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Price Discovery in the South African Stock Index Futures Market

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Abstract

This paper examines the price discovery between futures and spot markets in South Africa over the period 2002 to 2006. We employ four empirical methods: (i) a cointegration test, (ii) a Vector Error Correction model, (iii) a Granger causality test, and (iv) an Error Correction model with TGARCH errors. Empirical results show that FTSE/JSE Top 40 stock index futures and spot markets are cointegrated. Furthermore, Granger causality, VECM and ECM-TGARCH(1,1) results suggest a bidirectional causality (feedback) between futures and spot prices. We show that futures and spot play a strong price discovery role (FTSE/JSE Top 40 futures prices lead spot prices and vice versa).

Keywords: Price Discovery, Stock index Futures, SAFEX, FTSE/JSE Top 40, South Africa
JEL Classification Codes: G13, G14, G15.

1. Introduction

Futures markets incorporate new information quickly than do cash markets given their low transaction costs and high liquidity. However, market restrictions may produce a lead-lag relationship between prices in spot and futures markets. The lead-lag relationship illustrates how well two markets are linked, and how fast one market reflects new information from the other (Herbst *et al.*, 1987). It investigates whether the spot market leads the futures market, whether the futures market leads the spot market or whether the bi-directional feedback between the two markets exists. Futures markets provide an efficient price discovery mechanism, which supports the hypothesis that futures prices lead spot prices (futures prices contain useful information about cash prices of mature markets). Also, when a bi-directional causality exists between the two price series, then spot and futures have an important discovery role. Lead-lag effects of futures price on spot price concerns timing differences between the two, which results in price discovery when futures lead spot, and mispricing when it lags it. Since stock index futures trading is less expensive than a spot transaction, futures market seems to be more efficient than spot and tends to lead the underlying asset market (Kawaller *et al.*, 1987; Stoll and Whaley, 1990).

The price discovery hypothesis [1] suggests that futures markets discover and establish a competitive reference price for an asset which is used to derive the subsequent spot price (Hasan, 2005). The discovery of one price will definite provide valuable information about the other.

According to Tse (1999), price discovery refers to the impounding of new information into the price. Kenourgios (2004) reports that price discovery refers to the use of futures prices for pricing cash market transactions. Its significance depends upon the equilibrium relationship between futures and spot prices. Price discovery is also interpreted to mean the Granger causality which is associated with the lead-lag relationship between the futures price and the spot price (Chan, 1992).

Most researchers show that futures returns lead spot returns, while futures market has a stronger lead effect (Brooks *et al*., 2001). Empirical research report that futures markets lead spot (cash) markets from a few seconds to hours (Kawaller, Koch and Koch, 1987; Stoll and Whaley, 1990; Brooks *et al*., 2001).

Although empirical studies generally support the price discovery hypothesis for mature futures and cash markets (Brooks *et al*., 2001), we know little about the empirical relationship between cash and futures in the emerging markets. Recently, Lien and Zhang (2008) summarise theoretical and empirical research on the roles and functions of emerging derivatives markets and the resulting implications on policy and regulations. They report that empirical results from a few emerging countries suggest a price discovery function of emerging futures markets. However, the findings on the price stabilization function of emerging derivatives markets are mixed.

In this paper, we examine whether stock index futures discover spot prices using daily data from the South African emerging market. The data employed in this study comprise daily nearby observations on the FTSE/JSE Top 40 stock index futures contract and its spot index (2 January 2002 - 28 February 2006) traded in the South African Futures Exchange (SAFEX) and Johannesburg Stock Exchange (JSE), respectively.

Our findings are very important since no previous work has examined the price discovery role (lead-lag relationship) between the spot index and stock index futures traded in the South African exchanges using recent data and time series methods.

2. Methodology

To investigate price discovery and lead-lag relationships between South African futures and spot markets, we employ four methods: (i) the Johansen (1988) test, (ii) a Vector Error Correction model (VECM), (iii) an Error Correction model with threshold GARCH errors (ECM-TGARCH), and (iv) a Granger causality test. Furthermore, we study the behaviour of series from real shocks using the impulse response functions of the selected VEC model (VECM).

Johansen Test

Let assume that f denotes log-futures and s log-spot prices. The basis of Johansen's (1988, 1991, 1995) approach is to estimate by maximum likelihood methods an equation of the form:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \mathrm{B} X_t + \varepsilon_t$$

$$\Pi = \sum_{i=1}^{p} A_i - I, \Gamma_i = -\sum_{j=i+1}^{p} A_j \qquad (1)$$

where the i determines the number of lags specified in the dynamic VAR relationship, where Δ is the first-difference lag operator, Y_t is a (p x 1) random vector of time series with I(1), Γ are (p x p) matrices of parameters and r is the number of cointegrating relations or vectors (i.e. the cointegrating rank). To test for cointegration between the two variables (futures, spot), Johansen's method (Johansen, 1988, 1991, 1995; Johansen and Juselius, 1990) estimates the Π matrix and also tests whether we can reject the restrictions implied by the reduced rank of Π. According to Johansen (1988), '*the matrix Π contains information about the long-run relationships between the variables in the data vector*'. If r = p (i.e. Π has full rank), then all elements in Y_t are stationary I(0). In this case, Π is the matrix of the form $\Pi = a\ \beta^T$, where a and β are (p x r) matrices of full rank. Johansen (1988) provides the *Trace statistic* to test for the null hypothesis of no cointegration, with *Trace Statistic* = $-T\sum_{i=k+1}^{N}\ln(1-\lambda_i)$ where λ_i (i=1..N) are the canonical correlations between Y_{t-i} and ΔY_t series. Trace test is a joint test where the null is that the number of cointegrating vectors is less than or equal to r (for the description of Johansen test see also Floros and Vougas, 2008).

Vector Error Correction Model (VECM)

Furthermore, if the two markets (spot and futures) are functioning effectively, a cointegrating relationship is expected, and price movements in these markets can be best described by a *Vector Error Correction Model* (see Floros and Vougas, 2008). The VECM [2] restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationships while allowing for short run dynamics. The cointegration term is known as the error correction term (*ect*) since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments (Floros and Vougas, 2008). Consider two variable system, *s* and *f*, with one cointegrating equation (*w*). The VECM has the form:

$$\begin{aligned}\Delta s_t &= \sum_{i=1}^{n}\beta\Delta s_{t-i} + \sum_{j=1}^{k}\delta\Delta f_{t-j} - a_s w_{t-1} + \varepsilon_{S,t}\\ \Delta f_t &= \sum_{i=1}^{n}\gamma\Delta s_{t-i} + \sum_{j=1}^{k}\phi\Delta f_{t-j} - a_f w_{t-1} + \varepsilon_{F,t}\end{aligned} \tag{2}$$

This model contains information on both the short run and long run adjustments. The coefficients a_s and a_f measure the speed of adjustment.

Impulse Response Functions

An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables (Root and Lien, 2003). For each variable from each equation separately, a unit shock is applied to the error, and the effects upon the system (spot, futures) over time are included (see Floros and Vougas, 2008). The impulse response function shows the effect of innovation ε_t on future value $Y_{t+i} = (f,s)_{t+i}$. We plot Y_{t+i} to investigate how the system will respond following a shock. Provided that the system is stable (cointegration and equilibrium exist), the shock should gradually die away.

Granger Causality Test

Under the Granger causality test, we test whether a scalar f_t can help forecast another scalar s_t**.** If it cannot, then we say f_t does not Granger-cause s_t. In particular, if s_t and f_t are cointegrated there must be a Granger causal link between them. That is, turning points in one variable come before turning points in another (Floros and Vougas, 2008). According to Granger (1986), '*if two variables are cointegrated, then causality must exist in at least one direction (or both directions)*'. Consider the models:

$$\begin{aligned}s_t &= a_0 + \sum_{i=1}^{n} a_i s_{t-i} + \sum_{j=1}^{N} b_i f_{t-j} + u_{s,t}\\ f_t &= b_0 + \sum_{i=1}^{n} a_i f_{t-i} + \sum_{i=1}^{N} b_i s_{t-j} + u_{f,t}\end{aligned} \tag{3}$$

where *s* and *f* are stationary variables. The Granger causality method of testing for the null that *f* does not cause *s* (second equation) is equivalent to testing

$H_0: b_1 = b_2 = ... = b_N = 0$ <u>against</u> H_1: at least one $b_j \neq 0$

Bi-directional causality exists if the coefficients b_i from both equations are jointly significantly different from zero (for more information about the Granger causality linear and non-linear tests see Hasan, 2005).

Error Correction Model with TGARCH Errors (ECM-TGARCH)

Following the methodology of Pizzi *et al*. (1998), Zakoian (1994), Glosten, Jaganathan and Runkle (1993) and Floros and Vougas (2008), we run an *ECM-TGARCH* method for testing for cointegration and possible lead-lag effects between the first differences of the spot (Δs) and futures (Δf) prices. We select ECM-TGARCH(1,1) because it allows the conditional volatilities and covariance to adjust to deviations from long-run price disequilibria, as well as, it captures financial time series characteristics (volatility clustering and leptokurtosis). Furthermore, a TGARCH model has the advantage of permitting investigation of the potentially asymmetric nature of the response to past shocks. The ECMs for futures and spot prices (mean equations of TGARCH), including the residuals (equilibrium errors), have the form:

$$\Delta s_t = c + a\vartheta^{s}_{t-1} + b\Delta f_t + \sum_{i=1}^{n}\theta_i \Delta s_{t-i} + \sum_{j=1}^{k}\phi_j \Delta f_{t-j} + u_t \tag{4}$$

where $\Delta s_t = s_t - s_{t-1}$, $\Delta f_t = f_t - f_{t-1}$ and $\vartheta^{s}_{t-1} = s_{t-1} - \beta_2 f_{t-1}$.

and $$\Delta f_t = c + a\vartheta^{f}_{t-1} + b\Delta s_t + \sum_{i=1}^{n}\theta_i \Delta s_{t-i} + \sum_{j=1}^{k}\phi_j \Delta f_{t-j} + u_t \tag{5}$$

where $\vartheta^{f}_{t-1} = f_{t-1} - \beta_1 s_{t-1}$. The conditional variance of TGARCH is given by

$$\sigma_t^2 = \omega + \sum_{i=1}^{q} a_i \varepsilon_{t-i}^2 + \gamma\varepsilon_{t-1}^2 d_{t-1} + \sum_{j=1}^{p}\beta_j \sigma_{t-j}^2$$

where $d_t = 1$ if $\varepsilon_t < 0$ and $d_t = 0$ otherwise. If the residuals (ϑ) are stationary, we are able to estimate the ECM using GARCH errors, under a TGARCH(1,1) model.

In TGARCH model, good news ($\varepsilon_t > 0$) and bad news ($\varepsilon_t < 0$) have differential effects on the conditional variance. In particular, good news has an impact of a, while bad news has an impact of $a + \gamma$. If $\gamma > 0$ and significant, then the leverage effect exists and bad news increases volatility, while if $\gamma \neq 0$ the news impact is asymmetric (see Zakoian, 1994 and Glosten, Jaganathan and Runkle, 1993).

Given that the fat tails are observed in most financial futures indices (Chan *et al*., 1991), we use the General Error Distribution (GED) assumption for the standardized residuals (see Floros, 2008).

3. Data Description

This study employs 1043 daily observations on the FTSE/JSE Top 40 stock index and stock index futures contract for the period 2 January 2002 - 28 February 2006. Closing prices for the spot index were obtained form the *DataStream International*, while closing futures prices were obtained from the official webpage of the South African Futures Exchange or SAFEX (http://www.safex.co.za), an emerging market.

According to Smith and Rogers (2006, p. 410), South Africa became the second emerging market to trade index futures when All Share futures were launched on 30 April 1990 (for more information about JSE and SAFEX, see Smith and Rogers, 2006).

The formal futures exchange was established in 1988 together with the SAFEX clearing company (see Smith and Rogers, 2006). FTSE/JSE Top 40 stock index consists of the largest 40 companies ranked by full market capitalisation (value) that is before the application of any weightings in the All Share Index. The futures contract is the FTSE/JSE’s Top 40 future nearest to expiration, assuming a rollover to the next contract expiration. Analysis is confined to the nearby contract because almost all trading volume is in the near month so that liquidity is much greater in that contract compared with the far contract. (Motsa, 2006)

The futures contracts are quoted in the same units (South African Rand) as the underlying index without decimals, with the price of a futures contract or contract size being the quoted number (index level) multiplied by the contract multiplier, which is R10 for the contract. Futures expiry months are March, June, September and December. The stock index futures contract is cash-settled and marked to market on the last trading day, which is at 15:40 South African time on the third Thursday in the delivery or expiration month. (for more details see Motsa, 2006)

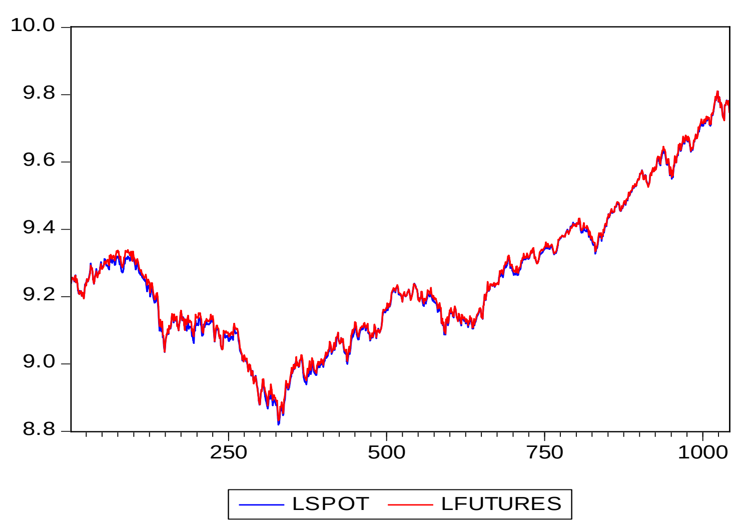
Table 1 gives the descriptive statistics for daily spot and futures logarithmic series. The positive value for skewness indicates that the series distribution is skewed to the right. The value for kurtosis is close to three for both indices. So, we find that prices show excess kurtosis (leptokurtic pdf), implying fatter tails than a normal distribution. The Jarque-Bera test rejects normality at the 5% level for all distributions. Also, Figure 1 presents the plots of logarithmic FTSE/JSE Top 40 stock index and stock index futures. We conclude that there is a comovement between logarithmic cash and futures prices (prices move together over time). Furthermore, unit root tests (ADF and PP) [3] results for both series indicate that the series are I(1), and cointegration tests can be used to confirm whether there exists such a cointegrating structure between spot and futures markets.

Table 1: Summary Statistics (logarithmic series)

	s	*f*
Mean	9.249320	9.254841
Median	9.214296	9.216223
Maximum	9.810420	9.810714
Minimum	8.819328	8.832150
Std. Dev.	0.216988	0.215452
Skewness	0.615590	0.617999
Kurtosis	2.801051	2.800908
Jarque-Bera	67.39996	67.91766
Probability	0.000000	0.000000
Observations	1040	1040

Notes: s denotes log(spot), f denotes log(futures)
Skewness is a measure of asymmetry of the distribution of the series around its mean.
Kurtosis measures the peakedness or flatness of the distribution of the series.
Jarque-Bera is a test statistic for testing whether the series is normally distributed.

Figure 1: FTSE/JSE Top 40 Spot and futures prices (in logarithms)



4. Empirical Results

Cointegration (Johansen) results

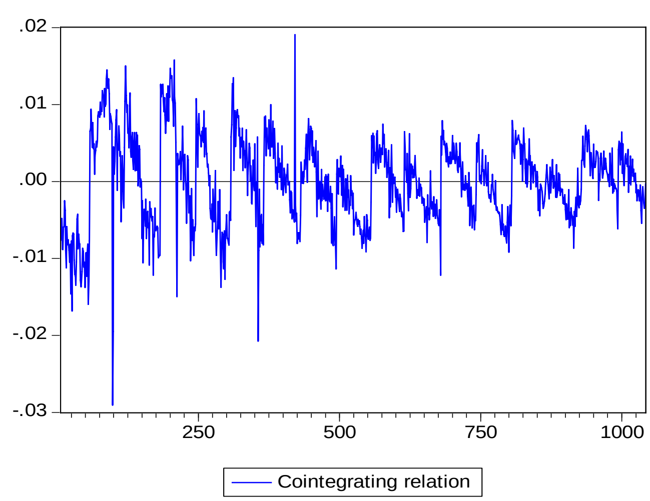
Table 2 presents the results from the selected VAR-Johansen (cointegration) test [4]. The results confirm that FTSE/JSE Top 40 futures and spot series are cointegrated with one cointegration relationship (this is in line with previous studies). Therefore, there exists a linear combination of spot and futures prices that is stationary. This is confirmed from the cointegration relation graph presented in Figure 2. Hence, the price discovery function implies here the presence of an equilibrium relation between South African spot and futures prices. This is in line with Smith and Rogers (2006) for SAFEX. They test the random walk hypothesis for 4 stock index futures and a sample of 36 single stock futures traded on the SAFEX. The data covers the period 1998-2005 (stock index futures) and 2000-2005 (single stock futures). Empirical results show that there is a high degree of weak-form efficiency (all SAFEX series follow a random walk).

Table 2: Johansen Test (equation 1)

Trend assumption: Quadratic deterministic trend Series: f s Lags interval (in first differences): 4 Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.035458	39.12944	18.39771	0.0000
At most 1	0.001630	1.691868	3.841466	0.1934

Notes: Trace test indicates 1 cointegrating equation at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Figure 2: Cointegrating relation (FTSE/JSE Top 40 spot and futures prices)



VECM results

The results from the selected VECM are presented in Table 3. Firstly, the cointegration term (lagged parameter of the cointegration equation) is negative and highly significant indicating a long-run relationship among the variables (futures and spot markets are moving together over time). The error correction term for futures is positive and significant, while for spot is negative but insignificant. This suggests that when the cointegrating vector is above equilibrium, then the futures returns increase by 19.39% in order to obtain its equilibrium position, whereas when it is below equilibrium they decrease by 19.39%. Similarly, for the spot case, when the cointegrating vector is above equilibrium the spot returns increase by almost 6% and vice-versa. The fact that the coefficient of the error correction term in the futures equation is significant but insignificant in the spot equation implies that only futures returns respond to correct a shock in the system in order to reach the long-run equilibrium. In addition, the error correction term in futures is greater than that in spot indicating greater error correction effect.

Further, in the futures equation the 2-periods lagged changes in futures and spot prices are significant (same in the spot equation). These findings show that spot and futures are strongly correlated and show lead (causal) effects. In other words, we conclude that futures market leads spot market and spot market leads futures market. Hence, there is a bidirectional causality relationship (from FTSE/JSE Top 40 futures to FTSE/JSE Top 40 spot and vice-versa). Also, the coefficient of the error correction term (ect) in the futures equation is positive and significant, while the ect of the spot equation is not significant at 5% level. Hence, for futures, the ect has a significant feedback effect on the changes in the dependent variable in order to force temporary deviations back towards long-run equilibrium (see Floros, 2005). It is obvious that spot index may have stronger information effect on futures index in South Africa.

Table 3: Vector Error Correction Model (equation 2)

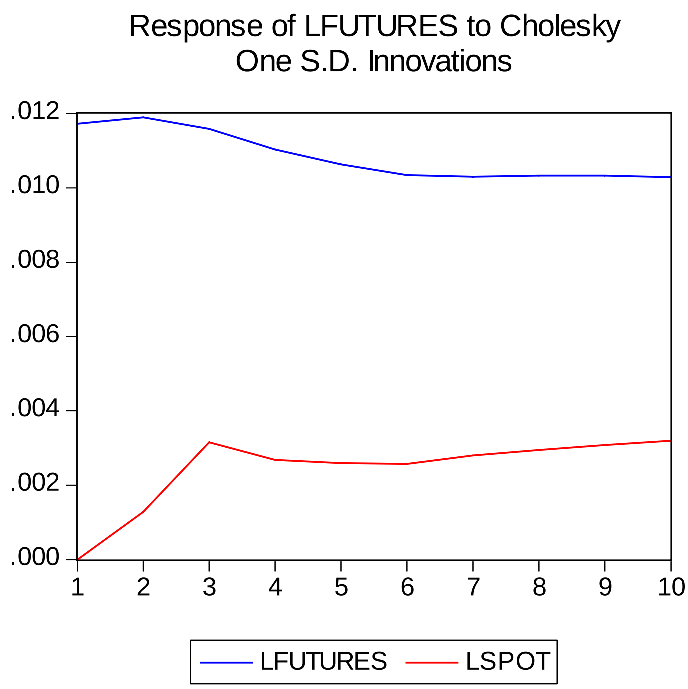
Vector Error Correction Estimates (VECM) t-statistics in [ ]		
Cointegrating Eq:	**Coint. Equation**	
s_{t-1}	1.000000	
f_{t-1}	-1.002710 [-192.432]*	
TREND	-4.65E-06*	
Constant	0.033046	
Error Correction:	Δs_t	Δf_t
ect	0.061960 [0.86510]	0.193967 [2.59664]*
Δs_{t-1}	-0.106231 [-0.90020]	0.197755 [1.60674]
Δs_{t-2}	0.327500 [2.76552]*	0.531087 [4.29990]*
Δs_{t-3}	-0.143303 [-1.23116]	-0.000524 [-0.00432]
Δs_{t-4}	-0.007603 [-0.07085]	0.015254 [0.13628]
Δf_{t-1}	0.169180 [1.49055]	-0.150428 [-1.27073]
Δf_{t-2}	-0.312087 [-2.71488]*	-0.517596 [-4.31713]*
Δf_{t-3}	0.043495 [0.38898]	-0.069984 [-0.60008]
Δf_{t-4}	-0.016649 [-0.16159]	-0.033079 [-0.30783]
Constant	-0.001027 [-1.45521]	-0.000953 [-1.29441]
TREND	2.92E-06 [2.47795]	2.76E-06 [2.24367]
Log likelihood		7613.073
Akaike information criterion		-14.63659
Schwarz criterion		-14.52217

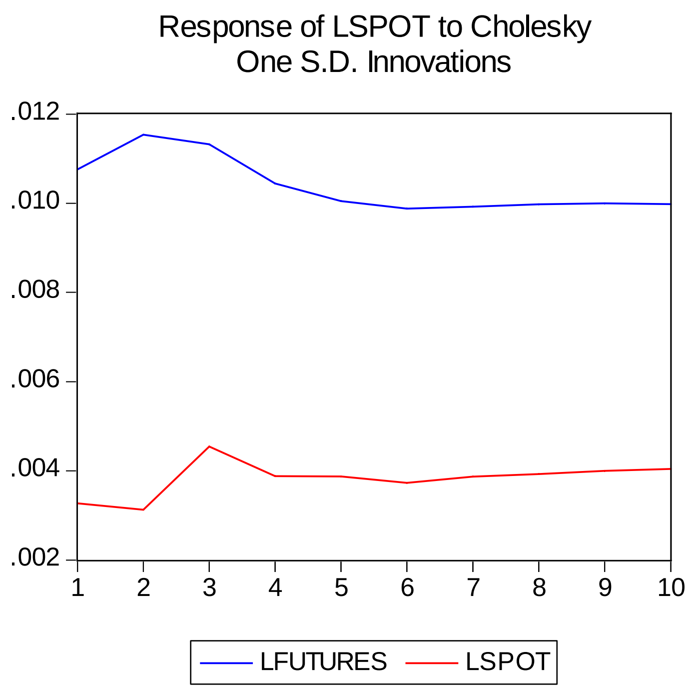
Notes: * Significant at 5% level

Impulse response functions results

The results from the impulse response functions are presented in Figure 3. Figure 3 shows that futures have a large response to the shocks in spot index for 8 to 9 periods. In addition, it takes 6 to 7 periods for the largest effects in this shock to settle down in futures. However, the impulse responses die out steadily, indicating cointegration between futures and spot in South Africa. Figure 3 also shows that a shock in futures initially increases and then decreases, while the opposite happens with a shock in spot.

Figure 3: Impulse Responses (FTSE/JSE Top 40 spot and futures)





Granger causality results

We use Granger-causality tests to determine whether changes in one variable (futures) cause changes in another (spot).The results from the application of Granger causality tests to FTSE/JSE Top 40 spot and futures data are presented in Table 4. Table 4 shows that there is strong evidence of bidirectional causality between futures and spot prices in South Africa. Therefore, we prove that there is a feedback relationship between FTSE/JSE Top 40 futures and spot prices. In other words, we find that futures (spot) can help forecast spot (futures) from SAFEX. We conclude that there is a strong correlation between the current and the past values (in line with the previous findings).

Table 4: Granger-causality test (equation 3)

Pairwise Granger Causality Tests Sample: 1 1042 Lags: 4			
Null Hypothesis:	**Obs**	**F-Statistic**	**Prob.**
s does not Granger Cause *f*	1038	11.3367*	5.E-09
f does not Granger Cause *s*		5.26932*	0.0003

Notes: * Significant at 5% level

ECM-TGARCH(1,1) Results

An error correction model exists if the residuals (ϑ_s and ϑ_f) are stationary. The ADF unit root tests on ϑ_s and ϑ_f (not reported here) show that the null hypothesis of a unit root is rejected indicating that there is a short-run relationship. Hence, an equilibrium relationship exists between *f* and *s*, implying market efficiency and cointegration (this is in line with Smith and Rogers, 2006).

The results from a selected ECM-TGARCH(1,1) model are presented in Table 5 (spot equation) and Table 6 (futures equation). For spot index, the sum of ARCH and GARCH coefficients (conditional variance equation) is very close to one, indicating that spot volatility shocks are quite persistent. The coefficient of the lagged squared returns is positive and statistically significant for both spot and futures. We also conclude that strong GARCH effects are apparent for both markets. In addition, the coefficient of lagged conditional variance is significantly less than one, indicating that the impact of 'old' news on volatility is significant. The magnitude of the GARCH coefficient,β, is quite high, indicating a long memory in the variance. The TGARCH leverage effect term γ is positive and significant in futures, and therefore, the news impact is asymmetric. Hence, the leverage effect exists and only bad news increases futures volatility. Further, the estimate of ARCH coefficient, a , is smaller than the estimate of γ in futures case only, which implies that negative shocks haven't a larger effect on conditional futures volatility than positive shocks of the same magnitude.

The results from the ECM's (mean equations) show that changes of the spot index depend on its own lagged changes and the current and present futures price changes. As the coefficients of the error correction terms (ϑ_s and ϑ_f) are negative and significant then a short run relationship between spot and futures prices exists in SAFEX. For lead-lag relationships, all coefficients are significant, indicating that the movement of spot is affected by futures (and vice-versa). In particular, the coefficients of Δs's and Δf's are positive and significant, indicating that the futures market leads the spot market and vice-versa. Thus, there is definite bidirectional causality effect, from futures to spot and spot to futures, in SAFEX. This is in line with Floros and Vougas (2008) paper for the Greek futures market.

Table 5: ECM-TGARCH(1,1) model for Spot (equation 4)

Dependent Variable: Δs_t Method: ML - ARCH (Marquardt) - Generalized error distribution (GED)				
Mean Equation	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
Constant	0.000210	6.27E-05	3.356713*	0.0008
Δs_{t-1}	-0.327682	0.024709	-13.26156*	0.0000
Δf_t	0.941194	0.005355	175.7442*	0.0000
Δf_{t-1}	0.343655	0.023731	14.48153*	0.0000
ϑ^s_{t-1}	-0.070422	0.012295	-5.727849*	0.0000
	Variance Equation			
Constant	1.17E-06	3.53E-07	3.322062*	0.0009
ARCH	0.232987	0.075229	3.097050*	0.0020
γ	-0.174705	0.078968	-2.212350*	0.0269
GARCH	0.753028	0.054826	13.73497*	0.0000
GED PARAMETER	1.006671	0.032647	30.83481*	0.0000

Notes: * Significant at 5% level

Table 6: ECM-TGARCH(1,1) model for Futures (equation 5)

Dependent Variable: Δf_t Method: ML - ARCH (Marquardt) - Generalized error distribution (GED)				
	Coefficient	**Std. Error**	**z-Statistic**	**Prob.**
Constant	-0.000245	6.42E-05	-3.809582*	0.0001
Δf_{t-1}	-0.356083	0.024969	-14.26084*	0.0000
Δs_t	1.017739	0.005774	176.2672*	0.0000
Δs_{t-1}	0.347279	0.025790	13.46576*	0.0000
ϑ^f_{t-1}	-0.076866	0.012613	-6.094254*	0.0000
	Variance Equation			
Constant	1.56E-06	4.49E-07	3.469343*	0.0005
ARCH	0.070220	0.036730	1.911799*	0.0559
γ	0.209592	0.097451	2.150743*	0.0315
GARCH	0.708158	0.062099	11.40360*	0.0000
GED PARAMETER	0.991345	0.032520	30.48388*	0.0000

Notes: * Significant at 5% level

5. Summary and Conclusion

The issue of linkages between financial markets is an important concern for investors and financial managers in emerging stock and derivatives markets. Lien and Zhang (2008) summarise theoretical and empirical research on the roles and functions of emerging derivatives markets, and report that the price stabilization function findings of emerging derivatives markets are mixed. In this paper, we empirically investigate the price discovery, lead-lag relationship and causality between the South African cash and futures prices. In particular, we investigate the relationship between daily spot and stock index futures traded in the South African Stock Exchange (JSE) and Futures Exchange (SAFEX) for the period 2002-2006. A lead-lag relation exists when one market reacts faster to information due to transaction costs or other capital market effects (Floros and Vougas, 2008). Further, one of the economic function of futures contracts, price discovery, refers to whether new information is reflected first in changes of futures prices or in changes of cash prices (Gardabe and Silber, 1983; Kenourgios, 2004).

Our empirical results have important implications for both emerging markets traders and speculators. First, we show that both series, FTSE/JSE Top 40 spot and futures, are cointegrated (under Johansen test). Therefore, a co-movement between prices exists (South African futures and spot prices form a stable cointegrating relationship). The presence of cointegration is also confirmed from impulse response functions, and suggests a violation of weak form market efficiency and possibility of an arbitrage opportunity. This is in line with the recent works of Smith and Rogers (2006) for South Africa, and Floros and Vougas (2008) for Greece. Hence, the existence of cointegration implies that one of the variables can be used to predict the other. Using a VECM and an ECM-TGARCH(1,1), we conclude that there is a bidirectional causality relationship (from futures to spot and vice-versa). Spot and index futures reflect new information because SAFEX traders buy or sell both stocks and index futures contracts, while they prefer to use both markets to exploit information about the South African economy.

In addition, ECM-TGARCH(1,1) results show that news impact is asymmetric for futures, while the leverage effect exists and bad news increases futures volatility. Further, negative shocks haven't a larger effect on conditional futures volatility than positive shocks of the same magnitude.

Overall, this paper provides some evidence on the empirical relationship between FTSE/JSE Top 40 spot and futures markets. The evidence of cointegration between the markets implies that prices cannot move far away from each other. We show that emerging spot and futures markets play a strong price discovery role, implying that futures (spot) prices may contain useful information about spot (futures) prices. This is in consistent with Lien and Zhang (2008) for emerging derivatives markets.

Our findings are helpful to traders, speculators and financial managers dealing with emerging stock index futures. Future work should investigate the dynamic linkages of derivatives emerging markets.

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Notes

[1] The price discovery implies that prices in the spot and futures markets are systematically related in both the short and long run (see Gardabe and Silber, 1983).

[2] A VECM is a restricted VAR designed for use with nonstationary series that are known to be cointegrated (see Floros, 2005).

[3] The results from the unit root tests, Augmented Dickey Fuller (ADF) and Philips-Perron (PP), are available upon request.

[4] Akaike information criterion (AIC) selects a Vector Autoregrssive (VAR) model with 4 lags for spot and futures; VAR results are available upon request.