The Effect of Heterogeneous Buyers on Agricultural Land Prices: The Case of the Czech Land Market

Auswirkungen unterschiedlicher Käufergruppen auf Bodenpreise am Beispiel des tschechischen Bodenmarktes

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Abstract

This paper analyses how different types of buyers affect the farmland price. We specify a flexible hedonic land pricing model that allows for non-uniform valuation of land characteristics among buyers. Data on 579 land sale contracts from five districts of the Czech Republic from 2008-2010 are utilised in the study. The results provide strong evidence of buyer-specific valuation of land's productive and site characteristics as well as systemic differences in land market conditions among groups of buyers, both of which affect the land price. Non-agricultural buyers are observed to significantly overbid agricultural buyers on land location and site characteristics rather than productive qualities. Among agricultural buyers, joint stock companies and cooperatives enjoy major land price discounts, while individual private farms and limited liability companies face land market access constraints that are surmountable only through paying high price premiums. These observations have important implications for future land ownership structure and land use efficiency.

Key Words

land price; hedonic pricing model; heterogeneous buyers; Czech Republic

Zusammenfassung

Der Aufsatz analysiert, wie unterschiedliche Typen von Käufern den Bodenpreis beeinflussen. Wir spezifizieren ein flexibles hedonisches Bodenpreis-Modell, das Unterschiede in der Bewertung von Bodeneigenschaften durch verschiedene Käufer erfasst. Daten aus 579 Verträgen zu Bodenkäufern aus fünf tschechischen Landkreisen der Jahre 2008 bis 2011 liegen der Analyse zugrunde. Die Ergebnisse liefern eindeutige Belege, dass sowohl käuferspezifische Bewertungen der Bodenproduktivität und Standorteigenschaften als auch systematische Unterschiede in den Marktbedingungen zwischen den Gruppen von Käufern den Preis beeinflussen. Nichtlandwirtschaftliche Käufer bieten signifikant höhere Preise als Käufer mit einem landwirtschaftlichen Hintergrund, dabei achten sie weniger auf die Bodenqualität, sondern schätzen mehr die Lage und andere Standortcharakteristika. Bei den landwirtschaftlichen Käufern werden Aktiengesellschaften und Genossenschaften oft große Preisnachlässe gewährt. Privatlandwirte und GmbHs sehen sich dagegen Beschränkungen im Zugang zum Bodenmarkt ausgesetzt, die nur durch Zahlung von signifikanten Preisprämien überwindbar sind. Diese Ergebnisse haben wichtige Implikationen für die zukünftige Bodeneigentumsstruktur und Effizienz der Bodennutzung.

Schlüsselwörter

Bodenpreis; hedonisches Preismodell; heterogene Käufer; Tschechische Republik

1 Introduction

The functioning of agricultural land markets has extensive implications for the efficiency of land allocation for agricultural production, as well as for the sustainable development of rural areas. Land markets not only impact the cost at which land will be acquired, but also who will acquire it, and thus how the land will be used in the future. The future control of farmland can be assumed to be transferred to those market participants with the greatest bidding potential, or to market actors with information advantages, greater bargaining power, stronger relationships to sellers, or other forms of market advantages. Despite the possible effect on efficient land allocation, rural landscape and sustainable development, the question of who has the greater potential or better terms of trade for acquiring agricultural land has received little attention in the literature. This study aims to fill this gap and to contribute to a better understanding of the functioning of land markets by analysing buyer-specific effects on land price formation.

Due to the heterogeneity of their land buyers, the land markets in Central and Eastern Europe countries (CEECs) can represent particularly interesting case studies. The combination of the socialist past and the processes of transition to market economies have brought about momentous land ownership fragmentation, as well as a great diversity of farms that cultivate agricultural land (e.g., SWINNEN, 1998; DE JANVRY and SADOUVLET, 2001; cf. Section 2 for the case of the Czech Republic). In CEECs with a dual farm structure, a significant share of the cultivated farmland is leased by large-scale farms. Therefore, as of now, how land is used or cultivated is still indirectly controlled by small-plot holders who predominantly live in rural areas and exhibit rural values. However, with the improving institutional land market environment, economic (efficiency) as well as intrinsic incentives can be expected to further spur activity on the land markets and lead to a concentration of land ownership and/or to separation of land ownership from local interests. Particularly in cases of such unconsolidated farm structures, knowledge of possible outcomes of increasing competition over land control can be of great importance.

As mentioned above, the effects of differences in buyers' characteristics on land prices have received limited attention in the literature, and not only in the context of transition. In existing studies, the role of heterogeneous buyers in determining land prices has been recognised due to disparities in bidding potentials (HARRIS and NEHRING, 1976; PEDERSON, 1982; DUNFORD, MARTI and MITTELHAMMER, 1985), or the buyers' specific relationship to land owners (PERRY and ROBISON, 2001; TSOODLE, GOLDEN and FEATHERSTONE, 2006; KOSTOV, 2010). HARRIS and NEHRING (1976) were the first to develop a theoretical model of differentials in bidding potentials among farmland buyers. These authors find that farm characteristics such as income and its variability, wealth, degree of risk aversion, rate of pure time preference and expected rate of growth have an impact on the buyer's maximum bidding price. Indeed, HARRIS and NEHRING's farm group comparison indicates a land price-increasing effect of farm size. However, this is found to be conditioned on other farm characteristics such as attitude towards risk. PEDERSON (1982) extended HARRIS and NEHRING's model by incorporating an asset pricing model developed by BAKER (1982). PEDERSON's model application indicates that larger farms have a competitive bidding advantage over smaller farms within the same land market. Nevertheless, it is not the economies of size, but rather tax brackets and differences in risk aversion that explain these findings. Furthermore, in their study of buyer-type effects on land prices, DUNFORD, MARTI and MITTELHAMMER (1985) show that partnerships and corporations pay higher prices for land than do individuals. These authors explain this finding mainly through the better access to a broader financial base enjoyed by partnerships and corporations. PERRY and ROBISON (2001), TSOODLE, GOLDEN and FEATHERSTONE (2006), and KOSTOV (2010) analyse land price in connection to personal relationships between buyers and sellers. These authors argue that a significant price discount to buyers who have a personal relationship to sellers is driven by the existence of social capital that allows for a better and faster information exchange. All of the aforementioned studies (except the study by KOSTOV (2010), who examines Northern Ireland) analyse the land market in various states and regions of the U.S.A. The role of heterogeneous buyers in European land markets, on the other hand, remains mostly underexplored.

Since land represents a good of heterogeneous characteristics and qualities, most of the discussed empirical studies analysed the effect of different buyer characteristics on land prices in the framework of a hedonic pricing model. The hedonic land price model applications that do not include land market actors' and transactions' characteristics assume that the land and land site attributes are valued uniformly by all market participants, and no deviations in terms of trade exist among these participants. Other studies in which variables for buyers' characteristics enter the main hedonic function perceive such attributes as buyer-specific shifters of the land price and disregard that the valuation of land characteristics and terms of trade can systemically vary among the buyers. Such assumptions imply, for example, that agricultural and non-agricultural buyers both identically value land and site characteristics such as proximity to urban areas or land's productive potential. Similar to KOSTOV (2010), we challenge the uniform effect assumptions. KOSTOV (2010) addresses this issue by considering a more flexible non-parametric model that assumes that buyer characteristics and personal relationships exert a non-uniform effect on the implicit (hedonic) prices of land characteristics. In our study, we deliver an application of a parametric model that allows for an analogical flexibility, and deem the non-uniform price effect as resulting from a buyer-specific valuation of individual land characteristics and from buyer-specific (also other than relationship-based) terms of trade.

The study was carried out on data from 579 farmland sale contracts in the Czech Republic that were concluded in 2008-2010. We consider five groups of buyers, of which four are agricultural: individual farmers, limited liability companies, cooperatives and joint stock companies. Non-agricultural buyers represent the fifth group. Characterisations of these groups of buyers, together with the description of the Czech land market, are provided in the next section. Section three describes data and variables, and delivers hypotheses on buyer type-related land price effects. The following section presents the specification of the econometric hedonic pricing model. Section five delivers empirical results, and section six concludes the study.

2 Czech Land Market and Farm Structure

At 3.5 million hectares, Czech agricultural land represents 45% of the total geographic area of the country (CUZK, 2012). The agricultural land is currently owned by ca. 1.1 million plot holders[1], which implies a highly fragmented land ownership. This fragmentation has mainly resulted from private ownership restoration during the country's transition to a market economy. In addition to returning historic ownership rights, private ownership has been restored through the privatisation of state land. Since 1999 the Land Fund, which is the authority responsible for state land administration and privatisation, has offered approximately 600,000 hectares of state agricultural land for sale, of which the majority (87.5 % by 2010) has been sold (MA, 2012a).

Since there was no agricultural land market during socialism, institutions necessary for its proper functioning had to be established during transition (land appraisement, physical identification of the plot in the terrain, mapping, etc.). An administrative land price, which was designed to serve mainly for taxation purposes, was used for individual plot appraisement for sale transactions. At the beginning of the 1990s, less than 0.5% of agricultural land was traded annually. Today, agricultural land trade amounts to more than 2.5% of agricultural land (UZEI, 2012). However, the peak of land market activity was observed in the time period 2005-2007, 6-8 years after the initiation of state land privatisation, when traded land accounted for 3.5 % of all agricultural land (UZEI, 2012). During this period, the trade of state land exceeded the trade of private land, despite some restrictions on state land sales; for example, preferential market access given to farmers.[2]

The increasing demand for land resulted in a unit price increase of 77% between 2005 and 2011 (MA, 2012b). Despite stable growth of 6-10% annually, agricultural land prices are still significantly below the EU-15 average[3]; parcels with average soil quality and topographic characteristics are currently traded between €3,000-5,000 per hectare (MA, 2012b), varying mainly with geographic location and proximity to towns. Recently, the economic recession is believed to have slowed down the increasing price rate. However, since the sale of state land will end in the near future (reducing the overall supply of agricultural land for sale) the land prices can be expected to rise faster again.

The fragmentation of farmland ownership in the Czech Republic had only a minor impact on farm structure development. Although overall farm structure has changed markedly since 1989, the present structure still reveals an extreme dual character that is specific to countries with a forced collectivisation past. From the nearly 25,000 farms with an agricultural land area above 1 ha in 2011, approximately 1.4% are farms larger than 2,000 ha; however, this small share of farms cultivates 28% of total utilised agricultural land. On the other hand, farms with 1-10 ha, which represent 37% of all farms, utilise only slightly above 1% of total agricultural land.[4]

[1] The number of land owners was estimated using data from the Czech Office for Surveying, Mapping and Cadastre (CUZK) from 2012.

[2] The already prioritised access to state land provided to individual farmers was further stimulated by the free interest rates offered by the government to farmers who bought state land.

[3] In 2005, the average price for agricultural land in EU-15 (except Italy, Grece, Portugal and Austria) was 13.362 €/ha (EUROSTAT, 2013). Also in Member States, for which data was not available in 2005, the agricultural land price in earlier years is on average higher than the price for agricultural land in the Czech Republic in 2011.

[4] These statistics were extracted from the database Land Parcel Identification System (LPIS), which was administered by the Ministry of Agriculture of the Czech Republic. This register only contains farms that cultivate land.

Table 1. Czech farm structure development, 1989-2010

Farm type	Year	Number of farms	Average (per farm) size of used land (ha)	Share of total land (%)	Share of own land in used land (%)
State farms	1989	174	6 261	29.2	-
	1995[1)]	80	660	1.5	-
	2000[1)]	87	362	0.9	24.6 (state)
	2010[2)]	6	1 500	0.3	0 (state)
Cooperatives	1989	1 024	2 561	70.4	-
	1995[1)]	1 105	1 507	47.0	-
	2000[1)]	723	1 465	29.3	0.6
	2010[2)]	527	1 392	21.1	7.1
Corporations	1989	-	-	-	-
	1995[1)]	1 196	833	28.1	-
	2000[1)]	1 726	914	43.7	1.2
	2010[2)]	2 432	742	49.0	15.2
of that, JSCs	1989	-	-	-	-
	1995[1)]	223	1 206	7.6	-
	2000[1)]	519	1 502	21.6	0.8
	2010[2)]	649	1 374	25.6	10.9
of that, LLCs	1989	-	-	-	-
	1995[1)]	945	756	20.2	-
	2000[1)]	1 171	669	21.7	1.7
	2010[2)]	1 751	458	23.0	20.0
Physical entities	1989	3 205	4	0.4	-
	1995[1)]	20 820	40	23.2	-
	2000[1)]	24 053	39	25.8	28.2
	2010[2)]	19 781	51	29.1	48.1
of that, IPFs	1989	-	-	-	-
	1995[1)]	19 648	39	21.6	-
	2000[1)]	20 115	42	23.5	26.6
	2010[2)]	15 321	62	27.3	47.0
Total	1989	4 403	846	100	-
	1995[1)]	23 215	153	100	-
	2000[1)]	26 640	136	100	8.4
	2010[2)]	22 746	152	100	23.5

Notes: [1)] Data includes only farms using more than 3 hectares of agricultural land. [2)] Data includes only farms using more than 5 hectares of agricultural land.
Sources: MA (1994), CZSO (1996, 2001, 2012).

The farm structure in the Czech Republic can be well characterised through established legal forms in which each represents not only a specific size group and governance structure, but also a transformation path. There are four main legal forms for farm entities: individual private farms (IPFs), limited liability companies (LLCs), joint stock companies (JSCs), and cooperatives (cf. Table 1). According to the 2010 Farm Structural Survey (CZSO, 2012), IPFs with more than 5 ha cultivate 27% of total utilised agricultural land. LLCs, categorised as medium-scale farms with an average of 458 ha, use 23% of all agricultural land. The remaining two types of legal entities, JSC and producer cooperatives, jointly utilise almost 47% of all agricultural land. The distribution of land among these legal forms has changed over the course of transition, especially in recent years, which have been marked by spontaneous rather than politically-driven structural changes.

The most momentous changes in farm structure occurred in the early years of transition, which were characterised by reform policies aimed at renewing private ownership and re-establishing individual private farms. According to these policies, most of the land was restituted to its former owners during the early years of transition. Restituents who decided to establish their own farms were given preferential rights to restitutions of agricultural assets. As a result of these policies, most IPFs were established in the early 1990s, and despite these policies, only 24% of the agricultural land ended up being used by these farms. More than 70% of agricultural land was leased from the 'new' land owners by the more-or-less transformed cooperatives and corporate farms (DOUCHA, MATHIJS and SWINNEN, 2001). The increasing average size of IPFs, together with their continuously increasing share of utilised agricultural land over the following years, could be attributed to their relatively good and improving performance supported by the stabilisation of market conditions, commodity price revitalisation, and changes in public transfers. Still, in spite of their gradually increasing position in land use, their share of leased land has not increased. On the contrary, this share decreased while the proportion of their own land increased from 27% in 2000 to 46% in 2010, which currently makes them the farms with the highest share of their own land.

Producer cooperatives are mostly the direct successors of former (socialistic) collective farms that were subjected to transformation reforms. Despite these reforms, cooperatives still cultivated 47% of Czech agricultural land in 1995 and 21% in 2010. The gradual decline of cooperatives in the Czech Republic has been accompanied by their transformation mainly to JSCs, which have significantly increased in numbers over the years. A study by CURTISS, RATINGER and MEDONOS (2006) suggests that it was mainly the larger and more effective cooperatives that were transformed to JSCs after 1997, the year in which all cooperatives were legally obliged to have repaid their transformation debts.[5] The structural differences between JSCs and cooperatives regarding size of labour force, land, or number of owners (members) are rather small. The main dissimilarity between these two forms of farming may lie in the decision-making process. Cooperatives are generally considered to have a more democratic governance structure. However, many Czech cooperatives changed their voting system from one-member-one-vote to a system where voting rights reflect the member's capital share (CURTISS, RATINGER and MEDONOS, 2006). Therefore, in the specific conditions of Czech agriculture, these two types of farms can be considered relatively similar.

However, the largest spontaneous dynamics are displayed by LLCs, the number of which has increased from 1,171 in 2000 to 1,751 in 2010. LLCs were often the successors of former state farms or were established jointly by the largest restituents to land and assets of cooperatives. A characteristic feature of this form is concentrated ownership (an average of 3-4 owners), and high transformation indebtedness (CURTISSOVÁ et al., 2006; DAVIDOVA et al., 2001). Also, the higher share of own land in total land used by LLCs distinguishes these enterprises from the other legal entities.

3 Data, Variables and Predicted Price Effects

Data and Variables

The data was extracted from individual contracts on farmland sales transactions registered with the Czech Cadastral and Mapping Office from 2008-2010. We obtained a total of 579 observations (contracts) from five districts[6] of the Czech Republic. These contracts include information on number and size of plots subject to the transaction, price of the farmland, plots' land cover (grassland versus arable land) and location, as well as the identity of the contractual agents. The geographic information allows us to derive variables such as plots' distance to the municipal centre or the district town, but also distances between centroids of traded plots.

To structure the description of the hedonic variables, we follow TSOODLE, GOLDEN and FEATHERSTONE's (2006) categorisation, which distinguishes four groups of land price components: production, transaction, consumption, and speculation. In our empirical model, the *production* component is represented by administrative land price, denoted *admin_price*. This price is based on land quality points that are derived from the following characteristics: climatic region, soil type, slope and exposure with respect to

[5] Transformation indebtedness originates in the asset transformation of cooperatives, which was often carried over to the successor companies. This is the companies' indebtedness toward eligible persons from transformation who acquired the right to a capital share in the cooperative or company based on a historic asset deposit and/or based on years of employment in the former collective farm.

[6] The districts were chosen to represent the country's heterogeneity in the land market and farming conditions, as well as their attractiveness to non-agricultural investors. From each district, 150 contracts were randomly selected; from these, contracts that included buildings or constructions were excluded.

cardinal points, soil depth, and frame structure. It is therefore a suitable variable for depicting land quality and thus the land's productive potential. As each plot has non-uniform land quality and thus more than one administrative price, we consider the prevailing administrative price on the plot and calculate a weighted administrative price average for all plots subject to the sale contract. To keep the administrative price and thus land quality constant over time, its 2009 value is considered in the model.[7]

The *transactional* component is represented by the following variables: total size (*area*) of farmland and number of plots (*nr_plots*) purchased through the contract, number of farms per km^2 (*nr_farms*)[8] in the cadastre in which the farmland transactions took place, and two time dummy variables (*year09*, *year10*; 2008 being the base year). The time dummies are intended to capture the dynamics of the land market development due to, for example, information accumulation and spread, the changing legal framework for farmland transactions (e.g., taxation or, importantly for transition countries such as the Czech Republic, state land privatisation regulations), and changes in assessor or realtor fees. The first two variables in this group depict characteristics of the sale transaction that can impact the unit transaction costs (per hectare of land) related to the process of purchasing and selling farmland, which are possibly more important for smaller-scale buyers who could also be more financially constrained. These costs would motivate one to bid a higher price for larger plots and more land in one sale transaction. TSOODLE, GOLDEN and FEATHERSTONE (2006: 128), however, derive a contrary prediction, which originates in the argument that the size of land plots increases the financial constraints, therefore limits the quantity of potential buyers and thus reduces demand. The effect of competition among buyers is in our model approximated through another variable, the number of farms per km^2 in the cadastre. Here, the greater density of farms, which could also capture the lack of local monopoly of a large agricultural company, is expected to increase the bidding price. The last variable in this category is the sale of municipal land (*municipal_sale*). Compared to sales by individual land owners, information on municipal land sales is publically accessible. Public information accessibility could be expected to increase the competition among buyers. Also, other transaction costs such as assessor fees could be reduced in the case of municipal sales, thereby allowing buyers to offer higher prices.

Unlike TSOODLE, GOLDEN and FEATHERSTONE (2006), we consider variables that possibly explain the *consumptive* and *speculative* components of farmland price jointly, as many of the variables can approximate both components. The *consumptive* component of the farmland price reflects the perceived (intrinsic) value of the land by the seller and buyer, while the *speculative* component pertains to their land price development expectations (TSOODLE, GOLDEN and FEATHERSTONE, 2006: 128). Farmers and other buyers who appreciate rural life might value farmland ownership differently than investors with less appreciation of the rural experience (POPE and GOODWIN, 1984: 750), for example urban land investors who invest for expected land price appreciation (i.e., they perceive land as an alternative investment to other capital investments) (REYNOLDS and CLOUSER, 2012). The perceived land value can also change with the lands' location with respect to other places of personal valuation, such as towns offering greater job opportunities. To capture the *consumptive* component of farmland price, we include variables such as the distances to the nearest municipality (*distance_munic*) and the district town (*distance_distrtown*), which were calculated as the distance of a straight line between the plots' centroid and the municipality and district town centroid, respectively. Furthermore, to reproduce the price effect of differences in market conditions, as well as attractiveness and distinctive characteristics (e.g., economic growth, demographic changes, unemployment) of the five regions for which data is available, four district dummy variables (*district_oc*, *district_pe*, *district_hb*, and *district_kt*) are included. The district dummies are, however, included mainly as control variables and their price effect will not be interpreted in great detail.

The last group of variables specifies different types of buyers. We consider that systemic differences in land prices among buyers can relate to differences in: (i) the buyers' bidding potentials (determined mainly by the expected returns on land, i.e., the *productive*

[7] The administrative price is increased irregularly to adjust its value to real estate inflation. Within the analysed period, the main administrative price increase was realised at the beginning of 2009 (on average by 1 CZK/m^2). With the intention that the administrative price will approximate land quality that is assumed to be unchanged by the administrative price increase, the official price increase will be captured by the parameter estimate on time dummy variables.

[8] This information was drawn from the database of the public land parcel register (LPIS).

Table 2. Description and summary statistics of variables (579 observations)

Variables	Description (unit)	Mean (frequency of value 1)	Stand. dev.	Min.	Max.
Dependent variable					
log(*p*)	Logarithm of unit price for sold farmland (CZK/m^2)	1.985	0.777	-1.238	4.484
Explanatory variables *x*					
admin_price	Administrative price 2009 (CZK/m^2)	8.103	4.729	1.010	17.250
nr_plots	Number of parcels sold	2.838	5.263	1.000	64.000
area	Total area of sold plots (ha)	2.604	3.636	0.010	46.449
year09	1 = 2009; 0 = 2008, 2010	(128)		0	1
year10	1 = 2010; 0 = 2008, 2009	(273)		0	1
nr_farm	Number of farms in cadastre per km^2	2.122	1.331	0.370	6.390
district_oc	1 = land sold in district Olomouc	(169)		0	1
district_pe	1 = land sold in district Prague East	(86)		0	1
district_hb	1 = land sold in district Havlíčkův Brod	(60)		0	1
district_kt	1 = land sold in district Klatovy	(106)		0	1
distance_munic	Distance of sold parcels to municipality centre (km)	8.359	4.611	0.568	26.403
distance_distrtown	Distance of sold parcels to district city (km)	15.648	7.177	2.501	31.003
municipal_sale	1 = land sold by state or municipality, 0 = land sold by private persons or entities	(20)		0	1
Explanatory variables *z*					
nonag_buyer	1= buyer is a private person or non-agricultural business	(272)		0	1
ind_farm	1 = buyer is an individual farmer	(161)		0	1
llc	1 = buyer is an agricultural LLC	(53)		0	1
coop	1 = buyer is an agricultural cooperative	(35)		0	1
jsc	1 = buyer is an agricultural JSC	(58)		0	1

Note: the observation unit is a sale contract on farm land.
Source: own calculations

land price component); (ii) intrinsic land valuations (*consumptive* component); (iii) degree of speculative intentions (*speculative* component); and (iv) land market conditions (terms of trade, i.e., *transactional* components). The data permits us to distinguish between non-agricultural and agricultural buyers, as well as between different types of agricultural buyers. Among agricultural buyers, we differentiate between IPFs (*ind_farm*), LLCs (*llc*), cooperatives (*coop*), and JSCs (*jsc*)[9]. Descriptive statistics of all described variables are presented in Table 2.

Land Price Effect of Heterogeneous Buyers – Discussion and Predictions

Empirical studies provide strong evidence of increases in the farmland value due to higher non-agricultural demand (e.g., REYNOLDS and CLOUSER, 2012), which suggests momentous differences in bidding potentials between agricultural and non-agricultural buyers. We postulate that the main differences between these two groups of buyers originate in the distinct composition of their utility functions, where the utility component related to agricultural land use and utility from future land development assume different values for agricultural and non-agricultural buyers. The rationale behind this argument is twofold. First, it can be found in differences in the intrinsic valuation of actively cultivating land and living in rural areas (cf. POPE and GOODWIN, 1984) that lowers the agricultural buyers' intention of speculative sales. Secondly, it is grounded in the differences in returns to agricultural use of land

[9] Due to the availability of the business identification numbers in the land sale contracts, it was possible to identify the legal form of the buyers in the Czech business register.

given by higher specialization and expertise in agricultural production possessed by agricultural land owners. Also, because of the relatively low rents and high transaction and agency costs of leasing land for agricultural use, non-agricultural buyers could be expected to particularly demand and appreciate land that has greater development potential and that would promise future rents from development (for example, land closer to towns or municipalities) rather than rent from lease. These investors could therefore be expected to have additional capital to develop the land for their own use in the future, or have speculative plans related to the expectation of future land value appreciation. Therefore, the empirical model is predicted to display a greater positive price shift parameter with respect to non-agricultural buyers' groups, as well as higher non-agricultural buyer-specific price sensitivity (elasticity) to land site characteristics such as distance to a town or a municipality. On the other hand, land quality is assumed to not significantly impact the non-agricultural buyers' valuation of land. Also, investing into land for the purpose of depositing free savings instead of investing into land as a production factor will constrain the non-agricultural buyers' investment to the amount of savings, which is expected to result in a decreasing price over an increasing land area. The opposite effect of land area purchased within one contract due to the decreasing unit transaction costs is expected for agricultural buyers, particularly financially unconstrained buyers.

To derive hypotheses on the effect of the specified types of agricultural buyers, we mainly refer to theoretical model, which predicts that the maximum bid price for a unit of land increases with increasing expected income from land (e.g., due to economies of scale in production or marketing, specialization or higher productivity of better management), decreasing risk aversion, decreasing variability of income from land, and increasing expected rate of income growth (HARRIS and NEHRING 1976: 163). Predicting bid price differences among different types of agricultural buyers based on expected returns from land is challenging due to inconclusive theoretical treatment of the topic, as well as the great ambiguity of empirical studies. We refer below to existing empirical studies carried out on Czech farms. Applying total factor productivity, HUGHES (1998) finds that Czech individual farms perform better in livestock production, but not crop production, and cooperatives outperform farming companies. MATHIJS and SWINNEN (2000) confirm the former finding by applying Data Envelopment Analysis; however, they do not find significant efficiency differences between cooperatives and corporate farms. Also, DAVIDOVA et al. (2005) find that individual farms display better performance and profitability indices than cooperatives and corporations. The most recent study of Czech large-scale farms by CURTISS, RATINGER and MEDONOS (2006) shows that LLCs have significantly higher profitability and labour productivity indicators, particularly higher investment activity than cooperatives and JSCs. If we consider the last study as depicting the most recent farm structure, we could assume that LLCs can bid the highest land prices among larger-scale farms due to possible expectations of higher returns on land. Previous studies suggest that individual farms could also be expected to have relatively high bidding potential due to higher expected returns to land, particularly in more labour-intensive technologies (cf. also CURTISS, 2002). Nevertheless, the differences in returns on land and related bidding potential between cooperatives and JSCs remain ambiguous. In our empirical model, which will allow us to control for land quality and other land characteristics, the effect of differences in returns on land investment among buyers will be reflected in buyer-specific shift parameters rather than in parameters that capture differences in the valuation of various land characteristics.

Significant differences between specified groups of buyers can also be assumed with regard to risk aversion, variability of income from land, and/or expected rate of income growth. The restriction on the scope of this paper does not allow us to elaborate on each of these aspects in much detail; however, the main expected effect of these behavioural differentials lies in the buyer-specific valuation of land characteristics that will approximate smaller or greater variability and/or rate of growth in the expected returns on land.

Observing land price differentials among buyers on uniform land characteristics will reveal important information on market performance. Since it can be assumed that buyers with the highest bidding potential would dominate the land market (cf. HARRIS and NEHRING, 1976: 161), significant systemic differences in the land price among different types of buyers will indicate land market imperfections. In perfect land markets, all market participants have symmetric access to full information, and only the highest bid prices on given land characteristics would be accepted by the selling land owners. Land market agents with low bidding potential would be excluded from participating in competitive land markets. Finding market participation evidence of buyers purchasing land of the same characteristics for markedly lower prices implies non-uniform terms of trade that can originate in irregular relationships (social capital) between market agents (PERRY and ROBISON, 2001; KOSTOV, 2010), or bargaining position differences among buyers. In this vein, for example, CIAIAN et al. (2012a; 2012b) argue that large corporate farms in CEECs enjoy greater bargaining power arising from lower implicit transaction costs (related to, e.g., information advantages about potential sellers among land lessors), and higher transaction costs to land owners and alternative buyers that stem from high land withdrawal costs and costs of plots' physical identification, or of changing the plots' location.

4 Econometric Model Specification

The hedonic land price model is specified as a log-linear function[10] of a land price dependent on variables defined in the previous section. We consider two model specifications. In Model I, buyer type variables enter the model as additional regressors to hedonic land characteristics; this is similar to studies carried out by DUNFORD, MARTI and MITTELHAMMER (1985) and TSOODLE, GOLDEN and FEATHERSTONE (2006). Incorporating such buyer-type variables implies that the parameters of the hedonic variables cannot be interpreted directly as implicit prices of each land characteristic; instead, the estimated coefficients explain the variation in the land price (KOSTOV, 2010: 49). The coefficients on the buyer-type variables represent buyer-specific shifters in the land price, holding land characteristics constant.[11] The Model I specification is as follows:

$$(1)\quad \log(p_i) = \alpha_0 + \sum_{j=1}^{k} \alpha_j x_{ji} + \sum_{m=1}^{n} \beta_m z_{mi} + v_i$$

where p_i represents average unit price for all plots of agricultural land subject to a sale contract i, x_i denotes a vector of hedonic plot and site characteristics[12], z_i represents a vector of buyer-type dummy variables (cf. Table 2), αs and βs are parameters to be estimated and v_i denotes a normally distributed error term.

The Model II specification introduces greater flexibility into the analysis of the buyers' effect on land price formation. Introducing additional interaction terms between x_i and z_i variables allows for the buyer-specific valuation of individual land and land site characteristics, as well as buyer-specific terms of trade. Further, α_s, β_s and γ_s are parameters to be estimated, and ε_i is the error term in the second model specification. Model II is finally specified as:

$$(2)\quad log(p_i) = \alpha_0 + \sum_{j=1}^{k} \alpha_j x_{ji} + \sum_{m=1}^{n} \beta_m z_{mi} + \sum_{j=1}^{k} \sum_{m \geq j}^{n} \gamma_{jm} x_{ji} z_{mi} + \varepsilon_i.$$

The geographic distribution of land that could cause neighbourhood effects or spatial dependencies calls for the consideration of spatial autocorrelation in the land prices, which if ignored could result in the loss of efficiency and consistency of the estimates (see e.g., HUANG et al., 2006: 461). Spatial autocorrelation in land prices can arise, for instance, from similar land quality on neighbouring plots, or the geographic diffusion of market information. To understand the spatial dependencies, we test for spatial correlation in land prices, administrative prices, and residuals of both model specifications to decide if the issue of spatial correlation needs to be addressed by an adequate model specification. As Moran's I statistics in Table 3 imply, the spatial autocorrelation in land quality (administrative price) is not transmitted to farmland prices. Also, as tests of spatial autocorrelation in the two models' residuals suggest, controlling for other spatial variables such as district dummies or the plots' distance to municipalities reduces unexplained spatial autocorrelation in the land prices. Therefore, model specifications as presented in equations (1) and (2) can be estimated using the ordinary least square method without controlling for spatial correlations.

[10] As the choice of the functional form is not intuitive, we applied the Box-Cox test to support the function choice. This test rejects (at 1% significance level) the null hypothesis of the linear specification being the best fit for the data, while the null hypothesis of logarithmic specification of the dependent variable being the best fit cannot be rejected. A comparison between log-linear and double log specifications suggests that transforming the right-hand side variables contributes to the overall model fit only marginally. Therefore, both log-linear and double log specifications are suitable for the model specification.

[11] To the degree specified by the hedonic variables included in the model.

[12] Note that an additional variable to the list of x variables listed in Table 2, concretely $area^2$, enters the model to allow for greater flexibility in the area-price relationship.

Table 3. Moran's I statistics – test of spatial autocorrelation

	Moran's I statistic [a]	Z-score (Normality)	Z-score (Randomisation)	P-value (Normality)	P-value (Randomisation)
Farmland price	0.280	0.946	0.959	0.344	0.338
Administrative price	0.991	3.330	3.326	0.001	0.001
Residual from Model I	0.245	0.827	0.830	0.408	0.407
Residual from Model II	0.201	0.681	0.683	0.496	0.494

Note: [a] H_0: prices or model residuals are spatially independent; H_1: prices or model residuals are not spatially independent. Computation was carried out with STATA 12.
Source: own calculations

5 Results

The first part of the results section discusses estimates of the pooled hedonic land price model, Model I (cf. Table 4), as specified in equation (1). This model includes buyer-specific shifts in the constant, which allows us to compare the average buyer-type differences in farmland prices while controlling for the hedonic variables, *x*.

As presented in Table 4, parameters on most of the hedonic variables are statistically significant. The productive component of land is found to have a significant effect on land value. Concretely, the land price is found to be significantly determined by the quality of land as approximated by the administrative price. The parameter estimate on this variable indicates that, holding other variables constant, a unit increase in the administrative land price approximating land quality results in a 2.9% increase in land price.[13]

While the number of plots is found to have no impact on the land price, the parameters on the variables *area* and *area*^{2} are jointly statistically significant at the 10% significance level. The sizes and signs of the parameters imply that the relationship between land price and purchased area (total plots' size) has a shape of an upward-open parabola that reaches its vertex at around 16.6 ha, which is far beyond the average area purchased within one contract (cf. Table A-2 in the Appendix). This result suggests that the valuation of land area purchased within one contract is not uniform across buyers. However, there are only a few observations (1.6% of observations) that fall under the upward slope of this curve. The prevailing part of the curve suggests a decreasing price effect of increasing area, which supports the hypothesis of financially constrained buyers proposed by TSOODLE,

Table 4. Estimates of pooled hedonic land price model with heterogeneous buyers (Model I)

Log(farmland price)	Hedonic model with heterogeneous buyers (base dummy = non-ag. buyer) Coefficient	P>|t|
Constant	2.117	0.000
x variables		
admin_price	0.029	0.000
nr_plots	0.002	0.720
area	-0.021	0.137
area^2	0.001	0.052
year09	-0.015	0.801
year10	0.086	0.134
nr_farm	-0.050	0.030
district_oc	0.140	0.041
district_pe	1.199	0.000
district_hb	-0.235	0.021
district_kt	-0.337	0.000
distance_munic	-0.003	0.726
distance_distrtown	-0.018	0.000
municipal_sale	0.331	0.019
z variables		
ind_farm	-0.152	0.013
llc	-0.027	0.779
coop	-0.310	0.000
jsc	-0.295	0.000
$R^2 = 0.418$		
$F\,(18,\ 560) = 21.68$; Prob > F = 0.000 [a]		

Notes: The Breusch-Pagan test suggests rejecting the null hypothesis of constant variance. Because of the detected heteroscedasticity, robust standard errors are estimates. [a] Wald test of joint significance of included variables (excluding constant) is based on the robustly estimated variance matrix.
Source: own estimates

[13] In the case of the log-linear model specification, the interpretation of the parameter estimates derives from this formula: $100 \cdot [exp(\hat{\beta}) - 1]$. Therefore, slight differences between the parameters in the tables and the text may occur, particularly in the case of large parameters.

GOLDEN and FEATHERSTONE (2006). We find this hypothesis particularly relevant for non-agricultural buyers who are expected to finance investment in land mainly from their savings. The increasing part of the function related to significantly larger areas might result from the interaction between decreasing supply of large land areas and financially unconstrained buyers.

The number of farms per km^2 in the cadastre of the land transaction, which was included in the model to depict competition on the local market, has a significant effect on land price; however, contrary to our hypothesis, this effect is negative. An increase in the number of farms per km^2 by one farm decreases the price for land by 4.8%. This result implies that in cadastres with a greater number of smaller farms compared to areas where only a few large farms dominate cultivation, farms can purchase land for lower prices. This may suggest that the absence of large-scale farms in the land cadastre improves market conditions for IPFs. This finding appears to be in line with results by HARRIS and NEHRING (1976: 168), which indicate that small farmers may be at a particular disadvantage when they attempt to bid away land from their larger neighbours. As will be shown later, the disadvantage of IPFs we observe does not lie in their lower bidding potential, but rather their weaker bargaining position when compared to large farms or lack of relationships to the land owners who lease land mainly to larger competitors. The last variable from the transaction component of land price is the sale of municipal land. In line with our hypothesis of public information accessibility and greater competition among buyers, municipal land sells for significantly higher prices (45.1% higher) than private land. Also, other market transaction costs can be expected to be lesser in the case of municipal sales, thereby allowing buyers to bid higher prices.

The variables for the distance of sold parcels to the municipality and the district town are included to evaluate either the effect of intrinsic valuation of non-productive land characteristics (job opportunities as well as public and market services) or, relevant to farms, the effect of the distance to a larger market or downstream agents. The estimates on these variables show an insignificant land price effect of the sold land's distance to a municipal centre, but a significant negative effect of the land's distance to a district town. Increasing the plot's distance to the district town by 1 km decreases the land price by 2%.

The parameter estimates on time dummies imply that there was a significant increase in farmland prices over time. Land prices are significantly higher in 2010 when compared to 2008, which seems to be unrelated to the increase in the administrative land prices that occurred in 2009.

When interpreting the estimated parameters on buyer dummy variables, we must consider that the base variable represents non-agricultural buyers. The constant in the model thus represents the intercept for the group of non-agricultural buyers, while the coefficients on the four agricultural buyer-group variables depict the difference in the intercept between the particular buyer group and the non-agricultural buyers. In the log-linear model specification, the parameter estimates on these variables then measure the proportionate difference in the average farmland price for each agricultural buyer-type relative to non-agricultural buyers.

The parameters on the buyer-type dummy variables imply that all four types of agricultural buyers purchase farmland for a lower price than non-agricultural buyers, holding fixed all other land characteristics entering the model. These price differentials are all significant, except for the difference between non-agricultural buyers and agricultural LLCs. The parameter estimates predict that holding farmland characteristics fixed, individual farmers buy farmland for 14.1% less, on average, than non-agricultural buyers, and agricultural cooperatives and JSCs are even able to buy farmland for 26.7% and 25.6% less than non-agricultural buyers, respectively.

The differences in price paid by agricultural buyers are of further interest. The average price difference between LLCs and individual farms is statistically insignificant.[14] The estimated difference in farmland price paid by LLCs and JSCs is 24.7%,[15] with JSCs paying the significantly lower price. The difference between prices paid between LLCs and cooperatives is similarly large (23.6%) and statistically significant. The difference in farmland price paid by cooperatives and JSCs is comparatively small (1.5%) and statistically insignificant. The economic interpretation of these differentials is provided below, along with the interpretation of the Model II estimates.

[14] The statistical significance of the price differences between the various legal forms of agricultural buyers is tested by re-estimating the model, and alternating the reference buyer-type variable.

[15] This corresponds to the difference between the parameters of these two variables, which equals -0.284.

Table 5. Estimates of the hedonic land price model with heterogeneous buyers (Model II – parsimonious, 579 observations)

Explanatory variables z / Dependent variable log(p)			ind_farm		llc		coop		jsc	
	Coef.	**P>|t|**	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**
Constant	2.425	0.000	-0.265	0.008	-0.726	0.000	-0.688	0.000	-0.382	0.010
Explanatory variables x			*x* * ind_farm		*x* * llc		*x* * coop		*x* * jsc	
admin_price	0.013	0.309	0.032	0.057	0.019	0.481	0.010	0.605	0.016	0.364
nr_plots	-0.011	0.170	0.019	0.173	0.004	0.594	0.016	0.324	0.020	0.080
area	-0.035	0.104	0.080	0.024	-	-	-	-	0.041	0.421
area^2	0.001	0.041	-0.002	0.131	-	-	-	-	-0.001	0.501
year09	-0.094	0.374	0.067	0.635	0.381	0.079	0.531	0.005	0.178	0.290
year10	0.010	0.889	-	-	0.552	0.006	0.526	0.001	0.137	0.354
nr_farm	-0.049	0.111	0.032	0.543	-	-	-0.043	0.455	0.110	0.259
district_oc	0.150	0.108	-	-	0.130	0.676	-0.239	0.064	-0.092	0.626
district_pe	1.008	0.000	0.228	0.350	1.309	0.013	-[a)]	-[a)]	0.641	0.028
district_hb	-0.429	0.005	0.461	0.012	0.436	0.119	-	-	0.205	0.622
district_kt	-0.452	0.004	0.194	0.326	0.597	0.034	0.193	0.353	-	-
distance_munic	-0.003	0.854	-0.004	0.793	0.029	0.178	-0.022	0.225	0.021	0.312
distance_distrtown	-0.018	0.015	-0.012	0.203	0.010	0.586	0.032	0.005	-	-
municipal_sale	0.147	0.578	0.198	0.518	-[a)]	-[a)]	0.930	0.004	-	-
R^2	0.470									

Notes: The Breusch-Pagan test suggests rejecting the null hypothesis of constant variance. Because of the detected heteroscedasticity, robust standard errors are estimates; interaction terms with coefficients with p values greater than 0.8 were eliminated from the model; [a)] was omitted due to collinearity that occurred because there are no purchases of municipal or state land by agricultural limited liability companies, and no sales of land to agricultural cooperatives in the Prague East district; the base (reference) buyer group is a group of non-agricultural buyers; interaction terms are estimated in the form of a multiplication of the dummy variable for a buyer type and x variables in the form of deviations from the arithmetic mean (to eliminate collinearity between buyer type and interaction term).
Source: own estimations

Model I has revealed information about the buyer-type-specific price differences, assuming that the groups of buyers value land characteristics uniformly, and assuming that their trading conditions are identical across regions and time. Model II relaxes these assumptions. The estimates of the parsimonious and complete form of the model are presented in Table 5 and Table A-3 in the Appendix, respectively. The explanatory power of the hedonic land price model increases with the increased flexibility (inclusion of the interaction terms) in Model II; nevertheless, with R^2 being equal to 0.47, it remains moderate. However, the test of joint significance of the parameters on all buyer group variables, including the interaction terms, indicates that the parameters are highly significant (cf. Table A-1 in the Appendix for the test statistics)[16]. This supports the importance of considering the buyer-specific valuation of land characteristics and market conditions. Indeed, the estimates in Table 5 manifest significantly distinct buyer-specific valuation of most of the land and market features considered in the models.

In addition to the finding that non-agricultural buyers pay, on average, significantly higher unit prices for farmland of the same characteristics, Model II (cf. Table 5) reveals that they are willing to pay more for parcels closer to district towns than are agricultural companies, particularly agricultural cooperatives. Although they are further found to purchase farmland

[16] Examining each group of buyers separately, parameters on interaction terms with agricultural LLCs, as well as with cooperatives, are jointly significant at the 1% significance level. The interaction terms with the remaining two buyer groups, individual farms and JSCs, are jointly insignificant. Removing the interaction terms with the most insignificant parameters (with p-value above 0.8) results in a more parsimonious model presented in Table 5. In this model, the remaining interaction terms with individual farms and JSCs are jointly significant at the 10% significance level (cf. Table A-3 in the Appendix).

significantly closer to municipalities (cf. Table A-2 in the Appendix), they are not willing to pay price premium for this proximity. Non-agricultural buyers also purchase land in cadastres of municipalities with significantly higher population growth and lower unemployment ratios, which indicate municipalities more attractive for living. All these findings support the hypothesis of land development and speculative intentions of the non-agricultural land investors. Furthermore, they are found to purchase land in cadastres with significantly higher farm density, which suggests their easier access to land when it is not leased to large-scale companies. Also, our expectation that the predominantly negative relationship between unit price and land area found in the pooled model (Model I) is formed mainly by non-agricultural buyers has been confirmed.[17] This result suggests that non-agricultural buyers use mainly their savings for their investments in land, which reduces competition for larger blocks of land.

Significant differences in land characteristic valuation are also found among agricultural buyers. We begin with the discussion of cooperatives and JSCs. Returning to the overall price level, both buyer groups were found to purchase land of similar characteristics for significantly lower prices than individual farms and LLCs. This result supports the bargaining power hypothesis related to the information and transaction cost advantages these companies enjoy when leasing a significant share of land from fragmentary land owners. However, the significant difference in prices paid by these two types of farms and LLCs supports the relationship hypothesis based on the fact that the fragmented capital ownership represents a broad bank of potential sellers of land to these companies. The members' and shareholders' direct economic interest in these companies, as well as their long-term relationship and possibly also a feeling of loyalty, can result in significant land price discounts.

Furthermore, compared to other legal forms, particularly IPFs, cooperatives are found to pay significantly higher prices with increasing distance to district towns.[18] This unexpected result could be explained by the cooperatives' location. As the comparison of buyer groups in Table A-2 suggests, cooperatives also purchase land in areas significantly more distant from district towns and areas affected by negative demographic developments (in cadastre areas of municipalities with significantly lower population growth). This could imply that these are regions in which the cooperative style of farming has endured. Since we do not control for the geographic distribution of buyer types in the model, the result of the cooperative-specific willingness to pay comparatively more for land in more remote areas could relate to the fact that a plot is more valuable to a farm that is currently leasing it or it is located in an immediate neighbourhood than to farms cultivating land in distant locations.

The specific valuation of land and site characteristics is also found in the case of IPFs and LLCs. Individual farmers are willing to pay a price premium for larger areas of land sold within one contract, which would indicate the relevance of the unit transaction cost and increasing rate of growth hypotheses. The IPFs' bid price also increases with increasing land quality (administrative price). This result would suggest that IPFs are more concerned with the productive potential of land than the other buyer types, or that they are trading on more competitive terms.

As described in the background section, LLCs are rapidly-expanding and fast-growing businesses. The group mean comparison tests show that these farms buy land significantly closer to district towns, as well as acquire land in cadastral areas of municipalities with a significantly higher share of economically active inhabitants. These two geographic aspects of their land market activity could be related to the location of their headquarters and business operations, and may be a result of their transformation strategies. Interestingly, LLCs purchase farmland of significantly lower quality and are willing to bid higher prices in more distant areas from municipalities than any other farm type. These findings together with the paid land price premium suggest that LLCs deal with an impaired access to land that, however, does not halt them from actively participating in the land market, and imply their high bidding potential.

6 Conclusions

The primary objective of this study was to analyse the effect of heterogeneous buyers on farmland price formation. The buyer-specific price effect is theorised to originate in differences in buyers' bidding potential, intrinsic farmland and site valuation, as well as non-

[17] The two parameters depicting the effect of the land size traded within one contract (*area* and *area2*) are jointly significant at the 5% significance level.

[18] Also in this case, the statistical significance of the price differences between the various legal forms of agricultural buyers is tested by re-estimating the model, and alternating the reference buyer-type variable.

uniform terms of trade. Relatively few studies consider a modelling framework flexible enough to allow for differences in buyers' valuation of individual land characteristics and buyer-specific land market conditions. This study applies a hedonic land pricing model that is specified to allow for this flexibility. It utilizes data on 579 land sale contracts from five districts of the Czech Republic from 2008-2010. The Czech land market environment and its unconsolidated dual farms structure make this case study particularly suited for the analysis, since it can greatly contribute to illuminating the present and future dynamics of agricultural land ownership.

The empirical model employed in the study delivers evidence of significant differences in farmland prices among groups of buyers related to variability in their market conditions, as well as dissimilar valuation of land's productive and site characteristics. Five types of farmland buyers - four agricultural and one non-agricultural - were investigated in relation to land prices. Non-agricultural buyers are found to bid significantly higher prices than agricultural buyers for identical land characteristics (land characteristics controlled for in the model). Further, non-agricultural buyers are willing to pay a price premium for proximity to urban areas, but productive characteristics of land play little role in their price offering. As they are active in land markets significantly closer to municipalities, non-agricultural buyers' purchasing power represents a market threat only to (mainly small) farmers cultivating leased land nearby municipalities and towns. Also, the geographic and demographic characteristics of areas in which non-agricultural buyers invest in land and their implicit intention of land development suggest continuous gradual change of the rural landscape and outmigration from most underdeveloped rural areas.

Among agricultural buyers, JSCs and cooperatives enjoy significant price discounts that could relate to transaction cost and information advantages, as well as to established lease relationships to small plot holders. IPFs and LLCs consequently pay significantly higher unit prices. Nevertheless, there are also major differences in the valuation of land characteristics among IPFs and LLCs. Prices paid by individual farms reflect the productive potential of land the most among all farms. LLCs, compared to other agricultural buyers, bid higher prices for more remote land, which demonstrates their high level of interest in land acquisition.

Since more than 70% of the utilised agricultural land in the Czech Republic is still leased, the majority of it by JSCs and cooperatives, the observed price discounts to these companies could represent constraints to efficient land reallocation. The protracted improvements in the use of rural resources, as well as the preservation of intensive and large-scale land cultivation can be expected to have adverse implications for the sustainability of both future land use and rural development.

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Appendix

Table A-1. Tests of joint hypotheses on parameters of Model II

Null hypothesis	Nr. restrictions	d.f.	F	Prob>F
Model II - complete				
H[0]: $\sum_{m=1}^{n}\beta_m + \sum_{j=1}^{k}\sum_{m\geq j}^{n}\gamma_{jm} = 0$, for m = 1, ..., n and j = 1, ..., k.	58	506	3.77	0.000
H[0]: $\sum_{j=1}^{k}\sum_{m\geq j}^{n}\gamma_{jm} = 0$, for m = 1, ..., 4 and j = 1, ..., k.	54	506	3.31	0.000
H[0]: $\sum_{j=1}^{k}\sum_{m\geq j}^{n}\gamma_{jm} = 0$, for m = 1 (indiv. farms) and j = 1, ..., k.	14	506	1.24	0.239
H[0]: $\sum_{j=1}^{k}\sum_{m\geq j}^{n}\gamma_{jm} = 0$, for m = 2 (ag. llc) and j = 1, ..., k.	13	506	2.99	0.000
H[0]: $\sum_{j=1}^{k}\sum_{m\geq j}^{n}\gamma_{jm} = 0$, for m = 3 (ag. coops) and j = 1, ..., k.	13	506	3.74	0.000
H[0]: $\sum_{j=1}^{k}\sum_{m\geq j}^{n}\gamma_{jm} = 0$, for m = 4 (ag. jsc) and j = 1, ..., k.	14	506	1.28	0.214
Model II - parsimonious				
H[0]: $\sum_{m=1}^{n}\beta_m + \sum_{j=1}^{k}\sum_{m\geq j}^{n}\gamma_{jm} = 0$, for m = 1, ..., n and j = 1, ..., k.	45	507	4.11	0.000
H[0]: $\sum_{j=1}^{k}\sum_{m\geq j}^{n}\gamma_{jm} = 0$, for m = 1, ..., 4 and j = 1, ..., k.	43	507	3.75	0.000
H[0]: $\sum_{j=1}^{k}\sum_{m\geq j}^{n}\gamma_{jm} = 0$, for m = 1 (indiv. farms) and j = 1, ..., k.	12	507	1.65	0.074
H[0]: $\sum_{j=1}^{k}\sum_{m\geq j}^{n}\gamma_{jm} = 0$, for m = 2 (ag. llc) and j = 1, ..., k.	10	507	4.45	0.000
H[0]: $\sum_{j=1}^{k}\sum_{m\geq j}^{n}\gamma_{jm} = 0$, for m = 3 (ag. coops) and j = 1, ..., k.	10	507	5.08	0.000
H[0]: $\sum_{j=1}^{k}\sum_{m\geq j}^{n}\gamma_{jm} = 0$, for m = 4 (ag. jsc) and j = 1, ..., k.	11	507	1.68	0.075

Source: own estimations

Table A-2. Mean values from group of buyers and t-test of buyer-group mean difference (with equal variances) in purchased land and site characteristics

Buyer groups / Variables	Non-agricultural buyers *Group 1* (272 obs.)	Agricultural buyers *Group 2* (307 obs.)	Subgroups of agricultural buyers: Individual farms *Group 2a* (161 obs.)	Lim. liability companies *Group 2b* (53 obs.)	Cooperatives *Group 2c* (35 obs.)	Joint stock companies *Group 2d* (58 obs.)	Group mean comparison[a)]
land price	12.426	8.253	8.697	10.431	5.627	6.612	$t_{1\ vs\ 2} = 4.51$***, $t_{2a.vs\ 2c.} = 1.89$*, $t_{2b.vs\ 2c.} = 1.81$*, $t_{2b.vs\ 2d.} = 1.78$*
admin_price	8.084	8.119	8.139	7.794	8.710	8.003	-
nr_plots	2.408	3.218	2.677	4.340	3.000	3.828	$t_{1\ vs\ 2} = 1.85$*, $t_{2a.vs\ 2b.} = 1.83$*
area	2.338	2.840	2.673	3.152	2.873	2.997	$t_{1\ vs\ 2} = 1.66$*
distance_munic	7.811	8.844	8.337	8.964	9.701	9.625	$t_{1\ vs\ 2} = 2.71$***, $t_{2a.vs\ 2d.} = 1.97$**
distance_distrtown	15.739	15.568	15.897	14.051	16.819	15.285	$t_{2a.vs\ 2b.} = 1.61$*, $t_{2b.vs\ 2c.} = 1.82$*
nr_farm	2.348	1.921	2.058	1.869	1.910	1.595	$t_{1\ vs\ 2} = 3.90$***, $t_{2b.vs\ 2d.} = 1.63$*, $t_{2c.vs\ 2d.} = 2.02$**
pop_growth	0.075	0.053	0.061	0.052	0.004	0.060	$t_{1\ vs\ 2} = 1.90$*, $t_{2a.vs\ 2b.} = 0.41$, $t_{2a.vs2c.} = 1.98$**, $t_{2a.vs\ 2d.} = 0.08$, $t_{2b.vs2c.} = 2.31$**, $t_{2b.vs2d.} = 0.39$, $t_{2c.vs\ 2d.} = 2.31$**
sh_ecact_pop	46.632	46.961	46.833	48.055	46.839	46.393	$t_{2b.vs\ 2d.} = 2.17$**
sh_unempl	8.690	10.092	9.368	11.316	11.215	10.307	$t_{1\ vs\ 2} = 3.89$***, $t_{2a.vs\ 2b.} = 2.82$***, $t_{2a.vs\ 2c.} = 2.28$**

Note: [a)] Only statistically significant differences are indicated in the last column; *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level; pop_growth = population growth in the municipality of the cadastre area; sh_ecact_pop = share of economically active population in the municipality of the cadastre area; sh_unempl = unemployment ratio in the municipality of the cadastre area. These variables were tested for significance in Models I and II; however, in combination with the district dummies, these variables had a statistically insignificant effect on land prices. The district dummies, on the other hand, contribute much more significantly to the overall fit of the model.

Source: own calculations

Table A-3. Estimates of the hedonic land price model with heterogeneous buyers (Model II – complete, 579 observations)

Explanatory variables z / Dependent variable Log(p)			ind_farm		llc		coop		jsc	
	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|
Constant	2.441	0.000	-0.278	0.053	-0.705	0.002	-0.702	0.000	-0.405	0.047
Explanatory variables x			*x* * ind_farm		*x* * llc		*x* * coop		*x* * jsc	
admin_price	0.013	0.348	0.032	0.069	0.016	0.599	0.012	0.587	0.018	0.408
nr_plots	-0.011	0.217	0.019	0.182	0.005	0.617	0.013	0.496	0.019	0.118
area	-0.037	0.209	0.083	0.046	-0.001	0.986	0.013	0.803	0.043	0.476
$area^2$	0.001	0.109	-0.002	0.138	0.000	0.933	0.000	0.993	-0.001	0.550
year09	-0.092	0.419	0.062	0.701	0.379	0.090	0.520	0.007	0.174	0.317
year10	0.011	0.908	-0.011	0.938	0.539	0.014	0.537	0.009	0.142	0.397
nr_farm	-0.050	0.139	0.034	0.544	0.010	0.887	-0.034	0.569	0.120	0.270
district_oc	0.133	0.353	0.039	0.831	0.143	0.672	-0.227	0.196	-0.067	0.794
district_pe	1.004	0.000	0.242	0.348	1.294	0.018	- [a)]	- [a)]	0.669	0.056
district_hb	-0.435	0.013	0.479	0.026	0.412	0.228	-0.015	0.952	0.235	0.597
district_kt	-0.465	0.015	0.222	0.358	0.568	0.100	0.226	0.403	0.059	0.839
distance_munic	-0.002	0.868	-0.005	0.777	0.028	0.181	-0.019	0.293	0.021	0.327
distance_distrtown	-0.018	0.042	-0.011	0.308	0.010	0.598	0.034	0.007	0.002	0.909
municipal_sale	0.149	0.632	0.198	0.570	- [a)]	- [a)]	0.883	0.019	-0.024	0.950
$R^2 = 0.472$										

Notes: The Breusch-Pagan test suggests rejecting the null hypothesis of constant variance. Because of the detected heteroscedasticity, robust standard errors are estimates; [a)]omitted due to collinearity; this occurred because there are no purchases of municipal land by agricultural limited liability companies, and no sales of land to agricultural cooperatives in the Prague East district; the base (reference) buyer group is a group of non-agricultural buyers; interaction terms are estimated in the form of a multiplication of the dummy variable for a buyer type and *x* variables in the form of deviations from the arithmetic mean (to eliminate collinearity between buyer type and interaction term).

Source: own estimates