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Analysis

Determinants of agricultural land values in Argentina

Johanna Choumert [a], Pascale Phélinas [b,*]

[a] CERDI-CNRS, Université d'Auvergne, 65, Boulevard F. Mitterrand, 63000 Clermont-Ferrand, France
[b] IRD-CESSMA-CERDI, 65, Boulevard F. Mitterrand, 63000 Clermont-Ferrand, France

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ABSTRACT

In the context of the rapid development of the cultivation of genetically modified soybeans in Argentina, we conduct a hedonic analysis of agricultural land values. The main objective is to evaluate the impact of land tenure systems and agricultural practices on these values. Data on 338 parcels, located in the Pampas region, are analyzed. The tenure appears to be a particularly important variable. We find that plots rented either by physical persons or by companies are negatively valued in relation to plots owned. Results also highlight the importance, though not to a large degree, of a diversified cropping pattern compared to soybean monoculture. Soil quality, location of the plots, distance to markets, as well as to the nearest city, were also found to affect land values.

1. Introduction

Genetically modified (GM) soybean cultivars were introduced in Argentina in 1996 and adopted at a tremendous rate. Currently, more than 90% of the total soybean production is genetically modified and GM soybeans encompass 19.5 million ha cultivated, that is nearly half of the total cultivated area. Argentina is now the second largest producer of GM crops with 21% of the world's biotech crop area and the third largest exporter of soybeans after the USA and Brazil (Filomeno, 2013; Leguizamón, 2013).

The development of GM soybean cultivation in Argentina was done under very specific circumstances. The adoption of biotechnologies was accompanied by radical changes in land use and by an original organization of the production. New forms of associations between farmers emerged "*pooles de siembra*" to manage and finance soybean production (Hernandez, 2009). These sowing pools are agricultural trusts consisting of farmers seeking to extend their scale of production, who gather temporarily (usually one planting season) to lease tracts of land as well as services for the main farming operations (planting, spraying and harvesting) and sometimes for transport. They also look for investors, who may come from outside of the primary sector (banks, finance companies) as well as inside (agro-industrial firms, providers of agricultural inputs) to finance soybean production.

The dramatic success of the so-called Argentinian "*modelo sojero*," based on intensive, large-scale mechanized production, and on a very efficient management of production has supported an impressive growth of soybean production. However, the long-term sustainability of this model became a matter of concern during the first decade of the 2000s. Various contributions documented the negative impacts of the "*modelo sojero*" (Carreño et al., 2012; de la Fuente et al., 2006; Gavier-Pizarro et al., 2012; Leguizamón, 2013; Bárcena et al., 2004; Pengue, 2005a). They include strong incentives for the intensification of agricultural land use resulting in rapid conversion of rotational cropping patterns into permanent soybean production, expansion of the agricultural frontier at the expense of natural lands, increase in short-term contracts for land, a growing use of glyphosate herbicide which results in soil contamination, intense deforestation in regions such as El Monte, destruction of ecosystems, and loss of species richness particularly in the sensitive bio diverse ecoregions such as the Yungas or the Great Chaco (Gavier-Pizarro et al., 2012).

In addition, the race for land induced by record profits of GM soybean cultivation has been dominated by acquisition of user's rights (renting and leasing) rather than by acquisition of land. Indeed, tenancy has increased compared to farming one's own land and accounts for nearly 60% of the land cultivated (Manciana, 2009; Delvenne et al.,

* Corresponding author.
E-mail addresses: Johanna.choumert@udamail.fr (J. Choumert), pascale.phelinas@ird.fr (P. Phélinas).

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2013).[1] The growing disconnection between land ownership and land cultivation tends to worsen the environmental impact of GM soybean production through the loss of control over the land by absentee landowners. Many are those who argue that pools are looking for short-term profit, and are thus responsible for the increasing number of short land lease agreements which support practices that are detrimental to the long-term preservation of land resource quality (Gras, 2009; Gras and Hernández, 2009; Leguizamón, 2013; Pengue, 2005b). In particular, the incentives to adopt the conservation practices proposed by the ley 22428 are inoperative under these circumstances.[2] The "*modelo sojero*" in Argentina thus remains a highly contested model.

Attention has recently been paid in the literature to the value of the biophysical attributes of land, suggesting that land values may vary with potential environmental contamination (Boisvert et al., 1997), soil exhaustion and degradation (Sills and Caviglia-Harris, 2009), and the cropping history of the plot (de la Fuente et al., 2006). Another strand of literature emphasizes the implications of land tenure on fertilization, adoption of conservation practices, and long-term land improvements (Abdulai et al., 2011; Myyrä et al., 2007; Soule et al., 2000). However, the extent to which different tenure modes are reflected in land values has not yet been examined. The Argentinian context of a growing number of sowing pools operating under lease is particularly relevant in order to explore and test the role of tenure and agronomic practices on these values.

This paper investigates the factors that determine the values of farmlands in the Pampas region, where GM soybean cultivation is concentrated, using hedonic price functions. The structure of this paper is as follows. Section 2 discusses the literature on the use of the hedonic price method applied to farmland values. Data collection and the empirical strategy are presented in Section 3. Results and their implications are discussed in Section 4 before we conclude.

2. Literature Review

Since the early analyses of Ricardo (1821) and von Thünen (1910), three types of theoretical models have been developed to explain the value of agricultural land, namely, the Demand–Supply Model (DSM),[3] the Net Present Value Model (NPVM),[4] and the Hedonic Price Method (HPM). The HPM is continuing on from the NPVM. The HPM is widely used in environmental and natural resource economics and in real estate economics.

The HPM consists of the analysis of the price of differentiated goods based on their characteristics. Rosen (1974) formalized the HPM through his seminal article that has since become the main reference in the field. The HPM consists of revealing the implicit prices of various attributes of heterogeneous goods. The HPM implies that housing or farmland is a heterogeneous good consisting of a set of characteristics $Z = (z1, \ldots, zk, \ldots, zK)$ sold in bulk. Properties are distinguished from each other, both through their intrinsic as well as extrinsic characteristics. The HPM calculates the implicit marginal price of these different characteristics from the overall price $P(Z)$ of the property. At equilibrium, each implicit marginal price pk is equal to the marginal willingness to pay for this characteristic and is calculated, in the case of quantitative variables, as the derivative of the aggregate price $P(Z)$ with respect to the quantity zk. The empirical calculation of different marginal implicit prices thus requires the estimation of the hedonic price function by regressing prices of properties on their various characteristics.

Turning to the HPM for agricultural lands, Palmquist (1989) and Palmquist and Danielson (1989) may be considered as the seminal papers, respectively, for rental values and for property values. One may also refer to Maddison (2000) for an application of the model to agricultural land.

While the literature on hedonic analysis of real estate properties is prolific, literature on agricultural land values is abundant in the USA and Europe but scarce in other countries.

Several types of dependent variables are used in the models. The different articles focus either on farmland values (e.g. Palmquist and Danielson, 1989; Sklenicka et al., 2013) or rental values (e.g. Palmquist, 1989; Donoso and Vicente, 2001). Among the studies using farmland values, most use the price per hectare (acre). Using a per hectare value reduces the risk of heteroscedasticity (Maddison, 2000). In the subsequent analysis, we will therefore use the value per hectare.

Depending on the country and the availability of data, data used are from actual transactions (e.g. Chicoine, 1981), survey data (e.g. Donoso and Vicente, 2001), or even professional valuation (e.g. Maddison, 2000). The number of studies on American farmlands can be explained in part by the availability of data on land transactions and the ease of access to these. In the case of developing and emerging countries, like Argentina, accessing sales data remains more difficult. There does not exist any consultable register that counts land transactions and gives indications on the characteristics of the land exchanged. Therefore, we use survey data.

Factors that are expected to influence farmland prices in the hedonic literature shall be split into two groups, intrinsic and extrinsic characteristics. The former includes structural characteristics such as surface (e.g. in Chicoine, 1981; Donoso and Vicente, 2001; Gardner and Barrows, 1985; Huang et al., 2006; Maddison, 2000, 2009; Troncoso et al., 2010, among others), soil characteristics (e.g. in Ay et al., 2012; Donoso and Vicente, 2001; Huang et al., 2006; Maddison, 2000, 2009; Miranowski and Hammes, 1984; Troncoso et al., 2010), land quality (Faux and Perry, 1999; Nivens et al., 2002; Palmquist and Danielson, 1989; Xu et al., 1993, etc.), productivity (Chicoine, 1981; Gardner and Barrows, 1985; Maddison, 2000; Wasson et al., 2013), and yield. Extrinsic characteristics include locational characteristics such as access to the nearest city (Ay et al., 2012; Maddison, 2000, 2009; Sklenicka et al., 2013), access to roads (Nivens et al., 2002; Troncoso et al., 2010), urban pressure (Herriges et al., 1992; Huang et al., 2006; Maddison, 2000; Sklenicka et al., 2013; Taylor and Brester, 2005), and climate (Maddison, 2000).

Few studies have been conducted in Latin America, except for instance Donoso and Vicente (2001) and Troncoso et al. (2010). In Chile, Troncoso et al. (2010) find that localization, soil quality and connectivity to roads are the most influential attributes of farmland prices. In Argentina, Donoso and Vicente (2001) focus on the value of soil erosion in an analysis of rental values.

3. Empirical Analysis

3.1. Study Area

The empirical analysis utilizes data collected from a sample of farms located in two provinces of the Pampas region of Argentina. Historically, agriculture in Argentina has been concentrated in this region where soils have the greatest productive potential. The Pampa's agriculture consists primarily of GM soybean production, followed by grain production and cattle rising.

[1] It has been difficult to assess land under tenancy since 2002. For different reasons, the results of the last Rural National Census conducted in 2008 are incomplete. The figure we mention comes from estimates given by different authors. It is in line with the share of land under tenancy we found in our survey.

[2] The national law for soil conservation promotion (no. 22428) was implemented in 1985 with the objective of giving subsidies to consortiums of farmers, freely made up, in order to share the expenses associated to soil conservation practices. The lack of public funds and sometimes their misuse, the significant economic profits generated by large scale GM soy production under lease contracts, explain that this law yielded to meager results (Acuña, 2009).

[3] The DSM consists of estimating a simultaneous equation model of demand and supply for agricultural parcels (cf. Devadoss and Manchu, 2007; Herdt and Cochrane, 1966; Tweeten and Martin, 1966).

[4] The NPVM approach assumes that farmland values are determined by discounted annual returns (cf. Burt, 1986; Devadoss and Manchu, 2007; Melichar, 1979).