Farmland rental values in GM soybean areas of Argentina: do contractual arrangements matter?

Abstract

We study the determinants of rental prices of farmland in the Argentinean Pampas. In particular, we examine the value of lease contract characteristics within a hedonic price framework, while controlling for other potential sources of variation. Using first-hand data for 255 parcels, our results indicate that both short-term contracts and contracts with sowing pools push rental prices upwards. We also find that soybean yields have a significant impact on land rental rates. These results suggest that if Argentina intends to protect the enormous natural advantage it has for agricultural production, it should consider strictly regulating land rental contracts.

Keywords: Argentina, hedonic price, lease, contracts, soybean

JEL codes: Q13, Q15, R11

1. Introduction

Argentinian land markets have experienced great changes in the past decades, notably with the expansion of biotech genetically modified (GM) crops. Since the introduction of GM soybeans to Argentina in 1996, there has been a dramatic rise in production.[i] As a result, all production of soybeans in Argentina is genetically modified and is mainly concentrated in the Pampas region. Today, Argentina is the third largest exporting country, after the USA and Brazil (Filomeno 2013; Leguizamón 2013; Urcola et al. 2015).

Within this context, the rental price of farmland has increased dramatically. In the Pampas, the central agricultural producing area of Argentina, land rental prices have doubled since 2001 (F. Bert et al. 2010). This upward movement was driven by a dramatic increase in land demand, brought about by record profits in GM soybean cultivation. Strong cost savings associated with high yields, high prices in international markets and economic reforms during the 1990s, contributed to increasing soybean producers' incomes.

Technical changes in GM soybean production have encouraged economies of scale in farming, leading to increased farm sizes. Between 1988 and 2002, the average farm size rose by 25%, according to agricultural censuses. Because of the high cost of land, the race for land to produce the very profitable GM soybean has been dominated by the acquisition of user's rights, rather than ownership of land. As a result, the total area of land farmed under tenancy contracts has increased sharply, compared to land farmed by landowners. Today, in the soybean growing regions of Argentina more than 60% of cultivated land is under some sort of tenancy contract. Fixed rental contracts account for 90% of total leased land, whereas share contracts represent only 10%. Among fixed rental arrangements, contracts for a single agricultural season are expanding at a high rate as well.[ii]

The growing disconnect between land ownership and land cultivation, compounded by the shortening of lease contracts, has important implications for land use sustainability. A large

number of studies suggests that rented land is managed differently according to the type of lease contract, which may affect the selection of crops, the choice of technological packages, and the use of conservation practices such as crop rotation (Abdulai, Owusu, and Goetz 2011; Fraser 2004; Myyrä, Pietola, and Yli-Halla 2007; Soule, Tegene, and Wiebe 2000). Indeed, the increased number of short-term cash lease contracts in Argentina has been correlated with a land allocation strategy favoring soybean monoculture and the massive use of agrochemicals. (F. E. Bert et al. 2011) have shown that, given the level of the rental prices, tenanted land must be allocated to soybean if producers want to be sufficiently profitable. How to promote rational use of the land in order to guarantee the preservation of the environment has become a central issue in Argentina.

Some of the literature attempts to explain agricultural land rents with hedonic models. The impact of farmland characteristics (such as quality of soils, localization of parcels, surface, and productive potential) on land-lease rates was highlighted, as well as the impact of public intervention, and more recently, environmental considerations. However, the extent to which lease contract properties are correlated to land rent prices is an intriguing question which has not been explored, but deserves attention. Obviously, contract design must affect the land-lease price because it determines the duration of payments, the level of risk taken, and sometimes the allocation of land to different uses.

The objective of this paper is to shed light on the effects of contract characteristics on farmland rental rates, while controlling for other potential sources of variation, such as land characteristics and expected returns. We assume that the contractual conditions are capitalized into land rents, as suggested by (Palmquist 1989). The great variety of contractual land arrangements in Argentina offers a good opportunity to evaluate the preferences of landowners and producers associated with specific contracts. Our results, based on a first-hand survey among producers, lead to a better understanding of the determinants of land rental prices.

To reach our research objectives, we use a hedonic price model. The structure of this paper is as follows. Section 2 discusses the design of lease contracts in the Pampas region of Argentina. Section 3 presents the hedonic literature on farmland rental prices. Section 4 contains the empirical analysis, followed by the conclusion.

2. Lease transactions in a GM soybean area of Argentina

2.1. The context of land lease in Argentina

The actors of the Argentinian land market are of two types: physical persons and societies; they can be lessors or lessees. Landowners are usually physical persons. Tenants might be farmers who already own land but seek to extend their production. Those farmers are the most important group, both in terms of number and area sown. Tenants can also be societies. Indeed, GM soybean cultivation has been accompanied with deep changes in the organization of the production. New forms of associations between farmers emerged, namely "*pooles de siembra"*, to manage and finance soybean production (V. A. Hernandez 2009). These sowing pools are agricultural societies consisting of farmers who gather to lease tracts of land as well as services for the main farming operations (planting, spraying and harvesting) and sometimes for transport.

The legal framework for agricultural land leases in Argentina is defined by the law n° 13246 passed in 1948. This law stipulated, among other things, a minimum term of three years for leasing contracts, the respective obligations of landlords and tenants, and stated that an "irrational use of the soil that causes its erosion or exhaustion is forbidden." This law was revised in 1980 and this updated version is nowadays in force. The most significant modification was the introduction of the *de facto* limited contract, which covers only one current vegetative cycle (that is one year or less). The revised law also states that rents must be expressed in currency units (local or foreign), but does not prescribe any form of price control mechanism. Landowners and tenants are free to negotiate a rate agreeable to both parties. In the same vein, no continuation rights are legally guaranteed, meaning there is no obligation for a landlord to renew a contract with a tenant. Therefore, tenants cannot claim rights on land they may have cultivated for a long period, and landlords have no tenure insecurity associated with leasing land.

Despite this legal framework, most land contracts are neither registered nor approved by the land law, and are frequently oral agreements. The terms and conditions are freely agreed upon by the parties, but officially unknown. However, information about the cost of rent for any given type of soil is usually known by most farmers. The Argentinian "*modelo sojero*" is characterized by intensive social interactions taking place through producers associations (Goulet and Hernández 2011). Information is easily obtained from other farmers or landlords, making the land market fairly transparent. Additionally, high competition among tenants, who are often farmers looking to enlarge their farms, ensures that rental prices, like in pure spot markets, are negotiated competitively, and result from individual decisions and profit considerations that reflect all the characteristics of the lease contract. The land market therefore appears quite open and dynamic. We can reasonably assume that the price equilibrates the demand and supply of leased land and clears the market.

2.2. Data on land-lease in the Pampas

Because data on land-lease transactions are not available in Argentina, we focus on a sub land-rental market in two provinces within the Pampas region, Buenos Aires and Santa Fé, where we collected information. Within these two provinces, a portion of territory of 110 thousand hectares was randomly selected and each plot of land pertaining to this selected area had been listed. Information about the owner or the producer, the type of productive activities, and the tenure modes were collected.[iii] This rich database allowed us to select a simple random sample comprising of 186 farmers cultivating 542 parcels, of which 321 were leased. The survey was undertaken during July and August of 2011, collecting information about each plot's size, location, type of land, cropping pattern, productive assets, type of lease contract, and method of payment.[iv] Detailed information was collected on the identity of contracting parties and some of the landlords' characteristics, such as living place, relationship to the tenant, and status with respect to agricultural activity (active farmer, retired farmer, non-farmer investor). We analyse data for 255 of the parcels, after removing those without a complete set of information.

Landlords in Argentina tend to be retired farmers or farmers that are no longer involved in farming activities. In our sample, nearly 75% of parcels are rented by landlords who are non-producers. Their children and/or heirs have left agriculture and migrated to urban centers. Most landlords describe themselves as too small to handle the technical changes or the risk of farming themselves, or they feel technically outdated and unable to compete with younger farmers for additional land (Gras 2009; Urcola et al. 2015). Other reasons are a lack of capital and ability to finance the purchase of inputs (seeds, agrochemicals, labor, agricultural services, and so forth). Their objective is to obtain the highest quasi riskless short-term return on land capital, and indeed, the level of rental prices is high enough to provide a comfortable standard of living (Urcola et al. 2015). These characteristics largely explain the progressive disappearance of share contracts and the lack of concern about tenants' practices that deviate from good agronomic routines.

As far as rent payment is concerned, a specific system is working according to the "use and customs." The survey data indicate that the dominant form of landlord-tenant contracts is a lease wherein the tenant pays the landlord a fixed amount, expressed in quintals of soybean per hectare rented (instead of its monetary equivalent), no matter the length of the contract. Since soybean prices exhibit high intra-seasonal fluctuations, payment in kind enables the landlord to reap the best possible price from his "rent" payment, either by storing the output to sell at a future higher price or by transporting it to distant markets that offer a better price. With a share lease, the landlord receives a stipulated percentage of the production.[v]

In the two provinces under study, we find three main types of lease contract: a regular, or multi-year, fixed-lease contract, with a term of at least three years; a one-cultivation-cycle fixed contract, where land is leased for a single growing season and sometimes for a single crop; and a multi-year share contract. The primary contractual arrangement remains the fixed lease, at 92% of plots, while share contracts still occur, though to a much lesser extent, at 6% of plots. There are many reasons that explain farmers' preference for a fixed land lease, and are well

documented in the existing literature on contract choice. Both risk and transaction costs are usually considered.

First, given the socio-economic characteristics of landlords in Argentina, the marked preference for fixed rent contracts reflects owners' disinterest in production and management decisions and/or difficulties in monitoring day-to-day farming operations. Fixed-rent contracts also protect landlords from suboptimal work effort from tenants, as well as underreporting of the harvest. Transaction costs, either in time or in money (if the landlord has to pay supervisors), are thus saved. There is evidence in the literature suggesting that transaction costs are an important factor in the choice of a fixed-rent arrangement (D. W. Allen and Lueck 1999; Jacoby and Mansuri 2009). On the other side, fixed-rent contracts tend to provide managerial autonomy to the tenant, who gains freedom in decision-making and ensures that his productive efforts and managerial ability will not be shared with the landlord.

Second, fixed-rent contracts protect landlords from market uncertainty, as well as from output fluctuations arising from exogenous shocks, such as climatic accident (flood, dryness) or pest invasion. A large strand of empirical evidence suggests that landlords who want to avoid risk prefer fixed-rent contracts (D. Allen and Lueck 1992a; Cheung 1969; W. Huffman and Just 2004; Stiglitz 1974).

Third, in a context where input and capital markets are well developed, or when the wealth level of the tenant is high enough, which is the case in the Pampas region of Argentina, a share arrangement is unlikely to occur (Rainey et al. 2005).

However, fixed-rent contracts create incentives for tenants to use land unsustainably in order to increase income, for instance by planting soybean crop after soybean crop, or by applying huge volumes of herbicides, practices that deplete the soil over time. If landlords have long-term interests in farming activities, then natural-resource conservation will be taken into account. One of the most problematic issues is how to monitor tenants' agronomic practices and ensure that overuse and misuse of land do not result in degradation and exhaustion of the soil.

Landlords who want to ensure that a tenant does not alter the long-term productive potential of the land have a higher probability of offering a crop-share contract, according to many studies (D. Allen and Lueck 1992b; W. E. Huffman and Fukunaga 2008).

Among fixed-rent contracts, 28% are short term. That share is rapidly increasing, driven by the boom in soybean prices, which has increased expectations about future returns from soybean cultivation. In that context, it is rational to roll over short-term contracts and negotiate an increase in rent each time, rather than engaging for longer terms and risking a lower income from renting. Short-term contracts are thus particularly suited for periods of rising prices. They also introduce increased flexibility in the seasonal decisions about what to produce and in what volumes. This allows producers to respond very quickly to a changing economic environment and large price fluctuations.

3. Capturing the effects of lease contract using a hedonic pricing framework

The rental price of an agricultural parcel represents the equilibrium relationship between supply and demand for land. Rents differ because parcels do not have the same characteristics and they are localized in different places. The hedonic price method connects the rental value of the plots to their characteristics. It allows for calculating the weight of each feature in the rent paid to landowners.

While (Rosen 1974) is the seminal article on hedonic pricing for housing, we refer to (Palmquist 1989) for a hedonic price model of the rental prices of farmland.[vivii] In his model, which is a standard hedonic equation, rents are explained by characteristics of farmlands such as:

$$R = R(z_1, \dots, z_n),$$

where R is the rental price of each parcel and z is a vector of n characteristics of parcels.

There are many empirical contributions, mostly from OECD countries (Donoso and Vicente 2001; Herriges, Shogren, and Barickman 1992; Huttel et al. 2015; März et al. 2014). (Herriges, Shogren, and Barickman 1992) analyze the capitalization of a U.S. commodity program into farmland rents using Iowa rental survey data. (Huttel et al. 2015) investigate, among other variables, the impact of the length of contracts (in years) on farmland rental values in Germany. More directly related to our study, (Donoso and Vicente 2001) investigate rental rates in the Pampas Region in Argentina using survey data for 86 parcels and focusing on soil erosion.

To the best of our knowledge, no hedonic study has connected farmland rental values and contractual arrangements, with the exception of (Huttel et al. 2015). To a broader extent, literature on any correlation between these variables is scant. There are, however, some exceptions. In the Netherlands, based on a survey asking land agents and landowners to rank the

value of tenanted land, (Slangen and Polman 2008) show that the value of land under tenancy depends on the type of contractual arrangement, with the shortest contract having the highest value. (Moss and Barry 2002) study the bidding behaviour of a panel of Illinois producers regarding different lease types. In an experimental approach, farmers were asked to make bids using the three different contractual arrangements (share, cash, and hybrid). The results indicate that the potential return to management drives more aggressive bidding behaviour for cash leases, compared to hybrid or share leases.

4. Empirical analysis

4.1.Sample characteristics

There are major differences between analysing farmland values and rental prices, and these shall motivate the choice of variables in the hedonic model. Quoting (Palmquist and Danielson 1989, 55) "When people rent land, their only interest will be in the current productive capabilities of the land, although the lease may require them to protect the interests of the landowner. The value of land as an asset depends on the present value of future rents. The land may be used for different purposes in the future, so different characteristics may be relevant. These characteristics would then influence asset value but not rental value. For example, proximity of farmland to a major population center might increase land values even though it did not increase agricultural productivity. In the same vein, a characteristic that is of value in agricultural use, such as soil productivity, may be discounted in the asset price if that characteristic is not as highly valued in some alternative use (for example, commercial use) that is anticipated in the near future." The variables used in our model are presented inTables

Table 1 and their summary statistics in Table 2.

The average rental price per hectare of land is $1,239, ranging from $160 to $2,571. The average surface of plots is 119 hectare. In our study, 42% of the plots are located in the province of Buenos Aires and 58% in the Province of Santa Fé. Although these two provinces are quite representative of Pampas agriculture, the former is more urbanized. Indeed, its capital city Junín is closer to the city of Buenos Aires than San Justo (Santa Fé). In the latter, livestock is more developed. As noted by (Choumert and Phélinas 2015b), farmland parcels in the province of Buenos Aires are more valued than those situated in Santa Fé, notably because the province benefits from better infrastructure (such as roads), greater commercial and residential development, and better accessibility to major markets.

As far as agricultural potential is concerned, the two districts differ more in the quality of their soils than in their climate. The territorial scan carried out by the project CLARIS LPB showed that 80% of Junin's soils are suitable for agriculture and have a very high productive potential whereas the proportion of land for agricultural use is only 44% in San Justo, among which, only 29% have a high productive capacity (V. Hernandez et al. 2015). Nonetheless, both provinces share the same climatic environment with mean length of dry spells as well as mean length of wet spells being nearly the same (V. Hernandez et al. 2015). These results are consistent with previous studies conducted in the Pampas region (Magrin, Travasso, and Rodríguez 2005; van Dam et al. 2009).

The sample of plots contains various land types (arable land, grassland), which are rented at different prices. However, most contracted land is used for grain or soybean production. In a majority of plots, farmers grow soybeans (72%). Wheat is grown on 20% of plots and corn on 23%. Only 15% of plots have been rented for cattle ranching or dairy production.[viii] We introduce measures of yields for the three crops and a binary variable for livestock activity. The measure of soybean yields allows us to take the expected return of land cultivation into account.

In our sample, family, neighbours, and local tenants dominate the land rental market, whereas sowing pools, which are agricultural trusts seeking to lease tracts of land temporarily, appear to be a minor actor. This is in line with (Urcola et al. 2015), where they analyse the land leasing market in Balcarce (province of Buenos Aires).

4.2.Empirical analysis

In line with the literature on hedonic models, we estimate two functional forms, that is log-lin and log-log.[ix] Plots are heterogeneous goods. This heterogeneity can create heteroscedasticity in the residuals of the estimation of the hedonic price function. We actually detect heteroscedasticity in our model; hence, we estimate a model with robust standard errors. Given that multicollinearity is a frequent concern in hedonic studies, we verify variance inflation

factors (VIF) to detect potential collinearity of the regressors, and find none, as the maximum VIF is 16.

4.3. Results

The results are shown in Table 3. Our hedonic analysis explains around 60% of rental price variations. Marginal effects are presented in Table 4. As expected, rental prices are higher in the Buenos Aires province. Renting a plot in this province is substantially more expensive than renting one in Santa Fé. This result is in line with the literature on land rental prices which demonstrates that the productive potential of the land is one of the main factor that affect land rents. Indeed previous studies, such as (V. Hernandez et al. 2015), have highlighted the productive and soil quality differentials between those provinces. This result also supports that localization is an important factor explaining land prices and corroborates the idea that better access to infrastructure and proximity to major markets are capitalized in rental prices.

Farmland rental values fluctuate according to the profitability of what is being produced on a rented plot, which, in turn, determine the income that can be generated from the parcel. As expected, we observe a variation in rental prices as a function of soybean yield, which is a good proxy for the expected market return of the plot, with soybeans being the most profitable crop. Similarly, allocating land to cattle production exerts a negative influence on farmland rents. Lower output prices and/or lower profitability explain this result.

The rental price per hectare tends to be negatively correlated with the surface of parcels. This is a standard result in hedonic studies. It also supports the inverse farm size-productivity relationship and its land market expression (Barrett 1996; Carter 1984).

The identity of contracting parties matters. The level of the rent is significantly affected by the nature of the relationships between the parties (familial or vicinity) and the geographical distance between landlords and tenants. Rental rates are much lower when the lease contract is concluded between family members or within the local network of neighbours and

acquaintances, than they are when the lease contract is concluded with societies, such as sowing pools. The latter are charged the highest rental price. Several factors drive these results. First, sowing pools have a strong motivation to secure access to land, without which they have no business. Since these societies usually lease services for the main farming operations (planting, spraying and harvesting) from professional service providers who are frequently agronomists, the land benefits from the best technical expertise and is expected to provide a high return. In addition, societies, which often operate in a more dispersed geographic area, including foreign countries, call upon the services of brokers to find leasing opportunities (Urcola et al. 2015). This might result in a higher cost for the whole process. They also might be less informed about land rental rates in an area.

Second, such results are in line with most previous studies on farmland transactions showing that transactions with family members are discounted because they are easier to enforce and the probability of morally hazardous behaviour is lower. The informational advantage of the local network, driven by long-term relationships, also plays a significant role (Kostov 2010; Otsuka and Hayami 1988; Rainey et al. 2005). However, (Bryan, Deaton, and Weersink 2015) do not find any impact of family relations on the magnitude of rental rates.

Third, the channels through which leasing opportunities are found differ according to the physical distance separating the contracting parties. Informal local networks allow local landlords to exploit informational advantages to learn about their tenants' skill, effort, reputation and trustworthiness. Usually, landlords and tenants who live in the same area already know each other before they enter into a contractual agreement. There is, accordingly, a tendency for the resulting rent to be lower, compared to the rent agreed between contracting parties living in a different district or department.

As far as the length of the contract is concerned, we found evidence that rental prices of short-term cash contracts lay well above rental prices for multi-year cash contracts, whereas prices for share contracts appear to be the lowest. These results largely reflect differences in

crop mix according to the type of contractual arrangement. There is a tendency for soybeans to be grown continuously in areas under short-term contract. Therefore, the significantly higher rent that is associated with this type of contract captures the short-term expected profits associated with soybean cultivation, which benefits both the landlord and the tenant. For the tenant, an intensive use of the soil means higher income and therefore higher capacity to pay a higher rent.

Unfortunately, insofar as the rent level is tied to the intensity of the land use, short-term contracts create disincentives to good agricultural practices or investment in soil conservation measures. Long-term productivity can be seriously diminished because of overplanting soybeans, since the benefits of chemical application have a short duration. An increase in the current year's income therefore comes at the expense of future income.

Longer cash leases are less valued than short cash leases, but not by much. This indicates that longer-term leases, which are agreed upon at the start of the lease period, and usually not re-negotiated or adjusted annually, might not reflect the current level of return in agricultural production exactly, since post-harvest commodity prices are unknown when rental agreements are made. This expectation error might be particularly strong in periods of increasing prices, as was the case in 2011, the year our field survey was conducted. A longer contractual period might also indicate mutual trust between the landlord and the tenant. The resulting lower rent could be considered as a market translation of lower enforcement costs. This argument is supported by the theory of incentive contracting (Huffmann and Just, 2004; Allen and Lueck, 1992a).

Share contracts exhibit the lowest rent, a result that is consistent with the existing theoretical literature on land-lease contracts. This result strongly supports the hypothesis that landlords who enter this type of contracts have requirements regarding land management, herbicide application, and rotation of soybeans with cereals, at the cost of a lower lease price. There is a large body of empirical evidence showing that share tenancy is preferred when landlords have the ability to monitor tenants, in order to avoid potential degradation of the land

asset, among other things. Immediate income is clearly sacrificed for soil conservation. Another explanation for this result might come from differences in tenants' entrepreneurial abilities, which are not easily observable. Those endowed with higher skills may seek fixed-rent contracts that allow them to perceive a higher return on their effort. As a result, less skilled tenants might be self-selected for share contracts.

5. Conclusion

High international prices combined with technological advances raised returns on Argentinian agricultural production, thereby increasing the demand for farmland. As a result, land rentals increased sharply during the last decades.

In this paper we have studied the rental farmland market in the Argentinian Pampas. In particular, we question the importance of contractual arrangements in the context of rapid GM soybean development. We used a hedonic pricing model, which includes three main types of leasing contracts and controls for other characteristics of the plots leased. We provide empirical evidence that contractual arrangements are capitalized in land rental values, all things being equal.

The one-cultivation-cycle contract has the highest rental value, and the land area under this type of contract is expected to increase. Since productive orientation is clearly related to land rental practices, continuous soybean cultivation is likely to expand. Indeed, the technically recommended crop rotation is rarely followed when the land is under short-term contract. Declining ecological conditions could be a serious consequence of the expansion of this type of contract. In particular, long-term negative effects on land's productive capacity are expected, due to excessive planting of soybeans.

Since a growing share of farmland in Argentina is cultivated by tenants, our results suggest that policy recommendations to minimize the adverse environmental impacts of changes in land tenure are needed. If Argentina intends to protect its enormous natural advantage for agricultural production, a strict regulation of land rental contracts, with respect to length of term and land management, should be considered. Another alternative would be to support the relative profitability of other crops through export taxes and/or input cost reduction.

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Tables

Table 1. Description of variables

VARIABLES	DESCRIPTION	EXPECTED SIGN
RENT	Rental price (US dollar per hectare)	Dependent variable
BUENOSAIRES	= 1 if the plot is in Buenos Aires province	+
SANTAFE	= 1 if the plot is in Santa Fé province	-
SURFACE_PLOT	Surface of the plot (hectares)	-
SOYBEAN_YIELD	Tons per hectare of land where soy is cultivated	+
WHEAT_YIELD	Tons per hectare of land where wheat is cultivated	+
CORN_YIELD	Tons per hectare of land where corn is cultivated	+
LIVESTOCK	= 1 if there is livestock activity on the plot	-
TENANT_FARMING	= 1 if tenant farming	-
SHARECROPPING	= 1 if sharecropping	-
SHORT_CONTRACT	= 1 if short contract	+
RELATION_PARENT	= 1 if contractual arrangement between relatives	-
RELATION_NEIGHBOR	= 1 if contractual arrangement between neighbours	-
RELATION_IN_DEP	= 1 if contractual arrangement between persons in the department	+

RELATION_OUT_DEP	= 1 if contractual arrangement between persons outside the department	+
RELATION_SOCIETY	= 1 if contractual arrangement with sowing pools	+

Table 2. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
Rent	1238.89	499.65	160	2571
Ln_Rent	7.03	0.45	5.08	7.85
Buenosaires	0.42	0.49	0	1
Santafe	0.58	0.49	0	1
Surface_plot	118.93	131.74	7	998
Wheat_yield	0.83	1.83	0	10
Corn_yield	1.50	3.20	0	13.33
Soybean_yield	1.97	1.42	0	4.83
Livestock	0.15	0.36	0	1
Tenant_farming	0.66	0.47	0	1
Sharecropping	0.06	0.24	0	1

Short_contract	0.28	0.45	0	1
Relation_parent	0.22	0.41	0	1
Relation_neighbor	0.29	0.46	0	1
Relation_in_dep	0.36	0.48	0	1
Relation_out_dep	0.11	0.32	0	1
Relation_society	0.02	0.12	0	1
N = 255				

Table 3. Results of the hedonic analysis

VARIABLES	(1) ln_rent	(2) ln_rent	(3) ln_rent	(4) ln_rent
Buenosaires	0.607***	0.616***	0.607***	0.617***
	(0.0405)	(0.0417)	(0.0404)	(0.0421)
Surface_plot	-0.000251	-0.000435**		
	(0.000172)	(0.000182)		
Wheat_yield	0.0130	0.0163	0.0120	0.0152
	(0.00975)	(0.0103)	(0.00986)	(0.0104)
Corn_yield	0.00219	0.00132	0.00196	0.00101
	(0.00729)	(0.00763)	(0.00725)	(0.00753)
Soybean_yield	0.0308**	0.0419**	0.0300**	0.0413**
	(0.0149)	(0.0165)	(0.0149)	(0.0166)
Livestock	-0.247***		-0.258***	
	(0.0825)		(0.0818)	
Tenant_farming	-0.0544*	-0.0881**	-0.0542*	-0.0895**
	(0.0324)	(0.0346)	(0.0325)	(0.0351)
Sharecropping	-0.217*	-0.219*	-0.218*	-0.219*
	(0.125)	(0.123)	(0.125)	(0.122)
Short_contract	-	-	-	-
Relation_parent	-0.579***	-0.525***	-0.574***	-0.509***
	(0.120)	(0.0913)	(0.121)	(0.0920)
Relation_neighbor	-0.399***	-0.328***	-0.396***	-0.314***

	(0.0969)	(0.0530)	(0.0988)	(0.0544)
Relation_in_dep	-0.496***	-0.442***	-0.491***	-0.425***
	(0.103)	(0.0649)	(0.105)	(0.0645)
Relation_out_dep	-0.441***	-0.358***	-0.444***	-0.353***
	(0.107)	(0.0637)	(0.110)	(0.0670)
Relation_society	-	-	-	-
ln_Surface_plot			-0.0247	-0.0477*
			(0.0243)	(0.0246)
Constant	7.294***	7.212***	7.372***	7.356***
	(0.0906)	(0.0381)	(0.110)	(0.0913)
Observations	255	255	255	255
R-squared	0.588	0.555	0.585	0.549

Table 4. Marginal prices for Model 1

Significant variables	**Variation of the rental price per hectare due for having the characteristic (dummy) or to a one unit increase (continuous variable)**	**Variation for the average rental price per hectare**
	%	USD per hectare
Buenosaires	83.49	1034.37
Soybean_yield	3.08	38.16
Livestock	-21.89	-271.14
Tenant_farming	-5.29	-65.60
Sharecropping	-19.51	-241.67
Relation_parent	-43.95	-544.54
Relation_neighbor	-32.90	-407.61
Relation_in_dep	-39.10	-484.45
Relation_out_dep	-35.66	-441.80

Footnotes

[i] The Argentinian model of GM soybean production is called "*modelo sojero*". For further information on its precise characteristics and it driving factors, see Bárcena et al., 2004; Burachik, 2010; Carreño et al., 2012; Choumert and Phélinas, 2015; de la Fuente et al., 2006; Gavier-Pizarro et al., 2012; Leguizamón, 2013; Urcola et al., 2015.

[ii] It is difficult to assess land under tenancy since 2002 because, for different reasons, the results of the last Rural National Census conducted in 2008 are not published. The figure we mention comes from estimates given by different authors (Delvenne, Vasen, and Vara 2013; Manciana 2009). They are consistent with the share of land under different tenancy arrangements we found in our survey.

[iii] This preliminary work was conducted within the context of two research programs implemented earlier. The first one is a European program on climate, named CLARIS LPB, and the second one is a project financed by the French Agency for Research (ANR), named INTERRA.

[iv] Since tenants sometimes contract with more than on landlord, the sample unit is a contract, not an individual tenant.

[v] In both cases, the level of the rent has been given in quintals of soybean by respondents, so that the rent for share and fixed contracts is expressed in the same unit. To obtain a value, we assumed that producers face the same price for output and used the mean of soybean prices for 2011 calculated from the time series given by the professional trade magazine "*Margenes Agropecuarios.*"

[vi] See (Palmquist and Danielson 1989), for a model on farmland values. For an overview of the empirical literature, see Choumert and Phélinas, 2015; Maddison, 2000.

[vii] Another strand of the literature is focused on farmland rental market in the Pampas and use agent based modelling. This literature goes beyond the scope of our analysis. For further reading see (F. Bert et al. 2010; F. E. Bert et al. 2014; F. E. Bert et al. 2011).

[viii] Note that farmers can grow several types of crops on a plot within an agricultural cycle.

[ix] A linear functional form would imply constant implicit marginal prices, that is independent of the level of characteristics.