Analysis of the Value Added by Risk Management

Abstract: *The value of an asset is composed of a series of factors. When the volatility of these factors is high, the execution of a risk hedging strategy can add value to the company. This study aims to measure the value added by a risk hedging strategy that assures the creation of value each period, seeking to give subsidies to managers to decide if risk hedging is economically viable. Through a case study methodology of a beef industry investment, the real options concept was utilized in which the "hedge" is seen as an "insurance" of the asset company's value, using the creation of value proposed in the Ohlson model (1995) as a parameter. Results indicate that this strategy can add value to an investment, but this value depends on the level of risk to which the company is exposed, as well as the volatility of the factors affecting this value.*

***Key-words*:** Real *Options; Investment; Hedge, Value, Ohlson's Model*

1. Introduction and Justification

The beef industry is growing fast in Brazil and becoming more relevant to the agribusiness economy and total Brazilian GNP. A major component of this industry, cattle, is subject to price fluctuations that are common to other agricultural commodities due to individual production factors. Currently, since the international market is an important destination of a large share of the Brazilian production, volatility of the exchange rate can result in great losses in this business. In addition to these market factors, there are other risks related to environmental, sanitary and social issues that are made more apparent by a dependence on exports.

The interaction between risk and management must be considered in the beef sector, since there are mechanisms to help manage some of these risks. Regarding the market risk of the beef industry (cattle and beef prices and exchange rate), managers have the option of using hedge strategies (operational or financial) in order to minimize possible losses due to unsatisfactory market positioning. Although this strategy has an operational cost, it may help increase a company's value, thereby reducing the volatility of the cash flow, making it possible to access capital at a lower cost, and assuring that the company always has the possibility of substituting assets and new investments.

Since risk management is a factor in the creation of value in a company, it becomes necessary to measure the value added by this strategy and verify its viability, answering the following question: what is the value added by a risk hedging strategy, assuring creation of value for the shareholder? Thus, the objective of this article is to measure the value added by a risk hedging strategy in a case study using the real options theory. This research presents a methodology of analysis that aims to measure the added value of this risk hedging, assuring the creation of value each period. Consequently, managers were given subsidies to verify the viability of this strategy's

implementation. This methodology of analysis uses the real options concept, which in the hedge is seen as "insurance" over the value added during the year, using the creation of value proposed in the Ohlson model (1995) as a parameter.

The paper is organized as follows: Section 1 - Introduction and justification of the subject; Section 2 - Presentation of real options; Section 3 - Description of research methodology; Section 4 - Presentation of case study; Section 5 - Results; and, finally, Section 6 - Final considerations of the work.

2. Real Options Theory

The real options theory is an extension of the financial options theory. The fundaments of evaluating assets by real options consist in analyzing an asset as a set of real chances of actions, represented by the managerial flexibility of the company faced with new information regarding the future. In the work that originated the valuation of financial options, Black and Scholes (1973) showed that the value of a company could be called an option. Merton (1974) complemented this theory showing that the value of equity can be seen as a call option on the value of the company's assets.

In the real options theory, the shareholder has a residual right to the value of an asset after the corporate debt has been paid. If the value of the assets is greater than the debts owed (face value of the debt), these will be liquidated and the shareholders will have the right to the value of the assets that remain after payment of the debts. When the value of the assets is less than the face value of the debt, the shareholders have the option of relinquishing the shares to the bondholders and not receiving anything else. In other words, the loss is limited to zero since the minimum value of equity is zero. When this occurs there is an asymmetry in the probability distribution of the equity.

Considering that asset value of the company follows a random process, determined by the use of these assets, and that liabilities are composed solely for bonds that expire on the same date, the volatility of the elements of the balance sheet can thus be represented (Illustration 1):

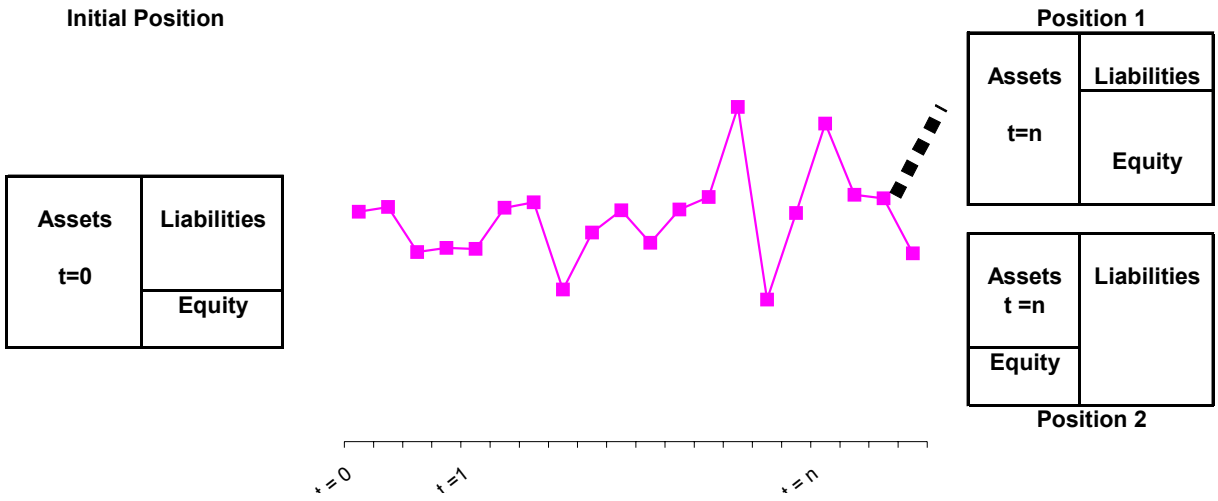

Illustration 1: Asset's volatility

The asset's volatility, as well as the characteristics of the debt value, determines the value of the equity in instant *n* of a bond's expiration. At position 1, shareholders exercise their option and pay the bondholders, having as "their residual right" the value of the equity.

At position 2, shareholders do not exercise their option to render their assets to the bondholders. Some models can price this option, such as the model of Black and Scholes (1973). Another model is a binomial model developed by Cox *et al.* (1979). This model uses a decision tree that incorporates concepts of the options theory in discrete time. Part of the idea is that the price of a share (or asset) is modeled according to a binary multiplicative random process. Initiating the process for an expected or observed value, the asset value moves in upward or downward movements at fixed intervals of time. This process is repeated at successive intervals, generating a binomial tree.

The occurrence of asset (S) with upward (u) and downward (d) movements is conditional to the probabilities of up p and down $1-p$ of this asset, where u and d represent rates of increase or decrease in the price of the asset: $u = 1 + i_u$ and $d = 1 + i_d$. In this way pricing of option (C), dependent on underlying asset (S) and its exercised price (X), is represented in Illustration 2:

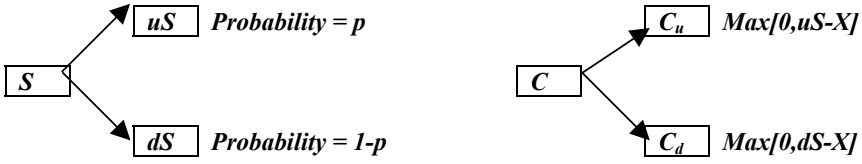

Illustration 2: Option Pricing - Binomial Model

As the model works within the concept of a risk neutral world, probability *p* is simplified using a factor *q*, calculated in function of the risk free rate (*r*) and upward (*u*) and downward (*d*) movements of the asset. This factor *q* is always a number between zero and one, therefore it has similar properties of probability in a risk free world; however, it is not exactly the probability of the asset movement.

With ***n*** periods, the multiplicative binomial option pricing formula would be:

$$C = \frac{\sum_{j=0}^{n} \frac{n!}{j!(n-j)!} q^{j} (1-q)^{n-j} \max(u^{j} d^{n-j} S - X, 0)}{(1+r)^{n}}$$

Considering that the duration of each period can be very small, tending to the infinite, a continuous time process (τ) can be approached. Within this limit, with a number of periods (*n*) tending toward infinite, the binomial distribution comes close to the lognormal, and the asset follows a *Wiener* process. In this way, values of (*u*) and (*d*) in continuous time, calculated from the asset's volatility (σ) would be: $u = e^{\sigma\sqrt{\tau}}$ and *d = 1/d*, and the risk neutral factor *q* in continuous time is given by $q = \frac{e^{r\tau} - d}{u - d}$.

This extension of the use of the options theory, considering equity as an option on the company assets has been employed in some works: to price different species of company bonds (Barth *et al*., 2000), to estimate the cost of subordination of company financial debt established for the current Brazilian law of bankruptcies (SECURATO et al., 2004), to estimate the probability of bankruptcy (HILLEGEIST et al., 2004), to estimate the effect of default risk on a firm's investment and financing decisions (RENDLEMAN Jr, 1978; TRIGEORGIS, 1993b), and in valuation using the sector's volatility (PERERA; SECURATO, 2004).

Extending the options approach even more, Carter *et al.* (2003) illustrated that a hedging strategy can be seen as a real option, since it enables the company to exploit favorable movements of an asset and to minimize adverse movements of the same. These authors studied the currency risk exposition of American multinationals and concluded that a majority of the companies studied have asymmetrical currency expositions, causing an effect similar to that of real option.

Regarding risk management, Damodaran (2005) stated that a risk hedging strategy is equivalent to a company buying a put option against specific eventualities, and that this strategy can increase a firm's value. Consequently, it is possible to price the risk hedging strategy in the beef industry, considering the slaughterhouse's asset volatility, and verify its viability. This hedging strategy will be analyzed as a put option on the assets of the slaughterhouse, having as exercise price the

minimum value of the equity evaluated by the opportunity cost of capital, following the concept of shareholder's value creation, which will be explored in topic 4 of this paper.

3. Research Methodology

The present research utilized a single incorporated case study, as suggested by Yin (2001). For that reason, a slaughterhouse plant in the installation phase was selected in the central northern region of Brazil. Specific criteria were followed in the selection of the company, given that a certain economic-financial profile was desired, and investors had to be willing to disclose confidential and strategic information for the research.

To guarantee the reliability of the methodology, a protocol was constructed to orient the researcher during the study, as suggested by Yin (2001, p.89). This protocol consisted of the guiding questions of the study, divided into five distinct blocks: investment characteristics, business operational profile, business financial profile, market, and business risks and opportunities. Each block contained a distinct group of questions which were put to key respondents, being: project investors, operational managers, financial executives, and general executives of other slaughterhouse plants, traders and market researchers.

In this way, an attempt was made to analyze information from diverse sources to include different perceptions of beef production and commercialization, in hopes of minimizing any personal biases. Likewise, numerical data regarding this business was also sought in different public information sources in order to contrast the perceptions obtained.

4. Case Presentation

The case in question deals with a slaughterhouse plant in the construction phase, in the state of Mato Grosso, Brazil. This plant was set up by a group of rural producers as a co-op, in which the capital required for the project originates from the co-op members. The basic objective of this refrigeration plant was the slaughter and deboning of beef cattle, primarily for export. The project was at the initial study phase, and the identity of the company representing the project will be maintained confidential, in agreement with the investors' wishes.

It is known that this type of business is exposed to macroeconomic, sectorial and private factors. All of which can be considered as factors of risk in this sector (beef industry). De Zen (2005) groups risk in the beef industry as follows: financial and accounting risks, related to the management of these companies; risk of cattle and meat prices; environmental and sanitary risks, as well as social risks.

Some of the abovementioned risks can be managed by the company. Pacifico (2005) shows that risk management propitiates that the financial results of the company are more informative about

the managerial ability of a company, therefore making it possible to minimize the effect of market volatility.

In the present work, only market risks which managers can identify and establish management policies to reach the enterprise objectives are considered, such as:

- **Risk of input prices**

The risk of input prices in a slaughterhouse is caused by a set of factors which are basically reflected in the final price of input (cattle). Determination of the internal prices of cattle in each region of Brazil depends on conditions linked to the demand and offer of animals to be slaughtered. This market operates under competition conditions (MILLER, 1987 *apud* DE ZEN, 1997).

In order to determine the behavior of a commodity's price, one must first calculate its volatility. Commodity volatility represents the standard deviation of the change in value of a commodity, expressed as a percentage, for a period of predetermined time (SILVA NETO, 1996, p.154). As it is impossible to determine the future volatility of an asset, historical volatility is used to forecast prices. To determine the effect of the volatility of cattle, the historical prices-day data negotiated in Cuiabá (MT) between January/2001 and May/2005 (CEPEA/ESALQ/USP) was chosen to calculate monthly variation. Since the option pricing model uses continuous rates, daily volatility is determined by (HULL, 2003, P. 254):

$$u_i = ln\ (S_i/S_{i-1})$$

in which:

u_i : compound continuous return

S_i : asset price at end of i^{th} interval (i=0,1,.....n)

Applying the above equation results in mean μ = 0.026% per day and volatility σ = 0.49, which corresponds to σ =2.3% per month and σ = 7.8% per year. Transformation of volatility for the desired period is given by:

$$vol = \sigma\sqrt{\tau}$$

Where: σ is the daily volatility of u_i, and τ is the desired time in days.

- **Risk of output price**

In the same way, using the historical beef prices day data (CEPEA/ESALQ/USP), it is possible to calculate historical volatility of prices and to use this volatility for future projections. Since the volatility of prices vary for each beef cut, it is necessary to average the effect of volatility in a slaughterhouse's revenue. In the present case study, the weighed estimate of volatility is σ = 14% per year.

The beef price risk does not have to be seen as an isolated risk in the determination of the slaughterhouse's cash flow. In testing the efficiency of this market, De Zen (1997) verified a bi-

causal effect between the price of cattle that of beef. In other words, it is not possible to determine whether beef affects the price of cattle or vice versa. Variations in the price of beef are followed by variations in the price of cattle. In other words, there is a positive correlation between the two; however, this correlation is not perfect. At times, there is a decrease in the price of beef and an increase in the price of cattle, due to the different agents of offer and demand acting in both. To verify the correlation of cattle and beef prices, monthly prices for each were obtained from April 2002 to April 2005. The resulting correlation index of 85% (Pearson's index, significance 1%) suggests a high level of correlation. However, at times when only the price of cattle was considered the contribution margin of the slaughterhouse narrowed considerably and even became negative at times. This is one of the relevant aspects of the financial management of this business, in which instability of the margins and consequently cash flow increases the level of business risk.

- **Exchange Rate Risk**

Although the average price of beef exports remains steady, there is a loss of real income, due to the recent valuation of the Brazilian currency. This occurrence illustrates that this economic factor must be seen as a risk factor in slaughterhouse management.

According to Brandão (2002), the recent evolution in Brazil's exchange rate can be divided into distinct periods. One begins before the beginning of the Real Plan in 1994 and continues until January 1999. Another begins after this period with the release of the exchange rate by the Central bank.

So, to estimate the historical volatility of the dollar, we used historical dollar end-of-day data from January 1999 to June 2005. The beginning of this period in 1999 was chosen, due to the alteration of the regimen of exchange to floating platform. Observed volatility was $\sigma = 17.9\%$ a year.

The commercialization margin, which is narrow, also becomes volatile with addition of the abovementioned risks. Big groups of this sector have invested in the formation of market financial team which follows each negotiation, making hedge (protection) in the financial and future markets. These procedures aim to guarantee an edge of constant commercialization and less frightening variation in the cash flow, thereby protecting the capacity of payment of the business. The history of the Brazilian beef industry is full of examples of companies that did not manage to surpass unexpected events.

Observing the firm's market value under the accounting concepts, it represents the shareholder's invested value (book value) plus the future expected earnings discounted by the cost of capital. This perception of the company's value under the accounting concepts was developed by Ohlson (1995), where the equation of a company's value is:

$$V_t = b_t + \sum_{\tau=1}^{\infty} R^{-\tau} E_\tau \left(x_{1+\tau}^{\partial} \right)$$

Where:

b: book value

R: interest rate

E: expect value

$x_{1+\tau}^{\alpha}$: Future abnormal earnings

This relation between a company's value, book value, earnings and dividends can be observed when the clean surplus relation is adopted, that specifies that the book value (B_t) is only modified by the earnings (X_t) and dividends (D_t) (PREINREINCH, 1938 apud BIDDLE et al., 2001), according to the equation:

$$B_t = B_{t-1} + X_t - D_t$$

Concerning risk management and analyzing the company's value according to Ohlson's model, we can infer that in order to maintain the company's value the demanded minimum earnings in each period *t* must be equal to the cost of capital ($B_{t+1} = r\ B_t$). Therefore, the company's book value in period ($t+1$), with no distribution of dividends, in order to keep only the capital invested, must be: $B_{t+1} = B_t + r\ B_t$.

Black and Scholes (1973) and Merton (1974) stated that the equity can be considered a call option on the asset's value, since this has a residual value on the asset after the company's debts are settled. As the asset follows a random process according to its volatility, the book value (B) is determined in function of the asset's value, having as strike price the face value of the debt. In this way, the value of B_{t+1} will depend on the assets' value at instant $t+1$.

Based on these objectives, in companies where the asset present high volatility, the value of B_{t+1} can be in price or not of the value's creation conditions established above. In this context, the managers must understand this volatility and establish policies and actions on the value drivers, in order to preserve the objective of value creation in that business.

5. Results and Discussions

Risk management in the company under study should take into account the parameter of value creation described above. Consequently, knowledge about the initial and possible future book value in a one year period is necessary. As already presented, the company is subjected to risk factors that compromise its margins, causing high volatility in its asset.

The initial investment (100% shareholder's capital) is R$ 17 million for slaughter of 600 heads/day, which can be expanded to 1,000 heads/day with additional investment. The book value in one year will depend on the asset value at that time.

Knowing the asset value at instant *t=0*, it is possible to shape the random distribution of this asset as a Geometric Brownian Motion (GBM), through a binomial model, considering the asset's volatility to determine upward *(u)* or downward *(d)* movements. Construction of the asset's binomial lattice is made by a multiplicative process, where in each period the underlying asset (*S*) (in this case represented by the company's asset value) can increase to S_u or decrease to S_d.

As the analyzed case is still a slaughterhouse's investment project, the asset is represented in this investment project. Thus, it is necessary to know the level of risk, given the volatility of the cash flow according to the variable's stochastic process. In this case, volatility is determined by simulation of random return's project movement: $d \ln V = \nu dt + \sigma dz$. According to Brandão (2002), the random variable of this return rate ($\tilde{y}$) is determined by the equation:

$$\tilde{y} = \ln\left(\frac{\tilde{V}_1}{V_0}\right)$$

Where the V_0 parameter is the project value calculated by the Net Present Value (NPV) method without alterations, and $\tilde{V}_1$ is the value of the project in the next period, considering the combination of alterations in the risk variables that act on the project's cash flow. After enough iterations, it is possible to determine the project's volatility, that is, the return's standard deviation (σ), which will be used in the construction of the asset's binomial lattice. For this, the project's cash flow was projected over the next six years. The cost of capital used in the model was 16.4%, which was estimated through the Capital Asset Price Model (CAPM). Volatilities of risk factors (cattle price, beef price, exchange rate) were also employed in the simulation model.

Values were simulated twice with 10,000 iterations each, and once with 50,000 iterations, utilizing @RISK software. Volatility was nearly 73% per year, which differs from the volatility of each isolated variable (beef - 14%, cattle - 7.8%, exchange rate - 17.9%), showing that the combination of risks is not related to the isolated risks.

Considering this volatility on a monthly basis, it is possible to determine the values of *(u)* and *(d)*, that will determine the upward and downward movements of the asset. These movements are given by: $u = e^{\sigma\sqrt{\tau}}$. With volatility of 73% per year, monthly values would be *u*= 1.2346 and *d*= 0.81. With this in mind, a binomial lattice of the asset's value over a 12 month period is shown in illustration 3.

Months	0	1	2	3	.....	12
R$ - thousand	17,045	21,043	25,980	32,074	.....	213,717
		13,806	17,045	21,043	.....	140,216
			11,183	13,806	.....	91,994
				9,058	.....	60,356
					.....	39,598
					.....	25,980
					.....	17,045
					.....	11,183
					.....	7,337
					.....	4,814
					.....	3,158
					.....	2,072
					.....	1,359

Illustration 3: Binomial Lattice of Asset Value

We see that, due to its high volatility, the asset can reach between R$ 213.7 and R$ 1.4 million after 12 months. Since the company analyzed in the present case study does not have the book value of the asset, it was determined according to the balance sheet equation: Assets = Liabilities + Equity. It is important to note that this analysis takes clean surplus relation into account, in which the value of equity is only modified by earnings and dividends.

For a company that neither creates nor destroys value, the book value in each subsequent period must be: B_{t+1} $B_t + r\ B_t$. In the binomial lattice represented in illustration 3, this value can easily surpass the expectations proposed in this equation, or be very low of the expected minimum. In the present study, initial value of equity is R$ 17.0 million, which represents the initial investment. Considering the cost of capital to be 16.4% per year, the value of B_{t+1} should be at least R$ 19.8 million.

Slaughterhouse management is a dynamic process, where an active management can improve results and minimize losses. Managers have the option of hedging prices, thereby assuring a return on investment. According to Carter *et al.* (2003), the result of a hedge position to the exposition of determined risk has an asymmetrical effect on the asset value's probability distribution, causing a result similar to that of real options. Consequently, it is possible to determine the value of risk management using the real options concept.

The equity (E) valuation concept considered in the Black and Scholes' model (1973) and Merton (1974) can be seen as a call option on the asset's value with the exercise price being the debt's face value (X). For the accounting equation, the value of the debt (D) and equity (E) is determined in function of the underlying asset at any instant (t) and debt face value (X) (Illustration 4).

A	$D = min\{S,X\}$
	$E = max\{(S-X),0\}$

Illustration 4 : Options on the accounting equation

As the analyzed company does not possess debts (D=0), *then* $E=Max\{(S-0),0\} =S$, therefore, at any instant *(t)*, the value of the equity will be the same as that of the asset ($A=E$). To guarantee the maintenance of the company's value at instant $t+1$, E must be: $B_{t+1} = B_t + r\,B_t$. Assuming that the company can be protected by hedging (H), the value of this protection would be thus represented:

- When $S > B_t + r\,B_t \rightarrow H = max\{(B_t + r\,B_t) - S);0\} = 0$
- When $S = B_t + r\,B_t \rightarrow H = max\{(B_t + r\,B_t) - S);0\} = 0$
- When $S < B_t + r\,B_t \rightarrow H = max\{(B_t + r\,B_t) - S);0\} = B_t + r\,B_t$

In the same way, equity (E) at instant $t+1$ would be:

- When $S > B_t + r\,B_t \rightarrow E = max\{S, (B_t + r\,B_t)\} = S$
- When $S = B_t + r\,B_t \rightarrow E = max\{S, (B_t + r\,B_t)\} = S$
- When $S < B_t + r\,B_t \rightarrow E = max\{S, (B_t + r\,B_t)\} = B_t + r\,B_t$

This protection may give the company an option that guarantees the equity value at instant $t+1$ as a value that at least remunerates the shareholders' capital, that is, this option may only be exercised when the asset's value is less than the invested capital remunerated by a cost opportunity rate. In this way, it is possible to determine the value of the "premium" of this hedge, using a pricing option model, which is considered the value of a option. In the latter, the exercise price (X) is given by the condition of maintaining the company value, $B_{t+1} = B_t + r\,B_t$. The characteristics of this option are shown in Figure 1.

To clarify these ideas, it is necessary, at first, to define the underlying asset. In this case, the underlying asset is the value of the slaughterhouse asset, which suffer alterations according to their volatility (Illustration 3). Thus, investors hold the underlying asset and desire to have an option that guarantees a minimum value for this asset in one year. This option (H) will only be exercised if the underlying asset is less than the value of the investment capitalized by the cost opportunity rate. A relation of the earnings in these positions is shown in Illustration 5.

Payoff Diagram for Risk Hedging

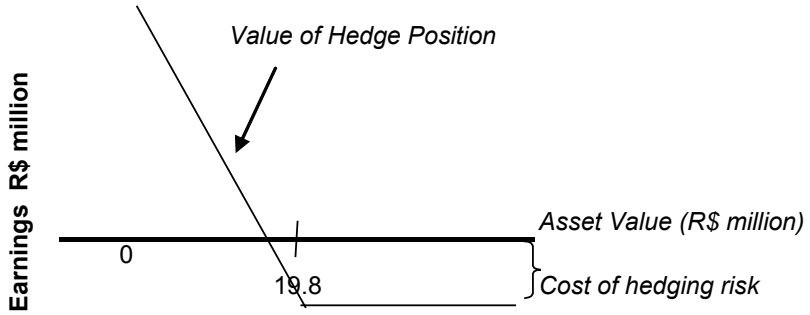

Illustration 5: Shareholder Position
Adapted from Damodaram; 2005, p. 42

As shown, the option generates positive results for the investor when the asset's value does not reach the minimum expected by the investor, that is, when the value of the asset is below R$ 19. 8 million. What is intended to evaluate here is the value of the premium to be paid to get the return of the option, represented by the value added by this hedge strategy. While the cost of this strategy will be less than the premium generated, the company will be adding value while using the asset.

In fact, a hedge strategy has a similar effect as insurance. In other words, the company acquires the right of "selling" its asset in the future for the exercise price, represented here as the value of the investment capitalized by the cost opportunity rate. This type of strategy is present in some investment funds that guarantee the investor a minimum return. If this minimum return is unsatisfactory, the investor needs to analyze if the cost of this "insurance" on the investment compensates for minimizing future losses. Therefore, it can be inferred that the value of this prize is analogous to a put option, and its characteristics are shown in Figure 1.

Figure 1 – Option Characteristics

Put option - Hedge	
Strike Price (X)	$B_t + r\ B_t$
Underlying Asset (S)	Asset value at time t
Time to expiration of the option (t)	1 year

The optimum decision in each period must take into account the comparison between the asset value at instant *t (S)* with the minimum value demanded by the shareholders:

$$Option\ Value = Max\ \{((B_t + r\ B_t) - S),\ 0\}$$

Where, S = asset value in a Binomial Lattice (Illustration 3).

Given that the admitted minimum value for B_{t+1} is R$ 19.8 million, in all points of the binomial lattice where $S < 19.8$ the option is "in the money". In this way, admitting a risk free rate of 9.75% (Brazilian Long Term Interest Rate), and using the binomial pricing option model, it is possible to estimate the risk-neutral probability *(q)* in function of *(u)* and *(d)*, and to calculate the value of the option's premium. With probability $q = 46.7\%$, the option's value is R$ 5.5 million.

This value represents 32.6% of the initial investment. This indicates that the company can assume the hedge strategy's cost up to 32.6% of its initial investment in operational assets, to guarantee a return of 16.4% on this investment. If the cost surpasses R$ 5.5 million, risk management is not viable.

The cost of implementing this strategy was not considered in the initial investment. Considering that this cost was equal to the value of the premium (R$ 5.5 million), the initial investment would increase from R$ 17 million to R$ 22.5 million. The expected value of the asset can be compared under the two conditions: with and without a hedge.

It is difficult to estimate the real probability of each event in the binomial lattice. Accordingly, it is difficult to arrive at an estimate of expected value of the asset. For the option pricing, probability was estimated as neutral risk (q) in function of (u) and (d). In fact, this probability is a supposition of the binomial pricing model, in which the investor is indifferent to risk, making it possible to price the options. Whereas to price one asset, this idea of a risk neutral world is not possible; therefore, it is necessary to calculate the real probability (p) of the binomial lattice (Illustration 3). This probability can be estimated in function of the volatility of the asset, and the upward *(u)* and downward *(d)* movements of the asset, according to the following equation[i]:

$$\sigma^2 = A_0{}^2 \left[\left(u^2 p + d^2 (1-p) \right)^n - \left(up + d(1-p) \right)^{2n} \right]$$

Where:

A_0, is the asset value at the moment $t=0$;

n is the number of periods

σ^2= asset variance

Using this equation and n=12, the real probability of occurrence is 42% for upward movements and (1 - 0.42) for downward movements. Inserting this probability in the binomial lattice, it is possible to calculate the expected value of the asset in one year. Table 1 demonstrates this calculation, using constant numbers at moment t = 12 of the binomial lattice (Illustration 3).

Table 1 : Asset's Expected Value

S	*S-Hedge*	*P(X)*	*V[E]*	*V[E] - Hedge*
213,717	213,717	0.00	6	6
140,216	140,216	0.00	70	70
91,994	91,994	0.00	349	349
60,356	60,356	0.02	1,054	1,054
39,598	39,598	0.05	2,148	2,148
25,980	25,980	0.12	3,113	3,113
17,045	19,840	0.19	3,291	3,831
11,183	19,840	0.23	2,556	4,534
7,337	19,840	0.20	1,447	3,914
4,814	19,840	0.12	583	2,402
3,158	19,840	0.05	158	995
2,072	19,840	0.01	26	250
1,359	19,840	0.00	2	29
Expected Value -R$ Million			**14,803**	**22,695**

The expected values of the asset, already weighed for the probability, consist of the last two columns of Table 1. If the company does not use a hedge strategy, the probability of a downward movement is greater than that of an upward one. The expected value in one year is R$ 14.8 million, whereas with the hedge strategy, this value reaches R$ 22.7 million.

The return on an initial investment without hedging (R$ 17 million) and with hedging (R$ 22.5 million) is -13.45% and +4.2%, respectively. Therefore, a hedge strategy can be more worthwhile than not hedging.

It is necessary point out that the value added by hedging depends as much on the project's volatility as on the cost of capital rate. Since the present study considered three types of risk (beef prices, cattle prices and exchange rate), we decided to include calculations of the value of hedging considering these risks in combination and isolation. The value of an option's premium was calculated correlating or not beef and cattle prices and considering or not the exchange rate (Table 2).

Table 2 : Risk Scenarios Analysis

Scenarios	***Volatility %***	***Premium – R$ Thousand***	***% do Initial investment***
1.Risk factors – correlating beef and cattle prices	25%	2,222	13%
2. Risk factors – non-correlating beef and cattle prices	73%	5,557	32.6%
3. Risk factors – only exchange rate	87.7%	6,490	38.1%
4 . Risk factors – non-correlating beef and cattle prices plus exchange rate	102.6%	7,400	43.4%

In a slaughterhouse which only operates in the national market, with input and output traded on the same day, a risk management strategy would add a value of R$ 2.2 million a year. Whereas in a company where the flow of operations in the national market does not have a "perfect arrangement" and it is also not possible to charge all of input's price variations to the beef prices, a hedge strategy would correspond to R$ 5.5 million annually, representing 32.6% of the initial investment.

For a company that is only subjected to the exchange risk, a hedge strategy would add R$ 6.5 million to the value of the company. In cases in which the company is subject to three non-correlated risk factors, a hedge strategy would add R$ 7.4 million. The decision to implement a hedge strategy must compare the value added by this strategy with the cost of its implementation under each scenario.

6. Final considerations

In the present work, we tried to analyze the decision to implement or not a risk management strategy through the analysis of value added in a beef industry, using a case study method. Risk management can add value to a business. Several authors, including Smith and Williams (1991); Bartram (2002); Kimura (2002) and Kimura and Perera (2005), have presented some advantages of risk management.

Using the concept considered in Ohlson's model (1995), a company adds value when it expects to generate future abnormal earnings. So, it was possible to establish a criterion to evaluate the effect of a hedge strategy on market risks. Within this criterion, a minimum value was established for the final equity of each period satisfying the condition of no value destruction.

By the theory of pricing contingent assets proposed by Black and Scholes (1973) and Merton (1973), equity value can be seen as an "option" on the asset value with the exercise price being the face value of the debt. With this concept, it is possible to determine the value added by a protection strategy, considering the exercise price to be the minimum value of the equity at the end of the period that satisfies the above value added condition. Using the binomial model, the value added by this strategy was R$ 5.5 million.

The company must evaluate the value of the hedge strategy, comparing it with the cost and efficiency of available hedge instruments. Complementing this analysis, the expected return in one year of a hedged company can be superior to that of a company that operates without any type of protection, given the real probabilities of upward and downward movements of an asset's value. In

the presented case, the expected return of a company without hedging would be -13.15% and with hedging 4.2%.

The methodology presented can also be applied to companies in operation, in order to estimate what would be the value added by a hedging strategy to protect against market risk. For this, it would also be necessary to adapt the conditions of capital structure and estimation of the asset's volatility.

Despite these limitations, the present work can contribute to the development of a methodology. This allows estimating the value added by a management risk strategy; given parameters that can help managers evaluate a strategy's viability. Intuitively the market already recognized that this strategy added value; as the present work has shown, it is possible to estimate this value and give more subsidies to managers.

[i] According classes' notes of "Pricing Financial Assets" – Professor : José Roberto Securato – 2004

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