following table 7.

Table 7: Summary of statistic values of average market price of agricultural land

Indicator	Value
Mean	97 408 CZK/ha
Median	96 300 CZK/ha
Maximum	162 656 CZK/ha
Minimum	42 750 CZK/ha
Variance	1103559771
Standard deviation	33 220 CZK/ha
Average coefficient of growth	1,117779
Average absolute increase	9984,583

Source: own computation, MS Excel (2016)

4.2 Simple Linear Regression and Correlation

Different variables will be tested by Simple Regression and Correlation Analysis that determinates the degree of dependence between two observed variables; in this case it will be agricultural land market price (dependent variable) and determinants affecting this market price. Regression function shows average course of dependence. Coefficient of Determination shows the percentage of variation explained by explanatory variable that affect the dependent variable.

Model of Simple linear regression analysis has this form:

$$y = \alpha + \beta x + \varepsilon$$

where:

y – dependent (explained) variable

α – absolute value

x – independent (explanatory) variable

β – regression coefficient

ε – random variable (error term)

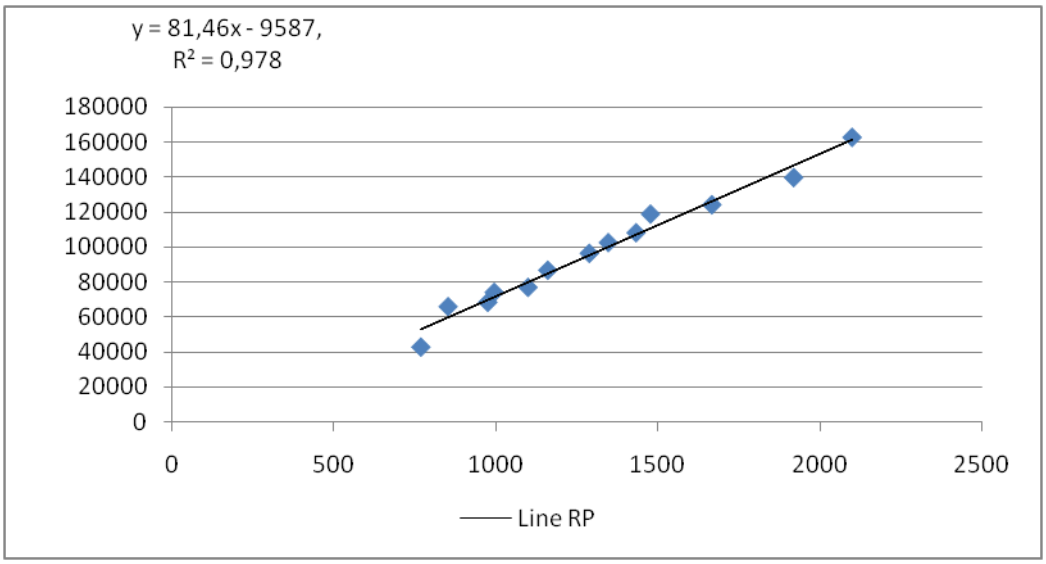
4.2.1. The analysis of average rental price

The introduction of CAP and a gradual increase of area payments cause that the average rents have rising character as well as market price of agricultural land. Then the question arises whether the average rents will affect the market price of agricultural land. The increase in rental prices should involve the interest of agricultural entrepreneurs in ownership of farmland; land purchase thus should lead to an increase in market prices.
Regression analysis answers the question, what is the relationship between two variables. It is one-side dependence, when exists independent variable – cause of phenomena and dependent variable - result of phenomena. This relationship is possible to determine using regression line.

Global p - value will be used for statistic evaluation of regression line. Hypothesis tests are used to test the validity of a claim, that is called null hypothesis H_0 says that results are not statistically significance and alternative hypothesis confirm the significance of parameters.

The level of significance (α=0.05) is compared with p - value. The p-value for rental prices is 1.78e-010, which is lower than α the null hypothesis is rejected, the results are statistically significant.

Graph 11: Regression line rental prices and ALMPC



Source: own computation, Ms Excel

The aim of linear regression is to find the best-fitting straight line through the points. This best-fitting line is called a regression line. The black diagonal line in Graph 11 is the regression line and consists of the predicted score on Y for each possible value of X. The distance from blue points to the regression line represents the errors of prediction. When the point is closer to the regression line; its error of prediction is smaller. By contrast, error prediction is higher when the point is far to regression line and therefore its error of prediction is large.

Coefficient of determination explains from how many percent the variability of dependent variable is explained by the regression line. The variability of average agricultural land market price is explained from 98% by the influence of land lease.

Parameters of regression line: y = - 9616+ 81.46x

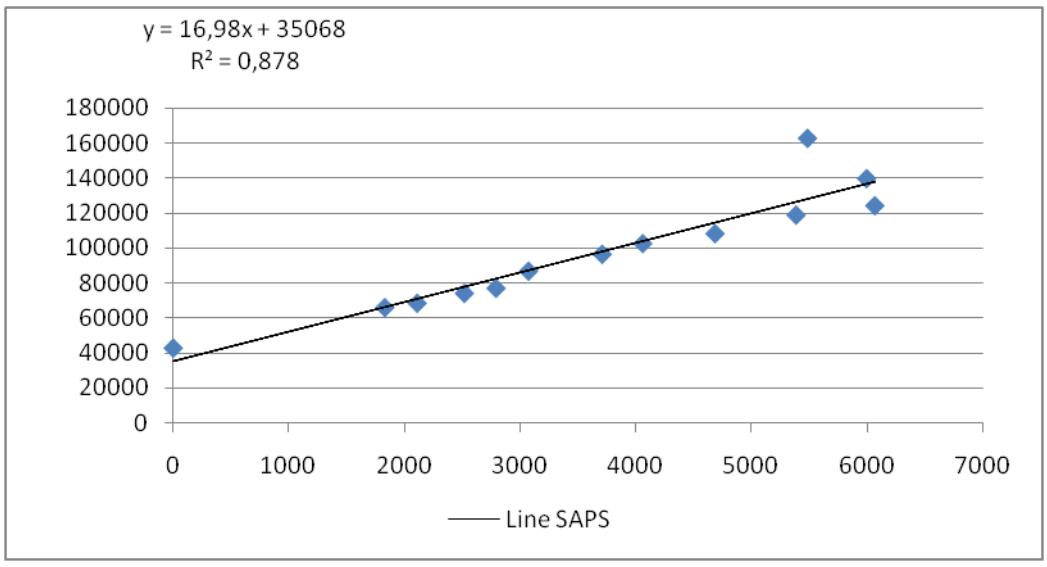
The interpretation of parameters is as follows: If the rental prices increases by 1 CZK/ha, average market price of agricultural land will increase by 81.46 CZK/ha.

4.2.2 The analysis of Single Area Payment Scheme

Direct payments SAPS represents significant source of income for farmers. The data of SAPS were provided by SZIF, which is responsible subject that administrates these payments in the Czech Republic. This payment is gradually growing until the year 2015 when new programme was introduced and new rules were implemented for drawing this type of subsidies. From 2015 the whole amount of subsidy will receive those applicants who fulfil the condition of so called greening – environmentally friendly farming. It means that this payment is divided in two separated payments. The basic payment is only 3 543 CZK/ha and second part of payment (greening) for farmers following these rules is the additional amount of 1943 CZK/ha in 2015. In following calculations will be considered full payment of 5 486 CZK/ ha.

The p-value (F) is 9.93e-10, it is lower than α the null hypothesis is rejected, and results are statistically significant on the level of significance 95%.

Graph 12: Regression line of SAPS and ALMPC



Source: own computation, MS Excel

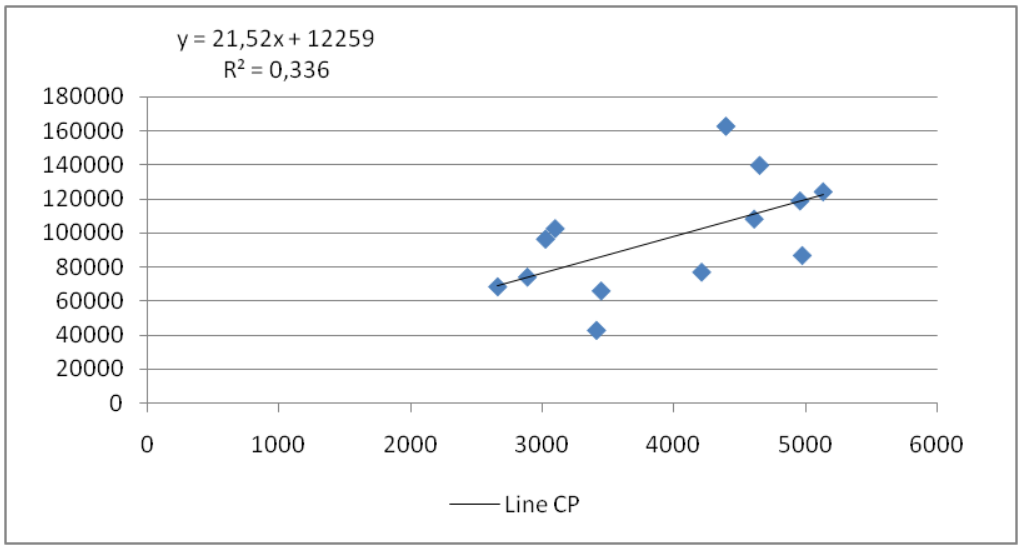
The regression line of this model is: y = 35 068 + 16.98 x

If Single Payment Area Scheme will increase by 1CZK/hectare, the average market price of agricultural land will increase by 16.98 CZK/ha.From the chart of regression line is seen, that for this model is convenient linear line, which is increasing. If the SAPS increase the average market price of agricultural land will increase too.

4.2.3 The analysis of cereal prices

Crops are considered as a common agricultural plant cultivated in natural- climatic conditions in the Czech Republic; also their total world consumption is higher than other types of agricultural commodities. The average price of crops includes average prices of wheat, barley, rye and oats). Data were gained from Czech Statistical Office.

Graph 13: Regression line of crops prices and ALMP



Source: own computation, Ms Excel

The p-value (F) is 0.037568, it is lower than α we reject the null hypothesis, results are statistically significant.

The regression line of this model is: y = 12 259 + 21. 52 x

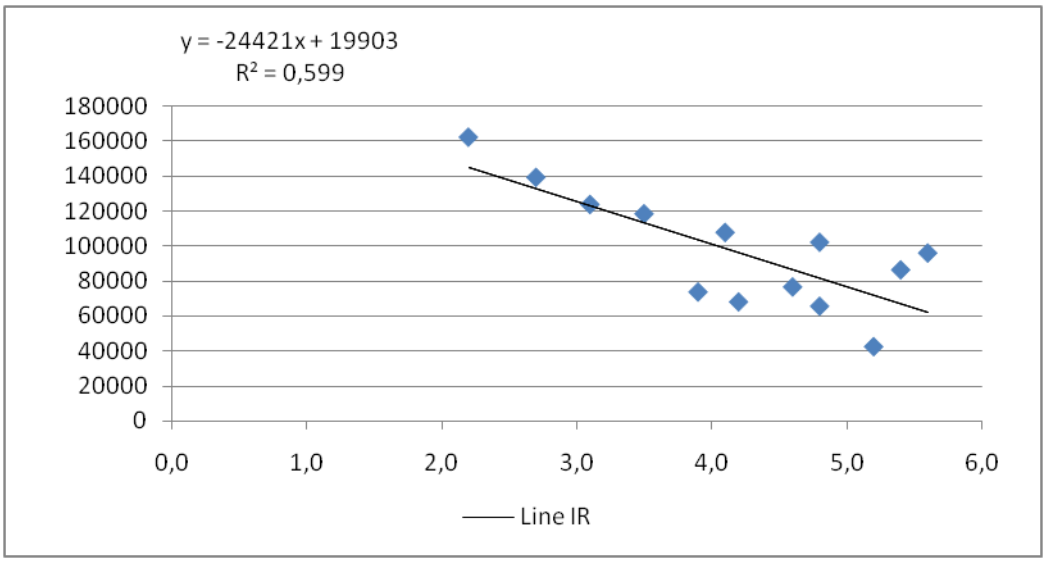
If crops prices will increase by 1 CZK/t, the average market price of agricultural land will increase by 21.52 CZK/ha.

Compared to other models the coefficient of determination in this model is really low. The variability of ALMP is explained from 33.6% by the influence of crops prices. Low R-squared informs about high variability of data. The graph shows that even high-variability data can have a significant trend. The trend indicates that the predictor variable still provides information about the response even though data points fall further from the regression line. Levels of variability affect the precision of these predictions.

4.2.4 The analysis of interest rates

Interest rates are regulated by Czech National Bank in the Czech Republic. In recent years interest rates have been very favourable which could contribute in land market development. Also the program *"Land"* within PGRLF that guarantees to farmers the interest subsidy for purchase of private agricultural land can have positive impact on market development of agricultural land.

Graph 14: Regression line of interest rates and ALMP



Source: own computation, MS Excel

The p-value (F) is 0.0019, which is lower than the level of significance 95%, results are statistically significant.

The regression line of this model is: y = 19 903 - 24 421 x

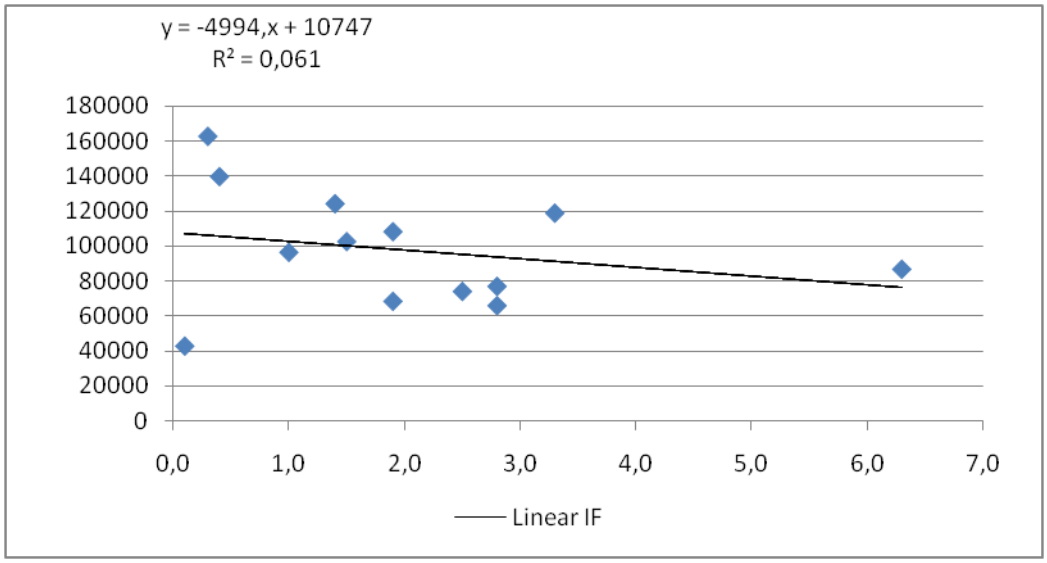
If interest rates will increase by 1%, the average market price of agricultural land will decrease by 24 421 CZK/ha.

The variability of ALMP is explained from 59.9 % by the influence of interest rates.

4.2.5 The analysis of inflation

Generally agricultural land is considered as reliable investment protected against inflation. This statement indicates that it can be expected that increasing inflation rate will raise agricultural land market price, but the real value of land should be higher than the effect of inflation rate.

Graph 15: Regression line of inflation and ALMPC



Source: own computation, MS Excel

The p-value (F) is 0.4158, it is higher than α the null hypothesis is accepted, and results are not statistically significant on the 95% level of significance.

The regression line of this model is: y = 10 747 - 4 994 x

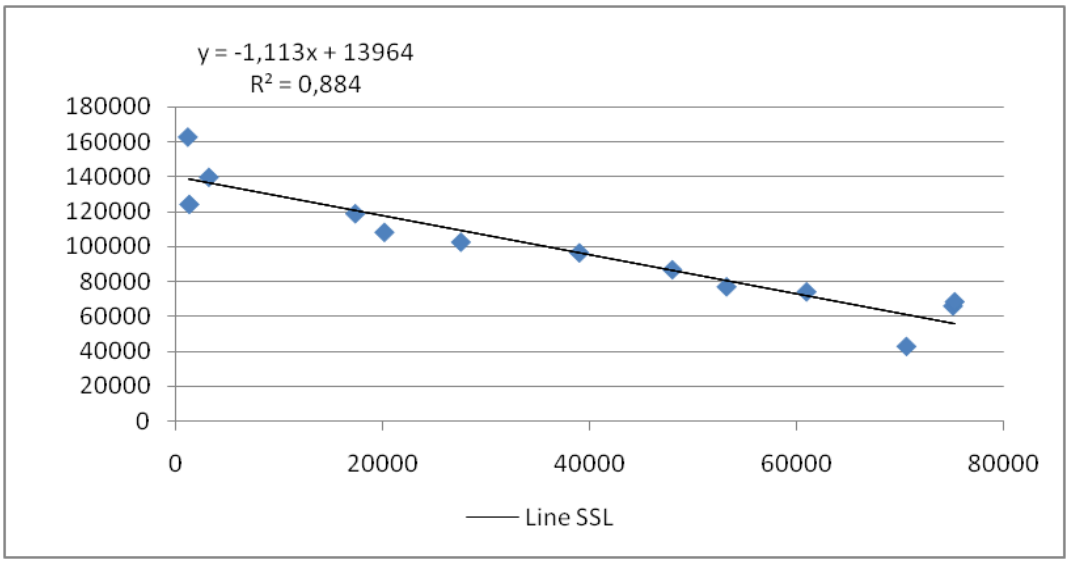
If the inflation rate will increase by 1%, the average market price of agricultural land will decrease by 4 994 CZK/ha.

The variability of ALMP is explained from 6.1 % by the influence of interest rates.

4.2.6 The analysis of sold state land

State supply of agricultural land for sale is almost finished. The end of sale of state land can involve increasing prices of agricultural land. Decreasing volume of agricultural land transfers can raise price of agricultural land market price. Potential buyers will demand the agricultural land from private owners who can require higher prices.

Graph 16: Regression line of sold state land and ALMPC



Source: own computation, MS Excel

The p-value (F) is 1.73e-06, it is lower than α=0.05 the null hypothesis cannot be rejected, results are statistically significant.

The regression line of this model is: y = 13 964 – 1.113 x

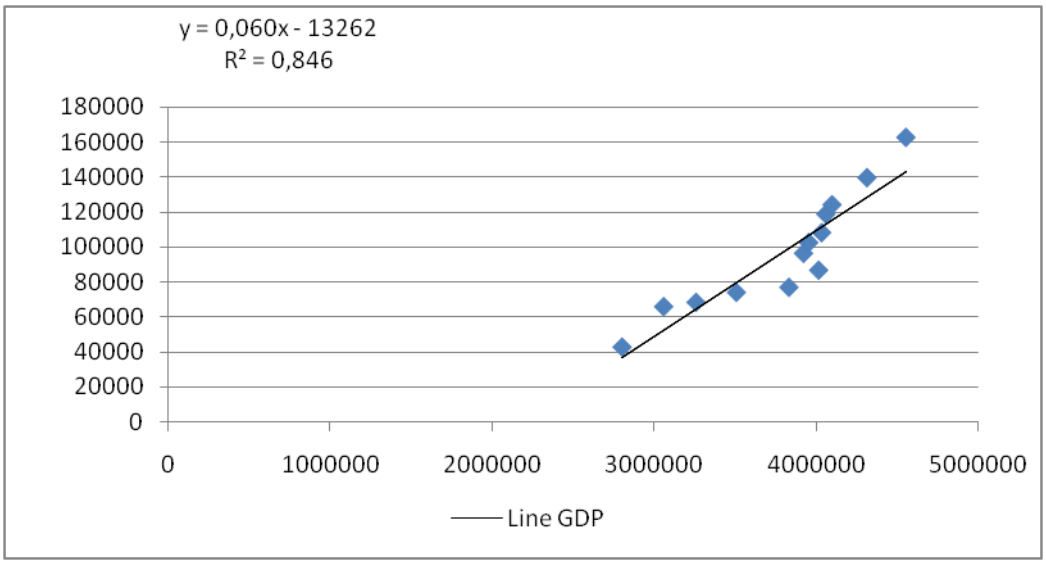
If the area of state land sold will decrease by 1 hectare, the average market price of agricultural land will decrease by 1.113 CZK/ha.

The coefficient of determination of this model explains the variability of ALMP from 88% by the influence of volume of area sold state land.

4.2.7 The analysis of Gross Domestic Product

GDP is indicator of economic health in the country. GDPs popularity is seen in its measuring of value added through economic process. If this economic indicator is growing the demand for agricultural land would increase too.

Graph 17: Regression line of GDP and ALMP



Source: own computation, MS Excel

The p-value (F) is 0.037568, it is lower than the level of significance 95%, the null hypothesis is rejected, and results are statistically significant.

The regression line of this model is: y = -13 262 + 0.060x

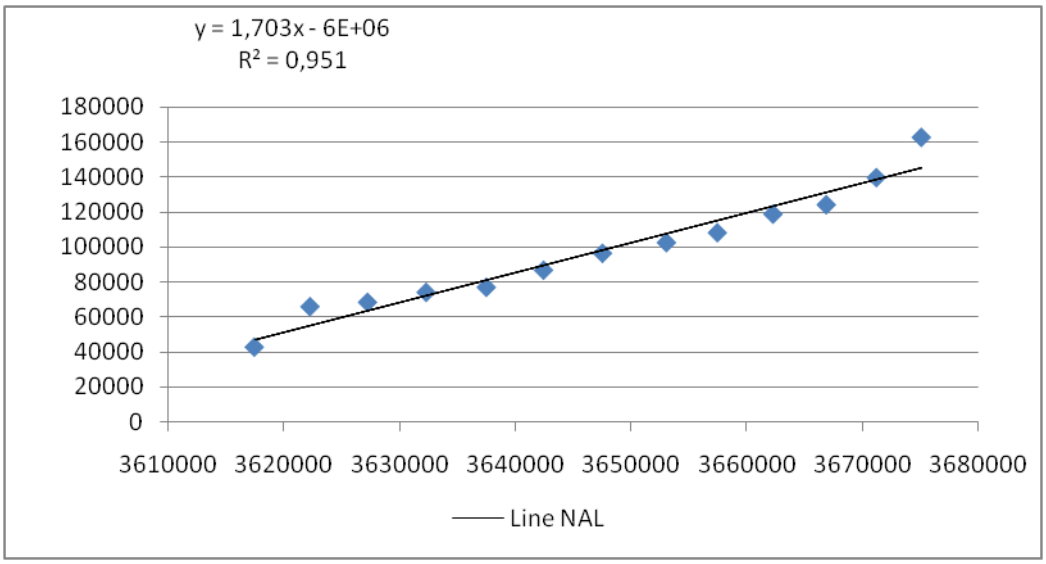
If GDP will increase by 1 million CZK, the average market price of agricultural land will increase by 0.06 CZK/ha.

The variability of ALMP is explained from 84.6% by the influence of GDP.

4.2.8 The analysis of non-agricultural land

The decreasing area of agricultural land is affected by many reasons. The most significant is the change of agricultural land for building plots and also afforestation. This leads to loss of farmland which may increase agricultural land market prices.

Graph 18: Regression line of non-agricultural land and ALMPC



Source: own computation, MS Excel

The p-value (F) is 1.38e-08 the result is statistically significant on the level of significance 95%.

The regression line of this model is: y = - 6E+06 +1.703 x

If the area of non-agricultural land will increase by 1 hectare, the average market price of agricultural land will increase by 1.703 CZK/ha.

The variability of ALMP in this model is explained from 95% by the changes in area of non-agricultural land.

4.3 Single - Equation Econometric model

An econometric model, in the form of a single stochastic equation will be applied to examine influences of determinants of agricultural land market price. The model will be statistically, economically and econometrically verified. Econometric model consists of one explained variable (endogenous) and explanatory (exogenous) variables.

From 2015 farmers have to follow new conditions for direct payments. The SAPS were decreased to 3 543 CZK/ha and if they fulfilled the condition of greening the received another 1943 CZK/ ha. In last year of observation 2015 data for SAPS includes the sum of these payments.

Economic model

Economic model expresses the relationship between the variables included in the model and should go along with the economic theory. Assumptions of economic relations are expected to be fulfilled. Explained variable is a function of explanatory variables:

$$MC\ f\ (RC, SAPS, CP, SSL, IR, IF, GDP, NAL)$$

Assumed economic relations between variables:

- *When the rental price increases the market price will increase too.*

The growth in rental price will involve the interest of agricultural entrepreneurs to manage the land which is in their ownership and also the interest of private investors who would rent the lend for higher price, then the demand for land will increase.

- *When the SAPS will increase it will cause the increase in the market price of agricultural land.*

SAPS capitalised into land market price. Direct payments are the main category of subsidies bringing farmers a guarantee of income in proportion to the area farmed. Currently, some production areas with quality soil the SAPS obtained is equal to the amount of rent paid for 1 hectare of agricultural land.

- *If the price of cereals will increase it will increase the market price of agricultural land.*

The biggest share on agricultural land represents these cereals (barley, rye, wheat, and oats). If prices of these agricultural commodities will growth, economic situation of farmers will be improved and they can invest into farmland.

- *When the GDP will increase, it will increase the market price of agricultural land*.

Increasing productivity and performance of the Czech national economy will increase the interest in land investment. More demanders in the market will cause higher price of supplied agricultural land.

- *When inflation will increase the average market price will increase too.*

Agricultural land is one of the production factors that can generate profit, usually from plants cultivation and also land cannot be depreciated because it does not lose a value. Many authors highlight the fact that agricultural land is not influenced by inflation as much as other commodities.

- *If the interest rates will decrease the agricultural land market price will increase.*

Low interest rates may attract many potential investors to purchase agricultural land. It will increase the demand for agricultural land and owners will offer higher price of land.

- *If the area of state land sold will decrease in different years, the average land market price will increase.*

Transfers of public land are almost over. State will not continue to offer agricultural land for sale. Potential buyers will procure land from private land owners. It will increase the demand for agricultural land and it will increase its market price.

Econometric model

Econometric model consists of endogenous and exogenous variables and must also include unit vector and stochastic variable (u_t). Random or stochastic variable contains those determinants that were not explained by exogenous variables. Therefore random variable is dependent on the influences that have not been included between explanatory variables and also mistakes in data set or mistakes in measurement.

$$Y_{1t} = \gamma_{0t} x_{0t} + \gamma_{1t} x_{1t} + \gamma_{2t} x_{2t} + \gamma_{3t} x_{3t} + \gamma_{4t} x_{4t} + \gamma_{5t} x_{5t} + \gamma_{6t} x_{6t} + \gamma_{7t} x_{7t} + \gamma_{8t} x_{8t} + u_{1t}$$

Basic data set contains all variables and it is shown in the Appendix 1**.** Data set for econometric model comes from different sources, prevailing were find at Green report issued by MZE, then Czech Statistical office, and subsidies history were send by SZIF via e-mail.

Declaration of variables

Y_{1t} - Agricultural Land Market Price

x_{0t} - unit vector

x_{1t} - rental prices

x_{2t} - Single Area Payment Scheme

x_{3t} - crops prices

x_{4t} - interest rates

x_{5t} - inflation

x_{6t} - area of sold state land

x_{7t} - Gross Domestic Product

x_{8t} - area of non – agricultural land

Correlation matrix

It is necessary to check variables (x) of estimated model for multicolinearity, its presence shows the correlation matrix. Multicolinearity refers to a state of very high intercorrelations among independent variables in the model. Unfortunately, the effects of high multicolinearity increase the variance of coefficient estimates and make the estimates very sensitive to minor changes. Multicolinearity can cause that the coefficient estimates are unstable and difficult to interpret.

Correlation matrix is gained by of normalized vectors X' multiplying by transposed matrix of normalized vectors X'^{T}. High multicolinearity is when one of the paired coefficient is higher than 0.8.

Table 8 : Correlation matrix

	ALMC	RC	SAPS	CP	IR	IF	SSL	GDP	NAL
ALMC	1,000	0,989	0,937	0,580	-0,774	-0,247	-0,940	0,920	0,976
RC	0,989	1,000	0,916	0,583	-0,787	-0,327	-0,947	0,904	0,970
SAPS	0,937	0,916	1,000	0,641	-0,702	-0,126	-0,948	0,908	0,971
CP	0,580	0,583	0,641	1,000	-0,443	0,275	-0,675	0,623	0,646
IR	-0,774	-0,787	-0,702	-0,443	1,000	0,375	0,687	-0,570	-0,710
IF	-0,247	-0,327	-0,126	0,275	0,375	1,000	0,271	0,000	-0,211
SSL	-0,940	-0,947	-0,948	-0,675	0,687	0,271	1,000	-0,894	-0,985
GDP	0,920	0,904	0,908	0,623	-0,570	0,000	-0,894	1,000	0,941
NAL	0,976	0,970	0,971	0,646	-0,710	-0,211	-0,985	0,941	1,000

Source: own computation, MS Excel

Table 6 illustrates correlation matrix of econometric model including all variables. High multicolinearity in this model is between variables RC, SAPS, SSL, GDP, NAL. Multicolinearity is possible to reduce by excluding some of the variables from the model, calculate with increases of correlated variables which is called first differences or include dummy variables.

Modified correlation matrix for new models will be showed in Appendix 2.

Ordinary Least Square Method

If there is no multicolinearity in the econometric model the parameters γ can be estimated by the Ordinary Least Square Method. Using this method it will be found the parameters minimizing the sum of squared deviation of theoretical values of endogenous variable (market price) from its real values.

Formula: OLS Method

$$\gamma = (X^T.X)^{-1} X^T y$$

Econometric model 1:

$$Y_{1t} = \gamma_{0t} X_{0t} ++ \gamma_{2t} X_{2t} + \gamma_{3t} X_{3t} + \gamma_{4t} X_{4t} + \gamma_{5t} X_{5t} + u_{1t}$$

Table 9: Model 1 - OLS estimates

	Coefficient	p-value	Significance α = 0.05
const	69577	0,07803	*
SAPS	14,2733	0,00195	***
CP	0,677435	0,91182	
IR	−5712.01	0,30863	
IF	−1722.78	0,54607	

Source: own computation, software Gretl

In modified model 1 only variable SAPS is statistically significant and other parameters are statistically insignificant for endogenous variable. In suggested model 2 were added first differences for variable SAPS and rental prices could be included in the model.

Gretl outpus for both model are included in Appendix 3 and 4.

Econometric model 2:

$$Y_{1t} = \gamma_{0t} X_{0t} + \gamma_{1t} X_{1t} + \gamma_{2t} X_{2t} + \gamma_{3t} X_{3t} + \gamma_{5t} X_{5t} + u_{1t}$$

Table 10: Model 1 - OLS estimates

	Coefficient	p-value	Significance α = 0.05
const	−17242.2	0,00451	***
RC	92,8883	<0.00001	***
CP	−3.68149	0,04327	**
IF	2381,98	0,01078	**
d_SAPS	5,70229	0,01584	**

Source: own computation, software Gretl

Statistic verification

T- test statistic

There are two ways how can be measured statistical significance of estimated parameters. Software Gretl use p – value of different parameters for determination of significance. The p- value must be smaller than level of significance 95%. Second method is using t –table

values which are compared with t – ratios. The results of software Gretl for statistical significance of parameters will be verified also by T-test.

H_0: parameters are not statistically significance

H_1: parameters are statistically significance

Calculated t- values are compared with table values of t – test for chosen level of significance $\alpha = 0.05$. When the value of t- test is higher than table value, we reject H_0, it means that parameters are statistically significance.

Table 11: Statistic significance of estimated parameters

Parameter	t- ratio	T = α .05	Significance Yes/No
Constant	2.020	1.782	Yes
SAPS	4.518	1.782	Yes
IR	-1.087	1.782	No
IF	-0.633	1.782	No
CP	0.1143	1.782	No

Source: own computation, Gretl Software

T –test statistic is consistent with results of Gretl, the parameters IR, IF and CP are statistically insignificant. It means that it was not proven the existence of relations between examined variables and its economic hypotheses.

R squared – consistency of estimated model with data

Model 1: $R^2 = 0.910406$

It means that changes of average agricultural land market prices are explained from 91% by changes of explanatory variables (SAPS, IR, IF, CP).

Model 2: $R^2 = 0.994340$

The changes of average agricultural land market price are explained from 99.5 % by changes of explanatory variables (RC, SAPS, IF, CP).

Mean Absolute Percentage Error

MAPE 1: 6.5%

MAPE 2: 1.8%

Mean Absolute Percentage Error shows what can be average percentage error in changes of land market price based on estimated parameters. The higher the error in the estimation the lower is the share of estimated directions of movement land prices.

Economic verification

Economic verification evaluates the direction and intensity of exogenous variables performance on endogenous variable. Results of parameters will be compared with economic hypothesis.

Estimated parameters are statistically significant in model 2 and its coefficient of determination is also higher than in model 1. Other variables included in model were irrelevant to describe the effect on the market price.

Economic verification of model 2:

$$Y_{1t} = -17\,242.2 + 92.8883\,x_{1t} + 5.70229\,x_{2t} - 3.68149x_{3t} - 2381.98x_{5t} + u_{1t}$$

Interpretation of results:

- Whenever the rental price will increase by 1 CZK/ha, the market price of agricultural land will increase by 92.8883CZK/ha directly proportional. *Economic assumption was fulfilled.*
- Whenever the annual change of SAPS will increase by 1 CZK/ha, the average market price of farmland will increase by 5.70229 CZK/ha directly proportional. *Economic assumption was fulfilled.*
- Whenever the crops prices increase by 1 CZK/t, the average market price of farmland will decrease by 3.68149CZK/ha indirectly proportional.

Economic assumption was not fulfilled.

- Whenever the inflation will increase by 1 percentage point, the average market price of farmland will increase by 2381.98CZK/ha indirectly proportional. *Economic assumption was fulfilled.*

Economic prediction which is not consistent with result of variable crops prices is going to be explained in more detail in chapter Results and discussion.

Econometric verification

Econometric model must fulfil assumptions; these assumptions can be tested by several tests. Autocorrelation test shows if the error terms are dependent between each other in different periods of time, which can cause bad quality of the model. *Heteroscedasticity test* shows if error term is constant in time. If the model is positive for heteroscedasticity test, then it means that error terms are not possible to predict and estimate. Stochastic variable should have *normal distribution*. It means that model should not include data with shock values (Woolbridge, 2009).

Econometric verification will be provided for model two. The outputs from Gretl programme will be for model 1 and model two in Appendix.

Test for autocorrelation

H_0: autocorrelation of residuals is not present

H_1: autocorrelation of residuals is present

Breusch - Godfery test with p – value 0.608 is higher than 95% level of significance. The null hypothesis is rejected, there is no autocorrelation.

Test for heteroskedasticity

The test for hesteroskedasticity examines the variance of residuals. Heteroskedasticity cen be tested by White´s test or Breusch – Pagan test. The test confirms or reject if the variance of residuals is dependent on values of explanatory variables

H_0: homoscedasticity

H_1: heteroscedasticity

P - value of Breusch-Pagan test is 0.21579 then the null hypothesis cannot be rejected on level of significance $\alpha = 0.05$. The residuals in the model has constant variance, hetereoskedasticity is not present.

Test for normality

Usually the normality test is done for larger size of data series. On the basis of Jarque – Bera test with p – value 0.1866 it can be stated that residuals are normally distributed on the level of significance $\alpha = 0.05$.

5 Results and discussion

The analytical part researches the influence of selected factors on the level of the average market prices of agricultural land between the years 2003 and 2015. For this analysis were used data on average market prices of agricultural land plots which are bigger than 5 hectares. Two methods were used to investigate determinants influencing average agricultural land market prices.

On the basis of Simple regression analysis all results were statistically significant except the inflation. More than 95% of the variability observed in agricultural land market prices can be explained by assessed values of *rental prices* and area of *non- agricultural land.* These parameters are also statistically significant. High Coefficient of Determination (more than 80%) was measured through the variable of *Gross Domestic Product* and the *area of state land sold* and these parameters are also statistically significant.

Compared to the results of other determinants the coefficient of determination for *crops prices* is really low. The variability of agricultural land market price is explained from 33.6% by the influence of crops prices.

The variability of average agricultural land market price is explained from 59.9 % by the influence of *interest rates*. Although the results are statistically significant model is not consistent with the economic theory. These problems usually arise on the basis of the inappropriateness of empirical data that were used for model estimation.

The dependence between *inflation* and average agricultural land market price is not statistically significant on 95% level of significance. The changes of interest rates explain the variability in average land market prices from 6.1%. This factor is not statistically significant and does not go along the economic theory.

As a second method econometric model was applied to determine the direction and intensity of influences of selected factors on agricultural land market price. The model had to be modified because of the high correlation between the variables. The multicolinearity was eliminated using first differences for variable Single Area Payment Scheme which correlated with rental prices. Other correlated variables were omitted from the model. The best results were gained in model 2 which includes only statistically significant variables.

The model was estimated by the Ordinary Least Squares method and consists of these determinants:

- rental prices (RC)
- first differences of Single Area Payment Scheme (d_SAPS)
- cereal prices (CP)
- inflation (IF)

The following results indicate that agricultural land market prices are explained by performance determinants given here to the tune of 91%.

Interpretation of results:

- Whenever the rental price will increase by 1 CZK/ha, the market price of agricultural land will increase by 92.8883CZK/ha directly proportional.
  Economic assumption was fulfilled.
- Whenever the annual change of SAPS will increase by 1 CZK/ha, the average market price of farmland will increase by 5.70229 CZK/ha directly proportional.
  Economic assumption was fulfilled.
- Whenever the crops prices increase by 1 CZK/t, the average market price of farmland will decrease by 3.68149CZK/ha indirectly proportional.
  Economic assumption was not fulfilled.
- Whenever the inflation will increase by 1 percentage point, the average market price of farmland will increase by 2381.98CZK/ha indirectly proportional.
  Economic assumption was fulfilled.

The Single Area Payment Scheme is increasing gradually after the year 2004. Ciaian et al. (2010) showed that direct payments were capitalized at the strongest rate into land values. In the opinion of Medonos (2015), the SAPS payment influences the level of rent price required by the owners of agricultural plots. In some production areas with high soil fertility (Polabí, Haná, Prague – East) price of land rental reached the level of payments

SAPS for last two years. An increasing rental charge is main indicator of the agricultural land market development because it has increased demand for agricultural land purchases, not only on the side of economically prosperous agriculture entities but also non-agricultural investors.

Cereal prices were selected because of their highest share at total area of arable land. World consumption of cereals represents the biggest share of agricultural plants cultivated on arable land. The model does not confirm the economic hypothesis and increasing crops prices affects the average agricultural land market prices negatively. The reason for this can be that cereal prices have fluctuated in each year because their demand is dependent on natural climatic conditions, not only in this country but also throughout the world. If weather conditions are favourable for two or more seasons it is usually reflected in a price reduction and vice versa. Another indicator that influences cereal prices positively is the production of alternative sources of energy. There are various EU programmes supporting the production of bio - energy (e.g. bio-fuels, bio-gas stations).

The model confirms that inflation inflences the price of agricultural land but still the price of land grows faster than the inflation rate. Since 2003 the average agricultural land market price is more than three times higher than it would be after the influences of inflation in 2015. This hypothesis supports the opinion of Geman (2015), who stated that farmland, is not influenced by the inflation since it is a real asset that is linked to food and energy production.

Low interest rates on financial deposits, bonds and other financial funds change the preferences of investors. Agricultural land has been becoming interesting commodity as well as gold or crude oil in recent years. As mentioned above, in fertile areas rental prices in the last three years have increased up to the level of the subsidies provided, this means that rental prices reached 4000 - 6000 CZK/ha in localities with quality soil. Therefore capital appreciation by investing in agricultural land is about 1-3% (Novotný, 2016).

The results of the analysis may differ in relation to the used source of data on market prices of agricultural land. Institutions dealing with agricultural land market prices use different methodology of data collection. For this research were publically available data provided by Farmy.cz. The company specializing in the agricultural land market collects data on the basis of realized trade agreements on the purchase of land.

6 Conclusion

The situation on the agricultural land market is important in the context of agricultural production, food safety, and protection of the Agricultural Land Fund. In the Czech Republic the share of leased land is still higher than in the old countries of the EU. However, the economic conditions of farmers are stabilizing and it can be expected that the share of leased land farmed could gradually decrease.

Generally speaking, the development of the land market in the Czech Republic was influenced by transfers of public land in 1999 and the enacting of a subsidy policy (1997). The volume of land traded from 2001 to 2003 reached more than 160, 000 hectares. Since 2004 the Czech land market has been positively affected by subsidies from EU funds and also by national support for purchases of agricultural land. Although, the volume of traded land has decreased, the average price per hectare of agricultural land has grown.

On the basis of the analysis, it was found that the important economic factors which influence price of agricultural land include land rental and the Single Area Payment Scheme. Other factors affect the price with low intensity. The quality of the model could be improved by including other important variables or extend the time series of variables.

Another problem is that each institution uses different methods for monitoring of agricultural land market prices. The results of the analysis could change in relation to the source of data used.

The diploma thesis deals with statistically quantifiable factors, but agricultural land market price is also influenced by determinants that cannot be statistically examined. Among these factors belong the size of plots and their location and accessibility, the soil type and its fertility, the relations between the seller and buyer, and other subjective and speculative aspects. There are also some technical factors such as digitization and landscaping whose completion should facilitate the sale of agricultural land.

Furthermore, without taking into account current conditions and their spill – over effect on agriculture and investment behaviour the results suggest that the price of agricultural land will rise in the coming years. However, it is not assumed that agricultural land prices will reach the level of existing prices in the Netherlands or in Denmark. Underdevelopment compared to Western states was caused by the previous regime – a centrally planned economy that stopped the development of a public market in agricultural land.

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8 Appendix

8.1 Appendix 1

Basic Data set

Factor/ units	Unit vector	Agricultural land market price (CZK/ha)	rental prices (CZK/ ha)	SAPS (CZK/ha)	cereal prices (CZK/t)	interest rates (%)	inflation (%)	sold state land (ha)	GDP (mil./CZK)	Area of non - agr.land (ha)
year	X_{0t}	Y_{1t}	X_{1t}	X_{2t}	X_{3t}	X_{4t}	X_{5t}	X_{6t}	X_{7t}	X_{8t}
2003	1	42750	768	0	3407	5,2	0,1	70 628	2801163	3617462
2004	1	65 864	852	1830	3443	4,8	2,8	75 119	3057660	3622265
2005	1	68 336	974	2110	2655	4,2	1,9	75 286	3257972	3627233
2006	1	73 983	994	2518	2881	3,9	2,5	60 977	3507131	3632296
2007	1	76 901	1099	2792	4208	4,6	2,8	53 245	3831819	3637489
2008	1	86 673	1160	3073	4974	5,4	6,3	48 007	4015346	3642431
2009	1	96 300	1288	3710	3019	5,6	1,0	39 032	3921827	3647517
2010	1	102 456	1347	4061	3093	4,8	1,5	27 582	3953651	3653037
2011	1	108 100	1433	4687	4608	4,1	1,9	20 196	4033755	3657431
2012	1	118 712	1477	5387	4958	3,50	3,3	17 383	4059912	3662231
2013	1	124 070	1667	6069	5134	3,10	1,4	1 351	4098128	3666840
2014	1	139 590	1920	5997	4650	2,70	0,4	3 239	4313789	3671158
2015	1	162 565	2100	5486	4393	2,20	0,3	1 204	4554615	3675038

Source: MZE, CSO, CNB, CUZK, Farmy.cz

8.2 Appendix 2

Correlation matrix Model 1

	ALMC	*SAPS*	*CP*	*IR*	*IF*
ALMC	1				
SAPS	0,937417	1			
CP	0,580373	0,6413	1		
IR	-0,77424	-0,70208	-0,44325	1	
IF	-0,24703	-0,12567	0,274746	0,374539	1

Source: MS Excel, own computation

Correlation matrix Model 2

	ALMC	RC	CP	IF	d_SAPS
ALMC	1	0.989	0.5804	-0.247	-0.3655
RC	0.989	1	0.5831	-0.3271	-0.4518
CP	0.5804	0.5831	1	0.2747	-0.1099
IF	-0.247	-0.3271	0.2747	1	0.3339
d_SAPS	-0.3655	-0.4518	-0.1099	0.3339	1

Source: MS Excel, own computation

8.3 Appendix 3

Gretl outputs – OLS estimates Model 1

```
Model 1: OLS, using observations 2003-2015 (T = 13)
Dependent variable: ALMC

             coefficient    std. error    t-ratio   p-value
  ------------------------------------------------------------
  const      69577.0        34440.1        2.020    0.0780   *
  SAPS          14.2733         3.15886     4.518    0.0020   ***
  CP             0.677435       5.92737     0.1143   0.9118
  IR         -5712.01        5254.03      -1.087    0.3086
  IF         -1722.78        2733.22      -0.6303   0.5461

Mean dependent var   97407.69   S.D. dependent var   33219.87
Sum squared resid    1.19e+09   S.E. of regression   12178.18
R-squared            0.910406   Adjusted R-squared   0.865609
F(4, 8)              20.32298   P-value(F)           0.000299
Log-likelihood      -137.5866   Akaike criterion     285.1732
Schwarz criterion    287.9980   Hannan-Quinn         284.5926
rho                  0.298892   Durbin-Watson        1.193386

Excluding the constant, p-value was highest for variable 4 (CP)
```

```
White's test for heteroskedasticity
OLS, using observations 2003-2015 (T = 13)
Dependent variable: uhat^2

               coefficient        std. error     t-ratio  p-value
  ---------------------------------------------------------------
  const           4.31155e+09       2.22298e+09   1.940   0.1244
  SAPS       128202             164985             0.7771  0.4805
  CP        -865083             880724            -0.9822  0.3816
  IR             -1.32982e+09       6.19220e+08  -2.148   0.0982  *
  IF              1.76031e+07       1.65824e+08   0.1062  0.9206
  sq_SAPS       -34.0791           31.9515        -1.067   0.3463
  sq_CP         131.754           125.886          1.047   0.3543
  sq_IR           1.47780e+08       7.67209e+07   1.926   0.1264
  sq_IF          -1.14545e+07       2.26040e+07  -0.5067  0.6390

  Unadjusted R-squared = 0.803666

Test statistic: TR^2 = 10.447656,
with p-value = P(Chi-square(8) > 10.447656) = 0.235001
```

Breusch-Godfrey test for first-order autocorrelation
OLS, using observations 2003-2015 (T = 13)
Dependent variable: uhat

	coefficient	std. error	t-ratio	p-value
const	18106.6	38678.3	0.4681	0.6539
SAPS	-1.93285	3.67787	-0.5255	0.6154
CP	2.72710	6.49028	0.4202	0.6869
IR	-5305.05	7386.80	-0.7182	0.4959
IF	987.042	2893.50	0.3411	0.7430
uhat_1	0.897046	0.880146	1.019	0.3420

Unadjusted R-squared = 0.129220

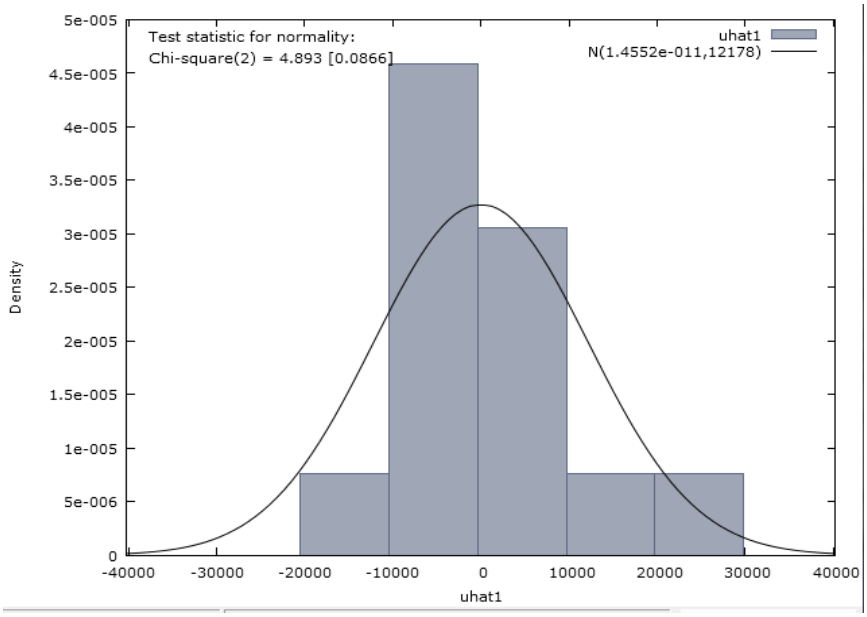
Test statistic: LMF = 1.038771,
with p-value = P(F(1,7) > 1.03877) = 0.342

Alternative statistic: TR^2 = 1.679861,
with p-value = P(Chi-square(1) > 1.67986) = 0.195

Ljung-Box Q' = 0.337197,
with p-value = P(Chi-square(1) > 0.337197) = 0.561

Forecast evaluation statistics

Mean Error	1.4552e-011
Mean Squared Error	9.1267e+007
Root Mean Squared Error	9553.4
Mean Absolute Error	6988.6
Mean Percentage Error	-0.62068
Mean Absolute Percentage Error	6.595
Theil's U	0.51173



8.4 Appendix 4

Gretl outputs – OLS estimates Model 2

```
Model 6: OLS, using observations 2003-2015 (T = 13)
Dependent variable: ALMC

             coefficient    std. error   t-ratio   p-value
  ---------------------------------------------------------
  const      -17242.2       4415.12      -3.905    0.0045   ***
  RC             92.8883       3.66276   25.36     6.26e-09 ***
  IF           2381.98       720.708      3.305    0.0108   **
  d_SAPS          5.70229      1.86999     3.049    0.0158   **
  CP             -3.68149      1.53482    -2.399    0.0433   **

Mean dependent var   97407.69   S.D. dependent var   33219.87
Sum squared resid    74954217   S.E. of regression   3060.927
R-squared            0.994340   Adjusted R-squared   0.991510
F(4, 8)              351.3548   P-value(F)           5.11e-09
Log-likelihood      -119.6346   Akaike criterion     249.2691
Schwarz criterion    252.0939   Hannan-Quinn         248.6885
rho                 -0.130062   Durbin-Watson        2.083549
```

```
Breusch-Pagan test for heteroskedasticity
OLS, using observations 2003-2015 (T = 13)
Dependent variable: scaled uhat^2

             coefficient    std. error    t-ratio    p-value
  ----------------------------------------------------------
  const      -3.09917       2.15571       -1.438     0.1885
  RC          0.00166893    0.00178836     0.9332    0.3780
  CP          0.000469842   0.000749386    0.6270    0.5482
  IF          0.0307054     0.351890       0.08726   0.9326
  d_SAPS     -3.14073e-05   0.000913035   -0.03440   0.9734

  Explained sum of squares = 11.57

Test statistic: LM = 5.785004,
with p-value = P(Chi-square(4) > 5.785004) = 0.215790
```

```
 Forecast evaluation statistics

 Mean Error                      -1.1194e-012
 Mean Squared Error               5.7657e+006
 Root Mean Squared Error          2401.2
 Mean Absolute Error              1858.7
 Mean Percentage Error            0.0049355
 Mean Absolute Percentage Error   1.8028
 Theil's U                        0.12792
```

```
Breusch-Godfrey test for first-order autocorrelation
OLS, using observations 2003-2015 (T = 13)
Dependent variable: uhat

             coefficient    std. error    t-ratio   p-value
  ------------------------------------------------------------
  const      -1290.20       5214.23       -0.2474   0.8117
  RC            -1.41142       4.65354    -0.3033   0.7705
  CP             0.800500      2.19421     0.3648   0.7260
  IF          -192.635       836.214      -0.2304   0.8244
  d_SAPS         0.669214      2.32299     0.2881   0.7816
  uhat_1        -0.348457      0.649830    -0.5362   0.6084

  Unadjusted R-squared = 0.039456

Test statistic: LMF = 0.287540,
with p-value = P(F(1,7) > 0.28754) = 0.608

Alternative statistic: TR^2 = 0.512933,
with p-value = P(Chi-square(1) > 0.512933) = 0.474

Ljung-Box Q' = 0.208349,
with p-value = P(Chi-square(1) > 0.208349) = 0.648
```