Bulgarian Journal of Agricultural Science, 25 (No 6) 2019, 1114–1121

Determinants of agricultural land rent and its development in Czechia

Radek Zdenek[1*], Jana Lososova[1], Tomas Mrkvicka[2]

[1]*University of South Bohemia, Faculty of Economics, Department of Accounting and Finance, Studentska 13, 37005 Ceske Budejovice, Czech Republic*
[2]*University of South Bohemia, Faculty of Economics, Department of Applied Mathematics and Informatics, Studentska 13, 37005 Ceske Budejovice, Czech Republic*
[*]*Corresponding author:* zdenek@ef.jcu.cz

Abstract

Zdenek, R., Lososova, J. & Mrkvicka, T. (2019). Determinants of agricultural land rent and its development in Czechia. *Bulgarian Journal of Agricultural Science, 25* (6), 1114–1121

The paper deals with the main factors influencing agricultural land rent and its development. We use our own sample survey data of agricultural farms complemented by the data from other sources. The sample contains 48 identical farms between 2011 – 2015 from the whole territory of the Czech Republic. The data were analysed with the mixed effect model. We investigated the influence of both agricultural and non-agricultural factors. Of the observed factors explaining the growth in land rent, the most important factor is time. Other significant agricultural factors are land share in the LFA, the area of utilised agricultural land, production orientation on crop production, livestock density and the share of rented land. Population density is the only significant non-agricultural factor.

Keywords: land rent; agricultural land; mixed-effect model

Introduction

The Czech Republic is a country consisting of a large number of small landowners, most of whom do not farm the land themselves. The restitution of agricultural land resulted in a severe fragmentation of ownership, sharply contrasting with the extreme land-use concentration (about 5% of the farms use about 75% of the land) (Lošťák et al., 1999; Voltr, 2000; Doucha & Divila, 2005; Sklenička et al., 2014). Due to the previous developments, the share of rented land is higher in the Czech Republic compared to the rest of the EU (Lososová et al., 2017). The share of rented land was 53.8% in the EU28 in 2015 (last published year) according to the FADN public database (FADN, 2018). The countries with the highest proportion of rented land are Slovakia (91.4%), Bulgaria (84.4%), France (82%), Malta (81.8%) and Czech Republic (77.3%). On the other hand, the lowest proportion of rented land was in Ireland (18.6%), Portugal (21.8%) and Poland (25.6%). However, it is important to note that not only the high proportion of rented land but also the area of rented land. While (again according to FADN 2015) the average area of rented land was 18.3 ha in the EU28, in the Czech Republic it was 158.1 ha (in Slovakia even reaching 482.9 ha).

The aim of this article is to find out the factors that form the price of renting the land in the territory of Czech Republic. The aim has emerged from discussions with farmers who feel a great deal of concern about the growing demands of landowners that had led to land rent becoming their most dynamic cost item.

Most of the current work is focused on research on the price of agricultural land rather than on renting agricultural land. According to the capitalization theory (Akerson, 2009; Mařík, 2011), the price of land is equal to the present value of the expected returns from the rented land. This relationship between the market price of land and the rent can be expressed as (Clark et al., 1993; Střeleček et al., 2010)

$$P = (R - T) / i,$$

where P is the market price of the land, R is the land rent, T is the land tax and i is the capitalization rate. They have found the relationship between land prices and land rents to be inconsistent, which means that the simple asset pricing model does not hold. Falk (1991) found that although movements of farmland rents and prices are highly correlated, price movements are more volatile than land rent movements. One of the causes may be the existence of long-term lease agreements. The very fact that the land is managed by the owner or tenant can influence the market price of the land. Results by Choumert & Phélinas (2015) show, that plots rented have a lower value relative to plots owned (all other things being equal). This can mean that land owned may be under better conservation practices than land rented, as there may be fewer incentives to adopt long-term practices.

Factors affecting the land price as well as the land rent were researched by Huang et al. (2006). Land productivity, land size, distance from major cities, index city–countryside, farm density, income and inflation were set as explanatory variables in the analysis. The regression shows that land prices are positively correlated with soil productivity, population density and personal income per capita. On the other hand, it is negatively correlated with the land size, rural character of a district and the distance from city centres. Craig et al. (1998) modelled the land prices as a function of land type, terms of trade, traffic conditions and geographic and demographic factors while Kocur-Bera (2016) identified the key determinants of agricultural land prices as the location of land relative to rural settlements, soil quality, land fragmentation, forest cover in the municipality, and the location of farms in less-favoured areas. Czyżewski et al. (2017) divide factors influencing land price into the quantitative and the qualitative. Among the quantitative attributes, distance from a city and distance from buildings have the greatest influence on land prices; among the qualitative attributes, the most significant are the type of rural area and building permission. The results of the analysis by Ustaoglu et al. (2016) in the EU-28 indicate that agricultural land values in Europe vary substantially and depend on a number of factors. The factors causing variations of the agricultural land value are: differences in production costs, revenues from agricultural production, the growth rate assumptions regarding the costs and revenues between 2010 and 2030, and geographical differences in discount rates. Breustedt & Habermann (2011) apply a spatial regression model to determine spatial relationships among the farmland rental prices of neighbouring farmers in Germany.

Hamza & Miskó (2007) described the adjustment of land rent in Hungary during the accession to the EU. The land rents are bound to the yield and the price of wheat grain on the grain exchange. Many landowners do not agree with such price setting and prefer a fixed amount such as a certain percentage of subsidies (40-50% in this case). According to Stoyneva (2007), the land rent situation in Bulgaria is similar to Hungary. There are no significant differences in the land rent across the regions and the land rent mainly depends on the agricultural income level. The land rent amount is mainly determined by the demand and is neutral towards supply.

Boinon et al. (2007) and Ciaian et al. (2010) analysed the effects of the Common Agricultural Policy on agricultural land prices and land rents across the EU states. The results of their studies show that the introduction of a single payment scheme area has a greater impact on rents than on land prices. Feichtinger & Salhofer (2016) discussed the extent of the capitalization of decoupled direct payments into land rental prices in Bavaria. Furthermore, studies conducted e. g. by Featherstone & Baker (1988), Barnard et al. (2001), Happe & Balmann (2003), Roberts et al. (2003), Lence & Mishra (2003), Latruffe et al. (2008) and Patton et al. (2008) demonstrated the positive impact of direct payments on land rent. In this context, Marks-Bielska (2013) divided the motives of tenants and buyers of agricultural land into three categories;(1) to expand their own farmland or to set up a new farm; (2) or investment due to the expected increase of land prices; (3) or to benefit from EU funds. Kilian et al. (2012) answered the question of whether a change in policy has any impact on agricultural land rents and the degree of capitalization of support. As a result of decoupling, a high capitalization rate into land values can be expected. Remaining high land prices may create a barrier for structural adjustment and to the entrance of new farmers and potentially hinder the competitiveness of European agriculture.

Sklenička et al. (2013) regressed the influence of eight variables (municipality size, the size of a parcel sold, soil quality stated by official prices, the distance between a sold parcel and the edge of a settlement, the accessibility of the land, travel time to the capital city, travel time to a regional town, travel time to a district town) on the price of agricultural land in Czechia using a linear regression model. The results showed that the most influential factor is the distance from a current settlement. Other significant factors were the size of a municipality, the distance from the capital city, the accessibility of the land and the land fertility. The results were interpreted by setting a threshold value for significant factors that support the future non-agricultural use of land and significantly boost the current price of the land.

In most Central and East European countries land was privatized by restitution. The land was given back to former owners or their descendants within certain limits of size. If

the restitution of the original land was not possible for some reason, another land parcel of similar size and quality had to be given as a replacement (Burger 1998). In Czechia the restitution resulted in a severe fragmentation of ownership, sharply contrasting with the extreme land-use concentration with about 5% of the farms using about 75% of the land (Lošťák et al. 1999; Voltr 2000; Doucha and Divila 2005), 95% of agricultural land being leased, and with less than 1% of landownersactively involved in agriculture (Bański, 2017).

Data and Methods

Data

The paper uses our own sample survey data of agricultural farms complemented by data from the Czech Statistical Office as well as from the online application www.mapy.cz. The sample contains 48 identical farms in 2011 – 2015 from the whole territory of the Czech Republic.

The influence of the these stated fixed effects (both agricultural and non-agricultural) on land rent was tested: utilized agricultural area; area of rented land; share of rented land; share of land under LFA (total, in mountain LFA, in other LFA); share of arable land; operational subsidies directly connected with land (single area payment scheme, less favoured areas, environmental subsidies); share of agricultural land in the municipality; livestock density; administrative price of land; and non-agricultural indicators are: distance to the capital; distance to regional centre; distance to district centre; distance to municipality with extended competence; distance to municipality with authorized municipal office; population density; average altitude. These are complemented with categorical variables such as legal form (cooperative, joint-stock, limited liability and company of individual); economic size[1] (small and medium); and prevailing production orientation (plant, animal and mixed) according to the share of revenues. Their basic characteristics are shown in Tables 1 and 2.

On the basis of a literature survey, a positive effect on the following factors can be hypothesized: area (and share) of rented land (that represent demand), administrative price (which represents soil fertility; Sklenička et al., 2013; Dirgasová, 2017), share of arable land, operational subsidies (Fuchs, 2002), livestock density (Fuchs, 2002; Breustedt & Habermann, 2011) and population density (Huang et al., 2006). For other factors, we assume the effect is either negative or cannot be estimated ex-ante.

[1]Commission Recomendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises.

Designed model

The data were analysed by mixed effect model (Zuur et al., 2009), where the farm was taken as a random intercept effect whereas all the other factors were taken as fixed effects. The residual plot and qq plot were checked for the assumptions of the model. The mixed effects model is defined as:

$$r_{it} = b_0 + \Sigma_j b_j x_{jit} + c_i f_i + u_{it}$$

where r_{it} is the land rent per hectare paid by farm i during the time period t, b_0 is intercept, b_j are regression parameters of fixed effects, x_{jit} is fixed effect j at farm i during the period t, c_i is the parameter of random effect assumed to be $N(0, d^2)$, f_i is random effect (farm i) and u_{it} is residual term with i.i.d. $N(0, \sigma^2)$. Estimate of model parameters was performed in R (R Core Team, 2017) using library „nlme“ (Pinheiro et al., 2017).

Results and Discussion

The sample contains 48 identical farms between the years 2011 – 2015, out of which 54.2% are cooperatives, 29.2% are joint-stock companies, 14.6% are limited liability farms and the rest are individuals. This structure may seem unusual, but in the Czech Republic, most of the land is managed by legal entities, although individuals are predominant in terms of a number of enterprises[2]. Surveyed farms are evenly distributed and operate in 10 regions of the Czech Republic. There are 27.1% of the farms operating outside the LFA area, 22.9% are operating within the mountainous LFA region, and 50% in LFA in other regions.

The range of land rent within the sample was stable between the years 2011-2013, ranging from 200 CZK.ha^{-1} to 4000 CZK.ha^{-1}, with a maximum increased to 5000 CZK.ha^{-1} in 2014 and to 5100 CZK.ha^{-1} in 2015 (Figure 1). The hypothesis of consistent distribution of land rent in each year is rejected by Friedman's ANOVA ($\chi^2(n = 48, df = 4) = 131.7$, p-level < 0.001).

The average land rent price per hectare increased from 1068 CZK (2011) to 2115 CZK (2015) and is increasing annually by approximately 18.6%. The distribution of land rents is characterized by a mild right-sided skewness and high kurtosis, both of which are decreasing in time. The sample median grew from 915 CZK (2011) to 2000 CZK (2015).

For comparison, the EC (2016) shows the average price of renting one hectare of agricultural land (arable and grassland) between 2011-2015, respectively 56, 61, 66, and 73 EUR.ha^{-1} (in Czech Republic; annual growth of 9.2%), and after conversion with an average annual exchange rate CZK / EUR 1377, 1534, 1714, and 2010 CZK.ha^{-1}.

[2]https://www.czso.cz/documents/10180/20567009/212712k06.pdf

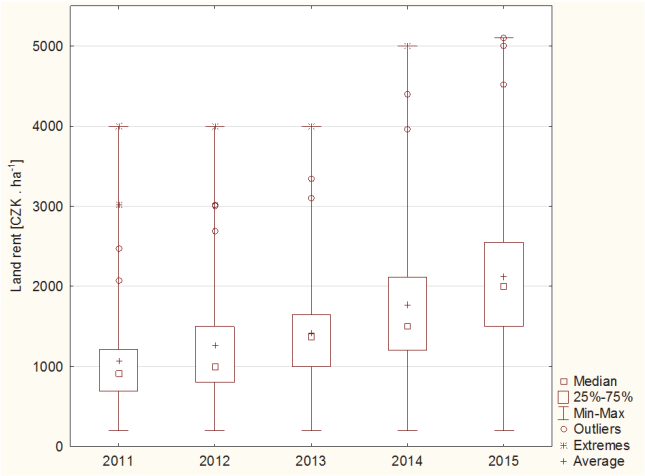

Fig. 1. Box plot of the land rent
Source: Sample of farms

Although from the point of view of the cost structure, the rent was among the less important cost items; its share in the costs is steadily increasing due to the increase inland rent per hectare despite the decreasing share of land rented (2.21% of the total costs in 2011, 4.02% of the total costs in 2015).

Table 1 shows the basic characteristics of the continuous fixed effects. The third column lists the average, minimal and maximal value, and the coefficient of variation in 2015, and the dynamics of the average value – the index of the average value in 2015 to 2011. For each variable, a hypothesis on the compliance of variable values over five years is being tested using the Friedman test (the last column contains the value of the test statistics and the reached level of significance).

Significant differences are approved in the utilized agricultural area where the average land area is reduced from 1688 ha (2011) to 1630 ha (2015); area of rented agricultural land decreased from 1522 ha to 1373 ha; the share of land rented decreased from 90.3% to 84.8%; operational subsidies per hectare increased from 6820 CZK.ha^{-1} to 7260 CZK.ha^{-1} (maximum was 8152 CZK.ha^{-1} in 2014); livestock density gradually increased (from 0.458 LU.ha^{-1} to 0.517 LU.ha^{-1}), and the administrative price of land also increased (from 4.49 CZK.m^{-2} to 5.73 CZK.m^{-2}). The share of agricultural land in municipalities declined from 59.1% to 58.7%. For other indicators, differences in the values of the indicators have not been approved. Indicators of distance to the centres have not been tested.

Table 2 shows the values of the rent (average, minimal and maximal values, and the variation coefficient in 2015) according to the values of categorical variables. Using the Kruskal-Wallis test, the hypothesis on the distribution of land rent among the values of the categorical variable in individual years was tested (third column). In the case of a legal form, the rent is not

Table 1. The basic characteristics of explanatory variables

Variable	Abbreviation [unit of measure]	Data average; min; max; coefficient of variation [%] in 2015; index (avg'15/avg'11)	Friedman's test $\chi^2(n = 48, df = 4)$, p-level
Utilized agricultural area	UAA[ha]	1630; 424; 5301; 62.8; 0.97	53.9; < 0.001
Area of rented agricultural land	rentedL [ha]	1373; 361; 3960; 62.9; 0.90	102.8; < 0.001
Share of land rented	%rentedL	0.848; 0.374; 1.0; 13.5; 0.94	98.9; < 0.001
Share of land under LFA	%LFA	0.744; 0; 1; 55.4; 1.01	2.22; 0.695
Share of land under LFA mountain	%LFA-M	0.228; 0; 1; 167.6; 0.99	4.88; 0.300
Share of land under LFA other	%LFA-O	0.436; 0; 1; 102.4; 0.97	5.34; 0.254
Share of land under LFA specific	%LFA-S	0.058; 0; 1; 352.4; 1.00	4.37; 0.359
Share of arable land	%arableL	0.668; 0; 0.994; 37.7; 1.00	3.88; 0.423
Operational subsidies	opSubs [CZK ha^{-1}]	7261; 3561; 14050; 29.7; 1.06	125.2; < 0.001
Livestock density (per hectare)	livDens [LU ha^{-1}]	0.517; 0; 1.025; 44.6; 1.13	37.4; < 0.001
Administrative price of land	admPrice [CZK m^{-2}]	5.73; 1.42; 15.50; 62.0; 1.28	85.9; < 0.001
Distance to the capital	Dcapital [km]	144.6; 14; 287; 38.0	–
Distance to regional centre	Dregional [km]	52.0; 8; 106; 43.0	–
Distance to district centre	Ddistrict [km]	18.9; 0; 43; 50.9	–
Distance to municipality with extended competence	DmunExt [km]	10.7; 0; 30; 59.5	–
Distance to municipality with authorized municipal office	DmunAuth [km]	8.2; 0; 21; 58.4	–
Population density in place of business	popDens [inhabitants km^{-2}]	89.57; 10.18; 398.7; 104.2; 0.99	5.52; 0.238
Share of agricultural land in the municipality	%agrLmunic	0.587; 0.200; 0.861; 27.9; 0.99	65.9; < 0.001
Average altitude of cultivated land	alt [m]	485.6; 230; 830; 27.0; 1.01	2.31; 0.679

Source: Sample of farms

Table 2. The basic characteristics of explanatory categorical variables

Variable	Value: data average; min; max; coefficient of variation [%]	K-W ANOVA for land rent p-level	Values (frequency), Friedman's ANOVA
Legal form LegF	Coop: 2203; 300; 5100; 49.0 Stock: 2086; 895; 4521; 45.2 Limited: 1736; 200; 2500; 49.9 Individ: 3000	2011: H = 0.270 p =0.966 2012: H = 0.279 p =0.964 2013: H = 0.755 p =0.860 2014: H = 1.430 p =0.699 2015: H = 2.471 p =0.481	Cooperative (26): $\chi^2 = 83.1$; $p < 0.001$ Joint-stock (14): $\chi^2 = 28.7$; $p < 0.001$ Limited liability (7):$\chi^2 = 18.4$; $p = 0.001$ Individual (1): ---
Economic size EcSize	Small: 1963; 200; 3232; 39.1 Medium: 2393; 1000; 5100; 54.5	2011: H = 0.884; p = 0.347 2012: H = 0.411; p = 0.522 2013: H = 0.274; p = 0.601 2014: H = 1.278; p = 0.258 2015: H = 0.205; p = 0.650	Small (31): $\chi^2 = 86.7$; $p < 0.001$ Medium (17): $\chi^2 = 45.9$; $p < 0.001$
Prevailing production orientation ProdOr	Plant: 3536; 1780; 5100; 37.3 Animal: 1736; 200; 3000; 46.6 Mixed: 1991; 1000; 3232; 30.1	2011: H = 5.071; p = 0.079 2012: H = 8.704; p = 0.013 2013: H = 5.922; p = 0.052 2014: H = 3.442; p = 0.179 2015: H = 10.778; p = 0.005	

Source: Sample of farms

different in individual years between the particular legal forms, as well as the economic size of the enterprise. According to the production orientation, the differences in land rent are significant in two years out of five.

Using the Friedman test, the hypothesis on the compliance of distribution of the rent for the individual values of the category variables over 5 years is tested. In all groups, according to the legal form and the farm size, there are significant differences in the shape of the distribution of land rent. For the production orientation, the Friedman test was not carried out because the production orientation of farms in individual years varies according to the current sales structure.

A number of explanatory variables represent a strong degree of mutual statistical dependence; therefore, in cases where $|r| > 0.6$ a variable that displays a lower correlation coefficient with the land rent will be removed (as suggested by Cipra (2008:118)). The highest degree of linear statistical dependence is given by the variables of utilised agricultural area (UAA) and area of rented agricultural land (rentedL, $r = 0.98$). Therefore, the variable rentedL will not be included in the model because it simultaneously shows a lower dependency degree than the variable UAA. Another pair with a high degree of dependence is the share of arable land (%arableL) and operating subsidies per hectare (opSubs) with $r = –0.9$; in this case, the variable subsidy per hectare will be removed. Negative strong correlation occurs between the share of land under LFA (%LFA) and the administrative land price (admPrice), so the %LFA (%LFA total, shares of LFA in mountain, other and specific areas stay in the model) will not be included in the model. The altitude is heavily correlated with several variables (%LFA – already discharged, %LFA-M and administrative land price). The administrative price shows a stronger dependence on the rent, so the altitude will not be included in the model. Furthermore, the share of agricultural land in the municipality ($r = 0.64$) will be omitted from the model from a pair of the share of arable land (%arableL) and the share of agricultural land in the municipality (%agrLmunic). After the exclusion of these variables, the %LFA-M and %arableL ($r = -0.59$) remains the pair with the strongest correlation.

The most powerful predictors of land rent are time, land share in LFA-M and LFA-O, utilised agricultural area, production orientation on crop production, livestock density and share of rented land (as agricultural variables), and population density as a non-agricultural variable (Table 3).

Land rent is positively and significantly influenced by time. Time enters the model as an ordinal variable. The year 2011 serves as a reference year and for the following years, the regression coefficients are positive and highly significant. Land rent grows between 2011 and 2015 independently of other factors. This trend has been described for the new member states of the Eastern Bloc in Lososová et al. (2013). In the period 2004 – 2009 land rent of the NMS was growing by 10.3%, in Czechia 13% per year.

The coefficients of the share of the land in LFA (mountain and other) are significant. With the increasing share of land in LFA, the land rent decreases, namely faster in mountain areas (for 100% area in LFA-M 901 CZK.ha^{-1}).

The next important factor is the utilized agricultural area. The utilized agricultural area, due to the high proportion of rented land, influences the demand curve of the rent, with the increase of the demand curve upward for increasing UAA.

The production orientation on mixed production serves as a reference variable. Prevailing plant production significantly increases the land rent (the variable representing livestock pro-

Table 3. Estimate of parameters of mixed effect model

Fixed effects	Estimate	Std. error	df	t-value	p-value
Intercept	2136.8	831.6	175	2.57	0.011
Year 1	Reference				
Year 2	178.3	68.9	175	2.59	0.011
Year 3	327.1	70.7	175	4.63	0.000
Year 4	673.6	72.7	175	9.27	0.000
Year 5	982.5	81.1	175	12.12	0.000
LegF – Stock	Reference				
LegF – Coop	172.6	168.0	175	1.03	0.306
LegF – Individual	-527.9	628.1	40	-0.84	0.406
LegF – Limited	80.2	329.4	40	0.24	0.809
ProdOr – Mixed	Reference				
ProdOr – Plant	365.8	149.1	175	2.45	0.015
ProdOr – Animal	110.9	95.7	175	1.16	0.248
EcSize – Small	Reference				
EcSize – Medium	-148.9	123.8	175	-1.20	0.231
popDens	-2.46	1.14	175	-2.15	0.033
Dcapital	2.74	1.70	40	1.62	0.114
Dregional	2.29	3.79	40	0.60	0.549
Ddistrict	-10.30	9.56	40	-1.08	0.288
DmunExt	-18.43	16.18	40	-1.14	0.262
DmunAuth	10.30	22.28	40	0.46	0.646
UAA	0.24	0.10	175	2.47	0.014
%arableL	45.4	341.9	175	0.13	0.895
%rentedL	-1115.5	574.8	175	-1.94	0.054
%LFA-M	-901.2	299.5	175	-3.01	0.003
%LFA-O	-608.4	224.4	175	-2.71	0.007
%LFA-S	-298.2	486.9	175	-0.61	0.541
admPrice	22.8	21.1	175	1.08	0.280
livDens	-475.0	242.9	175	-1.96	0.052
AIC	3378.6				
BIC	3469.6				

Source: Sample of farms

duction is insignificant). While for the predominant livestock production, the average rent is 1736 CZK.ha^{-1} and for mixed production it is 1991 CZK.ha^{-1}, in the case of the prevailing plant production, the rent is 3536 CZK.ha^{-1} (in 2015). Farms focused on crop production pay roughly double the rent (compared to livestock farms) in all years except for 2014 (Figure 2).

This demonstrates the link with land quality and its yield, although other factors such as land use intensity may have an impact. Extensive grazing has a positive influence on soil quality and, on the contrary, intensive use in crop production can, under certain conditions, devastatingly affect the quality of the soil. The connection of rental growth and declining soil quality is pointed out in Lyu et al. (2019).

The share of rented land and the livestock density are at the limit of statistical significance. The impact of livestock density on the land rent is negative in contrast to e.g. Fuchs (2002) or Breustedt & Habermann (2011) who found a positive impact of regional livestock density. They conclude that although livestock subsidies may support farm incomes, they also increase land rent in the long run and the overall effect on farm incomes is dissipated.

Surprising is the negative sign of the coefficient of the population density, which we assumed to have a positive effect (as Huang et al., 2006). Variables of distance from cities usually have a strong effect on the market prices of land for non-agricultural use and do not affect market prices (and similarly rent) land for agricultural use (respectively, interaction between distances from cities and specific plots from existing buildings is an important factor – for use as a future build-up area). According to Sklenička (2013), only the distance to the capital is

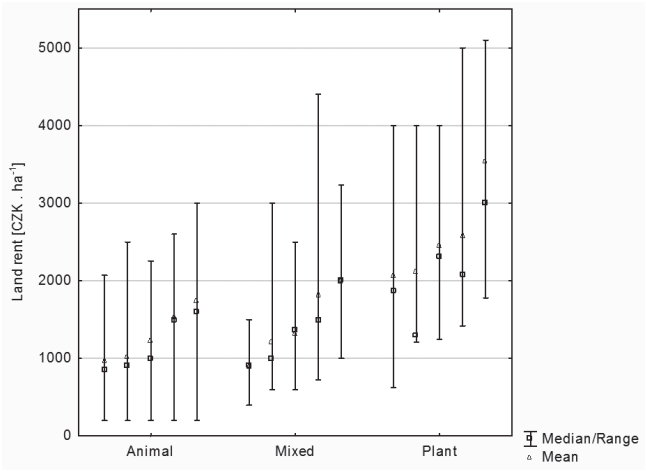

Fig. 2. Box plot of land rent according to production orientation (2011-2015)
Source: Sample of farms

significant in terms of the market price of the land. Also, Drobne et al. (2008) concluded (in the case of Slovenia), that accessibility to the capital significantly influences rural land prices. In our case, the distances from the centres of all levels (from the capital city to the municipalities with the authorized municipal office) are insignificant for the level of the land rent.

Conclusion

In conclusion, land rent growth (along with the growth in prices of agricultural land), affects the majority of the Czech farms due to the high percentage of rented land. Despite the fact that these farms are trying to purchase rented land and so the share of rented land is decreasing annually, such a share percentage is still high above the EU average.

Farmers fear that the cost of land rent may negatively affect their farm plans in the near future, and therefore, the article is trying to describe land rent development and define the most influential items behind the land rent procedure.

Regardless of the limited data available (using the database of the agricultural farms within 2011 – 2015) it is clear that the land rent growth rate significantly exceeds the growth rate of profit, revenues and subsidies.

Our mixed-effect model allows identification of factors influencing the agricultural land rent price in Czechia. The land rent shows significant trend. Out of the observed factors, the significant agricultural factors are land share in mountain and other LFAs, the area of utilised agricultural land, production orientation on crop production, livestock density and share of rented land. Population density is the only significant non-agricultural factor.

Acknowledgement

This study is an output of Research Program of Faculty of Economics, University of South Bohemia No. IGS01C1. The authors thank Justin Calvin Schaefer for English proofreading.

References

Akerson, C. B. (2009). Capitalization Theory and Techniques. (3rd ed.). Appraisal Inst.

Bański, J. (2017). The consequences of changes of ownership for agricultural land use in Central European countries following the collapse of the Eastern Bloc. *Land Use Policy*, *66,* 120–130. doi: 10.1016/j.landusepol.2017.04.045

Barnard, C., Nehring, R. D., Ryan. J. & Collender. R. (2001). Higher cropland value from farm program payments: who gains? *Agricultural Outlook*, 26–30.

Boinon, J. P., Kroll, J. C., Lepicier, D., Leseigneur, A. & Viallon, J. B. (2007). Enforcement of the 2003 CAP reform in 5 countries of the West European Union: Consequences on land rent and land market. *Agricultural Economics-Zemedelska ekonomika*, *53(4),* 173–183.doi: 10.17221/860-AGRICECON.

Breustedt, G. & Habermann, H. (2011). The incidence of EU per-hectare payments on farmland rental rates: A spatial econometric analysis of German farm-level data. *Journal of Agricultural Economics*, *62(1),* 225–243. doi: 10.1111/j.1477-9552.2010.00286.x

Burger, A. (1998). Land valuation and land rents in Hungary. *Land Use Policy*, *15(3),* 191–201. doi: 10.1016/S0264-8377(98)00013-1

Choumert, J. & Phélinas, P. (2015). Determinants of agricultural land values in Argentina. *Ecological Economics, 110*, 134–140. doi: 10.1016/j.ecolecon.2014.12.024

Ciaian, P., Kancs, D. & Swinnen, J. F. M. (2010). EU land markets and the common agricultural policy. Centre for European Policy Studies, Brussels.

Cipra, T. (2008). Financial econometrics. Praha: *Ekopress.*

Clark, J. S., Fulton, M. & Scott, J. T. Jr. (1993). The inconsistency of land values. Land rents and capitalization formulas. *American Journal of Agricultural Economics, 75(1),* 147–155. doi: 10.2307/1242963

Craig, L. A., Palmquist, R. B. & Weiss, T. (1998). Transportation improvements and land values in the Antebellum United States: A Hedonic Approach. *Journal of Real Estate Finance and Economics, 16(2),* 173–89.

Czyżewski, B., Przekota, G. & Poczta-Wajda, A. (2017). The incidence of agricultural policy on the land market in Poland: Two-dimensional and multilevel analysis. *Land Use Policy*, *63,* 174–185. doi: 10.1016/j.landusepol.2017.01.016

Dirgasová, K., Bandlerová, A. & Lazíková, J. (2017).Factors affecting the price of agricultural land in Slovakia. *Journal of Central European Agriculture*, *18(2),* 291–304. doi: 10.5513/jcea01/18.2.1901

Doucha, T. & Divila, E. (2005). Possible impacts of the Czech agricultural policy after the EU accession on the land market and land usage. *Agricultural Economics-Zemedelska ekonomika*, *51(5).* 185–193. doi: 10.17221/5093-AGRICECON

Drobne, S., Lisec, A. & Bogataj, M. (2008). GIS Analysis of Rural

Land Market in Slovenia. In: *11th AGILE International Conference on Geographic Information Science 2008*. Girona, 5-8th May 2008.

EC (2016). *European Commission Research Paper: Agricultural Land Prices and Rents data for the European Union*, December 2016.

FADN (2018). The Farm Accountancy Data Network. Standard Results. Available at http://ec.europa.eu/agriculture/rica/database/database_en.cfm.

Falk, B. (1991). Formally testing the present value model of farmland prices. *American Journal of Agricultural Economics*, *73(1),* 1–10.

Featherstone, A. M. & Baker, T. G. (1988). Effects of reduced price and income supports on farmland rent and value. *North Central Journal of Agricultural Economics, 10(2),* 177–190.

Feichtinger, P. & Salhofer, K. (2016). Decoupled Single Farm Payments of the CAP and Land Rental Prices. *Diskussionspapier DP-65-2016*, Institut für nachhaltige Wirtschaftsentwicklung.

Fuchs, C. (2002). The influence of per-hectare premiums on prices for rented agricultural area and on agricultural land prices. *Agrarwirtschaft*, *51(8),* 396–404.

Guyomard, H., Le Mouël, C. & Gohin, A. (2004). Impacts of alternative agricultural income support schemes on multiple policy goals. *European Review of Agricultural Economics, 31(2),* 125–148. doi: 10.1093/erae/31.2.125

Hamza, E. & Miskó, K. (2007). Characteristics of land market in Hungary at the time of the EU accession. *Agricultural Economics-Zemedelska ekonomika*, *53(4),* 161–168.doi: 10.17221/864-AGRICECON

Happe, K. & Balmann, A. (2003). Structural efficiency and income effects of direct payments: an agent-based analysis of the alternative payment schemes for the German Region Hohenlohe, *IAAE Annual Meeting*, Durban.

Huang, H., Miller, G. Y., Sherick, B. J. & Goméz, M. I. (2006). Factors influencing Illinois Farmland Values. *American Journal of Agricultural Economics*, *88(2),* 458–470.

Kilian, S., Anton, J., Salhofer, K. & Roder, N. (2012). Impacts of 2003 CAP reform on land rental prices and capitalization. *Land Use Policy*, *29(4),* 789–797. doi: 10.1016/j.landusepol.2011.12.004

Kocur-Bera, K. (2016). Determinants of agricultural land price in Poland – a case study covering a part of the Euroregion Baltic. *Cahiers Agricultures*, *25(2),* 25004. doi: 10.1051/cagri/2016013

Latruffe, L., Doucha, T., Le Mouël, Ch., Medonos, T. & Voltr, V. (2008). Capitalisation of the government support in agricultural land prices in the Czech Republic. *Agricultural Economics-Zemedelska ekonomika*, *54(10),* 451–460. doi: 10.17221/278-AGRICECON

Lence, S. H. & Mishra, A. K. (2003). The impacts of different farm programs on cash rents. *American Journal of Agricultural Economics, 85(3),* 753–761.

Lososová, J., Zdeněk, R. & Kopta, D. (2013). Differences in the Land Rent among EU Countries. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, *LXI,* 2435–2444.

Lososová, J., Zdeněk, R. & Kopta, D. (2017). Development of the main production and economic indicators of Czech farms. *Custos e Agronegocio*, *13(2),* 88–109.

Lošťák, M., Hudečková, H. & Rikkon, S. (1999). Land ownership and the challenge of "late modernity" (new institutional settings and behaviour of Czech landowners). *Agricultural Economics-Zemedelska ekonomika*, *45(11),* 481–490.

Lyu, K., Chen, K. & Zhang, H. (2019). Relationship between land tenure and soil quality: Evidence from China's soil fertility analysis. *Land Use Policy, 80,* 345–361.

Mařík, M. (2011). Advanced Business Valuation Methods. A deeper look at selected problems. Praha: *Ekopress.*

Marks-Bielska, R. (2013). Factors shaping the agricultural land market in Poland. *Land Use Policy*, *30(1),* 791–799. doi: 10.1016/j.landusepol.2012.06.003

Patton, M., Kostov, P., Mcerlean, S. & Moss, J. (2008).Assessing the influence of direct payments on the rental value of agricultural land. *Food Policy*, *33(5),* 397–405. doi: 10.1016/j.foodpol.2008.01.001

Pinheiro, J., Bates, D., DebRoy, S., Sarkar, D. & R Core Team (2017). nlme: Linear and Nonlinear Mixed Effects Models. *R package version 3.1-131*, Available at https://CRAN.R-project.org/package=nlme.

R Core Team (2017). *R: A language and environment for statistical computing. R Foundation for Statistical Computing*, Vienna, Austria.Available at https://www.R-project.org.

Roberts, M. J., Kirwan, B. & Hopkins, J. (2003). The incidence of government program payments on agricultural land rents: the challenges of identification. *American Journal of Agricultural Economics, 85(3),* 762–769.

Sklenicka, P., Janovska, V., Salek, M., Vlasak, J. & Molnarova, K. (2014). The Farmland Rental Paradox: extreme land ownership fragmentation as a new form of land degradation. *Land Use Policy*, *38,* 587–593. doi: 10.1016/j.landusepol.2014.01.006

Sklenicka, P., Molnarova, K., Pixova, K. C. & Salek, M. (2013). Factors affecting farmland prices in the Czech Republic. *Land Use Policy, 30(1),* 130–136. doi: 10.1016/j.landusepol.2012.03.005

Stoyneva, D. (2007). Land market and e-services in Bulgaria. *Agricultural Economics-Zemedelska ekonomika, 53(4),* 167–172. doi: 10.17221/868-AGRICECON

Střeleček, F., Lososová, J. & Zdeněk, R. (2010). The relations between the rent and price of agricultural land in the EU countries. *Agricultural Econonomics-Zemedelska ekonomika*, *56(12),* 558–568.doi: 10.17221/130/2010-AGRICECON

Ustaoglu, E., Castillo, C. P., Jacobs-Crisioni, C. & Lavalle, C. (2016). Economic evaluation of agricultural land to assess land use changes. *Land Use Policy*, *56,* 125–146. doi: 10.1016/j.landusepol.2016.04.020

Voltr, V. (2000).E U Accession and the Land Market in the Czech Republic. In: *Land ownership, Land Markets and their influence on the Efficiency of Agricultural Production in central and Eastern Europe*. IAMO Studies, *9*, 273–283.

Zuur, A., Ieno, E. N., Walker, N., Saveliev, A. A. & Smith, G. M. (2009). *Mixed Effects Models and Extensions in Ecology with R*. New York: *Springer.*

Received: January, 7, 2019; *Accepted:* July, 1, 2019; *Published:* December, 31, 2019