TESTING THE EFFICIENCY OF THE SOUTH AFRICAN FUTURES MARKET FOR WHITE MAIZE

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Cointegration analysis is used to test whether the South African futures market for white maize was efficient (futures prices predict spot (cash) prices that reflect all publicly available information) in 1997 and 1998. Tests are also conducted to assess whether or not white maize futures prices are unbiased predictors of future spot prices (for effective price discovery). There was no long-run relationship between white maize futures and spot prices for 1997, but there is evidence of a long-run relationship between these price series in 1998. Furthermore, the 1998 futures price was an unbiased predictor of future spot prices for both the annual and three-month contract. This could be evidence of a market learning process and a progression towards efficiency, which has seen a marked increase in market liquidity (contract volumes traded) since late 1996.

TOETSING VAN DIE DOELTREFFENDHEID VAN DIE SUID-AFRIKAANSE TERMYNKONTRAKMARK VIR WITMIELIES

'n Doeltreffende termynkontrakmark behoort 'n vooruitskatting te bied van die toekomstige kontantprys wat alle openbaar beskikbare inligting weerspieël; ideaalweg, vir doeltreffende prysblootlegging sou sulke vooruitskattings ook onsydig wees. Die verhandeling van witmielietermynkontrakte het teen die middel van 1996 in Suid-Afrika begin nadat die Mielieraad se magte om mielieprodusentepryse vas te stel, afgeskaf is. Kointegrasieontleding van die doeltreffendheid van witmielietermynkontrakte toon geen langtermynverhouding tussen termynkontrak- en kontant- (loko-) pryse vir 1997 nie, maar daar is aanduidings van 'n langtermynverhouding tussen hierdie prysreekse in 1998. Die 1998-termynkontrakprys was 'n onsydige voorspeller van latere kontantpryse. Dit is bewys van 'n mark leerproses, wat 'n merkbare toename in marklikwiditeit (verhandelde kontrakvolumes) sedert laat in 1996 beleef het.

1. INTRODUCTION

The demise of the Maize Board - which set producer prices and acted as a single channel marketer - in 1996 has created the need for South African (SA) maize farmers to individually give more attention to managing price risk. Futures

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trading is one mechanism for managing the effects of price instability resulting from the production, marketing and purchase of a commodity. Increasing concerns over continued SA government expenditures for farm programmes, and movements toward trade liberalization, make it likely that the government's contribution towards the management of commodity price risk will continue to diminish in future years. An important component in understanding and managing market price risk for maize is identifying the relationship between local cash and nationally traded commodity futures market prices. Understanding the extent to which cash prices are cointegrated with national futures prices - that is, whether or not they move apart through time - is critical in 'localizing' futures price information (Fortenbery & Zapata, 1993).

The notion of market efficiency is of considerable importance to any investor who wishes to use futures markets to hedge against price risk. An efficient market is one where asset prices fully reflect all known information (Bodie, *et al.*, 1995). A well-functioning futures market adjusts instantaneously to all new information and, therefore, profitable trading strategies cannot exist in an efficient market. Consequently, agents can engage in efficient markets at lower transaction costs than in markets which require extensive information search (Chowdhury, 1991). The key feature of well-functioning futures markets is their ability to predict prices at a specified future date both efficiently and in an unbiased fashion. An empirical analysis of efficiency, therefore, is critical to any assessment of the *value* of a futures market (Aulton, *et al.*, 1997:408). As yet, there has been no study in South Africa of the efficiency of maize or other agricultural commodity futures markets, probably because the Agricultural Marketing Division of the South African Futures Exchange (SAFEX) began trading futures only in mid-1996. Trading volumes have increased from 193 contracts per month in March 1996 to 6610 contracts per month in July 1998 (SAFEX, 1998a).

The aim of this paper is to test the efficiency of the SA futures market for white maize, for both 1997 and 1998 contracts, using cointegration analysis. The results should indicate whether or not these nationally traded maize futures contracts are a useful source of price information for local spot markets for white maize. Key concepts of market efficiency, cointegration and unbiasedness are first outlined. Tests of market efficiency and unbiasedness are then described, after which cointegration results are reported. A concluding section considers the management and policy implications of the study.

2. MARKET EFFICIENCY, COINTEGRATION AND BIAS

The Efficient Market Hypothesis (EMH) postulates that an asset price reflects all known information (Aulton, *et al.,* 1997). For empirical tests it is common to distinguish between weak, semi-strong and strong-form efficiency, with the distinction based on the definition of information. Tests for weak-form efficiency rely on information embodied in past prices, while tests for semi-strong form efficiency would typically use all publicly available information on prices and other relevant information (Garcia, *et al.*, 1988). Tests for strong-form efficiency would be based on all information, including insider information. Testing for weak-form efficiency is the most common approach, and will be applied in this paper. A futures market is efficient relative to an information set such that only new unanticipated information leads to a price change (Chowdhury, 1991:577).

Traditional efficiency tests regress the spot price series, Sp, on the futures price series, Fp, using Ordinary Least Squares (OLS), and test whether the intercept term, a, equals zero and the slope coefficient, B_0, equals one in equation (1):

$$Sp_t = a + B_0\, Fp_t + u_t \qquad (1)$$

where

u_t is the residual (error) term.

If a and B_0 are, respectively, not statistically significantly different from zero and one, the futures price is regarded as being an unbiased predictor of the spot price (Chowdhury, 1991). However, testing only that $B_0 = 1$ is not a sufficient test for pricing efficiency. Financial price series are generally found to be non-stationary and contain a unit root, making the standard t- and F-tests of the hypotheses $a = 0$ and $B_0 = 1$ inappropriate as they tend to bias toward rejecting market efficiency (Elam & Dixon, 1988:368; Lai & Lai, 1991). A time series is stationary if its mean and variance are constant over time and the value of the covariance between two time periods depends only on the distance or lag between the two time periods and not on the actual time at which the covariance was computed (Gujarati, 1995). In other words, a stationary time series does not grow or decline systematically over time.

Tests for market efficiency that use cointegration analysis are designed to deal with the issue of non-stationarity. If two non-stationary series are cointegrated, then there is some linear combination of the two series which is stationary, meaning that in the long-run the two series cannot drift too far apart (see Kennedy, 1996 for a lucid guide to cointegration tests). Thus, if SA white maize futures and spot price series are cointegrated, there is probably a long-run relationship between them, and hence cointegration is a necessary condition for efficiency (Chowdhury, 1991; Crowder & Hamed, 1993; Fortenbery & Zapata, 1993; Lai & Lai, 1991; Lu, 1994).

A time series is integrated of order d, denoted I(d), if the series becomes stationary after differencing d times. An I(0) series is thus, by definition, stationary; whereas a I(1) series contains a unit root and is non-stationary. When the spot price and the futures price are both I(1), the linear combination $u_t = Sp_t - a - B_0Fp_t$ is generally also I(1). However, if there exists a and B_0 such that u_t is stationary or I(0), then Sp and Fp are said to be cointegrated (Engle & Granger, 1987). The standard test for cointegration between Sp and Fp, therefore, entails estimating the residuals series, $\hat{u}_t$, after a and B_0 are estimated from equation (1), as

$$\hat{u}_t = Sp_t - a - B_0Fp_t \qquad (2)$$

and then testing whether or not the û series is stationary using appropriate 'augmented Dickey-Fuller' tests (Dickey & Fuller, 1981) outlined in section five below. If the û series does not have a unit root, Sp and Fp, despite being individually non-stationary, do not drift apart over the long-run, and are cointegrated (Gujarati, 1995). In other words, the forces determining delivery date Sp are reflected in the present futures price, Fp, and Fp can provide reliable forecasts of the *future* Sp. This supports the presence of weak-form market efficiency and implies that information is being transmitted between Fp and Sp, and that price discovery is taking place.

A limitation of this procedure is that no strong statistical inference can be drawn with respect to the parameters a and B_0 which are of main interest here. Although the coefficient estimators can be shown to be consistent, the estimated standard errors may be misleading for hypothesis testing (Johansen 1988; 1990). However, if the residual series is autocorrelated rather than being white noise, past price information as well as Fp can be used to predict the subsequent Sp, and this constitutes a violation of efficiency (Aulton, *et al.*, 1997:410).

Thus, weak-form market efficiency requires that past Sp and Fp do not provide additional and useful information to agents in forming expectations about the future Sp. This embodies the notion that the futures market is well-functioning and instantaneously and fully reflects all available information, and that agents are efficient information processors. Furthermore, if agents are risk neutral, efficiency also implies that Fp provides an unbiased predictor of the subsequent Sp. Tests for efficiency and unbiasedness are described in sections 3.1 and 3.2 below.

3. TESTING FOR EFFICIENCY AND UNBIASEDNESS

3.1 Efficiency test

Testing the hypothesized relationship in equation (1) for efficiency comprises three steps, namely (i) test whether the Sp and Fp series are individually non-stationary, (ii) test for cointegration; and (iii) if the null hypothesis of no cointegration is rejected, then proceed to test for the parameter values consistent with efficiency. The first step involves assessing whether or not the Sp and Fp series individually have a unit root. The second step requires a test of the null hypothesis that there is no cointegration between Sp and Fp. If the two series are cointegrated then there is a linear combination of the two (the û series estimated by equation (2)) that is stationary.

Testing for cointegration entails estimating the long-run relationship and testing the û series for non-stationarity. The estimated parameters of the long-run regression are consistent but have a non-standard distribution (Gujarati, 1995). If the null hypothesis of no cointegration is rejected, the second stage of testing for efficiency entails a test of the joint null hypothesis that $B_1 = \delta = 0$ in equation (3), which ensures that the lagged futures price and the lagged spot price do not contain additional information that could be used to forecast Sp, thus giving traders information with which to make abnormal profits. Since these coefficients can be rewritten as coefficients on stationary variables, the standard distributions apply to the parameter estimators of B_1 and δ obtained via OLS on (3) (Aulton, *et al.*, 1997:413):

$$Sp_t = a + B_0Fp_t + B_1Fp_{t-1} + \delta Sp_{t-1} + \in_t \qquad (3)$$

where

$\in_t$ is the residual (error) term.

If Sp and Fp are cointegrated, and lagged futures and spot prices do not contain any relevant information for forecasting Sp, then it is appropriate to test for unbiasedness, namely that $B_0 = 1$.

3.2 Test for unbiasedness

There is no direct way to carry out this test if Fp and Sp are I (1) series. Following Aulton, *et al.*, (1997:413), however, the restriction $B_0 = 1$ can be imposed and the residual series $u_t = Sp_t - a - Fp_t$ tested for stationarity. If the residuals are stationary then there is evidence to support the hypothesis that $B_0 = 1$ and the market is unbiased. The rationale for this approach is that the cointegrating parameter is unique if cointegration exists between two I(1) series (Granger, 1991 cited by Aulton, *et al.*, 1997:413). If the hypothesis of unbiasedness ($B_0 = 1$) is incorrect when the two series are cointegrated, the residual series obtained by imposing unbiasedness will be non-stationary. In other words, if unbiasedness holds, then the spot and futures series are cointegrated with a unit parameter (see Enders, 1995). Conversely, if the unbiasedness hypothesis does not hold, the spot and futures prices will diverge without bound. White maize spot and futures price data used to apply the above tests are described in section 4.

4. DATA

Daily white maize spot prices and futures prices for the July contract year during both 1997 and 1998 were collected directly from SAFEX. In dealing with crop commodities which experience a one-time supply shock each year and exhibit futures price structures which essentially allocate the crop through the current crop year, the long-run would be that crop year. This is the horizon over which most marketing and storage decisions are made and the period over which futures markets allocate supply. This is the rationale for selecting the year contract. The July contract is the most appropriate year contract as it represents the start of harvesting, and farmers, millers and traders would need to decide what action to take with maize orders from this time on for the year ahead. As a result, this is a fairly well traded month on SAFEX in terms of contract volumes.

The spot price series used is that published by SAFEX as a weekly updated price calculated from the actual cash trade prices submitted by five of the main users of SAFEX - including cooperatives and large traders. This was found to be the most reliable source of daily price information available, since other sources contacted by the authors - like millers and smaller traders - had incomplete data sets, and there is no established price reporting system available in SA (SAFEX, 1998b). The weekly update of Sp may artificially cause heteroskedasticity in the residuals, and so the diagnostic statistics proposed in the paper must be interpreted with caution.

Results for three-month period contracts are also presented, as the relationship between the Sp and Fp series will probably become stronger as the contract nears maturity date as more information is available to agents on likely crop size and expected maize carryover tonnages.

5. RESEARCH METHODOLOGY

5.1 Unit root tests for stationarity

The existence of a unit root in a price series indicates non-stationarity, and implies that conventional regression statistics are inappropriate (see section 2). Test statistics can be based on the OLS estimation of suitably specified 'augmented Dickey-Fuller' (ADF) regression equations for both time series. Equations (4) and (5) below show these equations for the Sp series (similar equations substituting Fp and û for Sp would be estimated for the futures price and residuals series, respectively):

$$\Delta Sp_t = c + gSp_{t-1} + ht + e_t \tag{4}$$

where

t is the time or trend variable with estimated coefficient h, and e_t is the residual (error) term, and

$$\Delta Sp_t = c + gSp_{t-1} + ht + \xi\Delta Sp_{t-1} + \dots\dots + \eta\Delta Sp_{t-j} + e_t \tag{5}$$

if the residual term is expected to be auto-correlated. The number of lagged terms j is chosen to ensure that the residuals are uncorrelated (SHAZAM, 1993:157).

The null hypothesis of a unit root in each equation is that g=0. To test the significance of the estimated g coefficients, the Dickey-Fuller unit root test computes the tau statistic, τ, for each estimated coefficient, in exactly the same way as the Student's t statistic is calculated (estimated g divided by estimated standard error of g). The estimated τ values, however, do not follow the Student's t distribution, even asymptotically, and so the statistical significance of estimated τ values must be assessed by comparing them with critical τ values derived for τ distributions tabulated in Fuller (1976) and Dickey & Fuller (1981). The unit root hypothesis cannot be rejected if the estimated τ is smaller in absolute terms than the appropriate critical τ value.

The ADF equation τ statistics estimated from equation (4) for both the Sp and Fp series for the 1997 white maize contracts are shown in Table 1, where the prefix 3 for series in the right hand side of the table indicates the three months prior to delivery contract.

Table 1: Unit root test statistics for the July 1997 white maize contract price series

Series	τ statistic	DW[1]	Series	τ statistic	DW[1]
Fp	-4.696	1.730	3-Fp	-1.852	2.170
Sp	-0.492	2.059	3-Sp	-1.631	2.094

Note: [1] DW is the Durbin-Watson statistic.

The Fp series for the annual July 1997 contract is stationary (estimated τ exceeds the critical τ value of 2.58 in absolute terms), whereas the Sp series is non-stationary. Therefore the daily price series analysis cannot continue as the two different series cannot be compared (this approach is consistent with Lu (1994)). The three-month 1997 contract price series are both non-stationary series as their absolute estimated τ values are less than the critical value of 2.58, so the analysis can continue with them.

Tau test statistics for the Sp and Fp series for the 1998 white maize contracts are given in Table 2 (the prefix 3 again indicates the three-months prior to delivery contract). Both price series are non-stationary for the annual and three month contracts (estimated τ statistics are less in absolute terms than the critical value of 2.58).

Table 2: Unit root test statistics for the July 1998 white maize contract price series

Series	τ statistic	DW[1]	Series	τ statistic	DW[1]
Fp	-1.088	1.371	3-Fp	-1.031	1.791
Sp	-1.336	1.955	3-Sp	-1.703	2.251

Note: [1] DW is the Durbin-Watson statistic.

The next step in the procedure is to test for cointegrating (long-run) relationships (necessary condition for efficiency) between the non-stationary Sp and Fp series.

5.2 Testing for cointegration and efficiency

Cointegrating equation regressions estimated by equation (1) for the non-stationary Sp and Fp series identified by the unit root tests reported above are presented in Table 3. Year-98 is the annual 1998 contract, while 3-98 and 3-97 are, respectively, the three-month 1998 and three-month 1997 contracts.

Table 3: 1997 and 1998 white maize contract cointegrating regression coefficient estimates

Contract	a	B_0	DW^1	R^2
Year-98	287.000	0.545	0.474	0.74
3-98	280.000	0.557	0.511	0.86
3-97	-0.200	1.058	0.047	0.27

Note: 1 DW is the Durbin-Watson statistic.

The estimated intercept coefficient, a, is far from zero for the annual and three-month 1998 contracts, but close to zero for the three-month 1997 contract. The B_0 estimators, which are consistent if the price series are cointegrated, are not that close to one for both 1998 contracts and, therefore, may indicate bias. The estimated B_0 coefficient for the three-month 1997 contract shows unbiasedness as it is very close to one. The unbiasedness hypothesis is formally tested for each regression in the next section.

Estimated cointegrating regression Durbin-Watson (DW) test statistics are computed to test the null hypothesis that DW=0. The critical DW values are about 0.51 at the 1% level, 0.39 at the 5% level and 0.32 at the 10 % level (Gujarati, 1995). Estimated DW statistics for both of the 1998 contracts indicate rejection of the null hypothesis, and imply cointegration between the 1998 price series. The relatively low estimated DW value for the three-month 1997 contract indicates acceptance of the null hypothesis, and, consequently, that the three-month 1997 contract price series are not cointegrated. The sharp drop in the coefficient of determination, R^2, for the three-month 1997 contract shows that Fp explains relatively less of the variation in Sp for this contract compared to the 1998 contracts. Other variables, like past spot or futures prices, may better explain the variation in the three-month 1997 contract spot price.

Table 4 shows τ estimates for testing the stationarity of the $\hat{u}$ (residuals) series estimated from equation (2) for both of the 1998 contracts and the three-month 1997 contract.

Statistically significant τ values indicate that the null hypothesis of a unit root is rejected for both of the 1998 contracts. This implies that both estimated residual series are stationary - strong evidence of a long-run relationship between Sp and Fp for 1998 (they are cointegrated). The regression coefficients for these cointegrating regressions are, therefore, consistent estimators of the long-run relationship between these price series. In comparison, the three-month 1997

Table 4: Unit root test statistics for residuals series estimated from the 1997 and 1998 white maize contract cointegrating regression equations

Contract	τ statistic	DW[1]
Year-98	-2.878**	1.820
3-98	-3.081**	2.011
3-97	-0.498[NS]	1.938

Note: ** denotes statistically significant at the 1% level of probability.
NS denotes not statistically significant.
[1] DW is the Durbin-Watson statistic.

contract shows no evidence of cointegration between Sp and Fp. The change in cointegration status from 1997 to 1998 may indicate that there has been an improvement in the information transmission performance (progression towards efficiency) of the white maize futures market since 1997. As expected, the three-month 1998 contract shows a stronger relationship than does the annual 1998 contract. The DW statistics reveal no serial correlation in the residuals series of any of the contracts.

Having established the necessary condition for efficiency (presence of cointegration) in the 1998 contracts, the second stage of testing is to consider whether the current futures price on these contracts does contain all publicly available information for predicting the future spot price. The F-test statistics obtained to test the joint significance of lagged spot and lagged futures prices after estimating equation (3) for this purpose are given in Table 5.

Table 5: Second stage test of efficiency for the 1998 white maize contracts

Contract	F value
Year-98	1368**
3-98	68**

Note: ** denotes statistically significant at the 1% level of probability.

Using the joint null hypothesis

$$F = ((R^2_{ur} - R^2_r) / m) / ((1-R^2_{ur}) / (n-k)) \quad (6)$$

where

R^2 is the coefficient of determination, subscript, ur, represents the unrestrained equation (3), subscript, r, represents the restrained equation (1), m is the number of omitted variables in the restrained equation, and k is the number of parameters, all of the estimated F values are highly statistically significant ($F_{2,236}$ =4.61; $F_{2,40}$ = 5.18). Past price information, therefore, seems to have a major effect on the current spot price. This could be evidence that the market is not wholly efficient and that lagged spot and futures prices do contain useful information for forecasting spot prices in subsequent periods. Further evaluation of efficiency can be made by examining the residuals to determine whether or not they are white noise.

The Jarque-Bera (JB) statistic (SPSS, 1975) is used for testing the residuals for normality by equation (7) as:

$$JB = N(S^2/6 + K^2/24) \tag{7}$$

where

N = number of observations, S is the skewness and K is the kurtosis in the sample.

The JB statistics (with estimated probability of normality in parentheses) for the annual 1998, three-month 1998 and the three-month 1997 contracts were 14.95 (0.0), 2.86 (0.25) and 6.57 (0.04) respectively, implying that only the estimated residuals of the three-month 1998 contract approach being normally distributed. White's general heteroskedasticity test (Gujarati, 1995) showed further that the residuals are not white noise. The presence of heteroskedasticity most probably reflects the way that the Sp data used in the analysis were recorded by SAFEX. The spot price on Monday, when the spot price based on data from five of the major traders on SAFEX is reported, is closest to the actual value, but as the week continues the spot price is held the same whereas the futures price will diverge away. Therefore, every week, the residuals from the regression of spot prices on futures price will diverge and then converge repeatedly.

5.3 Testing for unbiasedness

The results given above identify some inefficiency in the SA white maize futures market, but they do not formally show whether the cointegrating relationships are unbiased - that is, whether or not $B_0 = 1$ in equation (1). The τ values estimated for the 1998 contracts by imposing the condition that $B_0 = 1$ and then testing the residual series $\hat{u}_t = Sp_t - a - Fp_t$ for stationarity are reported in Table 6. As explained in section three above, evidence of stationary residuals supports the hypothesis that $B_0 = 1$ and that the market is unbiased.

Table 6: Testing for unbiasedness in the 1998 white maize contracts

Contract	τ statistic	Biased
Year-98	-2.206**	NO
3-98	-1.818*	NO

Note: ** denotes statistically significant at the 5 % level of probability.
* denotes statistically significant at the 10% level of probability.

Statistically significant τ values for both of the 1998 contracts imply stationary residuals and that Fp is an unbiased predictor of Sp, though at the 5% and 10% significance levels. These results again suggest that there could have been a degree of market adjustment toward eliminating some inefficiencies in the SA white maize futures market as market players gained more experience, and market liquidity (volume of contracts traded) improved from late 1996 through to 1998.

6. CONCLUSION

Commodity futures markets can be a useful tool for price risk management if they are efficient (futures prices reflect all publicly known information) and futures prices are unbiased predictors of future spot (cash) prices. Given that there is no published research on the efficiency of the South African futures market for white maize which was established in mid-1996, this paper has examined the performance of annual and three-month July white maize contracts in 1997 and 1998 using cointegration analysis.

The study results suggest that in both the annual and three-month 1998 contracts there is a long-run relationship between the spot price and futures price for white maize, whereas there is no evidence of such a relationship between the two price series for the three-month 1997 contract. The futures price for both 1998 contracts was also an unbiased predictor of the spot price, but both 1998 contracts show weak-form market inefficiency - past prices, especially past spot prices, provide information that can be used to predict spot prices in subsequent periods. White maize futures prices over the study period, therefore, do not seem to incorporate all the information needed to predict future spot prices. This implies that agents in the South African futures market for white maize have been able to profit from information embodied in past prices since trading started in mid-1996. The change in cointegration status from 1997 to 1998 could reflect an adjustment or market learning process toward removing some inefficiencies as market participants gained more experience, and market liquidity rose (contract trading volumes increased). This provides support for continuing education efforts like marketing seminars or extension programmes to educate potential users as to the possible benefits of trading on SAFEX to manage white maize price risk.

This evidence, albeit limited, suggests that South African commercial producers of white maize can use nationally quoted SAFEX white maize futures contract prices to predict the likely direction and level of 'local' (regional) future spot (cash) prices and manage white maize price risk, at least for a portion of their expected annual maize crop. These predictions will be improved by additional knowledge of trends in the size of the local basis (costs of storage) over time. They can also use price information derived from white maize futures contracts in 'discovering' white maize prices when negotiating with millers and other traders of white maize.

The data used in the analysis were not ideal as the spot price series sourced from SAFEX were based on the cash trading prices reported by five major players in the local white maize market. Industry players indicate, however, that these data were the best available source of cash prices. This identifies a market price reporting opportunity for the private sector or an appropriate government agency like the Directorate of Statistics and Information Management. A more representative white maize spot price reporting series needs to be developed, probably on a regional basis. At present, industry players use the SAFEX white maize futures price as a basis for estimating a regional spot price, by discounting from it the transport costs to the specific region. This relatively simple method, though, is flawed as supply conditions differ in different locations. An improved price information service to farmers and other users of white maize may help participants to improve forecasts of future spot prices. This will depend upon the costs of acquiring additional information relative to the benefits. Freer trade in white maize between South Africa and other Southern African countries could encourage more use of SAFEX and further improve futures market liquidity.

Further research opportunities lie in testing the efficiency of the South African yellow maize futures market. Yellow maize is mostly used as an animal feed, unlike white maize which is used mainly for human consumption. Further, South Africa is regarded as a leader in the world market for white maize, whereas for yellow maize, which is traded on the Chicago Board of Trade, South Africa has a very small role in world trade. These differences may identify different factors that need to be addressed in trying to improve the efficiency of these two futures markets.

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