Design of instruments for modeling economic and commercial behavior in bovine production

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ABSTRACT: Agricultural companies base their decisions on the anticipated behavior of variables. This paper aims to analyze and model the behavior of livestock producers in relation to the adoption of marketing strategies in uncertain scenarios. Through structured questionnaires administered to cattle producers, stated preference models were developed for various strata, taking into account the number of animals. An inverse relationship was observed between income, derived from higher cattle stocks, and hypothetical and real choices of the direct marketing channel. Among the conventional variables, it was confirmed that beef cattle producers prioritize harvesting time over selling price and marketing cost.

Diseño de instrumentos para modelar el comportamiento económico y comercial en la producción bovina

RESUMEN: Las empresas agropecuarias basan sus decisiones en variables anticipadas. Este trabajo tiene como objetivo analizar y modelar el comportamiento de los productores de ganado en relación con la adopción de estrategias de comercialización en escenarios inciertos Mediante cuestionarios estructurados, se desarrollaron modelos de preferencias declaradas para diversos estratos según el número de animales. Se observó una relación inversa entre ingresos, derivados de mayores existencias de ganado, y elecciones de canal de comercialización directa. Entre las variables convencionales, los productores de ganado de carne priorizan el tiempo de recolección sobre el precio de venta y el costo de comercialización.

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1. Introduction

Decision-making processes are conditioned by the internal structure of the organizations. The economic-financial situation of the companies is related to the economic development of the people involved (Grado, 2011; Canós Darós *et al*., 2012). This is especially important in family businesses in the agricultural sector in Latin America (Sabourin *et al*., 2020).

Livestock enterprises work with biological assets, which requires an adequate description of the current economic situation. This implies identifying and categorizing the assets and sequencing the decision-making process (Tixi-Torres *et al*., 2020). The production and marketing stages acquire substantial relevance since these actions determine the final economic value of the asset. However, the profitability of livestock activities remains relatively low compared to the capital invested, which is of particular importance in extensive livestock practices (Pietrantueno, 2019). Long production cycles are difficult to reduce, generating complexities in terms of payback times. In addition, access to capitalization sources poses difficulties, as financial institutions may lack flexible credit options aligned with the organic production cycle, where climate-related risks act as additional challenges. This complex scenario highlights the hurdles producers must overcome to expand livestock production.

The importance of the beef cattle agri-food industry, both in Argentina and in the province of La Pampa, is characterized by the level of per capita consumption, production volumes, generation of foreign exchange and employment, among others (Paturlanne, 2019; Alonso & Szpak, 2020). Given the favorable agroecological conditions in the province of La Pampa, this activity has very good opportunities for its development, making efficient use of its available resources and comparative advantages (Estelrich & Castaldo, 2014). However, the livestock industry is below optimal standards of competitiveness and has not yet reached its full production potential (Pordomingo *et al*., 2019; Galperín & Molina, 2018). Among the main obstacles that limit and condition this activity, academic literature identifies especially the lack of coordination and integration in the supply chain, poor decision-making processes, and high marketing costs, resulting from excessive intermediation (Angulo Agudelo, 2018; Quiroga, 2018).

In addition to the particularities of livestock activities, there are political, social, environmental, and economic context factors that make decision-making scenarios more complex (Rolla *et al*., 2019; De Rito *et al*., 2020). The characteristic of the environment has influences on business decisions; variables such as inflation and interest rates, currency devaluation, loss of purchasing power and price variability, among others, represent factors that describe a marked macroeconomic instability that complexify the choice scenarios (Pordomingo, 2018). In these contexts, making business decisions that positively impact the business economy becomes crucial (Marin & van Zwanenberg, 2023).

Cattle companies in Argentina can opt for two types of commercial strategies to sell their products (calves, steers, etc.): direct or indirect (Baudracco *et al*., 2022; Mac Clay *et al*., 2022). The former deal with the sale of animals to buyers, without intermediaries; they involve higher risks and possibly better profit margins. The latter use commercial channels where commission agents, consignees and other intermediaries are involved; these decisions entail lower economic-financial results, but more security in the sale. There is no information or models to explain why businessmen take one or the other option as a commercial strategy.

This study is based on the following hypothesis: the probability of adopting direct marketing strategies is inversely proportional to the level of production scale represented by livestock stocks. In other words, firms with a larger number of cattle have a lower probability of using direct marketing. The objective of this paper was to analyze and model the behavior of cattle producers in relation to the adoption of marketing strategies under uncertainty scenarios, focusing as a case study on cattle companies in the province of La Pampa.

Methodologically, the study focuses on behavioral economics, a theory that integrates ideas and results from psychology, sociology, and anthropology in the theoretical modeling of various economic issues of human behavior (Cartwright, 2009). Likewise, the theory of random utility represents a solid tool, which allows to adequately model the choice behavior of individuals, considering both traditional and non-traditional variables, faced with a set of available options (McFadden, 1974). For its part, the instrumentation of experiments makes it possible to give concrete answers to behavioral hypotheses, identifying psychosocial factors and measuring their usefulness in predictive capacity (Brañas-Garza, 2011).

2. Materials and methods

The behavioral economics approach makes important contributions in analyzing decision-making processes in contexts characterized by bounded rationality and cognitive biases. An important method for testing behavioral hypotheses in scenarios with imperfect information and cognitive biases is the use of choice experiments, employing statistical techniques to analyze the results. Choice experiments are valuable tools for studying decision-making processes under controlled conditions. One particular technique used in this context is discrete choice experiments (DCE). DCEs allow researchers to investigate and determine preferences for various courses of action without explicitly asking individuals, but by exposing them to a set of options that allow for inferring decision-making structures (Train, 2009; Louviere *et al*., 2010; Lancsar *et al*., 2017). These types of experiments are commonly used in the literature to understand choices in agribusiness contexts and to test behavioral hypotheses under bounded rationality conditions (Bronnmann & Asche, 2017).

Simulation provides the opportunity to develop models that adequately represent the choice situations under study (Train, 2009; Ben-Akiva *et al.*, 2019). In this

study, binary logic statistical models were used to estimate the utility function of the investigated economic agents. Stated preference data collected through experiments, in which participants were exposed to hypothetical choices, were analyzed. For this purpose, a questionnaire was designed in which respondents were presented with choice scenarios. In each experiment, two options were presented, and respondents were asked to indicate which alternatives they would choose in a real-life situation.

2.1. Theoretical model of choice

The proposed choice model, based on random utility theory (Ortúzar, 2015; Sartori, 2006; Jiménez, 2018), aims to comprehensively model behavior under uncertainty scenarios. Random utility is expressed as:

$$W_{jq} = V_{jq} + \eta_{jq} = U_{jq} + r_{jq} \tag{1}$$

Where: V_{jq} corresponds to the deterministic, systematic or representative deterministic measurable factor of random utility W_{jq}; while η_{jq} represents the random error of individual preferences in the choice. U_{jq} is a pseudoutility and r_{jq} reflects the measurement error in the dependent variable, both results of the stated preference model. The subscripts $_{jq}$ correspond to the alternative –marketing mechanism– and the respondent, respectively. By inferring homoscedasticity in r_{jq} the equation can be reformulated as:

$$U_{jq} = V_{jq} + (\eta_{jq} - r_{jq}) = V_{jq} + \varepsilon_{jq} \tag{2}$$

If the experimental design is judiciously developed, r_{jq} will be negligible with respect to ε_{jq} and the model will be able to test the behavioral hypotheses successfully. For this, it is necessary to establish homogeneous parameters in the choice of the sample.

Consequently, if the economic agent *"q"* opts for alternative *"j"*, which brings him greater utility than alternative *"i"*, the choice function could be expressed as:

$$U_{jq} \geq U_{iq} = V_{jq} + \varepsilon_{jq} \geq V_{iq} + \varepsilon_{iq} = V_{jq} - V_{iq} \geq \varepsilon_{iq} - \varepsilon_{jq} \tag{3}$$

If the binary alternatives have uncorrelated residuals, with the same variances and under type I extreme value distribution (Weibull distribution), the logit model will be able to correctly estimate the probability of choice given by:

$$P_{jq} = Prob \left(\varepsilon_{iq} - \varepsilon_{jq} \leq V_{jq} - V_{iq}, \forall_{ij} \right) \tag{4}$$

The proposed model, in choice scenarios with binary alternatives, allows estimating the random utility as a function of the differences in the choice attributes. In it, the coefficients between the alternatives are fixed and the mentioned differences between the variables are generic. Thus, we can redefine the random utility function in difference of attributes as:

$$U_{kq} = V_{kq} + \varepsilon_{iq} \qquad [5]$$

where $k = j$ (direct marketing mechanisms) and $k = i$ (indirect marketing mechanisms). It is proposed as an estimable model that the deterministic utilities of each alternative are defined by the following specification of variables:

$$V_{jq} = ASC_j + \beta_1 SP_{dmm} + \beta_2 MC_{dmm} + \beta_3 PD_{dmm} \text{ and } V_{iq} = ASC_i + \beta_1 SP_{imm} \\ + \beta_2 MC_{imm} + \beta_3 PD_{imm} \qquad [6]$$

Where:

ASC: alternative specific constant;

β: generic coefficient of the choice attribute; SP: selling price ($):

MC: marketing cost:

PD: payment deadline (days):

dmm: direct marketing methods; imm: indirect marketing methods.

Finally, with the above, we can define the random utility model to be estimated based on the differences of the generic independent attributes as follows:

$$V_{jq} = ASC_j + \beta_1 (SP_{dmm} + SP_{imm}) + \beta_2 (MC_{dmm} - MC_{imm}) + \beta_3 (PD_{dmm} - PD_{imm}) \qquad [7]$$

The proposed choice model also allows testing the research hypotheses; it is developed from a standard cumulative logistic distribution (F). It can be expressed as:

$$P_j (Y = 1 | X_{j1}, X_{j2} \dots X_{jk}) = F (\beta_0 + \beta_1 X_{j1} + \beta_2 X_{j2} + \beta_k X_{jk}) \qquad [8]$$

Where:

β_0: represents a constant specific alternative.

$\beta_{.}$ is the generic coefficient of each electoral attribute. X_{j1}: is the selling price of alternative (j);

X_{j2}: is the marketing cost of alternative (j); X_{jk}: payment deadline of the alternative (j);

In this case, function (1) can be restated as follows:

$$P_i\,(Y = 0\,|\,X_{i1},\ X_{i2},\ \dots X_{ik}\ ) \ = \ \frac{1}{1 + e^{\,-(\beta_0\, +\, \beta_1\ X_{i1}\, +\, \beta_2\ X_{i2}\, +\, \dots +\, \beta_k\ X_{ik})}} \qquad [9]$$

&

$$P_i\,(Y = 0\,|\,X_{i1},\ X_{i2},\ \dots\ X_{ik}\ ) \ = \ \frac{1}{1 + \left(\dfrac{1}{e^{(\beta_0\, +\, \beta_1\ X_{i1}\, +\, \beta_2\ X_{i2}\, +\, \dots +\, \beta_k\ X_{ik})}}\right)} \qquad [10]$$

2.2. Declared preference tools: questionnaire design

The questionnaire was designed to estimate the probability of choice of marketing mechanisms in the primary sector of the bovine agrifood chain in the Capital Department of the province of La Pampa, focusing on cattle producers. Conjoint analysis tools were used to deconstruct the choice and identify the attributes of the alternatives according to their levels.

Experimental designs in discrete choice models consist of three elements (Louviere *et al.*, 2010; Sartori, 2006; Ben-Akiva *et al.*, 2019): scale, choice and ordering. The proposed choice model is defined by a dichotomous variable corresponding to the choice of marketing method. Correct processing of the information provided indicates that "alternative j" (direct marketing) is preferred to "alternative i" (indirect marketing). The coding of the binary dependent variable for the choice is given the values 0 and 1.

The experimental design, as shown in Table 1, includes a dichotomous dependent variable (marketing method) and three explanatory variables (decision attributes): i) selling price, which is established in $/kg; ii) marketing cost, referenced in percentage terms on the selling price; and iii) payment deadline, measured in days from the time the sale is made until payment is credited. Each attribute is classified into three levels: a) favorable scenario, where the sales price increases and commercial costs and payment deadline decrease; b) base scenario, in which the attributes behave neutrally; and c) unfavorable scenario, where the sales price decreases and commercial costs and payment deadline increase.

From the full factorial design of the experiment, resulting from three decision attributes with their respective three levels, $3^3 = 27$ possible choice scenarios emerge. To reduce the number of scenarios and eliminate statistical biases, some authors recommend the use of orthogonal fractional factorial experimental designs (Louviere *et al.*, 2010; Gabriel *et al.*, 2017). Following this recommendation, estimating a fraction $3^{(3-1)} = 3^2$, 9 choice scenarios are obtained under the assumption that some interactions are not significant due to the dominance effect. Each record represents one observation within the experimental design.

TABLE 1

Orthogonal experimental design

Experimental design	Treatment							
Scenarios	Selling price ($/kg)		Cod.	Cost of marketing (%)		Cod.	Payment deadline	Cod.
1	+	16	3	+	40	3	−	30 d.	1
2	+	160	3	=	30	2	+	90 d.	3
3	+	160	3	−	20	1	=	60 d.	2
4	=	140	2	+	40	3	=	60 d.	2
5	=	140	2	=	30	2	−	30 d.	1
6	=	140	2	−	20	1	+	90 d.	3
7	−	120	1	+	40	3	−	30 d.	1
8	−	120	1	=	30	2	−	30 d.	2
9	−	120	1	−	20	1	+	90 d.	3

Source: own elaboration

The scenarios were constructed based on secondary information sources. For example, Iglesias *et al.* (2017) mention that marketing costs are in relation to 30 % of total costs and Sánchez (2015) states that 60 days is the usual effective collection period in the activity. The market selling price, at the time of the study, was in the order of $140/kg.

The sample size was determined in relation to the population size, which is the number of cattle farms in the Capital Department of the province of La Pampa. Samples were selected using probabilistic methods to ensure representativeness and

the possibility of statistical inference. The individuals surveyed were identified by random sampling. Therefore, the sample size (*N*) is determined by the following expression:

$$N = Z^2 * (p) * \frac{1 - p}{C^2} \qquad [11]$$

According to the latest available data, the population of livestock establishments in the Capital Department of the province of La Pampa is composed of 372 establishments with livestock stocks (SENASA, 2021). Among them, 86 establishments have stocks of up to 100 heads (23.11 %), 98 establishments have between 101 and 250 heads (26.34 %), 94 establishments have between 251 and 500 heads (25.27 %), 61 establishments have between 501 and 1,000 heads (16.4 %), and 33 establishments have between 1,001 and 5,000 heads (8.88 %). There are no establishments with more than 5,000 head.

The cattle producers interviewed for the study were distributed as follows: n = 18 (24 %) in the category of up to 100 head, n = 20 (26 %) in the category of 101 to 250 head, n = 19 (25 %) in the category of 251 to 500 head, n = 12 (16 %) in the category of 501 to 1,000 head, and n = 7 (9 %) in the category of 1001 to 5,000 head. The proportionality and representativeness of the sample with respect to SENASA's zonal registries was respected.

The probabilistic analysis determined the completion of a total of n = 76 surveys, representing 20.4 % of the population. These surveys, involving the collection of primary information, were conducted in the fourth quarter of 2022. Each subject under study was surveyed in a semi-structured manner using the simulation framework to test their behavior. In each of the 9 scenarios, the 76 respondents were asked to choose and rank the commercial strategies, ordering them according to the model's binary ranking: 1 (direct marketing mechanisms) and 0 (indirect marketing mechanisms).

Finally, the results obtained in the surveys were analyzed and modeled. The modeling process involves the probabilistic construction of the scenarios analyzed in the experimentation, together with the respective choice (marketing method) of the economic agents under study. A total of 684 observations were recorded, resulting from exposing the 76 respondents to 9 choice scenarios. The database was analyzed with Stata v.16 software. This allowed a comprehensive understanding of the decision-making processes in the livestock agrifood chain of the Capital Department, La Pampa province.

3.   Results

The following section presents the results obtained. The sample of 76 respondents was subdivided into 5 categories: a) producers with up to 100 animals, b) producers with 101 and 250 animals, c) producers with 251 to 500 animals, d) producers with 501 to 1,000 animals, and e) producers with 1,001 to 5,000 animals.

Among the descriptive statistics, 80 % of the farmers interviewed are men and the remaining 20 % are women; 29 % have completed primary education, 43 % have completed secondary education and 28 % have a university education; 28 % only carry out livestock activities and the remaining 72 % carry out other complementary activities; 65 % of those interviewed own the land and 35 % lease it; 62 % of them are over 40 years of age and 82 % do not participate in agricultural institutions or associations.

As shown in Table 2, based on the database of 684 observations, four statistics were performed, including the analysis of frequencies corresponding to alternative $Y = 1$ and alternative $Y = 0$, the estimation of parameters $\beta_{0, 1, 2, 3 \text{ and } 4}$ the estimation of marginal effects and the validation of the models corresponding to each set of livestock producers.

In the initial group of producers with stocks of up to 100 head, the model shows a preference for the direct marketing method in approximately 73.46 % of the proposed scenarios. However, this preference decreases in the following groups. For producers with 101 to 250 head, the preference for direct marketing decreases to 67.78 % of the scenarios and decreases further to 63.74 % for those with cattle stocks between 251 and 500 cows, and 55.56 % for producers with stocks between 501 and 1,000 cows. The fifth group, consisting of producers with cattle stocks between 1,001 and 5,000, shows a preference of 50.79 %, indicating almost a parity between marketing mechanisms. These results reveal an inverse relationship between the level of cattle stock and the probability of choosing direct marketing, with larger producers tending to be less inclined to choose this method.

The parameters modeling the behavior of the economic agents were estimated by maximum likelihood, and as in all sets of individuals, it was found that both β_0 and β_1, β_2, β_3 are statistically significant, fulfilling the restrictions $P(|z|) \leq 0.05$ and $-1.96 \leq z \leq 1.96$. This implies that the variables proposed by the models are relevant for the modeling of each subgroup.

In the five groups of individuals, the $Y = 1$ method is the most favored option, both in declared and revealed preferences, with no significant variations ($\pm$ 5 %) between actual and hypothetical choices (Figure 1a). The factors motivating these choices are worth noting (Figure 1b). In the first group, where producers strongly prefer direct marketing, their commercial decisions are mainly motivated by experience (52 %) and trust (34 %). In contrast, the second group attaches greater importance to

commercial conditions as the most relevant variables (30 %), with special emphasis on payment term (ey/ex_1 = 1.52 %) and price (ey/ex_3 = –3.02 %), according to the marginal change analysis. The third subgroup, with a lower preference for direct marketing, seems to make more balanced commercial decisions, considering factors such as confidence in the marketing channel used (24 %), their own experience (25 %), professional advice (20 %) and evaluation of commercial conditions (20 %) with similar importance. In the fourth and fifth groups, consisting of larger beef cattle producers less inclined towards direct marketing, the decision-making process is mainly based on experience (35 % and 32 %, respectively), indicating their skill in managing their decisions professionally, even among producers of up to 5,000 head of cattle (35 %).

The model also allows us to analyze and compare the impact of marginal changes in the model coefficients. When there is a one percentage point increase in the explanatory variables, the probability of changing the choice, as indicated by ey/ex_3 = –3.71 % in the first group of individuals (up to 100 head of cattle), highlights the payment term as the most valued factor within the commercial conditions considered by the respondents. In the second subgroup (from 101 to 250 head of cattle), payment term also emerges as a determining variable (ey/ex_3 = –3.12 %), along with a greater emphasis on price valuation. This could explain the lower probability of choosing Y = 1 compared to the previous group. For the third (251 to 500 head) and fourth groups (501 to 1,000 head), the elasticities ey/ex_3 = –3.02 % and ey/ex_3 = –3.06 %, respectively, continue the downward trend in the valuation of payment term as the main influencing factor, although its importance seems to relatively stabilize. Finally, in the fifth group of individuals (from 1,001 to 5,000 head), the most relevant variables are payment term (ey/ex_3 = –2.89 %) and sale price (ey/ex_1 = 2.54 %). These results show that payment term and, to a lesser extent, sale price, are the variables most valued by the respondents.

Regarding the validity of the econometric models designed, there is a direct relationship between the probability of choosing the direct channel and the ability of the model to correctly discriminate the choices. As the probability of Y = 1 decreases, the models show a corresponding decrease in validity. For example, the model for the first set of individuals (livestock stocks less than 100 head) correctly discriminates 79.01 % of the observations, while the second model, for farmers with stocks between 101 and 250 head, correctly discriminates 77.78 % of the observations. Similarly, the third model, for producers with cattle stocks between 251 and 500 head, correctly discriminates 76.61 % of the records, and the fourth model (for those with stocks between 501 and 1000 head) correctly discriminates 75.47 % of the records. The fifth model, corresponding to farmers with stocks between 1001 and 5000 head, validates 74.60 % of the records. These accuracy values are within acceptable prediction standards (McFadden, 1974; Train, 2009).

Another useful tool for assessing the validity of models consists of estimating the area under the ROC curve (AUC). AUC values between 0.70 and 0.90 indicate very good classification models, while values above 0.90 indicate excellent models (Whitley & Ball, 2002; Armesto, 2011; Molina Arias & Ochoa Sangrador, 2016).

<div align="center">

TABLE 2

a) Frequency analysis corresponding to the choice of the commercial channel; b) Estimation of the parameters β of the random utility function using a binary logit model under maximum likelihood; c) Estimation of the marginal changes in the parameters β using the delta method; d) Validation of the random utility model

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| Alternative (a)	100 animals	101 to 250 animals	251 to 500 animals	501 to 1,000 animals	1,001 to 5,000 animals
0	43	58	62	48	31
1	119	122	109	60	32
Total	162	180	171	108	63
Parameters (b)	β	β	β	β	β
x_1: Price	0.1018885	0.119647	0.0977569	0.0758137	0.0891476
x_2: Commercial cost	−26.39139	−26.18181	−22.59703	−24.54045	−21.33995
x_3: Payment deadline	−0.058222	−0.0652653	−0.057531	−0.042316	−0.059161
X_0: Constant	2.901916	5.536031	3.871196	0.2325897	2.80132
$P > |Z| (x_1)$	0.01	0.01	0.01	0.014	0.031
$P > |Z| (x_2)$	0.03	0.02	0.03	0.02	0.003
$P > |Z| (x_3)$	0.02	0.003	0.008	0.001	0.005
$P > |Z| (x_0)$	0.01	0.049	0.015	0.05	0.046
Attributes (c)	ey/ex	ey/ex	ey/ex	ey/ex	ey/ex
x_1: Price	0.0128439	0.0157104	0.0151694	0.0132916	0.025374
x_2: Commercial cost	−0.007339	−0.0085697	−0.0089273	−0.0074188	−0.0102029
x_3: Payment deadline	−0.037112	−0.031219	−0.0302406	−0.0306907	−0.0289433
$P > |Z| (x_1)$	0.003	0.001	0.002	0.006	0.014
$P > |Z| (x_2)$	0.01	0.002	0.005	0.008	0.043
$P > |Z| (x_3)$	0.012	0.003	0.006	0.009	0.008
Matrix confusion (d)					
Sensitivity Pr (+| D)	87.39 %	86.07 %	83.49 %	81.67 %	80.77 %
Specificity Pr (–|~D)	55.81 %	60.34 %	64.52 %	60.42 %	70.27 %
Correct discrimination					
+	104	105	91	52	21
–	24	35	40	29	26
Total	162	180	171	108	63
	79.01 %	77.78 %	76.61 %	75.00 %	74.60 %
ROC	**0.8899**	**0.8385**	**0.8106**	**0.8102**	**0.7859**

Source: own elaboration.

FIGURE 1

**Comparison between stated preferences and revealed preferences
using the cattle herd criteria**

**a) Hypothetical choices derived from the experimental design versus actual choices
in the baseline scenario. Experimental design & Real choice Classification**
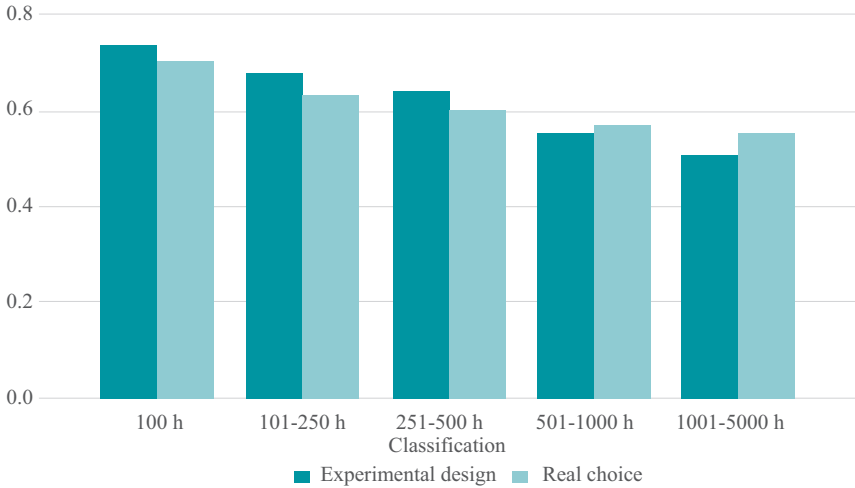
**b) Individual preference factors analyzed in the questionnaire.
Commercial conditions. Consulting. Experience. Others & Trust Classification**
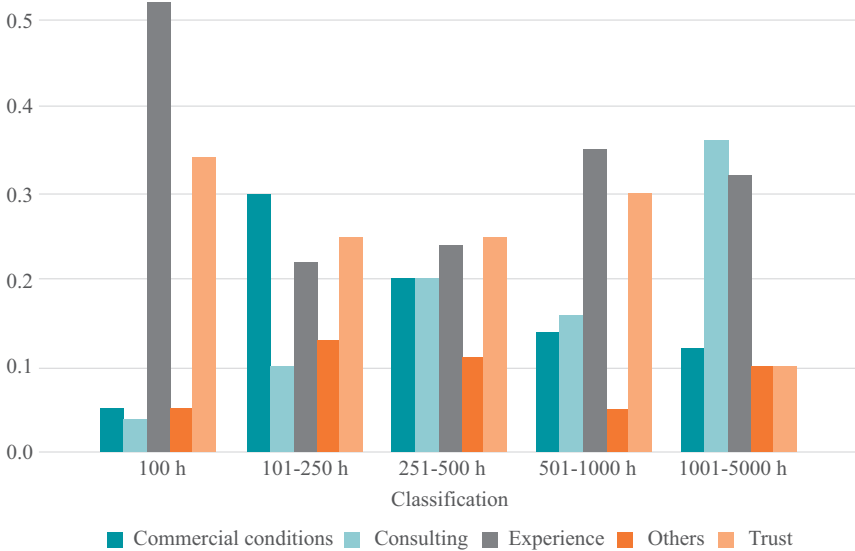
Source: own elaboration.

As observed in the confusion matrix, the AUC decreases as livestock stocks increase. This decrease is mainly due to the decrease in the probability of choice Y = 1 as livestock stocks increase (Figure 2). Analysis of these validity metrics provides important information about the robustness and accuracy of the models across different subsets of livestock producers and their decision-making processes.

FIGURE 2

Validation of the models according to the ROC criteria. The sensitivity of the model versus specificity is presented graphically
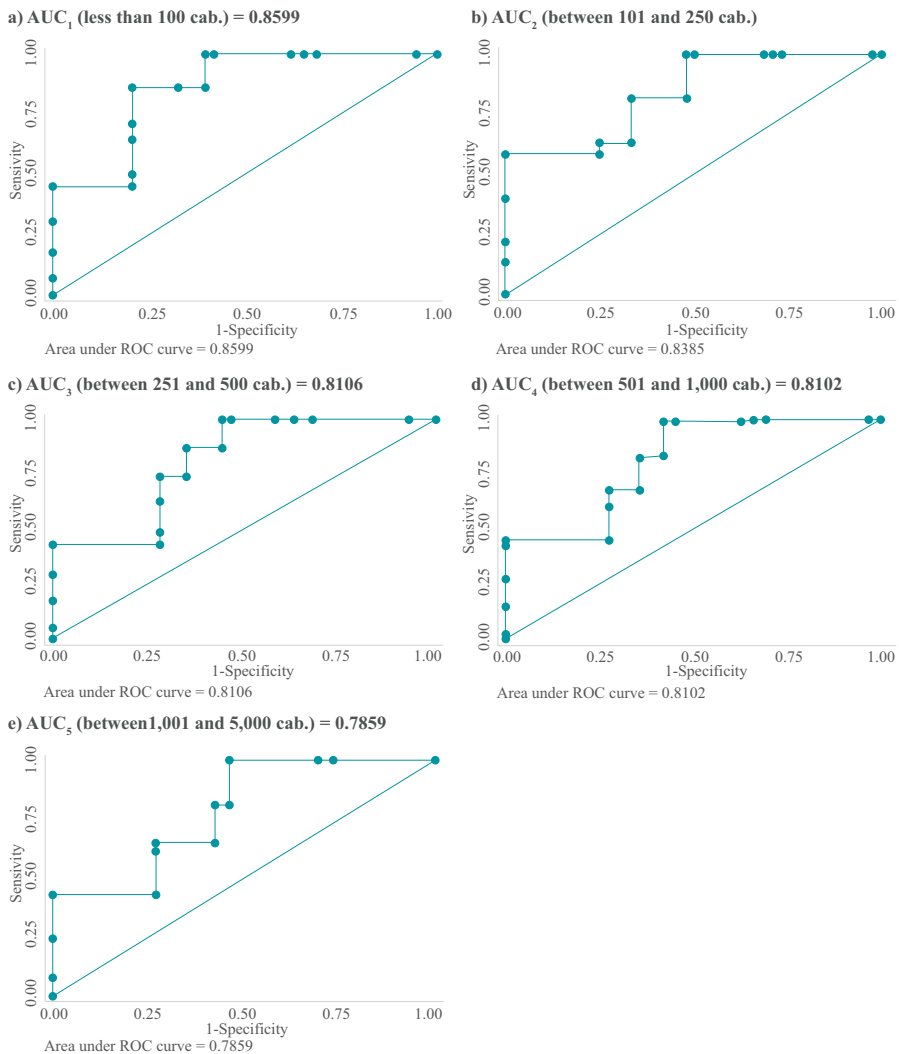
Source: own elaboration.

4. Discussion

The findings of the present study, corresponding to the perspective of economic capital, are in line with Grado (2011) and Canós Darós *et al*. (2012), who state that the internal economic structure of the agricultural enterprise conditions decisions and the implementation of strategies. Likewise, as Pietrantueno (2019) points out, difficulties in accessing sources of financing weaken the producer's bargaining power, leading him to accept commercial conditions that imply a lower payment in a shorter term, as can be seen in the results obtained.

The results show that economic analysis plays a secondary role in the decision-making process, as suggested by Ponssa *et al*. (2015), who state that cattle producers prioritize productive indexes, because cattle are sold without major difficulties, minimizing the relevance of the sale conditions themselves. In the same sense, the findings are consistent with the study of Balestri *et al*. (2001), who found that 80 % of producers disregard economic calculations.

Having economic-financial information is relevant to correctly estimate the economic result (Pellerano *et al*., 2003), which conditions the adoption of basic technologies such as those related to feeding systems, herd management, investments in infrastructure and sanitary practices. The economic sustainability of the agricultural enterprise should not be underestimated, since it is conditioned by the monetary income generated by the activity:

The production approach, the technology used and factors external to the company will determine to a large extent the volumes to be obtained or expected. Likewise, the prices with which the producer will face at the moment when he can put his production on the market are uncertain and depending on the magnitude in which they move, he will be able to obtain good, acceptable or bad results (Miguez, 2014).

Casari & Gorziglia (2014) provide an explanation for the relevance given to economic analysis in the commercial decision-making process in the bovine activity, insofar as they state that agricultural companies do not have an adequate administrative structure for the collection and analysis of information, where decisions are based on tradition.

As mentioned above, the payment deadline represents the variable related to commercial conditions that is most valued by cattle producers. In this sense, Torres Carbonell *et al*. (2022) mention that risk management is a fundamental component to ensure the continuity of agricultural enterprises, minimizing the probabilities of unfavorable events.

A relevant aspect to understand the observed results is related to the advantages and disadvantages of the beef cattle marketing alternatives: on the one hand, direct marketing mechanisms have a lower logistic cost, but require more time dedicated

to marketing, in addition to having less market information and bargaining power; on the other hand, indirect marketing mechanisms have more market information, better bargaining power, a wider customer portfolio, better sales prices, but also have higher transportation costs, collection terms and commission payments (Diez, 2020).

5. Conclusions

This study examined the impact of economic factors on the decision-making process of cattle producers in the Capital Department of La Pampa Province. Using livestock stock as a proxy variable, the research identified significant relationships between socioeconomic indicators and the preference for different marketing methods. The results revealed an inverse association between income levels, driven by higher livestock stock, and choices in favor of direct marketing. In addition, among the traditional variables, payment term emerged as a crucial determinant, surpassing the importance of selling price and marketing cost in commercial decisions.

In addition, the study delved into non-traditional variables encompassing individual characteristics and preferences, such as experience, trust, commercial conditions, and advice. These factors demonstrated considerable explanatory power, elucidating between 70 % and 95 % of the decision-making processes among the farmers surveyed, and played a key role in the random utility model employed.

The results of this research provide contributions to the understanding of the intricate dynamics of the cattle industry and highlight the influence of economic factors and individual attributes on marketing decisions. These empirical results provide concrete information for use by policy makers and industry stakeholders as they offer a deeper understanding of the decision-making patterns of beef cattle producers. They can facilitate the development of specific interventions and strategies to optimize marketing practices in this area, such as the development of programs, actions and public policies aimed at improving the coordination, integration, and competitiveness of the agrifood chain.

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