THE EFFECT OF PROCUREMENT STRATEGIES OF MILLING COMPANIES ON THE PRICE OF MAIZE

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Abstract

Since ultra poor South Africans spend up to a fifth of their income on maize alone, the demand for this commodity is price-inelastic, i.e. consumers have no choice but to absorb price increases. As such the success of procurement strategies from milling companies will ultimately have a direct impact on the financial well-being of the poor. Even though derivative instruments are available to use as counter against market fluctuations, the price risk management success of groups with a concern on SAFEX suggests that this is not achieved as yet, ultimately to the detriment of consumers. The view exists that markets are efficient and the return offered by the futures exchange cannot consistently be outperformed. This paper argues the exact opposite, since the use of the proposed futures/options strategies result in returns superior to that of the market.

Keywords: Price-risk, Futures contracts, Options contracts, Momentum strategy, Maximum price strategy, Indexed strangle strategy

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1. Introduction

Agriculture is of inestimable value to South Africa since it is a major source of job creation and plays an important role in earning foreign exchange. The most significant contribution of agriculture, and especially maize, remains its ability to provide food for the nation. For a number of decades grain prices were determined by government legislation until this policy of grain pricing was amended by the Marketing of Agricultural Products Act 47 of 1996. The introduction of this Act deregulated the agricultural sector and resulted in the value of soft commodities being determined by the futures price of the underlying asset as traded on the South African Futures Exchange (SAFEX). This required market participants to adapt to a volatile environment resulting in uncertainty and financial losses. Since ultra poor South Africans spend up to a fifth of their income on maize alone, the demand for this commodity is price-inelastic, i.e. consumers have no choice but to absorb price increases. As such the success of procurement strategies from milling companies will ultimately have a direct impact on the financial well-being of the poor.

The performance of price-risk management strategies, as implemented by stakeholders in the futures market was identified and the performance calculated against a relevant benchmark. In addition, a structured approach to price-risk management was investigated via three alternative strategies and in turn compared against a benchmark.

This paper aims to identify the success by which participants in the soft commodity futures market mitigate price risk of maize by means of derivative instruments. The derivative price risk management strategies will be benchmarked against the return offered by the market. Successful risk mitigation with predictable returns could serve as motivation for organisations to develop similar risk management strategies with the goal of realizing below-average procurement prices to the ultimate benefit of consumers.

This paper is divided into the following topics:

- Theoretical background on derivative instruments.
- Price-risk management performance of stakeholders in the futures market.
- Background and application of proposed price-risk management strategies.

- Evaluation of risk management strategies versus a benchmark.

2. Theoretical background on derivative instruments

According to Bodie, Kane & Marcus (2002:15), derivatives are financial arrangements between two parties whose payments are based on, or derived from, the performance of some agreed-upon benchmark. Derivative instruments can be based upon an underlying asset entailing one of the following:

- Currencies
- Commodities
- Government or corporate debt
- Home mortgages
- Equity shares
- Interest rates

2.1. Distinction between derivative instruments

2.1.1. Futures contracts

"A futures contract is a notional commitment to take delivery (purchase) or to make delivery of (sell) a given quantity of a specific instrument on a specified future date at a price determined at the time of taking out the contract" (Valsamakis *et al* 2003:267). Since futures are exchange traded contracts, the following characteristics are standardized:

1. The asset-type;
2. quantity of the asset;
3. quality of the asset; and
4. the future maturity date.

2.1.2. Options contracts

The fundamental difference between an option contract and futures contracts is the higher level of flexibility inherent in options contracts. This is due to the holder of an option having the right, but not the obligation, to enter into the underlying futures contract. (Madura 2000:66.). Two types of option contracts exist in the futures market, namely:

- *Call options.* A call option provides the buyer (long position holder) with the right, but not an obligation, to buy an asset for a certain price by a specific date.
- *Put options.* A put option provides the buyer (long position holder) with the right, but not an obligation, to deliver an asset for a certain price by a specific date

3. Price-risk management performance of stakeholders in the futures market

The feasibility and success of price risk management models applied on futures prices by speculators and hedgers can only be determined once its performance has been compared to the returns offered by the market or by alternative risk management models. The specific calculation of the market return or alternative risk management model against which the performance of the particular risk management strategy is measured is an important consideration in the evaluation of a strategy. The concept underlying the evaluation of the performance of risk management strategies is the comparison of net prices achieved by these strategies versus the returns offered by similar active strategies or the passive market. This benchmarking serves as an objective standard of performance (Irwin, Good, Martines-Filho & Batts 2006-03:2). In its simplest form, benchmarking involves comparisons (Brigham, Daves & Gapenski 1999:80).

Benchmarking, according to external benchmarks, is based upon the efficient-market theory. This entails that markets are rational, all-knowing and that competition among participants in the marketplace will immediately eliminate all possible arbitrage opportunities available through the exploitation thereof. (Irwin *et al* 2006-02:29-30.)

For the purposes of this paper the benchmark is described as the average price of a single commodity, or group of commodities, on a specific date or over a pre-determined period. In this context the benchmark used, should measure the average SAFEX white maize price for July delivery over the contract-lifetime for the processing company who follows no active hedging strategies. The average price is determined in order to reflect the returns of a naïve strategy, hedging equal amounts of the commodity every day over the duration of the contract. This is consistent with research already done on this subject (Irwin, Good, Martines-Filho & Hagedorn 2005:27-31).

The pioneering work in this field of performance measurement was done by Irwin, Good, Martines-Filho and Hagedorn (2003) for the AgMas project at the University of Illinois. Every price-risk management recommendation from over twenty professional trading companies was recorded since 1994. A comparison was made between the net results of every recommendation from the individual companies and the benchmark average price constructed from the daily closing prices over the contract lifetime. The results indicate that only one professional trading company managed to outperform the simple average benchmark (by less than 7% on average). In other words, less than 5% of the professional trading companies managed to outperform the futures market.

Another finding from the research indicated that the net advisory prices vary substantially between companies, with differences of up to 70% on the realized futures price. The conclusion is made that markets are efficient and no additional profits can be made through risk management strategies. (Irwin *et al* 2003.)

Thorough research has been done on the forecasting ability of speculators in the soft commodity futures market. The earliest findings on

the performance of speculators in the grain futures market were published in 1934. Stewart (1934:415-433) made a detailed analysis of 9000 accounts of a nationwide brokers' firm for the period 1925 to 1934. These accounts reflected exclusively speculative transactions in grain futures. The most striking finding of this research project was that nearly 75% of speculators lost money. More concerning, however, is that the entire sample highlighted losses six times the value of total gains.

In 2001, 67 years after Stewart published his findings, Wang (2001:929-952) released the results of his study on the predictability of returns in the futures market. It showed that large speculators in the futures market are still unable to accurately predict price movements.

Locally, the futures market was stunned when trustees of a pension fund stated their intention to sue WJ Morgan, a South African futures broker, for losses of R1.4 billion sustained due to over-exposure on SAFEX. The decision to expose funds of R2.7 billion to the derivatives market was taken by WJ Morgan on the basis of expectations of a continued rise in maize prices (The Star 2003).

The inability of producers to effectively manage their exposure to adverse price movements is highlighted in the well-known fact that two thirds of producers short the futures market in the bottom third of the price range (Decision Commodities 2006).

The inability of processors to effectively manage the risk of volatile prices has been well documented and for the purposes of this paper a non-probability purposive sample will be used with reference to the procurement companies and the trading year over which the hedging results will be evaluated. The accurate and available historical price and volatility information are the main reasons as to why a secondary data analysis is chosen as the most appropriate data collection method. The evaluation of the price-risk management performance of processors will be done through an investigation into the procurement results of African Products and Tiger Brands. These two processing companies are used for the purposes of this study since they are recognized as two of the main role players in the procurement market for the following reasons:

- African Products consume close to 7% of the average annual maize crop (Tongaat Hullett 2003:4).
- Tiger Brands is recognized as being among the four biggest milling companies in South Africa (Chabane 2003:6-7).

In order to determine the ability of African Products and Tiger Brands to successfully eliminate volatile futures prices, the year with the biggest maize price movement (2003) will be used in order to explore the impact of big price movements on hedging strategies.

African Products

Tongaat-Hulett is a Group consisting of four closely linked and focused businesses. One of these businesses is African Products, Africa's largest manufacturer of starch and glucose. Its five mills consume in excess of 600 000 tons of maize annually, i.e. nearly 7% of the average South African maize crop.

In the chairman's statement for the 2003 financial year, Cedric Savage blamed expensive maize procurement costs as one of the main reasons contributing to a headline loss of R93 million, down from a 2002 headline profit of R380 million. During the year African Products followed its long established strategy with a focus on price stability. A characteristic of this procurement strategy was that the impact of price increases was nullified. The strategy simply consisted of going long the futures market. As the market came down from levels of R2000/ton late in 2002 to below R800/ton in 2003, African Products incurred huge valuation losses on the procurement contracts. This forced Peter Staude, Chief Executive Officer, to comment in Tongaat Huletts' 2003 Annual Report that a new model of maize procurement is needed. (Tongaat Hulett 2003.)

Tiger Brands

In the Group results for the year ended 30 September 2002, the following comment is made:

"The effects of sharply higher grain prices were mitigated by the benefits of an effective procurement programme, which resulted in the group being able to source its grain requirements at below market prices." (Tiger Brands 2002.)

In the subsequent months the futures market was characterized by a sharp drop in white maize futures prices. This forced the Chief Executive Officer of Tiger Brands to make the following contrasting comment in the 2003 Annual Report:

"High priced maize stocks carried over from last year, volatile maize prices and the stronger rand impacted on operating income which declined by 5% to R1.9 billion." (Tiger Brands 2003.)

After much praise for the hedging strategy in the previous year, a comment was made in the 2003 Annual Report that new hedging strategies will be introduced to provide for better hedging against volatile commodity prices. This underlines the absence of a hedging strategy with a predictable outcome that is able to beat the average market price.

4. Background and application of proposed price-risk management strategies

In the previous section the conclusion was made that neither hedgers nor speculators are able to outperform the returns offered by the market, in accordance with the efficient market hypothesis. The average price was consequently chosen as benchmark against which the results from the proposed risk management strategies will be compared.

The three proposed price-risk management strategies are based on a core/satellite model. This

framework is used in order to develop a strategy with the potential to add additional value above an average price, where the main strategy is a risk-controlled position, with an active structure aiming to add additional value.

6.1. Momentum strategy

Erb and Harvey (2005:3) define the Momentum strategy as a method of pursuing above average returns by investing in commodity futures with positive past price movements. This is consistent with the description of Spurgin (1999:1) which states that the Momentum strategy involves buying the underlying asset that is rising in price and selling the asset when prices are falling. For the purposes of this study a drop in prices will not result in a short position being taken, as the underlying hedge position should result in delivery of the commodity being taken. Therefore the proposed Momentum strategy will hold exclusively long positions, similar to the Goldman Sachs Commodity Index (Spurgin 1999:1). The long-only Momentum strategy for the purposes of this paper is ultimately defined as buying the underlying commodity in the event of an increase in prices (or no change in prices), whilst a drop in the commodity price results in no action being taken.

Whilst sufficient literature on Momentum in equity markets exist (Carhart 1997:57-82; Johnson 2004:585-608) there does not seem to be general agreement as to the reasons why this strategy is successful in its application. In terms of the proposed Momentum strategy the view of Johnson (2004:585-608) seems to be the most likely reason for potential hedging success on SAFEX. He argues that the returns achieved by such a strategy are a payoff for taking more risk than merely buying the Average Price Index.

The Momentum strategy, to be applied on historical data, possesses the following distinctive features:

- Every trading day that July white maize prices increase (or remain unchanged), a long position will be taken.
- Every trading day that July white maize prices drop, no position will be taken on SAFEX.
- The first trading day on which July white maize prices increase after a drop in prices, long positions will be taken. The number of long positions entered into should equal the sum of the number of trading days since the last trading day on which prices closed higher.

The July contract is used in the evaluation of the proposed strategy, as it is the most liquid futures contract available on SAFEX. Although grain processors do not wish to take delivery of a year's stock all at once, the resultant long position can be rolled forward to the delivery month in which the grain is required. Rolling a position forward consists of going short the July contract against the long position obtained from the Momentum strategy, and immediately going long the desired contract month (Hull 2002:458).

For the purposes of the evaluation of the strategy, the assumption is made that a single daily position taken on SAFEX entails one futures contract (100 metric tons) traded at its closing price. Since processors are naturally much shorter the market, the daily number of futures contracts taken as position on SAFEX can be adjusted according to individual needs.

Table 1. Summary of Momentum strategy applied on July white maize data from 2001 to 2006

Year	Average price	Momentum strategy	Value gained (R/ton)	Total value gained*
2001	R 739.40	R 738.61	R 0.79	R 473,597.26
2002	R 1,254.24	R 1,252.48	R 1.76	R 1,057,304.03
2003	R 1,400.50	R 1,388.64	R 11.86	R 7,113,240.42
2004	R 1,086.16	R 1,084.39	R 1.77	R 1,060,166.59
2005	R 810.74	R 807.77	R 2.97	R 1,779,472.85
2006	R 958.11	R 959.72	R -1.60	R -962,400.85

* Based upon a processor procuring 600 000 metric tons of maize annually

The results indicate that the benchmark index is outperformed by the Momentum strategy in five of the six years under review, as the realized procurement price is lower than the Average Price Index. The extent by which the Momentum strategy beats the market varies substantially, from R0.79/metric ton in 2001 up to R11.86/metric ton in 2003.

6.2. Maximum price strategy

Hull (2002:461) defines an exotic option simply as "a nonstandard option". He states that the price and volatility of plain vanilla options are determined by an exchange, whereas financial engineers develop exotic options to be sold at a price not necessarily related to prices quoted by the market. He further argues that an exotic product comes about due to a number of factors. These include a specific need for a hedging product in the market and to reflect the user's view on

potential future price movements (Hull 2002:394). He identifies an Asian option as "an option with a payoff dependent on the average price of the underlying asset during a specified period" (Hull 2002:456).

In their research on options available in the futures market for hedging purposes, Hagedorn, Irwin, Good, Martines-Filho, Sherrick and Schnitkey (2003:3-5) describes new generation contracts as products which use automated pricing rules, discretionary marketing, options strategies, or a combination of all three in order to achieve an average hedge price. They classify new generation contracts into three basic categories, namely automated pricing contracts, managed hedging contracts and combination contracts.

The Maximum price strategy is an exotic option strategy since it possesses no standard features and come about due to a specific need expressed by risk averse hedgers in the futures market. The strategy may be mistaken for an Asian option, but since its payoff is not dependant on an average price, it should rather be classified as a managed hedging contract. It complies with the definition of a managed hedging contract (Hagedorn *et al* 2003:4) since a specific volume of the underlying commodity is hedged over a predetermined period with a fixed maximum price.

Taking all of the above into account, the Maximum price strategy can be defined as an exotic and managed hedging strategy which guarantees a maximum procurement price. The benefit of daily price movements lower than the maximum price will lead to a reduction in the final procurement price of the commodity, whilst daily price movements higher than the maximum price will have no adverse impact on the price at which the underlying commodity is bought.

The characteristics which distinguish the Maximum price strategy from alternative exotic options can be summarized as follows:

- On the trading day on which the strategy is initiated the buyer of the underlying commodity is guaranteed a maximum procurement price.
- The total volume of maize to be hedged is divided into the number of trading days over which the strategy will be applied on futures prices; i.e. the daily volume.
- Every trading day on which the daily price is higher than the maximum price the daily volume of maize will be purchased at the maximum price. Should the price of maize be lower than the maximum price on option expiration, the long position holder will receive the benefit of the lower price, as on option expiration, for the total number of trading days over which the maize price traded higher than the maximum price.
- Every trading day, on which the price of maize is lower than the maximum price, the daily volume of maize will be purchased at the lower price.

The average of the daily volume of long positions taken over a predetermined strategy period will result in the final procurement price. The practical implementation of this strategy is structured as follows:

- On the date of commencement, at-the-money call options are bought for the total volume of grain to be hedged. This results in a guaranteed maximum procurement price.
- The volume of grain to be hedged is divided into the number of trading days from the date of commencement to option expiration. This is known as the daily volume.
- Every trading day between the date of commencement and option expiry on which the daily price is lower than the maximum price, the daily volume of call options are sold and replaced by a daily volume long futures position. By going short the option (which is now an out-of-the money call option), the net cost of the strategy is reduced.
- Every trading day between the date of commencement and option expiry on which the daily price is higher than the maximum price, no action is taken. The daily volume of grain is hedged by the call option at the maximum price, which is the strike level of the call option. This call option is in-the-money.
- Should the daily price of the underlying commodity be higher than the maximum price (strike level of option) on date of option expiry, the call-options will automatically become long futures positions. In the event of a daily price lower than the maximum price on the date of option expiry, long futures positions will be taken to the extent of the daily volume multiply by the total number of trading days over which the daily price traded higher than the maximum price.
- The average price of the daily volume of grain hedged over the strategy period will result in the procurement price for the underlying commodity. By adding the premiums and broking fees of the call options to the realized procurement price, the net hedged price can be compared to the market benchmark.
- Since historical data on maize prices and volatility are available, the Black-Scholes model will be used to calculate the historical prices of options. The Maximum price strategy will be initiated on the day on which volatility are first published, since this represents the first trading day on which options can be traded.

The July contract is used in the evaluation of the proposed strategy, as it is the most liquid futures contract available on SAFEX. Although grain processors do not wish to take delivery of a year's stock all at once, the resultant long position can be rolled forward to the delivery month in which the grain is required. Rolling a position forward consists of going short the July contract against the long position obtained from the Maximum price strategy,

and immediately going long the desired contract month (Hull 2002:458).

For the purposes of the evaluation of the strategy, the assumption is made that the daily volume on SAFEX entails one futures contract (100 metric tons) traded at its closing price. Since processors are naturally much shorter the market, the volume of grain to be hedged can be adjusted according to individual needs. Once the value of the long call option is below R1/ton, no effort will be made to go short the option on days when the daily price is lower than the maximum price, since the broking cost will exceed the premium benefit of the option.

Table 6.2. Summary of Maximum price strategy applied on July white maize data from 2001 to 2006

Year	Average Price Index	Maximum price strategy	Value gained (R/ton)	Total value gained*
2001	R 739.40	R 713.29	R 26.11	R 15,663,209.30
2002	R 1,254.24	R 1,102.03	R 152.21	R 91,325,589.74
2003	R 1,400.50	R 1,291.70	R 108.80	R 65,280,000.00
2004	R 1,086.16	R 1,021.03	R 65.13	R 39,076,852.94
2005	R 810.74	R 787.55	R 23.19	R 13,913,010.75
2006	R 958.11	R 777.24	R 180.87	R 108,523,477.20

* Based upon a processor procuring 600 000 metric tons of maize annually

The results indicate that the benchmark index is outperformed by the Maximum price strategy in all of the years under review, as the realized procurement price is lower than the Average Price Index.

The extent by which the Maximum price strategy beats the market varies substantially, from R23.19/metric ton in 2005 up to R180.87/metric ton in 2006. There are two reasons for the inconsistency in the rand value by which the Average Price Index is outperformed:

- A bigger price movement over the duration of the contract results in a higher rand value by which the Average Price Index is outperformed.
- The level at which a long position in call options is entered into.

6.3. Indexed strangle strategy

In their study on information flows in financial markets, Berchtold and Norden (2005:1147-1172) analyzed two types of information flows, namely return information and volatility information. Whereas return information embodies the knowledge of informed investors on whether prices will increase or decrease, volatility information entails the lack of knowledge on the direction of market movements. The Indexed strangle strategy is consistent with volatility information flows, since the future direction of market movements cannot be predicted. As such the Indexed strangle will aim to provide additional value to an average price index on both upward and downward price movements.

Table 6.3 confirms a trend among historical volatility movements for the July white maize contract. The following important conclusions can be made from this information:

- Volatility is low at commencement of the contract.
- Volatility increase over time from commencement and reach a peak over December/January. This is due to the high levels of uncertainty in the maize market during planting time.
- From January up until option expiration volatility decrease. The lower volatility is brought about by higher levels of supply and demand certainty.

Table 3. 10-day Volatility 2002-2007

Period from:	Period to:	2002	2003	2004	2005	2006	Average
01-May	10-May					38.0	38.0
11-May	20-May					38.0	38.0
21-May	30-May		24.0			38.0	31.0
31-May	09-Jun		24.0			38.0	31.0
10-Jun	19-Jun		24.0			37.0	30.5
20-Jun	29-Jun		25.1	30.8		37.0	31.0
30-Jun	09-Jul		26.4	31.0	26.0	36.1	29.9
10-Jul	19-Jul		25.3	31.0	26.4	33.9	29.1
20-Jul	29-Jul		27.0	34.6	30.8	33.0	31.3
30-Jul	08-Aug		27.5	36.5	36.0	33.0	33.3
09-Aug	18-Aug		25.8	36.7	37.7	33.0	33.3
19-Aug	28-Aug		24.7	36.3	38.9	33.5	33.3
29-Aug	07-Sep		25.4	37.2	41.0	40.6	36.1
08-Sep	17-Sep		26.6	38.0	40.3	48.5	38.3
18-Sep	27-Sep		28.0	37.5	41.4	49.9	39.2

Table 3 continued

28-Sep	07-Oct		28.4	36.7	41.5	49.8	39.1
08-Oct	17-Oct		27.5	37.9	42.2	47.5	38.8
18-Oct	27-Oct		29.0	38.7	41.8	47.8	39.3
28-Oct	06-Nov		32.2	40.4	44.7	48.3	41.4
07-Nov	16-Nov		31.9	41.8	47.0	45.6	41.6
17-Nov	26-Nov		31.1	40.5	48.4	48.7	42.2
27-Nov	06-Dec		30.3	37.6	51.2	49.7	42.2
07-Dec	16-Dec		33.2	42.8	51.9	46.5	43.6
17-Dec	26-Dec		30.8	49.8	50.1	47.2	44.5
27-Dec	05-Jan	39.3	29.1	52.1	52.3	53.3	45.2
06-Jan	15-Jan	39.1	27.4	52.0	52.3	47.5	43.7
16-Jan	25-Jan	38.8	29.0	51.0	46.7	41.1	41.3
26-Jan	04-Feb	35.6	36.7	45.5	47.6	38.4	40.8
05-Feb	14-Feb	37.2	42.6	46.8	48.4	40.0	43.0
15-Feb	24-Feb	33.2	39.7	45.1	42.1	35.7	39.2
25-Feb	05-Mar	32.8	37.7	41.6	35.6	37.3	37.0
06-Mar	15-Mar	36.2	42.1	44.5	39.6	34.1	39.3
16-Mar	25-Mar	37.1	43.8	44.9	40.9	30.2	39.4
26-Mar	04-Apr	38.8	37.5	41.5	38.7	28.4	37.0
05-Apr	14-Apr	35.4	37.5	41.4	38.4	24.7	35.5
15-Apr	24-Apr	29.9	34.0	39.0	38.8	25.8	33.5
25-Apr	04-May	26.5	31.5	35.3	35.6	24.7	30.7
05-May	14-May	26.8	37.0	32.9	34.0	23.6	30.9
15-May	24-May	23.5	48.0	32.0	35.6	25.3	32.9
25-May	03-Jun	23.1	46.6	28.6	38.5	22.7	31.9
04-Jun	13-Jun	24.1	46.1	37.8	41.5	23.1	34.5
14-Jun	23-Jun	24.2	47.0	38.6	39.1	26.9	35.2

As discussed, one of the main variables determining the price of an option is volatility. Lower volatility leads to a lower premium being paid for an option, whilst high volatility levels will result in a higher premium being paid for an option on an underlying futures contract. The opportunity therefore is to go short volatility (sell options) over the 10-day period on which volatility historically peaks. Since the direction of market movement cannot be accurately predicted, a short position in both put and call options should be taken. Although market movements tend to be less aggressive after the historical volatility peak, the strike level of the options, in which a short position is taken, should be out-of-the money. This is commonly known as a short option strangle.

Hull (2002:13) defines a strangle strategy as a position being taken in a put and call option with the same expiration date and different strike prices. He states that a short strangle position will be entered into if large price movements are possible. Maximum profit occurs when the underlying futures price on expiration date is trading between the strike prices of the options sold.

The proposed Indexed strangle strategy will therefore aim to profit from volatility trends, in addition to an average price. This will be implemented in the following way:

- An average long futures price will be realized by buying equal volumes of futures contracts on a daily basis over the whole of the contract lifetime.
- Since volatility tends to peak annually over the period 27 December – 5 January, short strangles will be implemented during this period for the total number of tonnages to be hedged via the average price strategy. This volume of grain divided by the number of trading days between 27 December and 5 January will determine the daily number of short strangles to be entered into. Should the mentioned formula not result in a round hundred number, it will be rounded off and on the last trading day the resultant strangles will be entered into. The rule to be used is that an option will not be sold if the premium of the option is lower than R1/ton, since this is the breakeven value to offset broking fees.
- The strike of the call options to be sold will equal the SAFEX futures price for the July white maize contract as on 27 December (or the first trading day thereafter) plus 40%. The strike of the put options to be sold will equal the SAFEX futures price for the July white maize contract as on 27 December (or the first trading day thereafter) minus 40%. The resultant strike level will be rounded off to the nearest twenty rand interval.

It is important to consider the effect of the short options.

- If, on option expiry, the July white maize futures contract closes higher than the put option strike and lower than the call option strike the total amount of the option premiums will be realized as profit and deducted from the average long futures price.
- If, on option expiry, the July white maize futures contract closes higher than the call option strike, short futures contracts will be assigned against the short call options. These short futures

contracts will offset the long futures contracts entered into through the realization of an average price. As such no futures position will exist and the difference between the long- and short futures levels plus the option premiums will be the resultant cash flow per ton.

- If, on option expiry, the July white maize futures contract closes lower than the put option strike, long futures contracts will be assigned against the short put options. As such a double-up of tonnages will arise.

In this instance, the average long position price level can be calculated as follows:

AP = (LF + PS - OP)/2

where AP = average price of long futures position (per ton)

LF = average of daily long futures position (per ton)

PS = strike level of short put options

OP = sum of option premiums (per ton)

Example:

Average daily long futures position = R1 235/mt

Strike level of short put options = R1 000/mt

Call option premium = R50/mt

Put option premium = R40/mt

AP = (R1 235 + R1 000 – R90)/2

= R1 072.50/mt

Table 4. Summary of Indexed strangle strategy applied on July white maize data from 2001 to 2006

Year	Average Price Index	Indexed Strangle Strategy	Value gained (R/ton)	Total value gained*
2001	R 739.40	R 713.94	R 25.46	R 15,273,209.30
2002	R 1,254.24	R 1,200.85	R 53.39	R 32,033,589.74
2003	R 1,400.50	R 1,393.89	R 6.61	R 3,966,000.00
2004	R 1,086.16	R 1,028.64	R 57.52	R 34,510,852.94
2005	R 810.74	R 764.25	R 46.49	R 27,893,010.75
2006	R 958.11	R 907.68	R 50.43	R 30,259,477.20

* Based upon a processor procuring 600 000 metric tons of maize annually

The results indicate that the benchmark index is outperformed in all of the years under review, as the realized procurement price is lower than the Average Price Index. The extent by which the Indexed strangle strategy beats the market varies substantially, from R6.61/metric ton in 2003 up to R57.52/metric ton in 2004.

7. Evaluation of risk management strategies versus a benchmark

In section 6 three price risk management strategies were discussed and applied on historical market data. The resultant performance of each strategy was compared to the benchmark average July white maize SAFEX price. Even though all three strategies compared favorable to historical average SAFEX prices, the consistency and extent by which the benchmark average price was outperformed differed significantly.

By comparing the results of the three strategies against one another, the optimum single or combination procurement strategy can be identified. This will be achieved by comparing the consistency of performance as well as the extent by which the benchmark is outperformed.

Figure 7.1 graphically presents the 6-year results of the proposed strategies versus one another and the benchmark average price from 2001 to 2006. This is summarized in table 7.1.

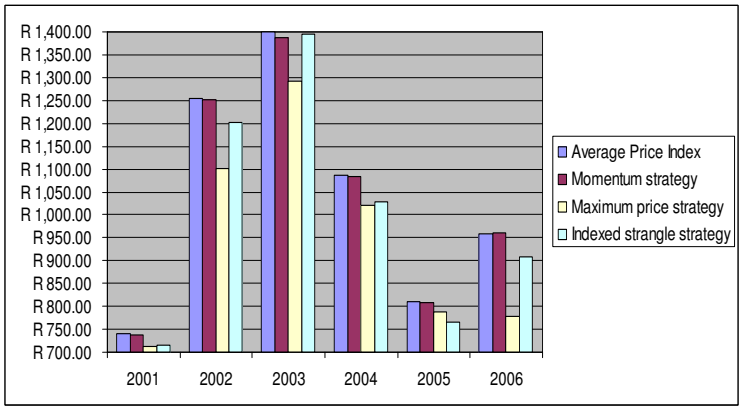

Figure 1. Comparison of price-risk management strategies vs. benchmark average price

Table 5. Comparison between performances of price risk management strategies vs. benchmark

Year	Average Price Index	Momentum strategy	% lower than average price	Maximum price strategy	% lower than average price	Indexed strangle strategy	% lower than average price
2001	R 739.40	R 738.61	0.11%	R 713.29	3.53%	R 713.94	3.44%
2002	R 1,254.24	R 1,252.48	0.14%	R 1,102.03	12.14%	R 1,200.85	4.26%
2003	R 1,400.50	R 1,388.64	0.85%	R 1,291.70	7.77%	R 1,393.89	0.47%
2004	R 1,086.16	R 1,084.39	0.16%	R 1,021.03	6.00%	R 1,028.64	5.30%
2005	R 810.74	R 807.77	0.37%	R 787.55	2.86%	R 764.25	5.73%
2006	R 958.11	R 959.72	-0.17%	R 777.24	18.88%	R 907.68	5.26%

The amount per metric ton by which the average price of the July contract is outperformed/ underperformed over the period 2001 to 2006, is presented in figure 2.

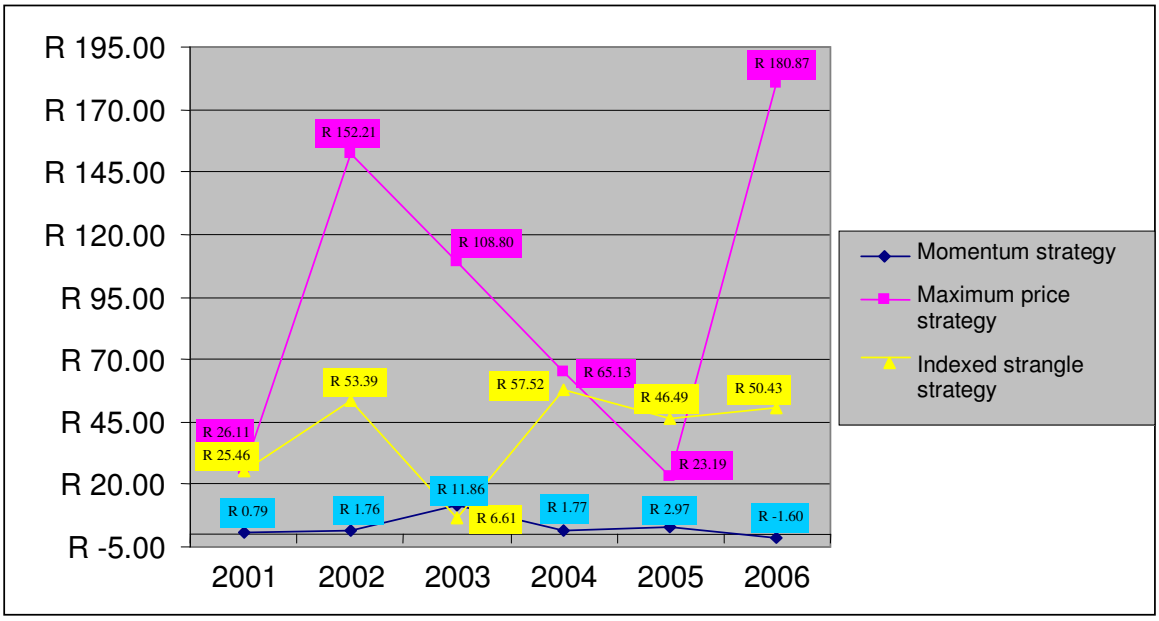

Figure 2. Price-risk management strategies performance vs. benchmark (R/metric ton)

From figure 2 it can be concluded that all three strategies are successful in reaching their objective. This statement is made since 17 out of the 18 strategy applications were able to outperform the average price over the last six years on which the data were tested. It is particularly true of the Maximum price- and Indexed strangle strategies, since both these strategies constantly achieved long futures positions at a price lower than the average price used as benchmark. These results are directly opposite the efficient market hypothesis and previous research done on this subject (Irwin, Good, Martines-Filho & Hagedorn 2005; Stewart 1934:415-433; Wang 2001:929-952).

The benefits and disadvantages of each individual risk management strategy are summarized in table 6.

Table 6. Benefits and disadvantages of individual price-risk management strategies

Strategy	Benefits	Disadvantages
Momentum strategy	No cost (premium) payable Easy to implement	Inconsistency of results (versus benchmark) Small Rand-value benefit versus benchmark average price No guaranteed maximum price
Maximum price strategy	Maximum price is known at inception of the strategy Consistency in performance versus benchmark High Rand-value benefit versus benchmark average price Relatively easy to implement	Premium payable
Indexed strangle strategy	No cost (premium) payable Easy to implement High Rand-value benefit versus benchmark average price	Price movement outside of short option strike levels results in double hedging/no hedging No guaranteed maximum price

Since the results achieved by these strategies are not consistent with the efficient market hypothesis, the question remains as to why these strategies are able to consistently outperform the market. The most obvious reasons for the superior performance of the individual strategies are as follows:

Momentum strategy:
No long positions are taken during bearish market movements, whilst futures are bought once prices move upwards. As such, short-term price trends are captured resulting in a favorable net long position price.

Maximum price strategy:
Call-options are bought on the day on which the strategy is implemented resulting in a maximum price equal to the sum of the call-option strike and the option premium. Price movements lower than the call-option strike are exploited whilst prices higher than the discussed strike level are nullified by the call-option itself. Since volatility tends to start at low levels and increase over time, the call-options are initially bought at a low premium and the subsequent rise in volatility will be exploited once long call-options are liquidated in favor of long futures contracts.

Indexed strangle strategy:
Options are sold during the period over which volatility tends to peak, resulting in a high option premium to be subtracted from the average price realized by going long equal volumes of futures contracts every trading day over the contract-lifetime. Since market movement is limited from the days on which the options are sold to option expiration, the net amount of the premiums will be realized.

8. Conclusion

Speculators, and more specifically for the purposes of this paper, hedgers, are currently unable to enter into contracts on the futures exchange in a manner that will minimize the impact of price volatility on their earnings. Indirectly this has a negative impact on consumers of the commodity underlying the futures/options contract.

Even though derivative instruments are available to use as a counter against market fluctuations, the price-risk management success of groups with a concern on SAFEX suggests that this is not achieved as yet, ultimately to the detriment of consumers. The view exists that markets are efficient and the return offered by the futures exchange cannot consistently be outperformed. This paper argues the exact opposite, since the use of futures/options strategies result in returns superior to that of the market. Two of the proposed price risk management strategies outperformed the market in every year under review, which is exactly opposite to popular belief of efficient markets. This is achieved by minimizing price volatility and gaining from short-term market trends. By applying these strategies to their procurement models, processors will benefit from below-average prices. In turn, this may have a favorable impact on food inflation.

Finally, the following recommendations could assist users of the futures market, particularly processors, in lowering the impact of market movement:

1. Personnel concerned with SAFEX should be educated on the use of derivative instruments in order to increase their knowledge.
2. Greater emphasis should be placed upon the development of core/satellite risk management strategies which will ultimately result in procurement models based on an indexing strategy.
3. The procurement function should in part be outsourced to companies specializing in exotic options based on the expectation of achieving average prices.

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