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Original Research

Hedonic Pricing of Grass-Fed Cattle in Uruguay: Effect of Regional Resource Endowments[☆]Bruno A. Lanfranco^{a,*}, José P. Castaño^b^a Senior Researcher, Economía Aplicada, Instituto Nacional de Investigación Agropecuaria (INIA), Uruguay^b Researcher, Agroclima y Sistemas de Información (GRAS), Instituto Nacional de Investigación Agropecuaria (INIA), Uruguay

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ABSTRACT

A hedonic model of feeder and replacement cattle prices in Uruguay was specified to include both permanent agroecological factors (soil productivity and water holding capacity [WHC]) and nonpermanent factors (season, available soil moisture, and pasture conditions) as explanatory variables. Results indicate that predominant agroecological endowments (soil characteristics, water availability, and average seasonal climatic conditions) determine geographic price patterns for cattle produced under extensive production systems. In addition, weather variability and especially extreme events have an important impact on short-run cattle markets. As pasture conditions improve or precipitation increases (e.g., both soil moisture and surface runoff), livestock prices tend to fall, *ceteris paribus*. A cattle price gap between different regions of Uruguay based on permanent resource endowments (e.g., soil productivity and WHC) and temporary agroecological conditions exists and is illustrated using a series of iso-price maps. The hedonic price model also included various cattle characteristics and marketing conditions as explanatory variables. Grass-fed cattle in Uruguay are not a homogeneous commodity; video auction prices incorporate information about a range of agroecological factors that influence cattle production, marketing patterns, as well as perceived and actual cattle quality and performance.

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Introduction

Live cattle are not a homogeneous commodity and have distinct qualitative differences. Cattle quality can be measured through a set of characteristics or attributes expressed in terms of price premiums and discounts (Ladd and Martin, 1976; Buccola, 1980). A herd of cattle has a set of measurable characteristics that completely describe and differentiate it from other herds. Cattle buyers and sellers assign values to animals with different combinations of characteristics and agree on market prices that embody the differences. When the attributes tied to a specific region of production influence prices, a resource endowment provenance is recognized. Buyers and sellers agree on cattle prices according to their assessments of cattle characteristics, their business objectives, tastes, and preferences. Cattle attributes recognized by buyers can be associated with a specific set of permanent agroecological characteristics defining a region and may be rewarded with either price premiums or discounts. Permanent agroecological conditions thus serve

as summary indicators of conditions under which livestock are produced and perceived characteristics of both the cattle and final meat product. Temporary agroecological conditions (e.g., precipitation) influence cattle prices through short-run supply and demand effects resulting from producers' herd liquidation or expansion decisions, in addition to cattle condition and appearance at time of auction.

Across the years, a number of studies have recognized the influence of cattle attributes, overall market conditions, and marketing strategies on prices at which cattle are bought and sold (Menzie et al., 1972; Buccola and Jessee, 1979; Buccola, 1980; Buccola et al., 1980; Sullivan and Linton, 1981; Ward, 1981, 1982; Kerr, 1984; Marsh, 1983, 1985; Schultz and Marsh, 1985; Faminow and Gum, 1986; Schroeder et al., 1988; Mintert et al., 1990; Bailey and Peterson, 1991; Bailey et al., 1991, 1993; Langemeier et al., 1992; Turner et al., 1993; Parcell et al., 1995; Dhuyvetter et al., 1996; Dhuyvetter and Schroeder, 1999; Avent et al., 2004; Dhuyvetter, 2004).

From the analysis of cattle sold in both traditional and video auctions, Buccola (1980), Schroeder et al. (1988), Mintert et al. (1990), Bailey et al. (1991), Turner et al. (1993), and Dhuyvetter et al. (1996) distinguished two types of short-run effects over auction prices: those involving physical traits of the lot of animals and those referring to the prevailing market conditions. None of them put the attention on the use of agroecological condition variables as a potential source of price variability in live cattle.

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According to these authors, the most relevant animal characteristics to be included in an empirical hedonic model are live weight, breed, sex, age, body conformation and frame, corporal condition, and presence of horns, among others. Kerr (1984) concluded that the price paid in auctions reflects the implicit value of animal traits. With regard to market conditions, most of these studies incorporated variables such as market location, price expectations, time or season of the year, and size of the auction (quantity of cattle lots). Bailey and Peterson (1991) considered other factors referring to marketing strategy, such as the size of the lot, availability of financial credit, time for delivery, and order of entry to the pit, as a third type of effect influencing cattle prices in the short run.

In South America, and more specifically in Uruguay, Lanfranco et al. (2006) were the first researchers to quantify the influence of livestock characteristics, marketing strategies, and market conditions on cattle prices. Regarding cattle traits, the authors found that body weight, sex, predominant breed, presence of certain crossbreeds, uniformity of animal size, and conformation are characteristics important to buyers for particular lots sold.

While many of these attributes can be measured more or less objectively, judgment of livestock quality through subjective visual assessment is key to livestock marketing. As pointed out by Buccola (1982), the order in which cattle are sold in auctions and the number of animals in a particular consignment influence prices received by cattle producers. In the case of video auctions, buyers rely on their own viewing of the videos and direct visual assessment of cattle by inspectors who certify the lots. Inspectors' recommendations are highly valued by video auction buyers, whose decision making is further influenced by market conditions, currency exchange rates, and longer run price expectations within the livestock sector (Lanfranco et al., 2006).

Moreover, Lanfranco et al. (2006) highlighted the existence of geographic and seasonal factors affecting cattle prices but in a general way. Their study considered both factors only through the inclusion of dummy variables. A limitation with dummies is that they can only assess for potential shifts between a certain status of a variable and its baseline status.

The statistical significance of the seasonal dummies used in this study captured the effects of the season of the year on cattle prices when cattle were marketed. There was a negative shift in the prices paid for cattle, *ceteris paribus*, between each one and the baseline (spring season). Nothing can be said about differences among summer, fall, and winter season, but the magnitudes of the shifts suggest that cattle prices exhibit a downward trend from summer to the beginning of winter, following an increase in supply. Cattlemen have to sell the excess cattle (weaned calves, cull cows and heifers, and feeder steers) in order to adjust their stocking rate to the lower pasture production faced during the winter season. The gradual increase in forage availability toward the spring allows producers to retain animals and eventually increase the stocking rate. This would cause an increase in demand that would drive up until the summer (Lanfranco et al., 2006).

On the other hand, another set of dummy variables was used in the referred work to seek for differences because of the animals' geographic origins. The authors suggested that the provenance effect embodies the effects of a number of variables relevant to the formation of livestock prices. Soil and forage types, as well as typical production conditions and practices derived from the natural resource endowment, are all factors that influence nutrition and management that, in turn, affect cattle development and condition at time of marketing.

Here the limitation was more evident due to the unavailability of explicit data accounting for differences among agroecological regions. Lanfranco et al. (2006) used department boundaries (equivalent to counties or provinces) to define the 19 binary variables accounting by the geographic origin of cattle sold during the study period. The associated coefficients were statistically different in 14 out of 18 variables compared with the baseline, suggesting the existence of price differentials related to provenance. However, the lack of explicit variables discriminating its underlying components (soil types, pasture conditions,

water availability) inhibited a better understanding of these phenomena and the magnitude of their impact on cattle markets.

Because of the agroecological endowments of rangelands, prices will vary among cattle prices, livestock income derived from cattle sales, and the value of lands dedicated to cattle production. Understanding the provenance effect on live cattle prices thus provides information about the ranch real estate market.

The objective of the current study is to quantify the effects of permanent and temporary agroecological conditions on live cattle prices in Uruguay. Permanent differences between the country's agroecological regions are primarily a function of soil types (e.g., the key determinant of soil productivity, water holding capacity [WHC], and thus forage production). Seasonal climatic variation that determines annual cycles of pasture growth and temporary effects due to deviations in the average meteorological conditions add to heterogeneity of the country's agroecological regions. The magnitude of agroecological effects is reflected in the marginal contribution that each makes to cattle prices at a particular time. This analysis also identifies regional patterns in cattle prices, illustrated through iso-price maps, incorporating both static and dynamic agroecological components.

Uruguay's national government and beef cattle supply chain have long-term objectives that involve increasing sector-wide productivity and earnings, total exports, and price premiums paid for high-quality, grass-fed beef.¹ Typical of rangelands composed mainly of native species, pasture growth exhibit pronounced seasonal patterns with important variability among years. A common practice during winter, when there is no growth and the volume and quality of pastures are insufficient for feeding cattle, is the use of supplementary forage (hay, silage) or grain.

Differentiation of Uruguayan beef in the world market based on provenance is one possible strategy for the sector, although as noted earlier, Uruguayan beef cattle production regions are not homogeneous. These results increase our understanding of the output price and the potential asset value impacts of agroecological variability in Uruguayan grass-fed beef production.

In the current study, cattle were identified by their Uruguayan police precinct of origin (a subdepartment administrative division). Police precinct boundaries roughly, but not exactly, define homogeneous agroecological conditions. In order to incorporate agroecological factors into an explanatory model of Uruguayan cattle prices, this research included explicit variables, directly or combined through indices, that would accurately capture resource endowment and microclimate effects on cattle quantity, quality, and market prices.

Materials and Methods

Dataset Description and Sources

The dataset used in the study was compiled using information from the three largest video auctions currently operating in Uruguay: Lote 21, Plaza Rural, and Pantalla Uruguay. Before each auction, the video auction operators publish the corresponding catalog (electronic version posted online and printed version published in the press or available during the auction). The catalogs contain all the information regarding the attributes of cattle lots being offered, as well as the marketing conditions of the auction. In Uruguay, cattle is marketed in US dollars. Cattlemen pay and receive US dollars, and prices are recorded and expressed per kilogram of live weight (US\$ kg⁻¹). The actual prices recorded at each auction were collected either online from the official

¹ Here, the term "grass-fed" does not relate to any private certification scheme standing for cattle fed only using 100% grass and forage (no supplemental grain feeding), as they exist in other countries (e.g., the grass-fed definition used by the American Grass-fed Association). In this article, it refers to open-sky, land-extensive systems that characterize livestock production in Uruguay, where cattle graze year-round over rangelands, from weaning to slaughter.

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