Economic Value of Brangus Cattle Traits in Argentina

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Abstract

Starting in the early 2000s, a boom in demand for agricultural commodities displaced cattle ranching out of the most productive areas of the Pampas' prairie. The crossbreeds between Angus and Hereford with Brahman, i.e., Brangus and Braford, have been successfully adopted across Argentina. However, little is known about the specific bulls' traits that drive the demand for cattle genetic selection outside the Pampas. Understanding the economic value of traits would help to identify the demand for adapting livestock production to different ecosystems while preserving the meat quality of Angus and Hereford cattle. We estimated hedonic price models using Brangus bull sales data from two cattle breeding ranches in the north of Cordoba province. We find that, after controlling by sire, stud, and transaction date, cattle ranchers prefer observed traits such as weight, coat color, and age, while genetic indicators such as Expected Progeny Differences (EPDs) have secondary importance. We argue that stronger preferences for read-coated bulls, as opposed to black-coated bulls, could be associated with the demand for reducing heat stress; the lack of response of price to EPDs may be related to understanding how correlations between bull genetic traits would later express in the herd.

Keywords: Hedonic Pricing, Auctions, Technology Adoption, Climate adaptation

JEL Classification: Q12, Q13, Q16

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1. Introduction

Cattle adaptation to new environments is a possible pathway for increasing productivity and meat supply. In Argentina, changes in relative prices between agriculture and livestock pushed cattle ranching out from the core of the Pampean prairie to other regions of the country (Reca et al., 2010). The demand for adaptation in less productive areas, such as subtropical regions, created the economic opportunity to develop new synthetic breeds, like Brangus and Bradford. These breeding preserve the meat quality of Angus and Hereford bulls while improving the animal's ability to withstand heat stress, mainly by crossing these breeds with Brahman bulls. While there is evidence of the adoption of crossbreeds, there is little to no information on the economic value of crossbreed traits in Argentina. Estimating the value of bull characteristics will help ranchers' investment decisions in genetics.

Ranchers select bulls according to their preferences for traits. A trait is any characteristic of the animal that has an intrinsic value. They can be phenotypical, that is, observed, such as the hide color or the sex, or genotypical (estimated) based on the Expected Progeny Differences (EPDs). EPDs are measures of the genetic contribution of an animal to the set of genetic traits of its progeny. These indicators provide helpful information regarding a bull's likelihood to father calves with superior attributes relative to its ancestors. Examples of EPDs are birth weight, weaning weight, and scrotal circumference (Dhuyvetter et al., 2005; Mitchell et al., 2018). For instance, a farmer who is looking to reduce birth complications would select a bull with a negative birth weight EPD. Incorporating that characteristic in the herd is intended to reduce the time of vigilance of calving cows.

This article aims to estimate the economic value of genetic and non-genetic traits for Brangus bulls in Argentina. We hypothesize that EPDs' economic value is affected by farmers' objectives and characteristics. The use of EPDs for bull selection is a new tool and its value comes from improving precision for genetic information and investments. If EPDs are a superior technology to bulls' visual aspect and own data, we should observe that all ranchers already adopted it. However, technology is not a random process and availability does not necessarily imply adoption (Hayami & Ruttan, 1971; Schultz, 1964; Sunding & Zilberman, 2001). At some point, top farmers adopt first, and other farmers are followers. Traditional farmers' choices are based on a combination of visual inspection and phenotypical data of the bull. Innovative farmers, which are less risk averse and have lower costs of adoption, are giving this information more relevance in bull selection. Hence, we should expect a coexistence of farmers with different levels of technology adoption.

To estimate the value of EPD information, we use a hedonic price model. We use the Ladd and Martin (1976) approach, which asserts that the value of an input can be decomposed into the value of each one of its characteristics. We employ cattle auction data of Brangus bulls' auctions from 2015 to 2022. In our dataset, we have bull sales price, their phenotypical attributes, and EPD information. Our results show that phenotypical traits are more relevant than EPDs as decision variables for cattle ranchers. We find that cattle ranchers prefer observed traits such as weight, coat color, and age, while EPDs have secondary importance, after controlling by sire, company, and transaction date. In general, EPDs are little or nonsignificant for the price-setting process individually; however, they are more important by groups. Production and reproductive traits taken together are statistically significant. We argue that the preference for read-coated bulls is a response to adapting animals to subtropical climates; on the other hand, the lack of response of price to EPDs may be related to a lack of information about the nature and uses of genetic traits.

Our results contribute to understanding the process of technology adoption in cattle production. We provide evidence that, while genetics tools and information are available, they are still not fully adopted. Our results indicate that there is still room for breeding programs to work on extension and education about new traits and breeds. Producers could benefit from obtaining information on animal genetic attributes to increase productivity per hectare, feed efficiency, and livestock quality. Likewise, the industry could benefit from cattle with genetic improvements resulting in better meat quality and quality that facilitates processing. The relevance of Argentina in beef markets is two-fold. First, Argentina is a historical producer and exporter of beef. In 2022, Argentina was the sixth producer and fifth exporter country (USDA, 2023). Like other producing nations from the developing world, its modal production system relies predominantly on pastures rather than feedlots (Greenwood, 2021). The latter is relevant because there is potential for productivity and efficiency gains from introducing changes to genetics in harmony with sustainable production practices. Second, because of its location, Argentina has the ecosystems to adapt breeding options for mild and subtropical weather, with the potential of developing and exporting cattle genetics to different parts of the world.

2. Beef Cattle Genetics Market in Argentina

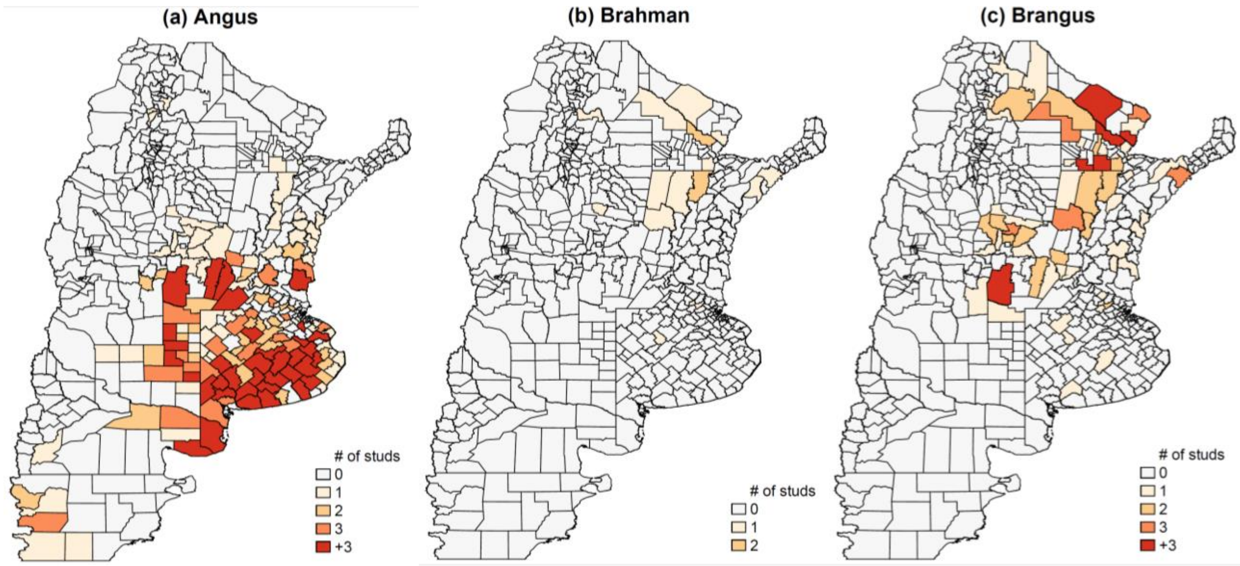
2.1. Supply of Beef Cattle Genetics

The genetics supply is studs that develop genetics to sell service bulls and heifers, semen, and embryos to commercial ranches, the demand for genetics. A series of factors influence beef supply; chiefly among them is the existence of diverse breeds. Crossbreeding is a method for increasing the productivity of cattle genetics, which constitutes a climate-induced innovation by the demand for beef, and other factors, such as grassland and pasture availability. Cattle breeders and feeders demand high-productivity bulls that increase the efficiency of their herds and sell their meat to domestic and foreign markets.

Beef cattle genetics in Argentina have been historically based on European breeds such as Aberdeen Angus and Hereford. Because of the demand for adaptation, some studs develop Brahman genetics. Ranches that breed Brahman bulls are mainly located in the northeastern region of Argentina, which observes subtropical conditions that are less suitable for Angus or Hereford. According to the 2018 National Agricultural Census, there are 788 bovine studs. Studs that keep bulls from these breeds are located mainly in the temperate Pampas region and constitute around 75% of the supply. Brahman studs constitute 2.4% of the total, but they are essential to improving the adaptability of Angus and Hereford breeds to subtropical climates.

Bovine genetics supply spatial distribution is strongly influenced by the different climates (Figure 1). Firms aim to breed pedigree animals adapted to the ecosystem where they are located. Ranchers in the area might be interested in buying bulls that have been adapted to the productive environment. This is important because the bull will be responsible for 50% of the genetics of the future herd. If that herd receives traits that are not suitable, it may harm productivity and ranchers' future income. The two main crossbreeds are Brangus (Brahman × Angus) and Braford (Brahman × Hereford) expanded beef cattle production to new areas. Figure 2 shows examples of three different breeds and how much a Brangus bull resembles a mixture of its original breeds. Brangus and Braford breeds constitute 31% of studs in Argentina. The geographical distribution of both breeds shows that they are in areas where Angus and Hereford bulls are not the first choices.

Figure 1. Spatial distribution of main beef cattle breeds



Source: 2018 National Agricultural Census

Figure 2. Aberdeen Angus, Brahman, and Brangus bulls

Note: The bull on the left is Angus[1], the middle bull is Brahman[2], and the one on the right is a Brangus bull.[3]

2.2.Demand for Cattle Genetics

Cattle studs sell their bulls through auctions or direct sales to commercial ranches. The auctions are sponsored by Breeders' Associations to signal the quality of bulls. Further, there are two types of bull sold on whether they have complete or incomplete genetic data. Those that have complete

[1] Extracted from: https://domesticanimalbreeds.com/angus-cattle-breed-everything-you-need-to-know/
[2] Extracted from: https://brcutrer.com/health-and-wellness-with-brahman-cattle/
[3] Extracted from: https://www.bovine-elite.com/shop/beef-semen-sales-registered/brangus-black/mr-new-blood-50h/

ancestry and pedigree data are purebred animals registered in the breed registry of the corresponding association. The main buyers of purebred bulls are other studs that are interested in reproducing them and offer more bulls for commercial ranches. The other type of bull offered in sponsored auctions are animals with incomplete data that have passed a visual inspection and gene testing and are marketed as pure controlled animals. These bulls are usually cheaper than purebred animals and the main alternative for ranchers interested in investing in genetics.

The demand for cattle genetics comes from cattle farmers who purchase bulls for crossbreeding and trait selection. Crossbreeding is a response to long-term demand trends from cattle farmers, and its main objective is to take advantage of heterosis, an increase in the performance of hybrids over that of purebreds caused by certain gene combinations (Bourdon, 2000, p. 29). In the case of Brangus animals, they have better survivability in hotter climates than Angus and can gain weight at a faster rate than Brahman bulls. Crossbreeding takes several generations; for example, Brangus and Braford crossbreeds require around ten years to stabilize their phenotypic and genotypic traits due to small initial herd numbers. Once traits are stable, breeders could use them in a genetic plan to select attributes that would like to improve in their herd.

Conditional on having or choosing a breed for the herd, farmers would select the bulls according to their preferences. Service bulls are the most common option for commercial ranchers interested in investing in genetic improvement. Several attributes matter in selecting the best bull. We can divide these aspects into (i) visual characteristics that describe bulls' breeding ability associated with their biological type and age; (ii) phenotypical traits are observed characteristics of bulls that are generally associated with their productive and reproductive abilities; and (iii) genetic traits which are objective measurements performed on pedigree cattle with genomic tests to determine their ability to pass certain traits to future generations.

Genetic traits are called Expected Progeny Differences (EPD) and are the genetic value of an animal as a parent, the value of an animal's genotype due to independent and transmittable gene effects (Bourdon, 2000). The intuition behind these estimations is that after controlling for all possible environmental factors that affect the characteristics of an animal, we end up with a portion of the variation in the value of each trait that can only be attributed to the inheritance of the animal's parents. These values are calculated using large-scale genetic evaluations that breed associations typically carry out periodically; results from these evaluations are reported in the sire summary, a list of animal traits relative to the average sellers use to market the bull. Examples of EPDs match phenotypical data of the bull such as birth weight, weaning weight, and scrotal circumference, or meat carcass attributes such as ribeye area (Dhuyvetter et al., 2005; Mitchell et al., 2018). For instance, selecting bulls with a negative birth weight EPD increases the probability of having lower birth weight in calves which could facilitate births and reduce costs for farmers. Further, its correlation with a high EPD weaning weight would increase the chances of increasing calves weight gaining productivity.

3. Theoretical Framework

3.1 Hedonic pricing model

We introduce the hedonic pricing model which is suitable for estimating the demand for cattle traits as an input of the commercial ranchers' production function. The hedonic pricing model asserts that the price of a good or service (livestock genetics in this case) is a function of its intrinsic characteristics (Rosen, 1974). Similarly, the Input Characteristics Model developed by Ladd and Martin (1976) is the theoretical basis for adapting the hedonic pricing framework to input demands.

According to this model, the price paid for a unit of the input depends on its set of characteristics; consequently, the value of such characteristics can be estimated using a linear regression of the price on their quantities. Dhuyvetter and Schroeder (2000) adapted this framework to the particular case of feeder cattle pricing, similar to our case, where the price of any lot of cattle depends on the attributes of the animal, which can be observed (weight, age, color, or breed) or estimated (such as the Expected Progeny Differences or selection indexes), as well as market factors such as expectations about input prices, interest rates or beef prices. In other words, the price of a bull *i* at time *t* on market *h* is:

$$price_{it} = f(X_{it}, Z_{ht}) \tag{1}$$

where X_{it} are the animal's characteristics and Z_{ht} are the factors affecting market *h*.

The literature on hedonic pricing has looked at the market value of cattle traits. (Dhuyvetter et al., (1996) is the first article that includes estimated and observed genetic traits in the pricing equation and additional variables such as the presence of a picture in the bull catalog, sale location, and percentage of semen rights kept by the seller. The authors find that all variables related to the animal's weight are significant (birth weight, weaning weight, and weight EPD), as well as those related to the visual aspect of the animal (color, polled, muscling, and conformation). Concerning market factors, sale location, picture in the catalog, order of sale, and location have significant effects on the price of the animal. Jones et al. (2008) improve on earlier articles by expanding the set of EPDs and market factors; the most important finding is that weight EPD had a higher value than the observed weight in their sample and predictors of carcass quality. This article also incorporates pedigree into the analysis using sire fixed effects and marketing factors such as order of sale, picture of the animal, and season. In dairy markets, Richards and Jeffrey (1996) elucidate the impact of production and health traits on the price of bulls' semen[4]. This article finds that production traits (milk yield, protein, and fat content), general conformation (also called "type"), body capacity, and bull popularity significantly impact the animal's price.

The literature uses data from cattle associations or auctions in different places in North America. Walburger (2002) shows that the most important traits for Canadian breeders are sale weight, birth weight, scrotal circumference, ribeye area, and weight gain; that is, production and reproductive traits, but the former have increasing importance. These findings are replicated in other segments of the market, Boyer et al. (2020) studied which factors affect the price of bred heifer prices, particularly months of pregnancy, lot size, heifer price, and timing of purchase affect their price; the authors also find that the effect of lot size is non-linear on the logarithm of bred heifer price.

Another strand of literature has investigated the demand side of cattle markets using surveys or choice experiments. Sy et al. (1997) ran a survey from different segments of the market (purebred breeders, commercial cow-calf producers, and cattle feeders). Each segment prefers one set of traits over another due to its distinct profit maximization objectives. Purebred breeders place more weight on milking ability and weaning weight, cow-calf operators value calving ease and temperament, while feeders prefer animals with higher slaughter weight and feed efficiency.

Recently, attention has shifted toward evaluating the impact of video cattle auctions, such as the Superior Livestock Auction (Zimmerman et al., 2012), which allows buyers from different locations to participate in the auction via the Internet. Video auctions created a demand for specific management practices such as age and source verification, vaccination protocol compliance, and

[4] Because of the nature of dairy farming, it is more common to sell a bull's semen instead of the animal itself.

weight variation certification. Similarly, Martinez et al. (2021) show that feeder cattle were sold at a premium if the animal has been tested for bovine diarrhea virus but also finds a significant impact of corn future prices on the valuation of animals.

3.2. Input Characteristics Model

To model the demand for cattle traits, we use the Input Characteristics Model from Ladd and Martin (1976). The model assumes that a firm uses a set of n inputs to manufacture one unit of a good q that is sold at a price p. Let r_i be the price of a unit of the input, which requires a fixed amount of a characteristic, such that ω_{ji} is the amount of characteristic j required to produce one unit of input i, then:

$$\omega_j = \sum_{i=1}^{n} \omega_{ji} x_i \tag{2}$$

The production function depends, in turn, on the entire set of characteristics, such that:

$$q = F(\omega_1, \omega_2, \dots, \omega_n) = F(\sum_{i=1}^{n} \omega_{1i} x_i, \sum_{i=1}^{n} \omega_{2i} x_i, \dots, \sum_{i=1}^{n} \omega_{mi} x_i) \tag{3}$$

The profit function can be written as:

$$\pi = pF(\omega_1, \omega_2, \dots, \omega_n) - \sum_{i=1}^{n} r_i x_i \tag{4}$$

The first-order conditions for $i = 1,\dots,n$ are:

$$\frac{\partial \pi}{\partial x_i} = p \sum_{j=1}^{m} \frac{\partial F}{\partial \omega_j} \frac{\partial \omega_j}{\partial x_i} - r_i = 0$$

$$= p \sum_{j=1}^{m} \frac{\partial F}{\partial \omega_j} \omega_{ji} - r_i = 0$$

Solving for r_i, we get:

$$r_i = p \sum_{j=1}^{m} \frac{\partial F}{\partial \omega_j} \omega_{ji} = p \sum_{j=1}^{m} \tau_j \omega_{ji} \tag{5}$$

Therefore, the price of input i is a linear function of the number of characteristics weighted by the value of their marginal product.

3.3. Empirical Specification

We estimate the input characteristics hedonic model for identifying where the price of a bull i in year t can be described as:

$$\log(price_{it}) = X_{it}\gamma + Z_{it}\beta + d_i\,\gamma + M_{it}\delta + \varepsilon_{it} \tag{6}$$

where $price_{it}$ is the price of the bull, X_{it} is a set of phenotypical traits, Z_{it} are genetic traits, and M_{it} are market factors, ε_{it} is the error term. Ranchers will look at these attributes in the catalog of the auction before going in person to the auctions to assess whether the bulls match their preferences. Phenotypical information about the bulls is an objective measurement of their characteristics. In our model, we include measures such as weight, age, or color of the animal which indicates the bull's condition and characteristics. The second group of variables, genetic traits, are statistical estimations calculated from the performance information of an animal relative to its relatives, past and present, controlling for pedigree, age, breed, season, and environmental factors. These data represent the potential of the bull to pass features to its progeny. In addition, we incorporate a dummy variable d_i to control differences in stud characteristics. Lastly, to control potential differences in auctions by year we include a set of market factors fixed effects which include lot order (τ_i) and sire (σ_i) fixed effects, and year (ρ_t) fixed effects.

4. Data

Our data consists of a list of bulls sold in auctions that happened in August of every year from two studs located in the Northwestern districts of Córdoba, Argentina. One of them has records from 2015 to 2022 while the other goes from 2018 to 2022. Both studs have a history of more than 20 years of auctioning bulls and heifers to ranchers in the northwest of the province. They sell Brangus bulls suitable for ranchers in the region, but also for ranches located in the northern provinces of Argentina, Paraguay, and south of Brazil.

In Table 1, we present the main variables of our dataset. For each bull, we obtained the price, and their phenotypical and EPD information (Table 1). The phenotypical variables available are coat color which takes a value of one if it is red, 0 if it is black, birth and final weight of the bull in kilograms, scrotal circumference in centimeters, and its age in years. The estimated genetic data contains two types of indicators, productive and reproductive EPDs. The first group indicates the potential growth attributes to be passed to the calves of the bull, which includes birth, weaning, and final weight. The second group indicates the ability of the bull to transmit reproductive features and it includes scrotal circumference, height, and milk productivity.

Table 1. Variables definitions

Name	Definition	Group
price	Price of bull (USD)	
color	= 1 if Red Brangus	Observable characteristics
fw	Final weight (kg)	
scirc	Scrotal circumference (cm)	
age	Age (years)	
bw_epd	Birth weight EPD (kg)	Production EPDs
ww_epd	Weaning weight EPD (kg)	
fw_epd	Final weight EPD (kg)	
scirc_epd	Scrotal circumference EPD (cm)	Reproductive EPDs
height_epd	height EPD (cm)	
milk_epd	Milk EPD (liters)	

Table 2 presents summary statistics for 723 Brangus bulls auctioned from 2015 to 2022. The average price is 3,029 USD per animal. On average, the weight of the bulls is 750 kilograms, they are 2.2 years old, and the scrotal circumference is 39 centimeters. In our sample, 33% of the bulls have a red coat while the remaining animals are black Brangus. Regarding EPDs, we can interpret them as deviations from the mean of the breed. Specifically, these bulls give calves with birth weights about the average of the breed (+0.21). Calves may gain 9 kilograms more than the Brangus average at the weaning stage while the final adult weight is 20 kilograms above average. The reproductive EPDs show that bulls have good qualities regarding scrotal circumference (+0.9 cm) and height of calves (+3.3 cm) as well as milk from heifers (+8.13 liters). In summary, these EPDs show that these animals have higher than-average calving aptitude.

Table 2. Descriptive statistics

	Mean	Sd	Min	Max
Bull Price (U$S)	3029.75	1193.52	1274.36	10590.06
Final Weight (kg)	750.04	86.92	557.00	1035.00
Scrotal Circumference (cm)	39.31	2.33	34.00	48.00
Age	2.24	0.37	1.65	3.34
Color (=1 if red)	0.33	0.47	0.00	1.00
Birth Weight (EPD)	0.21	0.85	-3.19	3.25
Weaning Weight (EPD)	9.54	3.93	-2.76	24.59
Final Weight (EPD)	19.93	7.26	-2.78	49.34
Scrotal Circumference (EPD)	0.93	0.60	-0.91	3.97
Height (EPD)	3.36	1.59	-4.13	9.02
Milk (EPD)	8.13	2.30	0.92	15.82
Observations	723			

5. Results

This section presents the results from a hedonic pricing analysis of Brangus bull characteristics. Table 3 presents the coefficients from the hedonic regressions; we use four specifications with varying numbers of predictors. From columns (1) to (4), we add a set of year, sire, and lot order fixed effects. Column (4) is the full and preferred specification.

We find that coefficient estimates associated with bulls' traits are not significantly affected by the incorporation of fixed effects. There is a positive effect of coat color on prices which cuts to almost half after incorporating fixed effects. The age coefficient is significant which implies that an additional year implies 10% lower prices per bull. An additional centimeter of scrotal circumference implies 2.1% higher prices. This shows that phenotypical characteristics are associated with bull prices individually.

In columns (3) and (4), we are adding productive and reproductive EPDs, respectively. Results show that these attributes are sensitive. Productive traits show a negative sign indicating a lower price for weights above the average of Brangus. The birth weight coefficient shows that there is a non-significant 1.5% discount on bull prices. The negative association in this case is expected because a higher-than-average birth weight increases birth problems for ranchers. In contrast, the coefficient of weaning weight EPD is unexpected. This might be explained by a strong genetic correlation between weight EPDs. Genetic traits related to reproduction are statistically significant (height and milk). Smaller height and higher milk production than the average are the desired attributes for future herd mothers.

Table 3. Brangus Bulls price analysis

	Ln(price)			
	(1)	(2)	(3)	(4)
Final Weight (kg)	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Scrotal Circumference (cm)	0.028***	0.024***	0.024***	0.021***
	(0.006)	(0.005)	(0.005)	(0.006)
Age	-0.088**	-0.137***	-0.144***	-0.102**
	(0.038)	(0.041)	(0.043)	(0.045)
Color=1 if red coat	0.175***	0.177***	0.180***	0.105***
	(0.023)	(0.021)	(0.021)	(0.038)
Birth Weight (EPD)			-0.032**	-0.015
			(0.013)	(0.015)
Weaning Weight (EPD)			0.003	-2.621***
			(0.004)	(0.951)
Final Weight (EPD)			-0.000	-0.003
			(0.002)	(0.003)
Scrotal Circumference (EPD)				-0.007
				(0.023)
Height (EPD)				-5.253***
				(1.904)
Milk (EPD)				5.249***
				(1.903)
d_i (stud)		0.019	0.024	0.023
		(0.025)	(0.025)	(0.057)
Year FE		X	X	X
Lot order FE		X	X	X
Sire FE				X
Observations	723	723	723	723
R-squared	0.241	0.541	0.545	0.694
$AdjR^2$	0.236	0.506	0.509	0.586

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Joint F tests show that while some traits might not be significant individually, they are relevant by group. Table 4 presents hypotheses testing to assess whether groups of traits are statistically significant using the estimates in column 4. This test is performed to verify whether the attributes have a joint association with prices. The results show that the coefficients by groups are statistically significant at different p values.

Table 4. F-test by groups of coefficients

	F statistic	P-value	Decision
Phenotypical traits	14.50	0.00	Significant at 1%
Production EPDs	3.38	0.02	Significant at 5%
Reproductive EPDs	2.68	0.05	Significant at 5%
All EPDs	20.02	0.06	Significant at 10%

6. Discussion

We can entertain a conclusion based on each market segment. Phenotypical traits are more relevant as decision variables for cattle ranchers. In general, EPDs are little or insignificant for the price-setting process individually. This can be attributed to two reasons; one is that we do not know the volume of transactions per bull, which would enable us to ascertain which animals are the most popular; the other reason is that the value of information may be correlated to unobserved variables, that is, demographic and other characteristics of ranchers. Alternatively, the attributes are valuable by groups. For instance, a rancher may look at productive or reproductive traits altogether. If we could capture demographic characteristics related to the production and knowledge of EPDs and how to use them. In that case, we can better understand the effect of farmer types and their preferences concerning investment decisions in genetics.

The three groups of traits might complement each other; however, whether farmers' choices are based on EPDs is associated with investment in human capital. More sophisticated ranchers may put more emphasis on reading EPDs before making decisions while some others may only look at visual characteristics and the bull's behavioral data. The more dimensions or traits to look at before choosing bulls, the more investment in human capital is required. However, buying a bull with the potential of reducing the average weight of calves comes with correlations with other genetic traits that may express themselves in calves. For instance, a bull with birth weight EPD lower than the average could come with low weaning weight EPD. For instance, the cow-calf operator already had a good average weaning weight from calves, incorporating the genetics of this bull may generate a decrease in productivity.

7. Conclusion

In this paper, we investigate the determinants of Brangus bull prices in auctions from Northwestern Cordoba to determine which attributes are more highly valued by cattle ranchers. Understanding these relationships would help to know the potential for breeding and trait selection in areas where production conditions are arid or semi-arid. Moreover, it has the potential to increase beef production by incorporating new lands into production as well as by productivity through technical efficiency. Our results show that observed traits have a statistically significant effect on the price of an animal, while Expected Progeny Differences mostly do not.

One possible interpretation of this result is that ranchers are still unfamiliar with EPDs and do not use them to base their breeding decisions. Similarly, it may also be the case that genetic traits are not as relevant for beef cattle as they are for dairy cattle; in the dairy industry, all relevant production traits are expressed in females only, and an estimation of the transmitting ability of such traits is needed to determine which traits will the bull's daughters inherit. For beef cattle, these traits are expressed in both sexes, so a visual evaluation of the bull may provide a sufficient evaluation of its characteristics.

Coat color stands out among the set of observable traits; we argue that the demand for coat color could be associated with the need for adaptation to hotter and dryer climates in Northern Argentina. Due to the competition for land with agricultural commodities, cattle have been adapted to these areas; however, from our results, we see that productive traits have heterogenous demand indicating that unobservable characteristics of the demand might be affecting the results.

A follow-up of this study will consist of a choice experiment with cattle ranchers to determine whether additional information about EPDs would change their decision when deciding which animal to buy. This experiment will also survey individuals about their knowledge of genetic traits and how to use them. Generating primary data would help us identify whether genetic trait information increases ranchers' willingness to pay and their perceptions about them.

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