Implementation of Futures Markets in the Livestock Sector of Sucre, Colombia: A Volatility Modeling Approach

Implementação de Mercados Futuros no Setor de Gado Bovino de Sucre, Colômbia: Uma Abordagem de Modelagem da Volatilidade

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Abstract

In this study, we assess whether the cattle market in Sucre, Colombia, has the necessary conditions for implementing futures markets. Using weekly data from January 2010 to September 2022, we analyze first-class cattle prices and quantities sold at livestock auctions. The results show that the market is relatively significant in terms of bovine inventory, trade volumes, and buyer participation. The four-firm concentration ratio, eight-firm concentration ratio, and Herfindahl and Rosenbluth indices suggest low to moderate concentration in cattle trading, indicating that price formation is driven by supply and demand dynamics rather than market power. The analysis reveals that cattle supply is stationary, while price series are integrated of order one, with return series exhibiting volatility clusters, confirmed by ARCH and GARCH model estimations. These findings suggest that the cattle market in Sucre experiences volatile price behavior. Given the sector's vital role in the local economy and its exposure to risks, such as climatic events, we recommend implementing futures markets as a potential solution to mitigate uncertainty and stabilize the livestock economy.

Keywords: Futures Market, Cattle, Time Series, Stationarity, Volatility

JEL: C32; G13; Q11; Q18

1. INTRODUCTION

Futures markets are part of the capital market and are considered financial derivatives, whose performance depends on the behavior of underlying assets. The profitability of financial derivatives is conditioned by fluctuations in the stock market, with commonly used underlying assets including stocks, stock indices, fixed-income securities, interest rates, and commodities. The main factor driving the implementation of futures markets is price uncertainty, as futures contracts allow market participants to minimize the risk associated with each transaction. In these markets, real or financial assets are bought and sold for delivery at a future date agreed upon at the time of negotiation. These contracts are fully standardized, as they specify in advance the quantity, quality, price, term, and delivery location of the product (Hull, 2016).

In 2019, the livestock sector accounted for 48.7% of the agricultural gross domestic product (GDP) and generated 810,000 direct jobs, making it one of Colombia's most important agricultural activities. In 2020, the Colombian cattle herd reached a total of 28,245,262 head. Between 2009 and 2016, the livestock sector faced severe climate adversities that led to the death of 377,000 cattle. However, between 2017 and 2019, the cattle inventory grew at an annual rate of 6%. Despite being significantly affected by adverse conditions, such as climate shocks, livestock remains the leading contributor to the national GDP within the agricultural sector. The livestock sector's contribution is 2.1 times that of the poultry sector, 3 times that of the coffee sector, 3.1 times that of coffee growers, 4.4 times that of the pig farming sector, 5.3 times that of the banana sector, and 8 times that of pig farmers (GIZ, 2020).

According to the Department of Sucre's Secretariat of Development and Environment (2024), the productive structure of the Sucre department has been predominantly agricultural, and although the sector has lost importance in its share of the total GDP in recent decades, livestock and agriculture remain key sectors for the department's economy. In 2017, Sucre had a cattle inventory of 1,350,430 head, but by 2020, this number had dropped to 1,158,068 due to the climate challenges faced by the region. The subregions of Sabanas, Majagual, and La Mojana account for 72.7% of the cattle population; however, these areas are the most affected during periods of flooding and drought.

Therefore, the livestock sector in the Sucre department, Colombia, could be considered a high-risk sector by investors due to its vulnerability to adverse factors such as price volatility, climate shocks, and natural disasters—elements that are generally difficult to predict. Despite these challenges, livestock remains a key contributor to the department's economy. Given its importance and the risks it faces, this research seeks to evaluate the feasibility of implementing futures contracts in the sector as a strategy to mitigate uncertainties and enhance investor confidence.

According to Gutiérrez and Caputi (2004) for a sector to be considered suitable for trading in futures markets, it must be of significant size, there should not be excessive concentration of power by a few agents, the product prices must fluctuate significantly, and these variations should be driven by random causes, with volatile price behavior. To verify the fulfillment of these conditions, in this article, we analyze the historical behavior of the variables price per kilogram and quantity sold of first-quality livestock in the livestock sector of the Sucre department, Colombia, from the first week of January 2010 to the first week of September 2022.

The results indicate that the cattle market in Sucre is a significant sector in terms of bovine inventory, trading volume, and the number of buyers. The low to moderate concentration in the auctions, reflected by the concentration indices, suggests that price formation is driven by supply and demand dynamics, rather than the market power of a few buyers. The temporal analysis shows that cattle supply is stationary, while the price series are integrated of order one, which limits the predictive capacity of past values. Additionally, the price returns exhibit volatility clusters, confirming the volatile behavior of prices. Given that the sector is crucial to the local economy and exhibits high volatility, the implementation of futures markets is recommended as a potential solution to mitigate uncertainty and stabilize the livestock economy.

This article contains, in addition to this introduction, four more sections. In the second section, the theoretical arguments involving the concept of futures markets are presented, along with a review of empirical studies that investigated the convenience of futures markets in some Latin American countries. In the third section, we present the data in detail and outline the methodological procedures used to conduct the analysis. In the fourth section, the

results obtained are addressed and discussed. Finally, in the fifth section, the conclusions of this study are presented.

2. THEORETICAL FRAMEWORK

The history of futures markets dates to ancient trading practices, where forward sale contracts were used to secure transactions in uncertain environments. Archaeological evidence suggests that as early as 1750 BCE in Mesopotamia, such contracts were recorded on clay tablets, allowing not only the advance purchase of goods but also the transfer of these rights to third parties. This mechanism facilitated the financing of operations and risk management while enabling the participation of purely speculative agents. Over time, similar practices spread to Ancient Greece and Rome and were later adapted to the needs of medieval and Renaissance trade. The emergence of organized markets in Europe consolidated the structuring of forward contracts and the development of a more sophisticated environment for commodity trading (Fisanott, 2014; Kummer & Pauletto, 2012).

Regarding the consolidation of futures markets as they are known today, Fisanott (2014) points out that a decisive milestone occurred in the United States, particularly in Chicago, where the expansion of commercial activity created favorable conditions for the structured trading of commodities. In the 19th century, the city became a crucial logistical hub due to its strategic location and its connection to the country's main trade routes. In 1848, the Chicago Board of Trade (CBOT) was founded, initially facilitating grain transactions but soon evolving into a marketplace where producers and traders entered forward contracts to hedge against seasonal price fluctuations. The growing volume of these operations led to the formalization of futures contracts in 1865, with standardized specifications and margin requirements, ensuring greater market security and liquidity (Williams, 1982). This model expanded to other sectors and regions, establishing Chicago as the global benchmark for derivatives and serving as an inspiration for the creation of new markets throughout the 20th century.

The increased integration between international and regional markets encourages the emergence of new financial mechanisms, including financial derivatives designed to improve market positioning. As Rojas (2010) explains, markets like agriculture or livestock exhibit uncertainty over time, and participants in these markets seek to protect themselves against

potential risks arising from economic behavior or other factors that could disrupt their operations. To address these challenges, forward futures contracts were developed.

Futures markets are organized markets where futures contracts are traded, involving a promise to buy and sell a specific commodity between negotiating parties at a set date when the contract is made. This is a standardized contract, as the quantity, quality, and price of the product are established in advance. In this type of market, the price is fixed at the time of the contract, regardless of future prices, and each party's position depends on their interests and expectations of market behavior. According to Arena and Scudiero (2023) futures markets offer advantages over forwards, including complete reliability, market organization, fulfillment guarantees provided by the parties' deposits, and the involvement of clearinghouses. For these reasons, futures markets are considered a better option by investors.

For a commodity to be viable in futures markets, it must meet certain requirements, such as: (i) low perishability and storage capability, which facilitate physical delivery or financial settlement; (ii) standardization and homogeneity, necessary to define contracts without additional inspection costs; (iii) price volatility in the spot market, which drives demand for risk hedging; (iv) a broad and liquid physical market, with a high volume of trades and a diverse range of participants; and (v) a competitive environment, free from price distortions caused by external interventions. The absence of efficient traditional risk management mechanisms also encourages the adoption of such contracts. These factors, combined with the interest of sector participants, determine the sustainability of a futures markets (Gutiérrez & Caputi , 2004).

However, considering that there are risks inherent to commodities eligible for the futures market, contracts require risk management mechanisms. In fact, in futures contracts, risk is managed securely. The possibility of default is reduced through a procedure called a margin, which can be in the form of a deposit, government bonds, or shares. This margin is required by exchanges from all investors to allow them to buy and sell futures contracts. In other words, to enter futures transactions, the full value of the contract is not required; only a margin deposited into the accounts of the negotiating parties is necessary. Generally, this margin is around 10% of the contract value. The position of the traders is adjusted daily based on the fluctuations in the price of the traded commodity (Gomes; Krieger, 2016).

Futures contracts involve daily debits and credits in the accounts of the traders due to price variations of the financial derivative. This is because it is not necessary to sell the commodity to realize profits or losses from the transaction. However, if one of the parties wishes to liquidate these adjustments, they simply need to sell their position. If, on the expiration date, the seller has not settled their position, they must pay the settlement price and receive the negotiated asset. The margin offered in futures contracts is made possible by the intervention of the Clearinghouse, a financial intermediary between the buyer and seller with substantial capital that guarantees contract fulfillment by both parties. The Clearinghouse acts as an auditor for these contracts, provides market information, handles futures settlement, and oversees the delivery and receipt of the agreed-upon products (Marques, 2014).

The experience regarding futures markets is diverse. In this regard, Dopchiz (2008) find that the Argentine livestock market lacks some necessary conditions to implement futures markets, suggesting that agricultural policies hinder the sector's development. On the other hand, Rojas and Abreu (2008) suggest that in Mexico, futures markets are strong candidates for importers and processors due to the country's heavy reliance on imported wheat. In the case of Brazil, which has a well-established livestock futures market, evidence suggests that it is efficient, and in the long run, futures prices serve as unbiased estimators of spot prices (Moraes et al., 2009). On the other hand, Rodrigues and Martinez-Filho (2015), when analyzing the Brazilian exchange markets for coffee, soybeans, ethanol, corn, and live cattle, found evidence of inefficiency in the cattle market. The authors suggest that the reasons for this outcome may be related to liquidity, transaction costs, and the market power of participants.

In Colombia, Castillo (2022) find that livestock farmers respond to market stimuli such as prices and production costs and are risk-averse regarding climate and price fluctuations. A study conducted by Arango Gil (2011), which points out potential difficulties for the implementation of the futures market in Colombia as a whole, without considering the specific characteristics of the departments. The author suggests that the Colombian derivatives market remains underdeveloped, with low liquidity and a lack of reliable daily price references — critical elements for futures contracts. Furthermore, past failures with forward contracts led to reluctance among financial institutions to support similar

instruments. These challenges, combined with limited regulatory clarity specific to agricultural derivatives and a lack of market participants' interest due to unfamiliarity with risk hedging mechanisms, suggest that the adoption of such financial tools in the country would require structural and educational advancements. Despite the importance of the livestock market for the department' economy and the risks present in this sector, no studies were found that assess the feasibility of implementing futures markets in Sucre's livestock sector.

3. DATA AND METHODOLOGY

We construct a weekly sample database of the price and quantity sold of first-quality livestock from the first week of January 2010 to the first week of September 2022. The data were provided by the Price and Agricultural Costs Observatory of the Northwestern Caribbean Region of Colombia (OPCA), a research group affiliated with the Faculties of Agricultural Sciences and Veterinary Medicine and Animal Science at the University of Córdoba, Colombia. This observatory is responsible for studying and providing information on livestock markets in the departments of Sucre and Córdoba. In Sucre, OPCA collects data from livestock auctions held weekly in the municipalities of Sampués, San Marcos, San Pedro, and Sincelejo.

The database is an aggregation of livestock data from the department of Sucre, compiled from weekly auctions held in various municipalities. Price and quantity data for top-quality cattle in Sampués, Sucre, were obtained from the Subasta Subastar auction, which provides weekly records from January 2010 to September 2022. The Subasta Subastar auction in Sincé, Sucre, was excluded as its data is only available from April 2007 until its suspension in August 2011. The Subasta Cogasucre auction in Sincelejo, Sucre, has records from January 1997 to September 2022, while the Subasta Sugasam auction in San Marcos and the Subasta Subastar auction in San Pedro both provide data from January 2010 to September 2022.

In Sucre's livestock auctions, two types of cattle are traded. The fat cattle, intended for slaughter, include barren cows, cows with calves, and bulls that have completed their production cycle, making their future yield declining and their commercialization less attractive. Additionally, there is commercial cattle, classified into first- and second-quality categories. First-quality cattle have excellent body conditions and are highly desirable for

trading, as they are well-suited for fattening. Second-quality cattle are crossbreeds with restricted lactation, which negatively affects their condition. On average, 81% of the cattle traded in Sucre's auctions are first-quality, while only 19% are second-quality. Of the total, 79% are males and 21% are females (Coronado; Bracamonte; Castillo, 2018).

Livestock auctions are efficient price formation mechanisms; however, buyers may collude to purchase at lower prices, leading to market concentration and distorting competition. Since one of the economic conditions for implementing futures markets is the absence of excessive market power concentration, it is essential to determine the degree of concentration in Sucre's livestock market in Colombia. To this end, we use the concentration index (CI_i) method, where i represents the number of buyers. This index measures the purchasing concentration of the largest buyers relative to total livestock sales, we calculate the index for the top four and eight buyers by dividing the number of animals they purchase by the total animals sold.

Additionally, we use the Herfindahl Index (HI) and the Rosenbluth Index (RI). The Herfindahl Index is calculated as the sum of the squared market shares of each buyer, including all market participants. An index value of one indicates that a single buyer acquires all the cattle, while the minimum value is 100 divided by the total number of buyers, implying equal market shares and the absence of market power. The Rosenbluth Index, in turn, is computed as the inverse of twice the sum of the product of market shares and the number of buyers, minus one. This index places greater emphasis on smaller firms since weights are not squared.

To assess the variability of cattle prices and supply, we conduct a stationarity analysis using the Augmented Dickey-Fuller (ADF) test. This test assumes an autoregressive structure of order p in which the following equation is estimated:

$$\Delta y_t = \alpha_1 + \alpha_2 t + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \qquad (1)$$

The parameter of interest is γ. The objective of this test is to evaluate the hypothesis that $\gamma = 0$. If this hypothesis is not rejected, the series has a unit root, meaning that the mean and variance of cattle prices and supply change over time. The test is repeated for the differenced variable until the null hypothesis is rejected. The lag length is selected using information criteria, as choosing the correct number of lags is crucial to ensuring the validity of the test.

Using too few lags may result in regression residuals failing to properly capture the behavior of the errors, so that γ and its standard errors will not be well estimated. Conversely, using too many lags reduces the power of the test, as estimating additional parameters decreases the degrees of freedom (Enders, 2015).

The main justification for futures markets is the price-risk faced by traders. Volatility in prices refers to the range within which future price variations of a commodity may fluctuate. When this price volatility increases, it means this range has widened, leading to greater uncertainty regarding future prices. Consequently, producers and consumers face higher risks in the market, as increased volatility limits agents' ability to predict future prices. Volatility is a phenomenon that cannot be directly measured, which is why a modeling approach is used, where the conditional variance of the model's stochastic disturbances is taken as a proxy variable to determine if they are homoscedastic or heteroscedastic. If this variance is not constant over time, autoregressive conditional heteroscedasticity (ARCH) models or generalized versions of the same family (GARCH) are specified, as including risk (if volatility is present) leads to better predictions (Enders, 2015). We estimate the following equations:

$$Y_t = \alpha + \sum_{i=1}^{p} \phi_i Y_{t-i} + \sum_{j=1}^{q} \theta_j \epsilon_{t-j} + \epsilon_t \qquad (2)$$

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \epsilon_{t-i}^2 \qquad (3)$$

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i \epsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 \qquad (4)$$

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i \epsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 + \gamma I(\epsilon_{t-1} < 0) \epsilon_{t-1}^2 \qquad (5)$$

To model cattle price volatility, the first step is to estimate equation (2) using ordinary least squares, as the conditional variance of the series is reflected in the residuals of this model. The model must be specified in a way that eliminates autocorrelation, ensuring that the residuals behave like white noise. The second step is to estimate the ARCH model in equation (3) and conduct a hypothesis test for ARCH effects on the estimated coefficients. If this hypothesis is rejected, it becomes necessary to model conditional heteroscedasticity. However, a limitation of this model is that it assigns equal importance to both positive and negative errors since it uses the squared residuals in the equation. Additionally, the ARCH model tends to overestimate volatility.

Since the ARCH model tends to produce many significant parameters, estimating equation (4) helps overcome this limitation by allowing for a more flexible and parsimonious structure. This model considers both past squared residuals and past conditional variance when modeling volatility. However, both ARCH and GARCH models assign equal weight to positive and negative shocks in terms of their impact on volatility. In practice, though, return volatility reacts differently to price increases and decreases. Estimating the TARCH model in equation (5) correctly captures the asymmetric effect of price variations on volatility (Enders, 2015).

4. RESULTS

An important condition for implementing futures contracts is that the sector operates similarly to a competitive market. In this regard, according to OPCA (2023) data, over the past 10 years, the auctions in San Marcos, Sincelejo, and Sampués have maintained between 400 and 600 annual buyers, each trading an average of 65,000 cattle per year. Meanwhile, the San Pedro auction has recorded around 300 buyers and over 25,000 cattle sold annually, with each entity conducting an average of 54 auctions per year. At the departmental level, an average of 225,000 cattle has been traded annually over the past decade. In 2020, the department had a cattle inventory of 1,158,068 and an average of 1,665 buyers. Therefore, this market can be considered relatively significant, which is crucial for fostering interest in futures markets and ensuring efficient price formation.

Over the past five years, livestock auctions in the department have reported an average four-firm concentration ratio (CR4) of 31% and an eight-firm concentration ratio (CR8) of 37%.

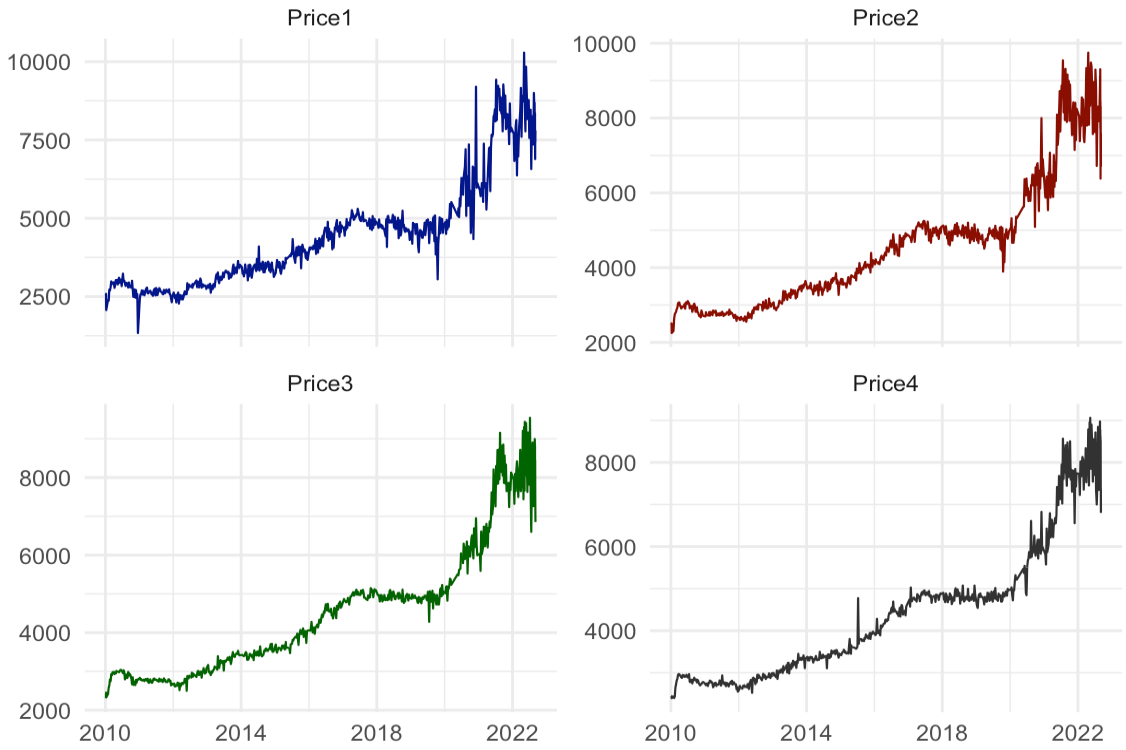
This means that the four and eight largest buyers accounted for 31% and 37% of the total cattle traded at these auctions, respectively. These values fall below the low-to-moderate concentration range[1]. The HI and RI indices averaged 1.19 and 0.66, respectively, with minimum values around 0.21. Based on this, it is reasonable to consider that cattle buyers in these auctions do not exert significant market power. Consequently, cattle prices are likely shaped by market forces and may also be influenced by random events such as climate shocks.

In Figure 1, we present weekly price variables for first-quality livestock under one year old (price1), one year old (price2), one year and three months old (price3), and one and a half years old (price4). This category of cattle is attractive for trade due to its good body condition and represents 81% of the total cattle marketed in the department. The price variable shows significant variations throughout the analyzed period, constantly experiencing changes in mean and variance. These fluctuations became more evident from 2020 onwards, suggesting that the price series may exhibit a stochastic trend.

In Table 1, we present the results of the Augmented Dickey-Fuller test, where we observe that all series exhibit statistically significant deterministic components. On the one hand, the price series show an upward trend, while the supply series demonstrate a downward trend, except for the supply of one-and-a-half-year-old cattle. Furthermore, we find that the four-cattle supply series are stationary at levels, indicating that the mean and variance of cattle sold in the livestock sector of the Sucre department remained constant during the analyzed period. On the other hand, the four-price series exhibit a unit root at levels, suggesting that the price of first-quality cattle experiences significant changes in its moments. When the Dickey-Fuller test was repeated, it was found that these series are integrated of order one. The results of this test are available upon request, which implies that past values of the series provide limited information for predicting cattle prices.

[1] Highly concentrated markets have a CR4 between 65% and 75% and a CR8 between 80% and 90%. Markets with moderate-to-high concentration show a CR4 of 50%–65% and a CR8 of 70%–85%, while those with low-to-moderate concentration have a CR4 of 35%–50% and a CR8 of 45%–70%.

Figure 1: First-Quality Livestock Prices



Source: OPCA (2023).

Table 1

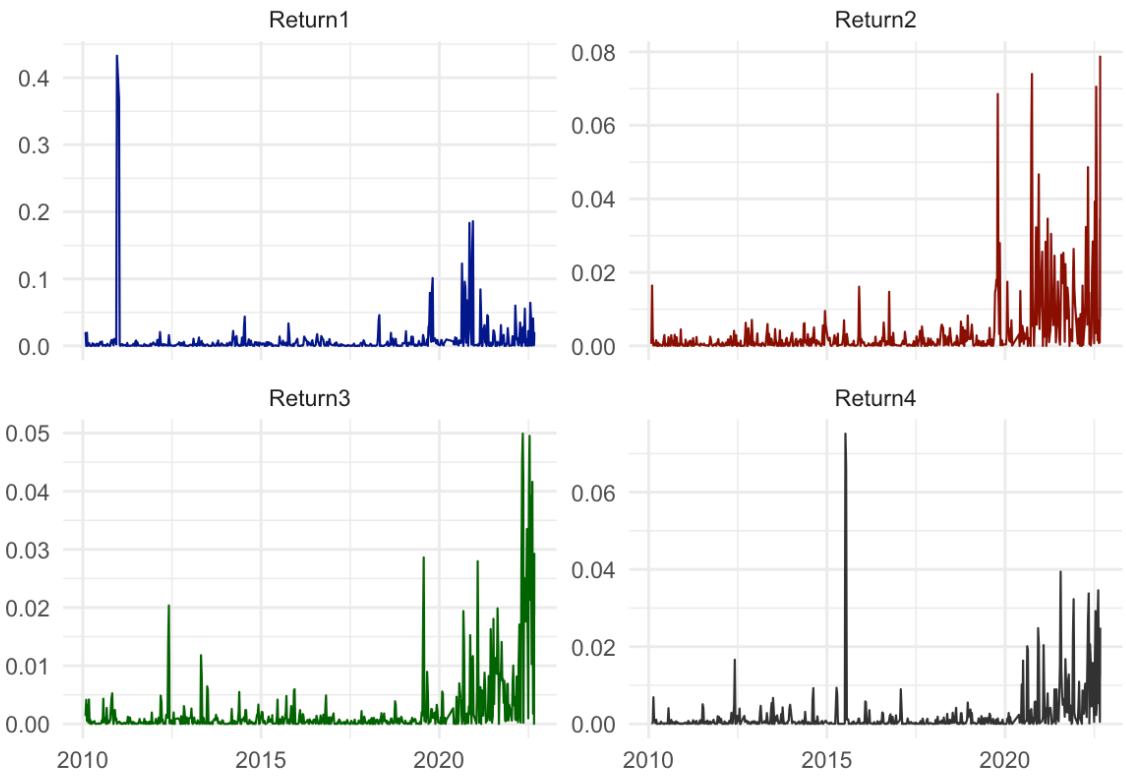
Augmented Dickey-Fuller Test for Cattle Price and Supply Series

	Price 1	Price 2	Price 3	Price 4	Qty. 1	Qty. 2	Qty. 3	Qty. 4
Int.	97.4**	95.3**	68.9*	61.6*	59.0***	95.6***	202.4***	135.1***
Trend	0.49**	0.40**	0.29*	0.27**	-0.1***	-0.4***	-0.1***	-
ADF	-2.53	-2.40	-1.90	-1.91	-7.35	-6.73	-7.13	-5.73
1%	-3.96	-3.96	-3.96	-3.96	-3.96	-3.96	-3.96	-3.43
5%	-3.41	-3.41	-3.41	-3.41	-3.41	-3.41	-3.41	-2.86
10%	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12	-3.12	-2.57
Lags	4	4	3	3	3	4	4	5

Note: The estimates are significant at *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In Figure 2, we present the squared price return series, revealing the presence of volatility clusters. Periods of relative calm are followed by low-fluctuation phases, while periods of uncertainty are followed by high-volatility phases. This is a clear indication that the return series exhibits an autoregressive structure, implying that livestock price returns are not independently and identically distributed. These findings are confirmed by the ARCH LM test, where p-values close to zero suggest that the return series exhibits the so-called ARCH effect. Additionally, the Jarque-Bera test produced negative skewness coefficients and kurtosis values significantly above three, indicating that the distribution of these series is left-skewed and leptokurtic. Furthermore, a p-value close to zero leads to the rejection of the hypothesis that returns follow a normal distribution, a common characteristic of series with volatile components.

Figure 2: Squared Weekly Returns of First-Quality Livestock Prices



Source: OPCA (2023).

Since there are conditional heteroscedasticity effects in livestock price returns, the GARCH family of models is appropriate for modeling volatility. The Box-Jenkins methodology suggests that an ARIMA (3,0,5) model is a suitable structure for modeling the mean equation, with the number of lags selected using the Akaike criterion. The Box-Ljung test produces a P-value close to one, indicating that the residuals are free of serial correlation, which suggests that they appropriately capture the behavior of the errors.

In Table 2, we present the estimation results. The first panel contains the estimates of the ARCH model for the return series of first-quality cattle younger than one year (Ret. 1), one year old (Ret. 2), one year and three months old (Ret. 3), and one and a half years old (Ret. 4). It is observed that, for all four-return series, past squared residuals play a significant role in explaining the conditional variance, confirming the presence of volatile behavior in the cattle price series of the department. Furthermore, the Box-Ljung test applied to the standardized squared residuals indicates that there is no dynamic structure in the residuals. Meanwhile, the ARCH LM test suggests that the residuals do not exhibit conditional heteroskedasticity, implying that the variance equation is appropriate for modeling conditional volatility.

Table 2

Results of the Estimation of ARCH and GARCH Models

	Ret. 1	Ret. 2	Ret. 3	Ret. 4	Ret. 1	Ret. 2	Ret. 3	Ret. 4
Lag 1	0.25**	0.05	0.15***	0.63***	0.25***	0.07***	0.16	0.33**
Lag 2	0.24**	0.15*	0.12**	0.32***	0.69***	0.92***	0.83***	0.64***
Lag 3	0.21**	0.21***	0.22**	-	-	-	-	-
Lag 4	-	0.24***	0.24***	-	-	-	-	-
Lag 5	-	0.13**	0.17***	-	-	-	-	-
Akaike	-2.768	-3.605	-4.179	-4.144	-2.793	-3.629	-4.186	-4.171
Bayes	-2.669	-3.492	-4.073	-4.058	-2.707	-3.537	-4.101	-4.078

Note: The estimates are significant at *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In the second panel, we present the results of estimating a GARCH (1,1) model. It is evident that both the squared residuals and past variance play a crucial role in modeling conditional volatility. Furthermore, the Box-Ljung and ARCH LM tests indicate well-behaved standardized squared errors. This model provides a more flexible and parsimonious approach to modeling conditional heteroskedasticity, as it requires estimating fewer coefficients. Additionally, the model generates more efficient estimates according to the Akaike and Bayesian information criteria, improving the accuracy of the results. Finally, the estimator governing volatility asymmetry in the TARCH model was not significant, indicating that positive and negative shocks have the same importance in explaining cattle price volatility.

5. FINAL REMARKS

The purpose of this article is to assess whether the cattle market in the department of Sucre, Colombia, has the necessary conditions to implement futures markets. To achieve this, we analyze historical data on the prices and quantities of first-class cattle sold at livestock auctions in the department. This information is provided weekly from January 2010 to September 2022 by the Price and Agricultural Costs Observatory of the Northwestern Caribbean Region of Colombia (OPCA). In this study, we exclude second-class cattle, as they are a type of crossbreeding with restricted lactation, which deteriorates their condition. In contrast, first-class cattle possess excellent body conditions and are attractive for commercialization.

The statistics provided by OPCA (2023) allow us to categorize the cattle market in Sucre as a relatively significant sector in terms of its bovine inventory, the amount of cattle traded, and the number of buyers participating in this market. On the other hand, the four-firm concentration ratio, eight-firm concentration ratio, and the Herfindahl and Rosenbluth indices indicate that there is low to moderate concentration in cattle trading at the auctions, which suggests that price formation is not the result of the market power of a few buyers and is potentially driven by supply and demand dynamics or random events. These characteristics make this sector behave similarly to a competitive market. The temporal analysis indicates that the cattle supply is stationary at levels, while the price series are integrated of order one, suggesting that their past values contain limited information to predict the future. On the other hand, the return series of prices exhibit volatility clusters. These results are confirmed

by the estimations of the ARCH and GARCH models, suggesting that cattle prices in the department of Sucre exhibit volatile behavior.

The livestock sector is of vital importance to the economy of the department of Sucre in terms of its contribution to the gross domestic product and its ability to generate jobs and income. However, despite its importance, this sector has been affected by various risk factors, such as climatic phenomena that impact prices and supply. The results of this research indicate that this sector behaves competitively and that prices exhibit volatile behavior. Therefore, futures markets are strong candidates to mitigate uncertainty in the livestock economy.

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