

Protection with Agricultural Futures Contracts in Uncertain Environments: An Approach for Soy and Coffee on the Brazilian Stock Exchange

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Abstract:

The present study aimed to analyze different scenarios aiming at optimizing gains in the operation with agricultural futures traded on the Brazilian Stock Exchange, in the study in question soy and coffee were taken as the object of study. In the Brazilian scenario, commodities account for 71% of exports to the agricultural sector. Using the theoretical approach, it was considered in the study the hedge strategy with agricultural futures, before such, through the study contribute to the various decision making that the agricultural producer can take in situations of uncertainty. The results indicate that products with high volatility linked to the foreign currency (dollar) quotation are liable for the realization of this strategy, whenever the producer wants to protect himself against the loss of purchasing power of the local currency and, because the greater demand for these products is the international market.

Keywords —Futures market; hedge operation, agricultural products, Brazilian market.

I. INTRODUCTION

Brazil is one of the biggest food producers in the world, and it’ agricultural business represented 21.4% of the total country GDP in 2019 [1]. The country is the biggest global exporter of sugar, coffee and orange juice, such as bovine meat, pork meat and chicken meat. Moreover, Brazil is the second global exporter of soybean and corn [2]. Furthermore, the country is one of the biggest exporters of agricultural products, and the coffee is the most important [3],[4].

Due the importance of Brazil as a global food supplier, amid the context of the pandemic, the country reported record numbers in grain production, mainly. According to the National Supply Company – Conab [5], Brazil recorded a record in the 2019/2020 grain harvest, with 253.7

million tons, being the largest producers of soy, coffee and corn, mainly. The Mapa[1], corroborates saying that due to this scenario, exports grew, mainly linked to a factor called “China”. Silva and Arevalo [6], report in their study (involving the crisis caused by COVID-19) that soy and beef proved to be an essential product, unlike corn.

However, the crisis caused by COVID, brought stress to the financial market which caused the loss of market value of several products¹. Also, due price volatility, future uncertainty while short-term trading and / or pricing has become difficult. In agricultural products, such as soybeans and coffee,

¹ Since the first months of the pandemic, it was known that the crisis provoked by the COVID-19 would be severe; and impacts caused by it would be an economic and a sanitary calamity [8].

short-term operations are more usual from the point of view of the producer, which aims to guarantee a price with a level of safety margin. This context reinforces the importance of operating in the future market in uncertain environments, which justifies the proposed study.

On the Brazilian stock exchange, the products under study, which are soy and coffee, are products traded in Dollars. In other words, the Brazilian market is a price taker and the accounts are strongly influenced by the NYBOT stock exchange for coffee and CBOT for soybean. Thus, the study takes as a premise of discussion that products with high price volatility are liabilities for options trading on futures since they offer greater liquidity unlike other commodities that are traded in domestic currency. In view of this, the strategy of the producer analyzing scenarios aiming at the optimization of resources is essential.

II. BRAZILIAN AGRARIAN CONTEXTS

Is important to highlight that the Commodities are goods that are in force without undergoing alteration processes, produced on large scales, and that can be stored for a long period, such as: coffee, soybean, corn and others. The Commodities defined as agricultural products, which do not pass by industrial process, they generally are raw material [7].

In the Commodities' global market, Brazil is an important player. According to the Agrostat's indicators (2020), the Brazilians exportations from agribusiness per product reached significant values for the country GDP; the destinations of the Brazilians' agricultural products are: China (37.96%), European Union (16.17%) and United States (6.09%). China, the biggest buyer of soy from Brazil, in the first half of 2020, the country bought about 43.3 million tons of soy [2]; on the other hand, the United States had an increase in the 2019/2020 harvest 16.67 million tons, and the exports of the old harvest was maintained at 44.91 million tons[9].

According to Comexstat[10], soybean exports totaled 13.750 million tons in June 2020, an increase of 60.8% over the same period last year,

8.552 million tons. The soybean market in Brazil is heavily influenced by the soybean market traded on the Chicago Stock Exchange (CBOT). Due to this relationship, it is possible to set up purchase and sale operations (arbitration) between the Brazil soy contracts (SFI) and the Chicago soy mirror contract (SFC), both traded on B3 [11]. However, the contracts aim to neutralize and / or protect the producer from the risk of price fluctuations, thus, the participants avoid the market risk, as a producer, industry, among others [11]. With the technical characteristics of an SFI trading code, soybeans, the contract size index is around 450 bags of 60kg net, approximately 27 tons, with a price of US\$ 0.01.

In the report of the Council of Coffee Exporters of Brazil - Cecafe[12], Brazil exported around 3.3 million bags of coffee in August of that year, considering the calculations of green, soluble and roasted and ground coffee. However, exports generated US\$ 386.6 million, corresponding to approximately R\$ 2.1 billion, which shows a growth of 25.2% above the previous year in August 2019. In relation to the main destinations for Brazilian coffee, these are the USA with 18.5%, which imported 4.9 million coffee crops; Germany with 17%, which imported 4.5 million crops; Italy with 7.6%, which imported 2 million bags; Belgium with 7.3% who also imported 2 million bags and Japan with 5.1% with imports of 1.3 million bags[12].

In the first half of 2020, corn had a large fall corresponding to 61.5%[13]. However, shipments are recovering in the second half of 2020. Corn exports gained 2 million tons in the second half of the year, from 332.8 thousand tons in August 2019 to 408.5 thousand tons in the five working days of August[13]. With the main importers of corn with Taiwan with 24%, Japan with 13%, Iran with 11%, Vietnam with 9.5% and Egypt with 8.4% [10].

A proposal of the Markowitz model [14] is to present the idea of the portfolio to the investor to diversify their investments in the investment portfolio, showing the idea of reducing the risks in the assets and increasing the return, being able to leave an option to the investor to optimize their asset portfolio[15]; [16]. Therefore, the Capital Asset Price Model - CAPM, which presents the

expected returns of a certain asset and uses the Beta coefficient (β) as a measure to prevent the systemic risk of the portfolio [17].

III. FUTURES MARKET – COMMODITIES

The futures market is basically a negotiation to buy and sell a certain asset, establishing a future date, for delivery to a defined location at a certain price [18];[19]. Many strategies are used by investors to reduce their risks, such as: risk profiles, protection of profits (hedge), fixed income (low risk) and speculative (high risk) [18]; [20].

In the agricultural context, due to the price risk, the climatic factors that affect the planting period and the sale of the product, fluctuations bring concern to producers. For [21], fluctuations in soybean prices, producers need guidance that contributes to the decision-making process, regarding the methods of marketing a product (soybean), because an alternative of options to sell guarantees the greater and more stable revenue.

Regarding fundamental aspects for economic performance in the field, grain yield has been essential for constant demand in world grain consumption[2].According to the Brazilian Agricultural Ministry [2], soybean (+ 19.8%), corn (+ 13.7%), coffee (+ 36.3%), rice (+ 12%) and orange (+ 9.8%) are the agricultural highlights of the year 2020, with performance and increased productivity in the field, exports also increased. This analysis of the volatility pattern of returns generated by this commodity has important implications, related to the formulation of policies for the coffee sector and the country's economic performance [18].

With advances in technology, food production has become more viable and efficient because it produces on a large scale. In recent years, terrestrial sensors, drones, satellite tracking systems and other devices have been introduced in the rural environment to collect data on variables that influence productivity, such as soil characteristics, climate variation and pest incidence[5].The increase in corn production is related to the increase in productivity, even considering the increase in the cultivated area [5]. For Tejada and Silva [22], the

change in the exchange rate perceived as transitory will have little effect on the determination of export prices, on the other hand, the greater reliability in the forecast of the future exchange rate is related to a greater effect on prices exports and the pass-through of the foreign exchange variation entirely to prices.

Thus, Tejada and Silva [22] studied two factors: null pass-through, no influence on the depreciation of prices in the export currency, this happens with changes in the profit margins of exporters, and in the case of through complete, with a change in the exchange rate the price of foreign currencies affects the competitiveness of domestic production in the world market. The situation most used in the empirical literature is that of incomplete pass-through, as it is a partial influence of exchange rate variations on the country's export prices [23].

A study carried out by [23], price transmissions to pass-through in Brazilian exports, analyzed the relationship between the exchange rate and export prices in Brazil, with the transmission of international prices to domestic export prices Brazilian corn. revealed that Brazil pointed to an incomplete coefficient in exports (between zero and -1 or zero and 1), with that the international transmission prices of corn at domestic prices was inelastic, that is, international prices are partially at domestic prices

IV. METHODOLOGY

A. Delimitation of the study scenario

Two cases have been reported in the result. Therefore, it was considered in the first case that the soy producer located in the region of *Campo Grande*, state of *Mato Grosso do Sul*, who was concerned with the fluctuations in the price of CBOT soy, and decides to use a strategy to protect himself in buying a Put. In the second case, we have a coffee producer located in the *Patrocinio* region, in the state of *Minas Gerais*, which decides to carry out an operation in the future market at the New York Board of Trade NYBOT. Therefore, the producer protects himself against the fall by buying at Put.

In the option contract, it would be equivalent to say that an individual has the advantage of choosing to buy or sell a specific asset at a future date, knowing in advance the price that he will pay or receive for the asset, with the guarantee that the counterparty will be obliged to carry out the future business, within specifications stated in the contract [24].

B. Hedge

The hedge is an important means of protection to be used by the agricultural producer. This tool is considered a protection, providing security in order to reduce the risks resulting from the volatility of commodity prices. In the case in question, the main concern is to guarantee the price, which can be of purchase or sale, thus mitigating the risk of adverse price variations. [25].

In situations where there is uncertainty, when the intention is to reach the end of a year with positive financial flows, the hedge strategy facilitates the visualization of the scenario, whenever it is possible to lock an objective price [26], [27].

However, for those who need to trade commodities in the Brazilian financial market, it may be the case of industries with a large volume of operations with the foreign market, options trading with futures is a good strategy, as it allows leveraging a high financial value with little capital.

Thus, when talking about options trading, you have the options to buy and sell, which can be used according to the need of the hedger. In the case of a call option, the equation to calculate the result of a position+ C position (the sign represents the purchase of an option), at maturity, can be written as:

$$R_{+c} = \text{Max}[S_t - K; 0] - c \quad (4.1)$$

Where:

R_{+c} : Result of the long position on call;

S_t : It is the difference between the price of the underlying asset at the option's maturity;

K : Strike price; and

c : Premium paid for option

When buying a call option, the loss will be limited, that is, you will not be able to lose more than the premium paid, if the option is not exercised [24]. If the difference between the price of the underlying asset at maturity and the strike price (Strike) is negative, the call option will not be exercised in this condition. In the case of $S_t - K$, if positive, the position in the call would be exercised.

In the case of a short position in Put, the following equation depicts this strategy, - P at maturity:

$$R_{-p} = -\{\text{Max}[K - S_t; 0] - p\} \quad (4.2)$$

That is, the result of the put short is the opposite of the put long. The gain of the put holder is the loss for the put seller and vice versa, hence the sign before the keys [24]. Rewriting the previous equation for easy understanding, we have:

$$R_{-p} = -\text{Max}[K - S_t; 0] + p \quad (4.3)$$

The maximum gain of the put launcher will be the premium received for the sale of the option and will occur if the price of the target asset at maturity is greater than the exercise price of the option [24]. As highlighted in the discussion and importance of the study, in this study the sales option is taken as a strategy, aiming at protecting the producer.

V. RESULTS

In the first case, we consider a soybean producer located in Campo Grande / MS on 12/03/2020 concerned with the fluctuations in soybean prices, decides to carry out an operation in CME's future market to guarantee the desired price at the time of harvest, avoiding exposure to the risk of falling prices. The minimum price desired by the producer for sale in the physical market was US\$15.12/sc. On that day, soybeans at CME for November 2020, the time of harvest, were quoted at US\$ 19.55/60kg².

² Approximate values converted from US\$/Bushel to US\$/60 Kg. The trading pattern in Brazil are bags of 60 kg.

TABLE I
 HEDGE WITH OPTIONS - GUARANTEE AGAINST PRICE DROP
 (WITHOUT ADVANCE SALE OF SOYBEANS).

Scenarios	CBOT price, November 2020 US\$/60kg.				
	18.99	19.25	19.55*	20.78	21.02
Base price Campo Grande/MS	-3.47	-3.47	-3.47	-3.47	-3.47
Expected price CG/MS	15.52	15.78	16.08	17.31	17.55
Premium paid	-0.57	-0.57	-0.57	-0.57	-0.57
Gain on put exercise	0.56	0.30	0.00	0.00	0.00
Net income	15.51	15.51	15.51	16.74	16.98

Source: Research results.

Obs: The value of the option premium was calculated using the Black – Scholes methodology.

The producer to protect himself bought a Put for November for US\$ 19.55/ 60kg, paying a premium of US\$ 0.57/60kg. The base for the Campo Grande/MS region is US\$ 3.47/ 60kg. Discounting the base and the value of the premium, the producer achieved a minimum net result of US\$ 15.51 / 60kg, higher than the desired minimum, US\$ 15.12 / 60kg.

Note in Table 1 that when the future price falls below US \$ 19, 55 / 60 kg, the producer exercises the option by receiving the option adjustment and guaranteeing the net result obtained at the beginning of the operation. Therefore, the producer when buying Put can protect himself against the drop in the price of soybeans. But if the future price goes up, the producer will not exercise Put and sell his product at a higher price.

Following the behavior of the prices of the contract due in November, on 10/19/2020 (with a month remaining to expire), it appears that a date on which the seller could have sold the option was on 8/10/2020 when the price was US\$ 19.12 / 60kg. Graphically, the exercise of the option would be as follows:



Fig. 1 Result for the producer purchasing a Put.

Source: Research results.

If the producer does not exercise the option and waits, the price behavior for the following months would indicate that the best decision in the future would be to sell on the physical market, for example, on 10/19/2020 the quotation on the physical market in Campo Grande / MS was US\$ 28.18 / 60kg[1].

Next, we will consider a coffee producer located in the Patrocínio / MG region on 03/12/2020 concerned with the fluctuations in soybean prices, decides to carry out an operation in the NYBOT futures market with September maturity to guarantee the desired price at the moment of the harvest. The minimum price desired by the producer for sale in the physical market was US\$ 96.32 / 60kg.

On that day, coffee on the NYBOT for October 2020, harvest time, was quoted at US\$ 133.55 / bag. In the simulation in question, a premium of US\$ 8.41 is considered, considering a volatility of 10% for a period of 120 days using the methodology of Black & Scholes [28].

The producer to protect himself bought a Put for October for \$ 133.55 / 60kg, paying a premium of US\$ 8.41 / 60kg. The base for the Patrocínio / MG region is US\$ 20.43 / 60kg. Discounting the basis and the value of the premium, the producer achieved a minimum net result of US \$ 104.71 / sc, higher than the desired minimum, US\$ 96.32 / 60kg.

TABLE III
HEDGE WITH OPTIONS - GUARANTEE AGAINST PRICE DROP
(WITHOUT ADVANCE SALE).

Scenarios	CBOT price, September2020 US\$/60kg				
	105.5	115.05	133.55	143.78	154.55
Base price Patrocínio/MG	-20.43	-20.43	-20.43	-20.43	-20.43
Expected price Patrocínio/MG	85.07	94.62	113.12	123.35	134.12
Premium paid	-8.41	-8.41	-8.41	-8.41	-8.41
Gain on put exercise	28.11	18.5	0	0	0
Net income	104.71	104.71	104.71	114.94	125.71

Source: Research results.

Still in relation to table 2, when the future price falls below US \$ 133.55 / 60kg, the producer exercises the option receiving the adjustment of the option and guaranteeing the net result obtained at the beginning of the operation. Therefore, the producer when buying Put can protect himself against the drop in the price of coffee. But, if the future price goes up, the producer will not exercise Put and sell his product at a higher price. Graphically, the option simulation would look like this:

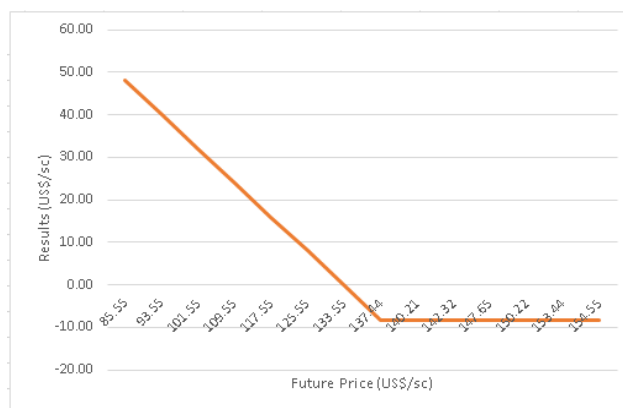


Fig. 2 Result for the producer purchasing a Put.

Source: Research results.

In figure 2, we can see the possible results for the holder of a Put. For $P_f > 135.44$ the Put will not be exercised, and the holder will lose the value of the prize in full. But, for $P_f < 135.44$ the Put will be exercised, and the holder can stay in 3 situations,

recover part of the premium paid; recover every prize; or even, in addition to recovering the premium paid having a gain.

VI. CONCLUSIONS

It is undeniable that in situations of uncertainty making predictions aimed at determining prices and profit in the future becomes a difficult issue. Such is the case that was experienced in the first six months in 2020, when products traded on the financial market lost market value. However, the financial market and specifically the theory focused on this area provide several tools that assist in decision making when crises or high price volatility occur.

Thus, the objective of the study was to analyze different price scenarios using the future market, linking options on futures in the financial market. The products under study are coffee and soybeans, the possibility of being able to carry out hedging operations with options on futures was also considered considering the quotations on the American stock exchanges NYBOT and CBOT in relation to the physical price of Brazilian locations.

The results are plausible and corroborate the premise of the importance of the future market and of hedge operations to be used to carry out hedging operations. In the case of soybeans and coffee because they are products quoted in foreign mills (dollars) and given the high demand for products in the foreign market, producers are encouraged to carry out protection operations, not only of the products, but also of the dollar.

In future studies, it is suggested to incorporate and jointly analyze options on futures for short-term portfolios. A short-term analysis process would be stress tests, in view of this, the objective would be to determine possible levels of gains and or losses when there is high volatility in the market. important in this context, to consider the daily loading cost that includes an option operation.

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