REVISTA DE ECONOMIA E AGRONEGÓCIO

Revista de Economia e Agronegócio - REA
ISSN impresso: 1679-1614
ISSN *online*: 2526-5539
Vol. 22 | N. 1 | 2024

ANALYSIS OF RISK IN THE LIVESTOCK OF THE STATE OF RIO DE JANEIRO AND BRAZIL BETWEEN JANUARY 2007 AND MARCH 2020

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ABSTRACT

The article aims to analyze the exposure to risks that livestock farmers in the state of Rio de Janeiro face to Brazil using the Value at Risk (VaR) metric as a measure of risk and price return for cattle from January 2007 to March 2020, providing an expanded information that allows for presenting the level of risk of the activity between the analyzed states and comparing their levels. Through this metric, it is possible to have the total volume of losses that can occur for different types of assets and portfolios, including commodities. The results showed that ranchers in the state of Rio de Janeiro are exposed to a greater probability of financial losses when compared to other Brazilian ranchers. While in the state of Rio de Janeiro there is a 95% probability of finding maximum losses in investment of 4.81%, in Brazil the maximum losses were 3.09% for the 95% statistical confidence level. Finally, the non-parametric VaR metric of historical simulation proved to be a valuable tool in the risk management of livestock.

Keywords: Value at Risk; Livestock; Brazil; Fat Cattle

RESUMO

O artigo tem como objetivo analisar a exposição aos riscos que os pecuaristas do estado do Rio de Janeiro enfrentam em relação ao Brasil utilizando a métrica *Value at Risk (VaR)* como medida de risco e retorno do gado, entre o período de janeiro de 2007 a março de 2020, fornecendo informação que permite apresentar o nível de risco da atividade entre os estados analisados e comparar seus níveis. Por meio desta métrica, é possível ter, para um determinado nível de confiança, em uma determinada linha do tempo, o volume total de perdas que podem ocorrer para diferentes tipos de ativos e carteiras, incluindo commodities. Os resultados mostraram que os pecuaristas do estado do Rio de Janeiro estão expostos a uma maior probabilidade de perdas financeiras quando comparados aos demais pecuaristas brasileiros. Enquanto no estado do Rio de Janeiro há 95% de probabilidade de encontrar perdas máximas em investimentos de 4,81%, no Brasil as perdas máximas foram de 3,09% para o nível de confiança estatística de 95%. Por fim, a métrica não paramétrica de VaR de simulação histórica mostrou-se uma ferramenta valiosa na gestão de risco da pecuária.

Palavras-chave: *Value at Risk*; Pecuária; Brasil; Boi gordo

Código JEL: Q13, Q14

Recebido em: 18/01/2024
Aceito em: 06/09/2024

INTRODUCTION

For a better management of agricultural activities, managers have sought ways and measures to measure the risk of their activities. In the case of agricultural chains marked by price fluctuations, such as livestock, risk analysis can contribute to agricultural planning, helping farmers make the best investment decisions (Leismann, 2002).

According to Leismann (2002), market risk is one of the most relevant risks when it comes to agribusiness, and is linked to the fluctuations that occur in commodity prices, caused by strong dependence and sensitivity to factors such as: climate, biological, and political. Thus, for the good financial performance of agribusiness, price analysis is essential.

For Vale et al. (2002) the selection of prices to be used in the analysis process is one of the basic steps in the planning of rural production, requiring a price study as a criterion to establish the base price that will be used in the productive analysis of the business. Therefore, a correct decision on the base price is essential to determining the profit or loss as well as the risk of an agribusiness.

When it comes to cattle production in Brazil, data from the National Confederation of Agriculture and Livestock (CNA) in 2021 shows Brazil as having the largest commercial cattle herd, with around 193 million head of cattle. In addition, the country ranks second in the production of beef, with a share of 16.7% of world production, behind the United States, which has a share of 21.8% (CNA/CEPEA, 2022).

When analyzing the Gross Domestic Product (GDP), Brazilian livestock represented 6.8% of the GDP and 25.6 % of the Brazilian agribusiness GDP (CNA/CEPEA, 2022). However, livestock production in the state of Rio de Janeiro, the second-largest federative unit in terms of GDP, does not have the same economic relevance to Brazil. The production of cattle raised in the state of Rio de Janeiro represented only 0.6% of all cattle raised in Brazil (IBGE, 2022).

Still, according to data from the IBGE - Brazilian Institute of Geography and Statistics, in 2017, they pointed out the state of Mato Grosso as the largest producer, being responsible for 14.5% of the slaughter of cattle in the country, followed by the states of Mato Grosso do Sul (11, 2%), Goiás (10.8%), São Paulo (9.6%), and Minas Gerais (9.2%). The sum of these states reaches more than half of the slaughter in the country.

In this way, the study aims to analyze the exposure to risks that livestock farmers in the state of Rio de Janeiro face about Brazil using the Value at Risk (VaR) metric as a measure of risk and price return for cattle between the period from January 2007 to March 2020, providing information that allows for presenting the level of risk of the activity between the analyzed states and comparing their levels.

It is then questioned whether there are significant differences between the risk levels of price returns in the state of Rio de Janeiro and nationally, and whether the Value at Risk (VaR) metric is efficient as a risk measure for the commodity under study.

THEORETICAL REFERENCE

Risk and Return

Risk is the possibility of a financial loss occurring, often defined as the variability of asset returns (Gitman, 2015). To Woiler and Mathias (1996), the risk is mainly due to the large amount of information contained in the project and the estimation of the values used for the variables, which is inevitably a risk as one does not work with real values. According to the authors, risks can be classified as internal and external, with the former coming from endogenous sources and liable to corporate influences, while external risks come from exogenous sources and companies have few means to circumvent them.

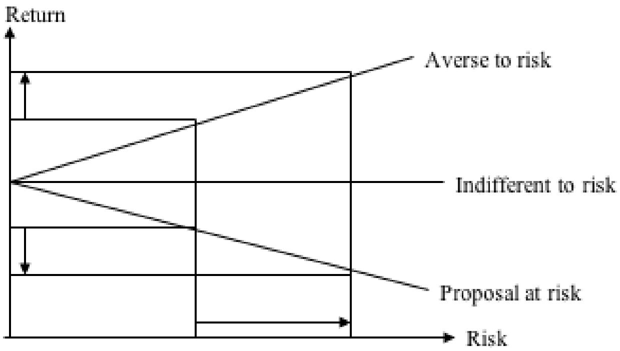
Thiry-Cherques (2004) suggests the following alternatives for minimizing risks: exhaustive analysis of the influences of externalities on the project, obtaining recent historical information on the sector where the project will be implemented, and surveying market data and commercial information.

Buarque (1991) presents three ways to reduce risks: i) careful analysis of future data, such as the conditions and possibilities for the propagation of prices and inputs and the useful life of equipment; ii) application of conservative data when the value of the variable is in doubt; iii) Use of optimistic, realistic and pessimistic values for the main project variables.

To minimize risks, Woiler and Mathias (1996) suggest: i) more careful estimates; ii) empirical adjustments to not overestimate or underestimate the values; iii) prepare pessimistic, median and optimistic projections of the variables, promote the adjustment of the risk discount rate, raising the rate for higher risk investments; iv) adjustment for the equivalent uncertainty; and v) promote sensitivity analysis.

Faced with risk, individuals can present three different behaviors: being averse, biased or indifferent (Gitman, 2015). Figure 1 graphically demonstrates the different behaviors.

Figure 1: Preferences and Behaviors in Relation to Risk

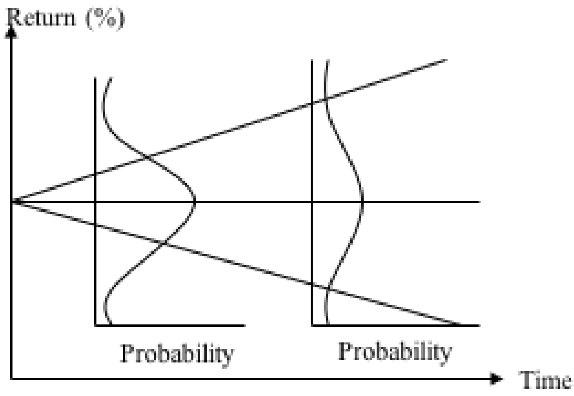


Source: Gitman (2015).

Conformable to Figure 1, when the individual is indifferent to risk, no change in the return level of an asset is required when risk increases. However, some individuals are risk-prone, being attracted by its elevation. This bias leads the individual to take greater risks, even in the face of lower returns. On the other hand, when one is risk averse, increments in the rate of return are required when risks increase; otherwise, the asset is discarded, as compensation is required when the possibility of losses increases. Most people fall into this type of conservative and non-aggressive behavior (Gitman, 2015). In general, individuals tend to prefer assets with a higher risk-return ratio over assets with a lower risk-return.

Furthermore, as future forecasts show greater levels of error over time, the variability of asset returns increases over time, characterizing risk as an increasing function of time, this relationship can be seen in Figure 2.

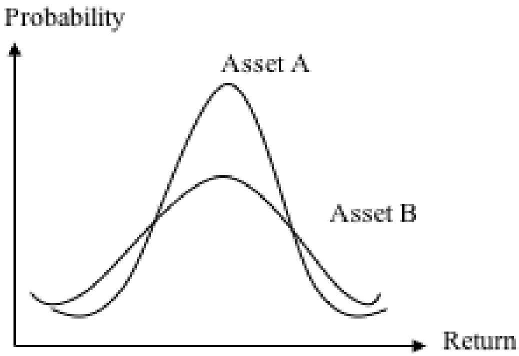
Figure 2: Risk as an Increasing Function of Time



Source: Gitman (2015).

The risks can be measured quantitatively by transforming the possibilities of losses into probabilities and are generally expressed by bar charts, which relate each rate of return to each probability of occurrence. When you have all possible rates of return and their probabilities, risk is better measured. In this case, it is feasible to express the risk by the continuous probability distribution, constructed from the frequency distribution of past returns, as shown in Figure 3 (Gitman, 2015).

Figure 3: Continuous Probability Distribution of Return on Assets



Source: Gitman (2015).

According to Gitman (2015), risk can be measured by the standard deviation, which measures the dispersion of returns in relation to their expected or average value. When there is a greater deviation, there is a greater risk to the asset. In Figure 3, asset B is more risky than asset A, as the return on asset B is more variable. The calculation of the standard deviation is given by the equation:

$$\sigma_K = \sqrt{\frac{\sum_{i=1}^{n}(K_i - \bar{K})^2}{n-1}} \quad (1)$$

where σ_K is the standard deviation of the asset's returns; K, the returns for each observation i; n, the number of observations analyzed; and $\overline{K}$, the expected return, which is given by the equation:

$$\overline{K} = \frac{\sum_{i=1}^{n} K_i}{n} \tag{2}$$

Still, according to Gitman (2015), when one wants to measure and compare the risks of assets with different returns, the coefficient of variation indicator is used, as it is more suitable for analyzing the relative dispersion of returns when the average returns are different. The coefficient of variation is determined by the equation:

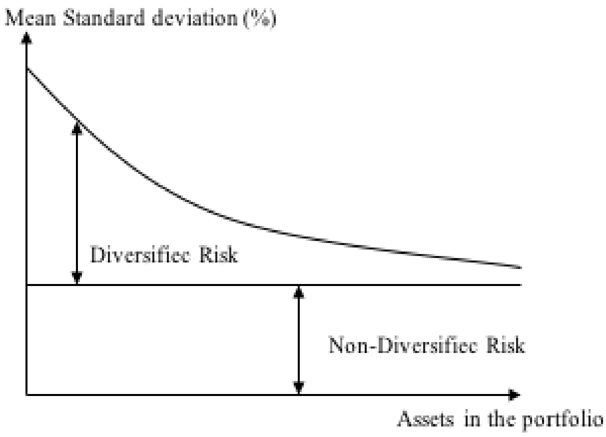
$$CV = \frac{\sigma_k}{\overline{K}} \tag{3}$$

where CV is the coefficient of variation. The greater the CV, the greater the risk of the asset, since the greater the proportion of the standard deviation in relation to the average return on the asset.

According to Ross et al. (2015), the risk can be systematic or non-systematic. The systematic risk is non-diversified or market risk, which influences most assets. The formation of an investment portfolio and its diversification do not eliminate this type of risk. In turn, non-systematic risk is about portfolio diversification by adding new assets and reducing risk. This is possible because, unlike systematic risk, non-systematic risk affects only a small group of assets. In this way, the diversification of investment portfolios is effective in reducing risk, but not completely, because a part of the risk is non-diversified.

A representation of the effects of diversification on the portfolios is shown below in Figure 4, in which it is observed that the increase in the number of assets in the portfolio promotes a decrease in risk, although the systematic risk is not removed, as it influences practically all assets in the portfolio and not just a small group of them (Ross et al., 2015).

Figure 4: Risk and Portfolio Diversification



Source: Ross et al. (2015).

As diversification can eliminate non-systematic risk, the expected return on the portfolio and each asset depends exclusively on the systematic risk. In this way, the adjustment of the return of the portfolio or the asset, assuming risk, must be carried out only by systematic risk (ROSS et al., 2015). According to the authors, the return of an asset i adjusted by the level of systematic risk is given by the equation:

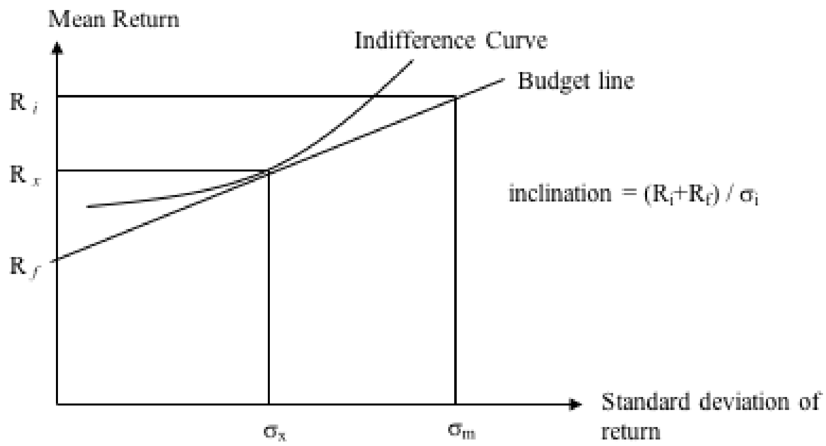
$$E(R_i) = R_f + \beta_i\left[E(R_m) - R_f\right] \quad (4)$$

where $E(R_i)$ is the expected return on asset i; R_f , the risk-free return; β_ii, the systematic risk level of the asset; $E(R_m)$, the expected market return; and $E(R_i) - R_f$, the risk-taking premium. Varian (2003) says that the equilibrium condition in the asset market is that the expected return on assets, which are risk-adjusted, is equal, as assets that have a higher return-risk ratio arouse a quick interest from individuals, causing their price to increase and present the same return-risk ratio as the other assets in the market.

According to Varian (1993), equation 3, known as the CAPM (Capital Asset Pricing Model), is derived from the intersection point of the budget line and the indifference curve of the individual's behavior in relation to risk. At this point, the Marginal Rate of Substitution (MRS) between risk and return is equal to the slope of the budget line, this slope being the price of risk.

Figure 5 shows the point of intersection of the budget line and the indifference curve of the individual's risk-averse. The indifference curve measures the individual's preferences in relation to return and risk, while the budget line expresses the cost of achieving a higher return given the increase in risk, measured by the standard deviation of the return (Varian, 1993).

Figure 5: Risk and Return



Source: Varian (1993).

Mathematically, at the point of optimal choice between return and risk, we have:

$$p = MRS = \frac{(R_i - R_f)}{\sigma_i} \quad (5)$$

where p is the risk price; MRS, the marginal rate of substitution between risk and return; $R_i$is the risk asset's return; R_f, is the risk-free return; and σ_i is the standard deviation of market returns.

MATERIALS AND METHODS

Value at Risk (VaR)

Value at Risk is a risk management tool that has become increasingly widespread in the financial market. The metric informs the risk of a portfolio, company or financial institution in a single number (Pamplona, 2003). According to Jorion (2006), VaR synthesizes the largest (or worst) expected loss within certain periods and confidence intervals.

Value at Risk was developed by J. P. Morgan in the 1980s, whose intention was to measure the potential risk of a loss through a single indicator in each time interval at a given level of significance (Jorion, 2006), statistically:

$$Pr(\Delta R_t \leq VaR_t) = \alpha\% \quad (6)$$

where Pr is the probability of the occurrence of a maximum loss given by the ΔR_t monetary variation of the asset, at a moment t at a level of significance α. Thus, for a monthly VaR of BRL 1,000.00 with 5% significance, or 95% confidence (1-α), there is only a 5% probability of the loss being greater than BRL 1,000.00 during the month.

In their studies, Rugani and Silveira (2006) and Pereira et al. (2010) estimate the maximum potential loss in the discussion of their results. For this, they calculated the relationship between the VaR and the amount invested (Rugani; Silveira, 2006). According to Rugani and Silveira (2006), the relationship allows obtaining the Risk Percentage (RP), that is, the risk absorbed by the agent.

In equational terms, the relationship between VaR and the amount invested is written as:

$$RP = \frac{VaR}{I}\ x\ 100 \quad (7)$$

where RP is the Risk Percentage or VaR in percentage of the invested amount; VaR is the Value at Risk; and I, the level of investment made by the agent. The higher the PR, the greater the risk exposure.

As for the calculation of VaR, there are two ways of estimating losses: the parametric and the non-parametric way. In the first, a certain probability distribution (normal) is assumed and statistical measures such as variance, standard deviation and covariance are used to measure the risks of assets and portfolios. As for the non-parametric or simulation method, no a priori assumptions are made about the behavior of the variables, that is, neither the probability distribution nor correlation are assumed (Silva Neto, 2002).

According to Silva Neto (2002), the VaR can be calculated using the normal parametric method and the non-parametric methods of historical and Monte Carlo simulation. However, as many assets do not have a normally distributed distribution, it is promising to overcome this problem by applying historical and Monte Carlo simulation methods.

In the present study, given the greater cost of applying the Monte Carlo method, it was decided to apply only the normal parametric method and the non-parametric method of historical simulation. This leaves a gap for other studies to investigate the advantages of applying the Monte Carlo method.

Statistical Indicators and Normality Test of Livestock Price Returns

As a methodological instrument of the study, the analysis of the statistical properties of the series of returns on prices of fat cattle for the State of Rio de Janeiro and Brazil was first carried out. Thus, statistical indicators were obtained, and the Jarque-Bera (JB) statistical normality test was carried out to verify whether the series are normally distributed.

To obtain the mean values and standard deviation of the series of returns on the prices of fat cattle, it was necessary to find returns on prices on what:

$$\bar{r} = \frac{\sum_{i=1}^{n} r_i}{n} \tag{8}$$

where r are the price returns for each observation i; n, the number of observations; $\bar{r}$, the average value of price returns; and later obtain the mean values and standard deviation, where:

$$\sigma_r = \sqrt{\frac{\sum_{i=1}^{n} (r_i - \bar{r})^2}{n-1}} \tag{9}$$

where r are the price returns for each observation i; n, the number of observations; the average value of price returns; and σ_r, the standard deviation of feed cattle price returns.

Still, according to Gitman (2015), to compare project risks with different returns, the coefficient of variation indicator is used, which is indicated for analysis of the relative dispersion of returns when their means are different. For these cases, the coefficient of variation is more appropriate than the standard deviation. To obtain the coefficient of variation, apply the equation:

$$CV = \frac{\sigma_k}{\bar{r}} \tag{10}$$

where CV is the coefficient of variation. The greater the CV, the greater the risk of the asset, since the greater the proportion of the standard deviation in relation to the average return on the asset.

Symmetry and kurtosis values were also obtained for the series of returns on fat cattle prices. The purpose of these estimates is that if the return series is normally distributed, then the normal parametric VaR model can be applied. The test of the hypothesis of normality of the distribution was the Jarque-Bera statistical test (JB), presented as:

$$JB = n\left[\frac{S^2}{6} + \frac{(C-3)^2}{24}\right] \quad (11)$$

The test has the normal distribution of the series as a null hypothesis, with the JB statistic having a chi-square distribution with 2 degrees of freedom. In the equation, S is the skewness and C the kurtosis of the distribution, and in the case of the normal, symmetric and mesokurtic distribution, the skewness and kurtosis values are, S=0 and C=3, (Gujarati, 2017).

Procedures and Data Source

The methodology used consisted of obtaining price series for the arroba of fat cattle in the State of Rio de Janeiro and Brazil in the period from January 2007 to March 2020, a period for which data were available, and because in 2007, Brazil became the largest exporter in terms of beef revenue according to Scot Consultoria (Brangus, 2008).

The National data were obtained from CEPEA (2021) and data referring to the State of Rio de Janeiro were obtained by Scot Consultoria (2021) in daily quotation periods, subsequently, the price series were deflated by the IPA-M based on March 2020. To analyze the data used in this research, Microsoft Office Excel was used, in which the price series were transformed into price return series by applying the equation:

$$r = \frac{(P_t - P_{t-1})}{(P_{t-1})} \quad (12)$$

where r is the price return, P_t is the price at time t and P_{t-1} is the price at time (t-1). Next, the statistical indicators of the price return series were obtained, and the VaR was calculated at the levels of 90%, 95% and 99%.

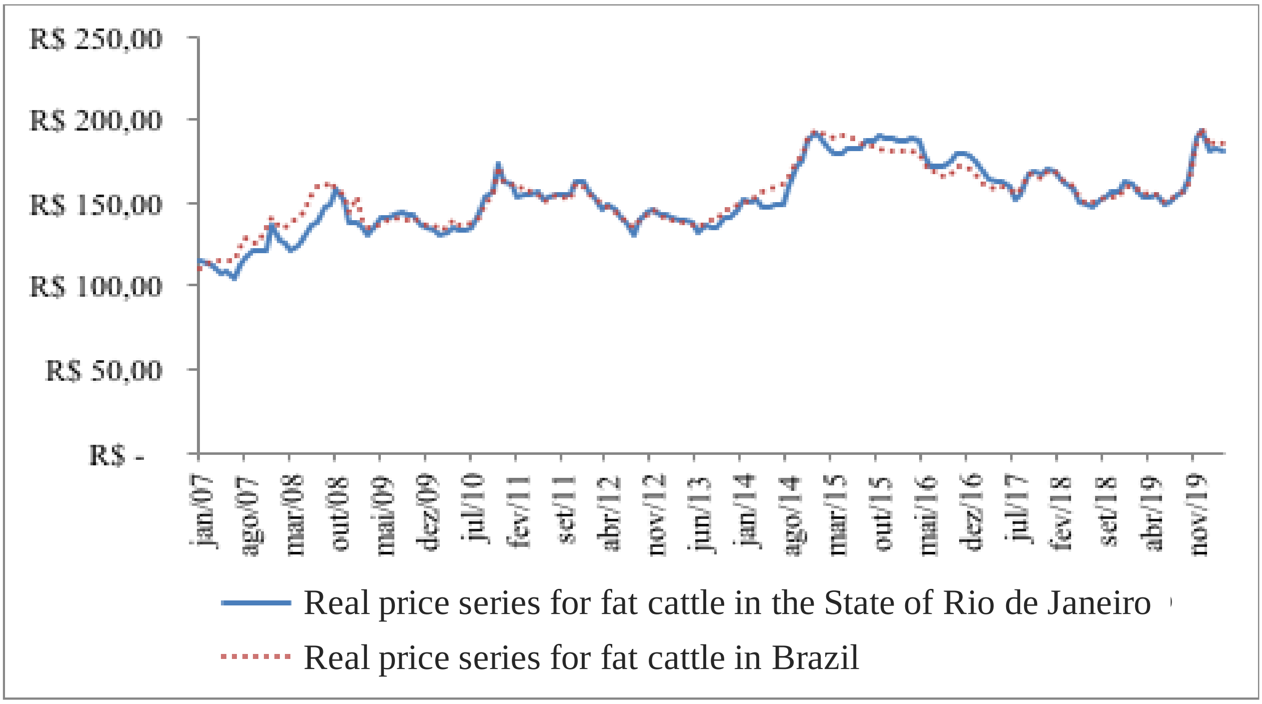
That said, given the robustness and size of the sample collected, it was decided to apply only the normal parametric and non-parametric historical simulation methods. However, the Monte Carlo method was not applied, as it falls into the same category of non-parametric historical simulation method, in addition to the higher cost of this method. However, this leaves a gap for future studies to investigate the effectiveness of the Monte Carlo method in research.

RESULTS AND DISCUSSION

Analysis of the Fat Cattle Price Series and Price Returns

To evaluate the market risks of the commodity under study in the state of Rio de Janeiro in relation to the Brazilian average, firstly, the real prices of fat cattle in the state of Rio de Janeiro were collected and plotted in Figure 6 and compared with the real prices of fat cattle in Brazil, referring to the period from January 2007 to March 2020.

Figure 6: Series Real Prices of Arroba of Fat Cattle in the State of Rio de Janeiro and in Brazil in the Period from January 2007 to March 2020.

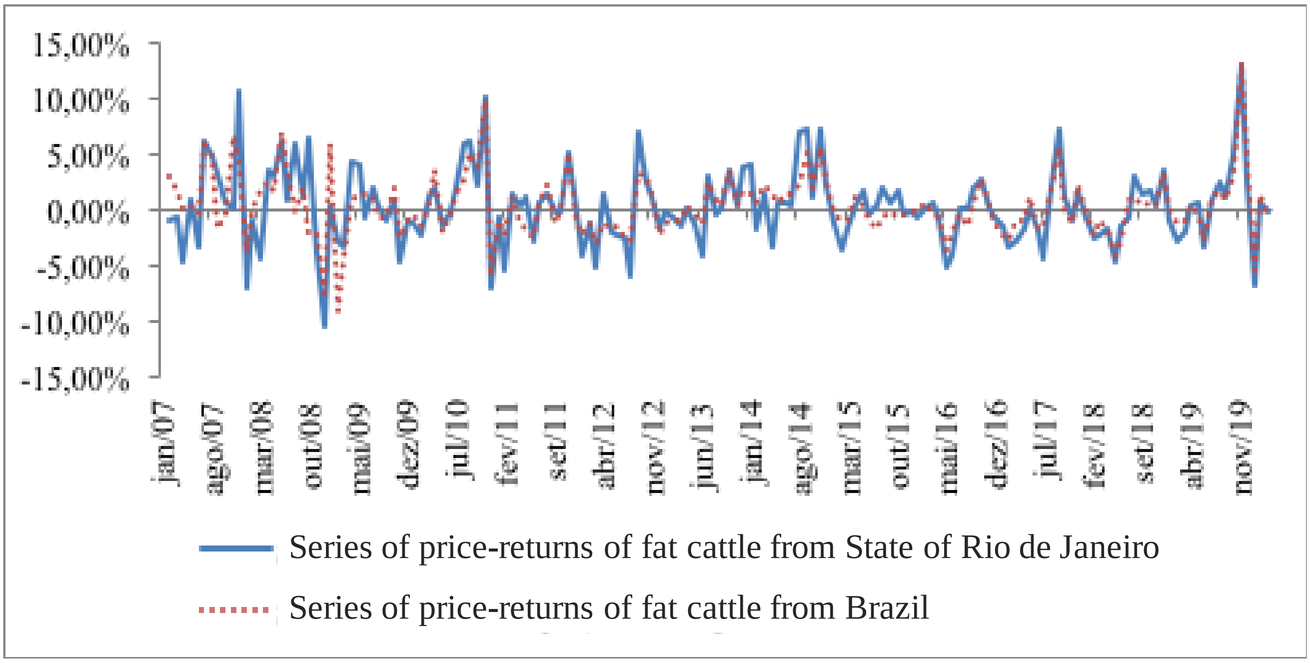


Source: Research Data.

Observing the figure above, the price series fluctuated, with a slight upward trend in the period, shifting from values close to BRL 100.00 at the beginning of the collected series and reaching values close to BRL 200.00 in March 2020, showing that the price of the ox had a real appreciation. There is a similarity in the configuration of the price curve in the state of Rio de Janeiro and the price curve in Brazil, with no strong disparities in the prices granted by both.

Using the real price series for fat cattle, shown in Figure 6, a series of returns on the price of fat cattle was obtained, which is shown in Figure 7.

Figure 7: Fat Cattle Price Return Series in the State of Rio de Janeiro and in Brazil in the Period from January 2007 to March 2020



Source: Research Data.

The statistical properties of the return series are presented in Table 1. The results show that the return series in Brazil had a maximum return value of 13.16% and a minimum return value of -9.12%, and the state of Rio de Janeiro had a maximum return value of 12.8% and a minimum return value of -10.36%. It was also noted that Brazil had a higher average price return, a lower standard deviation, and a lower coefficient of variation when compared to the indicators of the state of Rio de Janeiro. In this sense, there is evidence of a higher risk of loss for cattle ranchers in the state of Rio de Janeiro when compared to cattle ranchers from other states.

Table 1: Analysis of the Statistical Properties of the Fat Cattle Price Return Series, January 2007 to March 2020

Indicator	State of Rio de Janeiro	Brazil
Mean	0.231646	0.288165
Maximum	12.80000	13.16000
Minimum	-10.36000	-9.120000
Standard deviation	3.446227	2.844458
Coefficient of variation	1,487.7127	987.09351
Asymmetry	0.465907	0.701124
Kurtosis	4.415184	6.217672
Jarque-Bera	18.90090	81.10476
Probability	0.000079	0.000000

Source: Research Data.

Finally, it was found that the asymmetry and kurtosis values were very different from the values 0 and 3, which are necessary for the series to have a normal distribution. It can be verified by the Jarque-Bera test (JB), contained in Table 1, that the series of price returns are not normally distributed, and the null hypothesis of normality is rejected, since the calculated statistics of 18.90 and 81.10 were greater than the tabulated values of the chi-square statistic with 2 degrees of freedom, which is evidenced by the low p-value obtained.

According to Gujarati (2017), when the p-value (probability) of the calculated chi-square statistic is sufficiently low, close to zero, it means that the hypothesis of normality must be rejected. Therefore, due to this finding of non-normality in the distribution of the price return series, it was decided to estimate the VaR only by the non-parametric method of historical simulation, which does not require a predefined distribution of the series.

The results of the VaR estimates by the historical simulation method for the state of Rio de Janeiro are seen in Table 2, which presents in the first column the levels of statistical significance (90%, 95% and 99%) and in the other columns the cattle rancher's investment positions, which were 100 arrobas, 1,000 arrobas and 10,000 arrobas.

Table 2: Value-at-Risk (VaR) Obtained for the Return of Livestock Prices by the Historical Simulation Method, state of Rio de Janeiro, January 2007 to March 2020

Statistical significance	Investment		
	100 arrobas	1.000 arrobas	10.000 arrobas
90%	BRL 719.27	BRL 7,192.69	BRL 71,926.90
95%	BRL 873.27	BRL 8,732.68	BRL 87,326.81
99%	BRL 1,280.96	BRL 12,809.57	BRL 128,095.70
Market Value	BRL 18,140.90	BRL 181,409.00	BRL 1,814,090.00

Source: Research Data.

The risk values presented above show that a cattle rancher located in the state of Rio de Janeiro who owns 100 arrobas has, at March 2020 prices, an invested amount of BRL 18,140.90, being subject to a maximum loss of BRL 719.27, with 90% confidence. When the confidence level is 95% and 99%, the risk of financial losses increases to BRL 873.27 and BRL 1,280.96. Similar analyzes can be performed for the other investment positions of 1,000 arrobas and 10,000 arrobas.

The results of the VaR estimates referring to Brazil are presented in Table 3, containing the statistical significance levels of 90%, 95% and 99% and in the other columns the cattle rancher's investment positions in 100 arrobas, 1,000 arrobas and 10,000 arrobas.

Table 3: Value-at-Risk (VaR) Obtained for the Return of Livestock Prices by the Historical Simulation Method, Brazil, January 2007 to March 2020

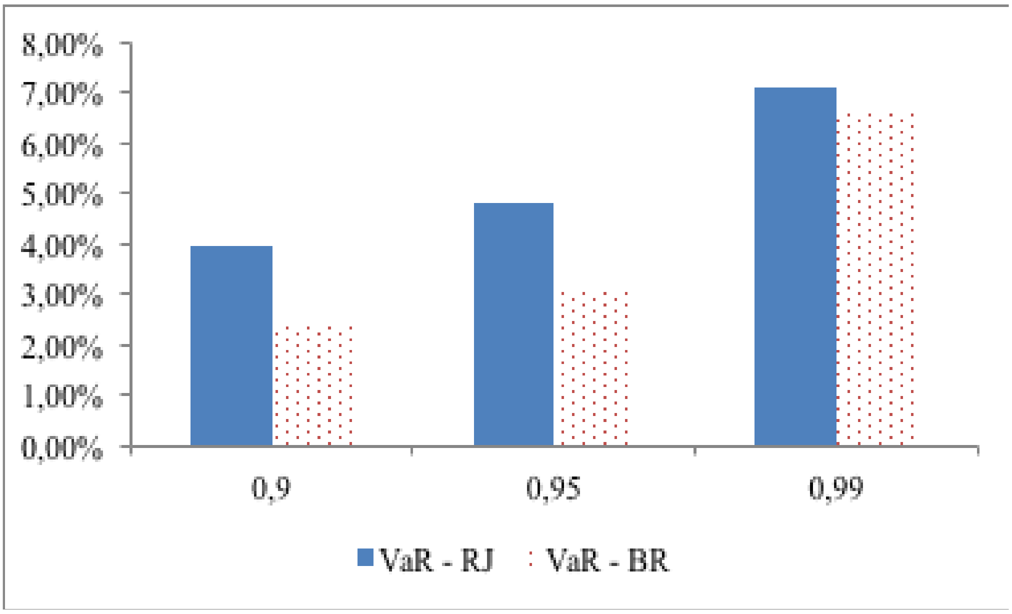
Statistical significance	Investment		
	100 arrobas	1.000 arrobas	10.000 arrobas
90%	BRL 441.02	BRL 4,410.25	BRL 44,102.46
95%	BRL 571.89	BRL 5,718.94	BRL 57,189.39
99%	BRL 1,232.55	BRL 12,325.51	BRL 123,255.14
Market Value	BRL 18,532.93	BRL 185,329.30	BRL 1,853,293.00

Source: Research Data.

In national terms (Table 3), when the rancher is invested in 100 arrobas, that is, in BRL 18,532.93, there is a 10% probability of loss greater than the value of BRL 441.02, 5% probability of loss be greater than the amount of BRL 571.89 in the month, and a 1% probability of the loss being greater than the amount of BRL 1,232.55. Considering the significance level of 95%, we can also interpret that in 100 days the estimated maximum loss for 95 days will be BRL 571.89 and in the remaining 5 days the loss may be greater than this BRL 571.89. Similar analyzes can be performed for other investment positions and confidence levels.

Figure 8 shows the Value-at-Risk (VaR) in percentage terms obtained by the historical simulation. It is evident that the cattle rancher located in the state of Rio de Janeiro is subject to a greater loss of investment than at the national level for all levels of statistical significance. For example, at a significance level of 95%, a cattle rancher located in the state of Rio de Janeiro has only a 5% probability of having a loss greater than 4.81% of the amount invested, while at a national level the loss would be a maximum of 3.09%.

Figure 8: Value at Risk (VaR) of Returns on Livestock Price Series in the State of Rio de Janeiro and Brazil, January 2007 to March 2020



Source: Research Data.

Finally, to verify the validation of VaR by the historical simulation method, back testing was applied to each series of returns. Thus, for each confidence interval, the limit of overshoots was calculated by multiplying the probability of losses in the period by the number of observations and then compared with the number of months in which there were overshoots greater than the limits accepted by the model.

For ranchers in the state of Rio de Janeiro and Brazil, it was found that at the 90% level of significance, the limit of losses greater than BRL 719.27 in Rio de Janeiro, and BRL 441.02 in Brazil, stipulated by the method was 15.7 months, but there were losses greater than these values in 16 months (Table 4).

Table 4: Backtesting of the Historical Simulation VaR Model

Statistical significance	Limit of losses accepted	losses > VAR-RJ	losses > VAR-BR
90%	15.7	16	16
95%	7.85	8	8
99%	1.57	2	2

Source: Research Data.

It is observed in Table 4 that for the 95% and 99% levels, the effective losses were also greater, however, close to the limit imposed by the significance level. According to Ando and Lopes (2010), cases like this, in which the total overshoot over the proposed period is very close to the calculated limit, must be continuously monitored over time to avoid losses not estimated by the model.

CONCLUSIONS

The proposal developed in this study is to analyze the level of risk that cattle ranchers in the state of Rio de Janeiro and Brazil face in the process of selling fat cattle, using the Value at Risk (VaR) metric as a tool in the period from January 2007 to March 2020 made it possible to detail the potential losses caused by fluctuations in the price of fat cattle and compare the risk of cattle ranchers from Rio de Janeiro in relation to the average risk of other cattle ranchers in Brazil.

Among the evaluated points, although there were fluctuations, there was a real increase in the price of fat cattle in the period analyzed both for the state of Rio de Janeiro and for Brazil. A smaller standard deviation was also observed in relation to the series of returns for Brazil in relation to the state of Rio de Janeiro, a factor that may explain this result is that the price in Brazil is the result of the weighted average price of all federal units , and the State of Rio de Janeiro itself is part of this composition.

Still checking the statistical properties, it was observed that Brazil has a higher average return than the state of Rio de Janeiro, associating that the state of Rio de Janeiro has only 0.6% of the production of fat cattle produced in Brazil, it can be considered that the The state of Rio de Janeiro is less efficient than other producing states, so it is important to carry out a study that allows evaluating the causes of this inefficiency compared to the other federative units.

As for the risk of Brazilian and Rio de Janeiro producers, it is concluded that the Brazilian producer has a lower risk of loss compared to the Rio de Janeiro producer, at all levels of significance, 90%, 95% and 99%. For example, given an investment in 100 arrobas from fat cattle, that is BRL 18,532.93 from the Brazilian producer, considering the safety levels of 90%, 95% and 99%, the maximum losses in a month for this producer were respectively BRL 441.02, BRL 571.89 and BRL 1,232.93, while for the producer from Rio de Janeiro the same 100 arrobas can represent, respectively, for the same significance levels, a maximum loss of BRL 719.27, BRL 873, 27 and BRL 1,280.96.

In this sense, the study allowed evaluating the VaR as risk analysis tool for cattle production, proving to be an effective tool when comparing the risks of Rio de Janeiro producers in relation to other national producers and thus making it possible to point out new studies that seek to improve the performance of local ranchers.

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