A TEST OF THE WEAK FORM EFFICIENCY OF SOUTHERN AFRICA POWER POOL

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ABSTRACT

Knowledge of whether or not a market is weak-form efficient is fundamental as it determines whether 'chartists' can study past price history in order to successfully forecast and make supernormal profits. This research investigates the informational efficiency of the Southern African Power Pool electricity market, in its weak form. The backbone of the study arises from the development of the random walk theory and efficient market hypothesis and the ability to integrate these theories that were developed mainly for stock markets, into other commodity markets like energy markets. According to the efficient market hypothesis and the random walk theory, in an efficient market it is not possible to predict the future commodity prices by analysing historical prices, since price movement tends to follow a 'drunkard man's walk' form- it is random. Daily price data for each of the thirteen market players, from 1 January 2011 to 28 February 2013, was used for the analysis. It was obtained from the Southern African Power Pool (SAPP) official website. Descriptive statistics like skewness and kurtosis were employed to test for normality in the data. Other normality tests, that is Kolmogorov-Smirnov and Shapiro-Wilk tests were used too. From the results obtained, most market players failed the test of normality. Autocorrelation tests and the Box-Ljung statistic were used to establish the relationship between consecutive prices up to a lag of 5. The Augmented Dickey-Fuller sought to find out if each trader does not have a unit root and hence confirming that prices do not follow a random walk. Other tests for non-randomness like the runs test confirmed that 86% of the market is definitely non-random and follows a certain pattern. The overall conclusion drawn was that the Southern African Power Pool electricity market, which has 13 active players is weak-form informationally inefficient. To the knowledge of the researcher, there is no study on weak form efficiency that has been done on the SAPP market.

Keywords: *SAPP, weak form efficiency, randomness.*

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INTRODUCTION

The Southern Africa Power Pool market is still a fairly new and developing market. In 1995, the Ministers responsible for energy in the Southern African Development Community (SADC) signed an Inter-Government Memorandum of Understanding that lead to the creation of a power pool under the name SAPP. The aim was to optimise the use of available energy resources in the region and support one another during emergencies. The countries in the Southern of Africa mainly export and import electrical energy among each other, with the SAPP as their medium of trade. The SAPP was created with the primary aim to provide reliable and economical electricity supply to the consumers of each of the SAPP members, consistent with the reasonable utilisation of natural resources and the effect on the environment. Table 1 shows the members of the SAPP, their generation companies and their respective capacities for electricity production, in MW, as of January 2013.

Table 1: Members of the SAPP

Country	Generation, transmission and distribution company	Available capacity (MW)
Angola	Empresa Nacional de Electricidade de Angola	1,480
Botswana	Botswana Power Corporation	322
Democratic Republic of the Congo	Société nationale d'électricité (SNEL)	1,170
Lesotho	Lesotho Electricity Corporation	72
Mozambique	Electricidade de Moçambique	2,279
Malawi	Electricity Supply Commission of Malawi	287
Namibia	NamPower	360
South Africa	Eskom	41,074
Swaziland	Swaziland Electricity Board	70
Tanzania	Tanzania Electric Supply Company Limited	1,143

Zambia	Zambia Electricity Supply Corporation Limited	1,845
Zimbabwe	Zimbabwe Electricity Supply Authority	1,600

Source: (Beta, 2013)

The efficient market hypothesis (EMH) has been applied to many other markets. However, there is very little research on testing efficiency of electricity market. The researcher focused on the efficiency of the electricity market, since it is a less explored area in the case of SAPP than the literature regarding market competition and therefore might have new answers as to whether SAPP is a well-functioning market. The article aims to bring some clarity to whether there is any viability in the claims of the electricity market being inefficient. In an efficient market systematic undervaluing or overvaluing of electricity does not occur. It is not possible to develop trading rules, which will beat the market by buying identifiable under-priced electricity units, except by chance. If the market is inefficient it regularly prices electricity incorrectly, allowing a perceptive trader to identify profitable trading opportunities.

LITERATURE REVIEW

The recent deregulation of the electric utility industry has led to the evolution of SAPP into a competitive market which, according to Beta (2013), SAPP believes would help to optimise the use of regional resources, assist in determining the correct electricity price in the pool, send signals for investments and real time utilization of existing assets; transmission, generation and consumption and enable the demand side to respond to the supply side price signals. If capital markets are sufficiently competitive, then simple microeconomics indicates that investors cannot expect to achieve superior profits from their investment strategies.

DEVELOPMENT OF A COMPETITIVE ELECTRICITY MARKET IN SOUTHERN AFRICA

In April 2001, the SAPP started the short-term energy market (STEM) as a precursor to a full competitive market. The development of the competitive electricity market started in January 2004 when an Agreement between the Government of Norway and SAPP provided SAPP with a grant to the amount of NOK 35 million for this purpose. The signing of the Revised Inter-Governmental Memorandum of Understanding by the Ministers responsible for energy in the SADC region in Gaborone, Botswana, on 23 February 2006, marked the beginning of the restructuring of the SAPP (Beta, 2013). At present, SAPP has since adopted the Day-Ahead market-trading platform that developed by Nord Pool.

THE DAY AHEAD MARKET (DAM)

The energy traders in the SAPP market trade energy through a system called the Day-Ahead Market, which is governed by the (SAPP, 2009), which stipulates trading procedures for DAM, price calculation, congestion management, confirmation of trade, how trades are settled, and how transmission losses are to be dealt with and obligations of the market operator. The Day Ahead Market facilitates the development of a competitive market in the Southern African Region. The DAM is a firm energy market. Trading is conducted daily for delivery next day, hourly energy contracts for each of the 24 hours of the following day, or a future day.

HOW ENERGY IS TRADED ON THE DAM

The market operator receives bids, transfers constraints and other related information and conducts a daily auction according to approved rules using relevant computer technology, publishes the allocated volumes and prices to the relevant participants according to the agreed time lines. In addition, the market operator will submit credit notes and invoices to the relevant participants according to the agreed timelines, and follow up on collateral requirements and payments for the relevant participants according to the agreed timelines and is also responsible for keeping transaction records.

EFFICIENCY RELATING TO ENERGY MARKETS

Nordic Power Exchange (NPE) was found to be market inefficient (Pettersen, 2007). However, testing of efficiency on the NPE using the co-integration and error correction model yielded inconclusive decision about NPE's efficiency (Salmi, 2010). Aatola, Ollikka and Ollikainen (2010) conducted a test for weak- form and semi-strong form efficiency on the European Union emissions trading market and they found that there had been some possibilities to trade successfully within the study period based on their trading simulation, the average returns covered the transaction costs and the risk premium only with the trading strategies based on the combined model of fundamental and technical analyses and they stated that they found empirical evidence of the weak form informational efficiency in the EU ETS market during 2006- 2009 by analysing the second phase forward contracts. The weekly based trading reflects well the way compliant traders are acting in the market (Sandoff and Schaad, 2009; Jaraite et al., 2010). Shawky, Marathe, and Barrett (2003) investigated the statistical properties of wholesale electricity spot and futures prices traded on the New York Mercantile Exchange for delivery at the California–Oregon Border using daily data for the years 1998 and 1999, they found that many of the characteristics of the electricity market can be viewed to be broadly consistent with efficient markets. Goss and Avsar (1999) investigated if prices on the New South Wales and

Victorian electricity markets reflect all publicly available information as fully as possible. This was done by the forecast error approach, which permits a test of the semi-strong efficient markets hypothesis (EMH) even with the small number of observations then available. The results suggested that the EMH could not be rejected, both in weak-form and semi-strong form. The researcher tested for randomness of the SAPP energy prices since testing for weak form efficiency has been typically based on investigating the behavior of price processes (Mazviona and Nyangara, 2013).

DESCRIPTION OF DATA

The analysis required the constrained energy price per MWh for companies trading on the SAPP energy market over a period of at least one year. SAPP prices data ranging from 1 January 2011 to 28 February 2013 has been used. It was obtained from the SAPP website. The period 1 January 2011 to 28 February 2013 was chosen as it presented big enough a sample size and sizeable to be manageable for calculations. Although there is some data available for the year 2010, they have been excluded from the study so as to allow for adjustment since the DAM was still fairly new. The data was not steady and according to the data custodians (The SAPP Coordination Centre), most part of 2010 was spent either trial-testing the system or trading at all due to system failure. The facts that by 2011, Zimbabwe, as a part of the SAPP market, had fully encompassed the United States dollar (USD), which is a stable currency, as its official currency and decent adjustments in its economy had happened by beginning of 2011, have also been taken into account.

HYPOTHESIS

The purpose of this study is to investigate whether or not the SAPP electricity market is weakly efficient within the context of the theoretical framework of the efficient market hypothesis. Under the hypothesis of the weak form informational efficiency, the price behaves like a random walk and therefore testing the random walk properties of the price series is necessary.

H_0: Electricity prices on the SAPP energy market follow the random walk.

H_1: Electricity prices on the SAPP energy market do not follow the random walk.

RESEARCH METHODOLOGY

The daily electricity prices for SAPP were assumed to follow a log-normal distribution. The returns from the SAPP were computed in a similar manner (see Mazviona and Nyangara, 2013):

$$r_t = In\left(\frac{P_t}{P_{t-1}}\right)$$

$$P_t = \text{Electricity price at time } t$$
$$P_{t-1} = \text{Electricity price at time } t-1$$

AUTOCORRELATION

It tests the relationship between the time series and its own values at different lags. Its aim is to determine whether electricity returns are correlated over time under the following hypothesis:

H_0: Electricity returns are not significantly correlated over time.

H_1: Electricity returns are significantly correlated over time.

Rejection criteria: Reject H_0 if the correlation coefficients of returns at all lags are not zero.

If the alternative hypothesis is accepted then that means there is autocorrelation, prices do not follow a random walk process, and the market is not weak-form efficient. Autocorrelation tests show whether the prices at the respective time lags are related to the prices at time 0. In a weak form efficient market we expect prices to resemble no correlation to prices in the past, therefore in an efficient market zero correlation must prevail (Hamid et al, 2010).

RUNS TEST

The runs test detects non-randomness. It is a traditional method used in the random walk model and ignores the properties of distribution (non-parametric), which is used to test the randomness of the series which autocorrelation fails to do. Runs tests also indicate that price changes (upticks and downticks) are independent over time. This is why they are done in binary form. It has been used to judge the randomness in the behaviour of other commodity markets, particularly energy markets. The actual number of runs is compared with the expected number of runs. If the actual number of runs is not significantly different from the expected number of runs, then the price changes are considered independent, and if this difference is significant then the price changes are considered dependent. In order to test the significant difference between the actual number of runs and expected number of runs, the test statistics employed will be 'Z'. The Z-value is tested at 5% significant level, that is, one cannot reject the null hypothesis with 95% confidence level.

H_0: Price changes are independent over time (the series are random).

H_1: Price changes are not independent.

Rejection criteria: Reject H_0 if the calculated number of runs falls outside the 95% confidence interval ($\mu-1.96\ \sigma \leq k \leq \mu + 1.96\ \sigma$) and accept H_0 if the value lies in between ±1.96.
The expected number of runs can be obtained by applying the following formula:

$$E(r) = 1 + 2\frac{n_0 n_1}{n_0 + n_1}$$

Where: E (r) = expected number of runs.
n_0 = number of negative runs.
n_1 = number of positive runs.

The standard error of the expected number of runs of all signs may be obtained as:

$$S.E = \sqrt{\frac{2n_0 n_1 (2n_0 n_1 - n_0 - n_1)}{(n_0 + n_1)^2 (n_0 + n_1 - 1)}}$$

The expected number of runs is now compared with the actual number of runs. The difference between actual number of runs and expected number of runs can be expressed by a standardized value 'Z' as shown below:

$$Z = \frac{R - E(r)}{S.E} + 0.5$$

Where R is the actual number of runs and 0.5 is a continuity adjustment. (Razali and Wah, 2011)

THE Q-STATISTIC

It is also known as the Ljung-Box (LBQ) test, it provides a superior fit to the chi-square (χ^2) distribution for little samples. In large samples, the Q-statistic is approximately distributed as a chi-square distribution with *m* degree of freedom. In the case that the computed Q exceeds its critical value on the chi-square distribution at a given significance level, null hypothesis is rejected.

H_0: The data is independently distributed (there is no autocorrelation).

H_1: The data is not independently distributed.

Rejection criteria: reject H_0 if the significance of the statistic based on the asymptotic chi-square approximation is 0.

The formula for the Q statistic is given below:

$$Q_{LB} = N(N+2)\sum_{j=1}^{k}\frac{\rho_j^2}{N-j}$$

Where N is the sample size, ρ_j is the sample autocorrelation at lag j, and k is the number of lags being tested. For significance level α, the critical region for rejection of the hypothesis of randomness is $Q > \chi^2_{1-\alpha,k}$, where $\chi^2_{1-\alpha,k}$ is the α-quantile of the chi-squared distribution with *k* degrees of freedom. (Burns, 2002)

KOLMOGOROV SMIRNOV AND SHAPIRO WILK TESTS

The Kolmogorov Smirnov and Shapiro Wilk tests are tests of normality. The Kolmogorov Smirnov test is a nonparametric test for the equality of continuous, one-dimensional probability distributions that can be used to compare a sample with a reference probability distribution. The Kolmogorov–Smirnov statistic quantifies a distance between the empirical distribution function of the sample and the cumulative distribution function of the reference distribution, or between the empirical distribution functions of two samples. The Kolmogorov- Smirnov and Shapiro- Wilk's tests for normality calculate the probability that the sample was drawn from a normal population. Large probabilities denote normally distributed data.

H_0: The sample data are not significantly different from a normal population.

H_1: The sample data are significantly different from a normal population.

Rejection criteria: reject H_0 if the lower bound of the true significance is not "large". At 95% confidence interval, the probability should be more than 0.05 for H_0 to be accepted.

The Kolmogorov-Smirnov test statistic is defined as

$$D = \max_{1 \le i \le N}\left(F(Y_i) - \frac{i-1}{N}, \frac{i}{N} - F(Y_i) \right)$$

Where F is the theoretical cumulative distribution of the distribution being tested which must be a continuous distribution and N is the sample size.

The Shapiro-Wilk test statistic is given by:

$$W = \frac{\left(\sum_{i=1}^{n} a_i x_{(i)}\right)^2}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

Where:
- n is the sample size
- $x_{(i)}$ is the ith order statistic
- $\bar{x}$ is the sample mean, and
-the constants a_i are given by:

$$(a_1,\ldots,a_n) = \frac{m^T V^{-1}}{(m^T V^{-1} V^{-1} m)^{1/2}}$$, where $m = (m_1,\ldots,m_n)^T$

-$m_1,\ldots,m_n$ are the expected values of the order statistics of independent and identically distributed random variables sampled from the standard normal distribution, and
-V is the covariance matrix of those order statistics

The null hypothesis is rejected if W is too small (Jarek, 2013).

AUGMENTED DICKEY–FULLER TEST (ADF)

The Augmented Dickey–Fuller test (ADF) is a test for a unit root in a time series sample (Francetic, 2013). It is an amplified version of the Dickey–Fuller test for a larger and more complicated set of time series models. The augmented Dickey–Fuller (ADF) statistic, used in the test, is a negative number.

H_0: A trader has a unit root.

H_1: A trader does not have a unit root.

Rejection criteria: The more negative the ADF statistic is, the stronger the rejection of the hypothesis that there is a unit root at some level of confidence.

If a trader has a unit root, it means that its prices follow a random walk.

EMPIRICAL FINDINGS

Table 2: Descriptive Statistics

	Minimum	Maximum	Mean	Std. Dev.	Skewness		Kurtosis	
					Stat	SE	Stat	SE
Sys PRICE	-5.749	5.089	0.002	0.478	-0.692	0.095	51.938	0.190
Botswana	-5.749	5.089	0.004	0.510	-0.509	0.095	40.386	0.190
DR Congo	-2.866	2.606	0.000	0.516	-0.067	0.095	6.789	0.190
Lesotho	-5.749	5.089	0.004	0.510	-0.509	0.095	40.386	0.190
Malawi	-2.914	2.652	0.002	0.240	-1.140	0.095	91.461	0.190
Moza. North	-2.866	2.575	-0.004	0.442	-0.154	0.095	10.398	0.190
Moza. South	-5.749	5.089	0.004	0.510	-0.506	0.095	40.510	0.190
Namibia	-5.749	5.089	0.004	0.510	-0.509	0.095	40.386	0.190
South Africa	-5.749	5.089	0.004	0.510	-0.509	0.095	40.386	0.190
Swaziland	-5.749	5.089	0.004	0.510	-0.509	0.095	40.386	0.190
Tanzania	-1.505	2.946	0.012	0.315	2.383	0.095	27.562	0.190
Zambia	-2.866	2.606	0.000	0.516	-0.067	0.095	6.789	0.190
Zimbabwe	-2.866	2.606	0.000	0.514	-0.081	0.095	6.890	0.190

From Table 2, the calculated values of skewness and kurtosis are not equal to zero for all traders, providing evidence that there is no normality in the data and therefore the null hypothesis that data is normally distributed is rejected at 5% level of significance.

Table 3: Autocorrelations

	LAGS									
	1		**2**		**3**		**4**		**5**	
	AC	**SE**	**AC**	**SE**	**AC**	**SE**	**AC**	**SE**	**AC**	**SE**
Sys PRICE	-0.312	0.039	-0.147	0.039	-0.036	0.039	0.002	0.039	-0.086	0.039
Botswana	-0.304	0.039	-0.158	0.039	-0.020	0.039	0.015	0.039	-0.109	0.039
DR Congo	-0.216	0.039	-0.185	0.039	-0.075	0.039	0.066	0.039	-0.112	0.039
Lesotho	-0.304	0.039	-0.158	0.039	-0.020	0.039	0.015	0.039	-0.109	0.039
Malawi	-0.311	0.039	-0.006	0.039	-0.012	0.039	0.207	0.039	-0.207	0.039
Moza. North	-0.215	0.039	-0.211	0.039	-0.073	0.039	0.095	0.039	-0.106	0.039
Moza. South	-0.304	0.039	-0.158	0.039	-0.020	0.039	0.016	0.039	-0.109	0.039
Namibia	-0.304	0.039	-0.158	0.039	-0.020	0.039	0.015	0.039	-0.109	0.039
South Africa	-0.304	0.039	-0.158	0.039	-0.020	0.039	0.015	0.039	-0.109	0.039
Swaziland	-0.304	0.039	-0.158	0.039	-0.020	0.039	0.015	0.039	-0.109	0.039
Tanzania	-0.163	0.039	-0.063	0.039	0.047	0.039	-0.022	0.039	0.031	0.039
Zambia	-0.216	0.039	-0.185	0.039	-0.075	0.039	0.066	0.039	-0.112	0.039
Zimbabwe	-0.217	0.039	-0.186	0.039	-0.070	0.039	0.064	0.039	-0.113	0.039

AC- Autocorrelation, SE- Standard Error

For all the traders non-zero autocorrelations prevail. There is not a single zero auto-correlation entry, and the standard error is 0.039 for all entries, implying that at 5% level of significance there exist supporting evidence to reject the null hypothesis that electricity returns are not significantly correlated over time, and therefore it can be concluded that there is autocorrelation between lags. Hence, in this regard, market exhibits inefficiency.

Table 4: Runs Tests

	Z
System	4.4007433
Botswana	4.171211278
DR Congo	2.509132505
Lesotho	4.171211278
Malawi	-6.73997002
M. North	-1.522920771
M. South	3.881026112
Namibia	-25.3113268
South Africa	4.171211278
Swaziland	4.171211278
Tanzania	-4.184680299
Zambia	2.509132505
Zimbabwe	1.394098413

At 5% significance level, a test statistic with an absolute value greater than 1.96 indicates non-randomness. From Table 4, it can be observed that all traders with the exception of Mozambique North and Zimbabwe exhibit randomness. This means that only 85% of the market does not confirm randomness implying that the SAPP is weak form inefficient.

Table 5: Box-Ljung Statistic

	LAGS									
	1		**2**		**3**		**4**		**5**	
	Value	**Sig.***	**Value**	**Sig.***	**Value**	**Sig.***	**Value**	**Sig.***	**Value**	**Sig.***
Sys PRICE	64.744	0.000	79.060	0.000	79.900	0.000	79.903	0.000	84.810	0.000
Botswana	61.331	0.000	78.005	0.000	78.268	0.000	78.420	0.000	86.403	0.000
DR Congo	31.011	0.000	53.731	0.000	57.477	0.000	60.362	0.000	68.805	0.000
Lesotho	61.331	0.000	78.005	0.000	78.268	0.000	78.420	0.000	86.403	0.000
Malawi	64.178	0.000	64.201	0.000	64.303	0.000	92.893	0.000	121.414	0.000
Moza.North	30.738	0.000	60.294	0.000	63.840	0.000	69.898	0.000	77.387	0.000
Moza.South	61.219	0.000	77.825	0.000	78.094	0.000	78.263	0.000	86.215	0.000
Namibia	61.331	0.000	78.005	0.000	78.268	0.000	78.420	0.000	86.403	0.000
SouthAfrica	61.331	0.000	78.005	0.000	78.268	0.000	78.420	0.000	86.403	0.000
Swaziland	61.331	0.000	78.005	0.000	78.268	0.000	78.420	0.000	86.403	0.000
Tanzania	17.556	0.000	20.181	0.000	21.659	0.000	21.974	0.000	22.614	0.000
Zambia	31.011	0.000	53.731	0.000	57.477	0.000	60.362	0.000	68.805	0.000
Zimbabwe	31.124	0.000	54.104	0.000	57.358	0.000	60.100	0.000	68.564	0.000

Sig.*- significance of the statistic based on the asymptotic chi-square approximation.

Table 5 results show that all the traders have zero as p-values for all lags. Hence we reject the null hypothesis, thereby concluding that there is autocorrelation between daily prices, and ultimately that the market prices do not follow a random-walk process.

Table 6: Tests of normality

	Kolmogorov-Smirnova		**Shapiro-Wilk**	
	Statistic	**Sig.***	**Statistic**	**Sig.**
Sys PRICE	0.176	0.000	0.684	0.000

Botswana	0.189	0.000	0.727	0.000
DR Congo	0.202	0.000	0.836	0.000
Lesotho	0.189	0.000	0.727	0.000
Malawi	0.474	0.000	0.163	0.000
Moza. North	0.277	0.000	0.699	0.000
Moza. South	0.191	0.000	0.725	0.000
Namibia	0.189	0.000	0.727	0.000
South Africa	0.189	0.000	0.727	0.000
Swaziland	0.189	0.000	0.727	0.000
Tanzania	0.375	0.000	0.499	0.000
Zambia	0.202	0.000	0.836	0.000
Zimbabwe	0.200	0.000	0.834	0.000

*This is a lower bound of the true significance.

From Table 6, all the probabilities for the traders are zero (to three decimal places), hence we reject the null hypothesis and conclude that the sample data are significantly different from a normal population.

Table 7: The Augmented Dickey-Fuller Test
Table 7a):

	(-1)		**D(-1)**		**D(-2)**	
	SE	**t-Stat**	**SE**	**t-Stat**	**SE**	**t-Stat**
System	0.1807	-21.263	0.1597	13.99	0.1332	12.431
Botswana	0.1775	-19.776	0.1568	12.41	0.1314	10.784
DRCongo	0.1595	-15.798	0.1407	8.231	0.11954	6.5706
Lesotho	0.1775	-19.776	0.1568	12.41	0.1314	10.784
Malawi	0.1123	-13.747	0.1012	2.108	0.0903	1.6808
M. North	0.1609	-15.763	0.1422	8.215	0.12087	6.3678
M. South	0.1773	-19.683	0.1566	12.31	0.13129	10.683
Namibia	0.1775	-19.776	0.1568	12.41	0.1314	10.784
S. Africa	0.1775	-19.776	0.1568	12.41	0.1314	10.784
Swaziland	0.1775	-19.776	0.1568	12.41	0.1314	10.784
Tanzania	0.1162	-10.583	0.1057	0.465	0.09308	-0.501
Zambia	0.1595	-15.798	0.1407	8.231	0.11954	6.5706
Zimbabwe	0.1593	-15.568	0.1406	7.981	0.11951	6.2963

Table 7b):

	D(-3)		**D(-4)**		**D(-5)**	
	SE	**t-Stat**	**SE**	**t-Stat**	**SE**	**t-Stat**
System	0.10213	11.135	0.06943	10.0035	0.03812	7.38846
Botswana	0.10124	9.5823	0.06924	8.68417	0.03859	6.01636
DRCongo	0.09334	5.1044	0.06579	4.74057	0.03948	2.07922
Lesotho	0.10124	9.5822	0.06924	8.68417	0.03859	6.01636
Malawi	0.07472	2.1552	0.05672	5.70531	0.03436	5.22622
M. North	0.09379	4.7893	0.06547	4.58423	0.03918	2.10625

M. South	0.10119	9.4828	0.06923	8.59652	0.03862	5.94872
Namibia	0.10124	9.5823	0.06924	8.68417	0.03859	6.01636
S. Africa	0.10124	9.5823	0.06924	8.68417	0.03859	6.01636
Swaziland	0.10124	9.5823	0.06924	8.68417	0.03859	6.01636
Tanzania	0.0788	-0.4056	0.06078	-0.7726	0.0393	-0.4578
Zambia	0.09334	5.1044	0.06579	4.74057	0.03948	2.07922
Zimbabwe	0.0934	4.8446	0.06584	4.45884	0.03951	1.77189

From the evidence in Table 7(a) and 7(b), it can be deduced that, except at the zero lag, the market traders generally do not have a unit root at 5% level of significance. Almost all the t-statistic are greater than critical values at 5% level of significance, therefore providing evidence to reject the null hypothesis that each trader has a unit root, meaning prices do not follow a random walk process. This confirms that the SAPP is not weak form efficient.

CONCLUSION

The weak form efficiency hypothesis has been tested on a number of energy markets like the Nordic Power Pool (Skånberg, 2012) and the European Union Energy Transmission System (EU ETS) market (Aatola et al, 2012). Diverse results have come up from all these studies. But the general observation has been that the developed markets like USA and some of the European have been found to be weak form efficient. On the other hand, evidence from developing markets (emerging markets) indicates that they do not satisfy the weak form hypothesis. Returns in these markets do not follow a random walk process and are generally predictable. Possible reasons for this being that generally, emerging markets are thin markets that lack the depth, regulatory framework and structural safeguards (Husain and Forbes, 1999). Linking the findings in this article with other studies on emerging markets, the conclusion that the SAPP market is not efficient seems to reinforce the notion by other researchers in the same field, that developing markets tend to be informationally inefficient, while developed markets, which are very competitive in nature, demonstrate efficiency. The ultimate conclusion drawn from this research is that; to a greater extent, the Southern African Power Pool electricity prices do not follow a random walk process and hence the SAPP electricity market can be said to be weak form inefficient.

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