
Modeling Factors influencing Stock Prices:

Empirical Evidence from Khartoum Stock Market

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Abstract :

This research aims at identifying factors that affect the average price of the stocks in the Khartoum Stock Exchange (KSE). Run test and EGARCH model were implemented by SPSS and EViews respectively. The sample period covers the years 1995 - 2014. It is has been shown that KSE is inefficient market of the weak form emphasizing the findings of Onour (2007). As expected there are positive effects of real GDP, money supply growth rate and the period before economic sanctions on the average value of stock prices, while inflation and real effective exchange rate have negative effects. There is a leverage effect suggests that negative shock has a greater influence on volatility of stock price rather than the positive shocks of the same size.. In the past leverage effect.

Keywords : stock price, efficiency, economic sanctions,

INTRODUCTION

markets were limited to buying and selling real goods, then the market concept had been developing until it was not restricted to a particular place and became a major key feature of today's markets. Money markets are markets specializing in buying and selling securities, it is an important tool for providing money to various activities through the primary role of all financial institutions. The economic role of the market has been developed to become Stock Exchange e.g. London Stock Exchange and the NYSE (Wall Street). Financial markets went through several stages where the first stage is characterized by the presence of a large number of private banks and exchange houses, second stage marked the beginning of central banks that dominate commercial banks, specialized banks deal with medium-and long-term lending appeared in stage three, the emergence of money markets dealing in short term loans was in the fourth stage, the fifth stage witnessed the money markets integration in securities markets (Jamal, 2002).

The first function of the stock market is selling and buying government and private stocks and bonds and determine the real price of the securities, in addition to promoting and mobilizing savings from many big corporations and their projects in the development of national income

and labour to prevent inflation and maintain consumer prices rise (Jamal 2002). Stock markets assist in forecasting price trends and the volume of production, where investment features flexible handling and ease of purchase and sale.

Thinking about creating a market for securities in Sudan dated back to 1962 whereas Ministry of Finance and the Bank of the Sudan with the participation of the International Finance Corporation of the World Bank conducted many studies and arrived in 1975 to a draft law regulating the functioning of the market, as well as taking the advantage of International Development Corporation IFC experience in the stock market where it studied aspects of the Sudanese economy as a result of these studies the first draft Securities Acts have been suggested to create a secondary market (stock exchange) and primary market in Sudan in October 1994 under the guidance of Islamic rules in all practices (Ali 2007).

There are a questions frequently asked by many about the weak culture of investment in securities and does investment in securities resemble other forms of investments in Sudan? The answer is yes, although the Khartoum stock market (KSE) attracted many investors when offering the governmental participation certificates (GMC) and the shares of Sudanese Telecommunication Company (SUDATEL) empirical studies revealed low awareness of investing in KSE (Marwa 2007). It should be noted that collaborative sense is rooted in the conscience of the Sudanese people for that orientation campaign continued to explain the importance of capital markets to include all segments of Sudanese society. And still the market encourages more new services associated with financial products other than listed funds and Government versions and different financial services development, in addition to the role of KSE in implementing the privatization programs. The role of the KSE doesn't stop there but a suggestion how to coordinate fiscal and monetary policies and capital movements and supervise policy on the development of medium and long-term funding sources in the Sudan and that in order to achieve financial and economic stability and thus achieve the objectives of economic development, so the importance of this research.

This research aims to identify the factors that influence the average stock prices of KSE market assuming that economic conditions characterized by real GDP, monetary and fiscal policies, and industrial conditions such as profits and reassess of capitalization and shares have a positive impact on the evolution of stock prices, while inflation, and exchange rate influence negatively the stock prices, in addition to test the market efficiency and transparency.

The research covers the period 1995-2014 for listed companies in KSE market using EGARCH analysis, testing of randomness (Runs) via by EViews and SPSS statistical packages respectively.

2. Literature Review

Various methodologies have been applied to discover the relationship between stock market and key economic variables. Chittedi (2015) by means of autoregressive distributed lag found long-run and short-run relationship between macroeconomic variables and stock prices in BRIC countries. Taimur, Purohit, & Pillai (2015) found that return on equity, book value per share,

dividend per share, dividend yield, price earnings, and firm size are significant determinants of share prices of 41 companies in the Bahrain market during the period 2006-2010. Kalyanaraman & Al Tuwajri (2014) established a long run relationship among five macroeconomic variables, consumer price index, industrial output, money supply, exchange rate, oil prices and the global stock prices proxy Standard and Poor 500 index and Saudi all share stock index with monthly data from Jan.1994 to June 2013. All macroeconomic variables are set up to impact stock prices. Standard and Poor 500 index does not affect Saudi stock prices. Vector error correction model displayed the presence of long run causality from the explanatory variables to the stock prices. Short run causality test found a two-way causality between stock prices and oil prices. Khositkulporn (2013) identified the dominant factors affecting stock market volatility in Thailand and measured the contagion effects of stock market volatility in Thailand on other South-East Asian stock markets. The influencing factors are equity price, company performance, economic variables, financial liberalization, market integration, and incidents. Tagne, et al (2013) investigated the impact of changes in selected macroeconomic variables on stock prices of the Stockholm Stock Exchange (OMXS30) using Ordinary Linear Square (OLS) and Granger causality test for monthly data 1993-2012. They found that inflation and currency depreciation have a significant negative influence on stock prices. No unidirectional Granger Causality is found between stock prices and all the predictor variables under study except one unidirectional causal relation from stock prices to inflation. Faris Nasif AL- Shubiri (2010) performed simple and multiple regression analysis on a sample of 14 commercial banks of Amman Stock Exchange for the period 2005 -2008 finding highly positive significant relationship between market price of stock and net asset value per share; market price of stock dividend percentage, gross domestic product, and negative significant relationship on inflation and lending interest rate but not always significant on some years of Amman Stock Exchange in Jordan. Dana (2008) recognized factors affecting stocks returns and causing sharp volatility in Oman stock Exchange during fiscal 2006. The study sample was stratified random covering (601 companies) 30% of the original population -2000 of listed companies in Oman. She reached a set of conclusions: existence of statistically significant between stockholders and both inflation and interest rates, the number of employees and the size of capital companies. Horobet and Ilie (2007) obtained a long-run relationship between the Bucharest stock market performance and the nominal and real effective exchange rates. Smith, et al (2000) set up negative correlation between the stock market with M2, interest rates, unemployment rate, commodity prices, and capacity utilization rate and positively correlated with CPI, consumer expectations, and manufacturing contracts and orders. Ziad (1989) found a significance statistical relationship between stock return and registered companies in a given year and desire on their stocks in the following year in Jordan that represent the four major sectors: banking, financial institutions, insurance sector, the service sector and industry for the period 1979 – 1982 as stock turnover each year from 1980 to 1983. He found a positive significant Spearman coefficient equals 0.878 for all companies except one only.

Marwa (2007) established positive impact of KSE on economic activity via multiple regression using primary data from two samples of equal size (50) secondary for the period 1996-2005 analyzing the data by EViews .She, and that the current market structure does not enable the

market to play its role. There are poor savings and investment awareness of citizens in general and of investors in a particular, in addition to weak publicity. Onour (2007) tested the efficiency of Khartoum stock market finding no indication of accepting the efficiency assumption of the market.

3. Theoretical Background.

The market is the exact location that brings together sellers and buyers to sell goods to satisfy certain prices according to life, likewise the stock market is the place to trade short term investment instruments such as stocks, bonds or undertakings, option, medium and long term contributions that extends for more than twenty years (Jamal, 2002). The stock market is divided into two parts: a) primary market: means the market where securities issued under the laws, regulations and directives and norms b) secondary market: the market where buying and selling securities directly or by proxy and Exchange securities trading Hall especially for that purpose. The secondary market is divided into: parallel and irregular.

Market efficiency is that at any given time, prices fully reflect all available information on a particular stock and/or market (Investopedia). Mahmoud (2005) describes three types of market efficiency: (1) Weak form: the current price incorporates all information contained in the past price. (2) Semi strong form: where the current price includes all known information in general, and its past price in particular. (3) Strong shape: where prices reflect all identifiable information, including known information. In general, there are two kinds of market efficiency Strong-form and weak-form efficiency. The weak form of market efficiency states that public information will not help an investor or analyst select undervalued securities because the market has already combined the information into the stock price everything is random. The strong-form states that no information, public or inside, will advantage an investor or analyst because even inside information is reproduced in the current stock price (investinganswers.com 2016).

Stock prices are affected by several internal and external factors and circumstances of the industry. Internal factors include economic growth, the general level of prices, interest rates, exchange rates, unemployment, economic policy, and economic cycles and can be summarized namely in economic conditions. External factors represented by wars and tensions and political and social changes. The industrial conditions are: reassessing stocks, earnings announcement, press conferences, and measures of market makers (intermediaries), speculation In the hope that rising stock prices later, prediction based on actual performance, and market liquidity ratio (anticipating higher prices), frequent stock move stock prices.

Economic growth is expected to have a positive effect on stock prices because announcement of an increase means increased economic activity and consequently high demand on stocks pushing stock prices up. Higher output comes indirectly by increasing the money supply with price stability which leads to lower real interest rates and then increased investment and production. On the contrary if economic growth is less optimistic about the future as a result of the belief that this increase leads to increase the money supply and thus higher prices causes

less demand for stocks and low prices (Muneer 2002).

Differing views on the impact of monetary policy on stock prices, some sees a correlation between the increase in the money supply, assuming steady demand leads to lower interest rates which encourage investment and thus lead to increased production and lower unemployment rate him higher stock prices the final outcome of monetary policy. While others have questioned this logic based on the negative impact is the prospect of inflation, which leads to the increase of the minimum return required by investors. It is well known that the market value of the ordinary shares is determined by the net profit after tax plus depreciation premiums and minimum required investment (Muneer, 2002). An increase in nominal money supply reduces the interest rate that leads to anticipate lower exchange rate for the current price. These two factors operate to reduce the attractiveness of local assets (Dornbush 1976).

Effects of fiscal policy come through taxation and government spending whereas reduction of profit tax increases net profits and hence the stock prices rise, on the hand reduced tax leads the government to resort to deficit financing triggering price rise thus decreases the stock price (Muneer, 2002). An increase in government spending raises interest rate and attracts foreign investment (Feleming 1964).

Inflation rate and general price level have adverse effects on stock prices directly and indirectly. The direct cause is that high rate of return on investment is required; while indirect refers to the tax system with expectation lower real value of profits in periods of inflation leading that lowers the market value of stocks (Muneer, 2002).

Interest rates in spite of its importance in many economic systems it has been prohibited by Islamic law to deal with in Sudan.

Fluctuations in exchange rates can sometimes have a significant effect on firm value, as they influence the terms of competition, the input and output prices, and the value of firm's assets and liabilities denominated in foreign currencies. Although firms with foreign operations are more affected as compared to "pure" domestic firms, virtually no company can be considered as being isolated from the effects of exchange rates changes. Consequently, all firms' prices may react sooner or later to changes in the exchange rates (Horobet and Ilie 2007). The real effective exchange rate (REER) is the weighted average of a country's currency relative to an index or basket of other major currencies, adjusted for the effects of inflation where the weights are determined by comparing the relative trade balance of a country's currency against each country within the index. The REER represents the value that an individual consumer pays for an imported good at the consumer level. A country can positively affect its REER through rapid productivity growth. When this happens, the country realizes lower costs and can reduce prices, thus making the REER more advantageous for the country (Investopedia 2016). Real effective exchange takes into account partners' exchange rates, and local and partners' prices consumer prices reflecting countries' competitiveness and purchasing power of its citizens. Thus it is important for investors to follow the CPI because periods of high inflation make difficult the market conditions.

Company stock prices and the stock market in general can be affected by world events such as war and economic sanctions, natural disasters and terrorism. These influences can be direct and indirect, and they often occur in chain reactions. The social uncertainty and fear generated by the terrorist attacks on Sept. 11, 2001, affected markets directly as they caused many investors in the United States to trade less and to focus on stocks and bonds with less risk (Chron.com 2016).

From above it is expected that real GDP and market capital k and monetary policy represented by the money supply MS have positive influence on stock prices, while the inflation rate (general price level), real effective exchange rate, and world events i.e. the American resolution seizing assets, stocks and property of the government of the Sudan

4. Methodology and Data

4.1 Data

The sample period covers the years 1995 to 2014. Data were collected from four sources: real GDP (Y) and inflation rate (INF) from Central Bureau of Statistics; money supply (MS) and its growth rate (MSDOT) from Central bank of Sudan; average stock value and Market value supplied by Khartoum Stock Exchange; dummy variable takes the value 1 for the period before US 2006 resolution provided the seizure of assets, stocks and property of the government of the Sudan, and 0 after that; and lastly the real effective exchange rate (REER) delivered by REER_database_ver19Jan2015

4.2 Methodology

4.2.1 Run Test

A run of a sequence is a maximal non-empty segment of the sequence consisting of adjacent equal elements. The run test is based on the null hypothesis that each element in the sequence is independently drawn from the same distribution. Under the null hypothesis, the number of runs in a sequence of N elements is a random variable whose conditional distribution given the observation of N_+ positive values and N_- negative values ($N = N_+ + N_-$) is approximately normal, with

$$\text{mean } \mu = \frac{2N_+ + N_-}{N} + 1$$
$$\text{Variance } \sigma^2 = \frac{2N_+ + N_- (2N_+ N_- - N)}{N^2(N - 1)} = \frac{(\mu - 1)(\mu - 2)}{N - 1}$$

This test (Adnan 1419 H) is used to see whether the order in which they appeared is random data. The run is a sequence of observations that fall into the same category. Since this test does not make any assumptions about the distribution of population parameters used to determine the order of response data above or below a specific value k random order. If the total few laps is

considered as an indicator of the presence of clusters or maybe a certain direction of rotating required make sure that this significant clusters or not? Any statistical test for independence of different changes of stock prices assumes that random sample located between two acceptance periods.

4.2.2 GARCH Models

Autoregressive Conditional Heteroskedasticity ARCH model was introduced by Engle (1982) and generalized by Bollerslev (1986) and is widely used specially in financial econometrics to model the uncertainty of exchange rate, inflation, interest rate. The basic idea of ARCH models is that (a) the mean a_t is serially uncorrelated, but dependent and (b) the dependence of a_t can be described by a simple quadratic function of its lagged values Ruey (2002). Specifically, an ARCH (m) model assumes that

$$a_t = \sigma_t \varepsilon_t; \varepsilon_t \sim iid(0,1)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 a_{t-1}^2 + \dots + \alpha_m a_{t-m}^2; \alpha_0 > 0; \alpha_i \geq 0; i > 0$$

These models suffer from many weaknesses Ruey (2002): first they assume that positive and negative shocks have the same effects on volatility because it depends on the square of the previous shocks. Second they are rather restrictive e.g. α_2 of an ARCH (1) model must be in the interval [0, 0.333]. Third they do not provide any new insight for understanding the source of variations of a financial time series. They only provide a mechanical way to describe the behavior of the conditional variance. It gives no indication about what causes such behavior to occur. Finally they are likely to over-predict the volatility because they respond slowly to large isolated shocks to the return series.

GARCH (m,s) is the Generalized ARCH by Bollerslev (1986) models are widely used in various branches of econometrics, especially in financial time series analysis

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^n \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^s \beta_j \sigma_{t-j}^2; \varepsilon_t \sim N(0,1); \alpha_0 > 0; \alpha_i \geq 0; \beta_j \geq 0.$$

The variance equation σ_t^2 is composed of three terms: the mean (long-term average) α_0 ; news about volatility from the previous period (the ARCH term) a_{t-i}^2 and the GARCH term σ_{t-j}^2 . It is a weighted average of the variance a (the constant), the ARCH term and the GARCH term. If there was unexpectedly large move in either the upward or the downward direction, then the forecaster will increase the estimate of the variance for the next period

EGRACH Model or Exponential GARCH model was proposed by Nelson (1991). The specification for the conditional variance is as follows:

$$\ln(\sigma_t^2) = w + \sum_{i=1}^p \alpha_i \left| \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right| + \sum_{k=1}^r \gamma_k \frac{\varepsilon_{t-k}}{\sigma_{t-k}} + \sum_{j=1}^q \beta_j \ln(\sigma_{t-j}^2)$$

The EGARCH model requires no restrictions on the parameters to assure that the conditional variance is nonnegative, and is able to model volatility persistence, mean reversion as well as the

asymmetrical effect. To allow for positive and negative shocks to have different impact on the volatility is the main advantage of the EGARCH model compared to the GARCH model (Wennström 2014). The presence of leverage effects can be tested by the hypothesis that $\gamma < 0$ otherwise the impact is asymmetric if $\gamma \neq 0$. A negative asymmetry term suggests negative shock has a greater influence on volatility rather than the positive shocks of the same size i.e. investors are more disposed to the negative news in contrast to the positive news. This implies that the volatility fall over mechanism is unequal.

5. Results and Discussion

5.1 Empirical Results

Run test results of market value discovered that there is enough evidence to conclude that the data are not arranged randomly (weak efficiency) thus the KSE market is not efficient a conclusion coincides with the conclusion of Onour (2007). The median and mean tests presented that cases above and below k are 10 for each, and 2 to 18 respectively, the number of run is 2, the asymptotic significance rejects the null hypothesis that market value data are arranged randomly, Mode test has been excluded since there multiple modes

Unit root tests discovered that all model variables are non-stationary and integrated of order one. Cointegration test revealed three cointegrating equations i.e. there is long run relationship among model variables.

Granger causality runs from asset value to real GDP, and money supply growth rate; from real effective exchange rate to real GDP, money supply growth rate, and inflation; from real GDP to inflation and real effective exchange rate (Annex 6).

$$V = 0.002 * Y + 0.158 * MSDOT - 0.836 * INF - 0.378 * REER + 4.21 * PSANC$$

$$\ln(\sigma_t^2) = 1.354 - 1.38 * \left| \frac{\epsilon_{t-1}}{\sigma_{t-1}} \right| - 0.538 * \frac{\epsilon_{t-1}}{\sigma_{t-1}} + 0.8202 * \ln(\sigma_{t-1}^2)$$

Mean equation: economic and statistical criteria have been attained where all variables have the anticipated sign, and highly significant different from zero, the model does not suffer from autocorrelation (see Annex 4).

Variance equation: all the estimated parameters are highly significant, in addition to the presence of leverage effects that can be seen from the estimated parameter $\gamma_1 = -0.538$ i.e. suggests that negative shocks generate higher volatility than positive shocks of the same size, and vice versa with possibility of a simultaneous feedback relationship between average price and its uncertainty. The last estimated parameter 0.8202 captures the persistence of shocks in the conditional variance.

Model adequacy has been verified by the lack of ARCH effect since F-statistic is 2.0268 with a probability 0.173 and Chi Square 2.024 with a probability of 0.155 (Annex 5). There is no serial correlation as appears in Figure (1) none of the first 12 autocorrelations and partial autocorrelations are significant at 5 per cent level. Residuals are normally distributed as Jarque-Bera statistics is 0.8165 and the corresponding probability is 0.67.

5.2 Discussion

A positive and highly significant relationship between average stock price and real GDP is detected, it well known that an increasing economic growth is expected to lead to an increase in companies' profits which in turn raise the stock value. The real growth of the Sudan economy has been fluctuating between 1.4 and 11.6 with an average growth rate of 6.1 per cent which means a considerable effect of growth is exerted on stock values.

On the other hand, a significant positive relationship has been established between stock price and money supply growth rate which has in average of 31. Stock prices tend to move higher when the money supply in an economy is high. Plenty of money circulating in the economy both makes more money available to invest in stocks and also makes alternative investment instruments, such as bonds less attractive (ZACKS 2016).

The inflation rate has been oscillating between 4.8 and 129.2 with an average 24.2 hence additional funds flow due to inflation are directed to supply of stocks than their demand which leads to depress stock price thus a rising inflation corresponds to a decreasing stock prices that is clear from the negative relationship between inflation and stock price.

As has been said before firms will react to exchange rate, given that causality runs from real effective exchange rate to real GDP, changes in exchange rates will increase or decrease the cost of doing business in Sudan, which will affect the price of stocks of companies doing business abroad. Moreover the depreciation of Sudanese pound (exchange rate) decreases the flow of capital and this will also decrease the additional funds flowing in the stock market.

The first American economic sanctions against Sudan were in 1989 having prevented getting American aid. In 1993 Sudan was added to the list of State sponsors of terrorism and denied from communicating with international institutions; the Bank and International Monetary Fund. However, in November 1997 sweeping sanctions on the country were signed by then US President Bill Clinton and became renewed annually by resolution 13067 followed by another in 2006 aimed at preventing people from communicating with USA. Plus another resolution also in 2006 provided for the seizure of assets, stocks and property of the Sudan government and banned the export of goods and technologies except relief and banned financial companies from contracting with the Government of the Sudan. At the end of 2007 the American President banned 31 public companies from entering USA. Economic sanctions affected adversely the Sudan economy whereas the loss has been estimated to be 500 billion dollars. the Stock market performance in the period 1995-2005 before 2006 sanctions have positive effect on asset prices revealing that the seizure of assets, stocks and property of the Government of the Sudan and

prohibited the export of goods and technologies were very influential on KSE.

Conclusion

The effects of key economic variables on average stock price at KSE have been investigated via EGARCH to reach the conclusion that money supply growth rate and economic growth influence the stock price positively and inflation and real effective exchange rate have negative effects. In addition to economic variables economic sanctions imposed by USA against Sudan in 2006 and on have a considerable adverse effect on the Sudan economy in general and KSE in particular. However, besides these difficulties KSE suffers from inefficiency, and low awareness of its role in investment both to public and businessmen. The necessary conditions for a market inefficiency to be eliminated are as follows: the assets which are the source of the inefficiency has to be traded; transactions costs of executing the scheme have to be smaller than the expected profits from the scheme; investors have to recognize the 'potential for excess return'; ensure the resources to trade on the stock until the inefficiency disappears (Jarrow and Larsson 2011)

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Annex

Annex 1 Descriptive Statistics

	V	Y	MSDOT	INF	REER
Mean	3.472384	20447.67	30.97244	24.208	86.69
Median	1.977166	19616.5	26.4762	13.65	78.1
Maximum	20.48019	31109.29	74.13612	129.2	128.1
Minimum	0.399452	10140	10.31222	4.8	52.7
Std. Dev.	4.832456	6981.735	16.52656	29.44709	23.17019
Skewness	2.639868	0.078448	1.213717	2.583366	0.216862
Kurtosis	9.227615	1.567078	3.972658	9.33493	1.66452
Jarque-Bera	55.54901	1.731567	5.698746	55.68872	1.643019
Probability	0.000000	0.420722	0.057881	0.000000	0.439767
Sum	69.44768	408953.5	619.4488	484.16	1733.8
Sum Sq. Dev.	443.7	9.26E+08	5189.417	16475.5	10200.3
Observations	20	20	20	20	20

Annex (2) Unit Root Test Results

	ADF		PP		KPSS	
	Constant	Trend and Constant	constant	Trend and Constant	Constant	Trend and Constant
REER	-0.9504	0.4819	0.9900	0.5607	0.6055	0.1131
Δ (REER)	0.0150**	0.0617*	0.0128***	0.0186**	0.2584	0.3160
INF	0.1620	0.4844	0.2011	0.6580	0.2698	0.5000
Δ (INF)	0.0001***	0.1453	0.0002***	0.0001***	0.2827	0.1634
Y	0.9630	0.2246	0.9574	0.7201	0.6061	0.1129
Δ (Y)	0.0872*	0.2570	0.0906*	0.2616	0.1534	0.1413
V	0.1875	0.2234	0.1713	0.4214	0.1353	0.1232
Δ (V)	0.0090***	0.0386**	0.0023***	0.0046***	0.2265	0.2284
Msdot	0.0311*	0.1146	0.0245*	0.1124	0.4239	0.0949*
Δ (msdot)	0.0020***	0.0078***	0.0020***	0.0078***	0.1422	0.0869*

*, **, *** denote rejection of the Null hypothesis at 10%, 5%, and 1% Significance Level

Annex (3) Cointegration Tests

Date: 09/25/16 Time: 06:22				
Sample (adjusted): 1997 2014				
Included observations: 18 after adjustments				
Trend assumption: Linear deterministic trend				
Series: V Y MSDOT INF REER				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.993799	182.4973	69.81889	0
At most 1 *	0.934486	91.00215	47.85613	0
At most 2 *	0.807594	41.94322	29.79707	0.0013
At most 3	0.386051	12.27652	15.49471	0.1441
At most 4	0.176495	3.495345	3.841466	0.0615
Trace test indicates 3 cointegrating equation(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Annex (4) Empirical Results

Dependent Variable: V				
Method: ML - ARCH (Marquardt) - Normal distribution				
Date: 09/28/16 Time: 14:34				
Sample (adjusted): 1995 2014				
Included observations: 20 after adjustments				
Convergence achieved after 18 iterations				
Presample variance: backcast (parameter = 0.1)				
LOG(GARCH) = C(6) + C(7)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(8)				
*RESID(-1)/@SQRT(GARCH(-1)) + C(9)*LOG(GARCH(-1))				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Y	0.001511	0.000232	6.508404	0.0000
MSDOT	0.157959	0.041275	3.826997	0.0001
INF	-0.08362	0.023395	-3.57414	0.0004
REER	-0.37771	0.050792	-7.43638	0.0000
PSANC	4.209396	0.814168	5.170178	0.0000
Variance Equation				
C(6)	1.35357	0.110877	12.20783	0.0000
C(7)	-1.38041	3.17E-06	-435982	0.0000
C(8)	-0.53835	0.162687	-3.30913	0.0009
C(9)	0.820254	0.011402	71.93898	0.0000
R-squared	0.60066	Mean dependent var		3.472384

Adjusted R-squared	0.49417	S.D. dependent var	4.832456
S.E. of regression	3.436928	Akaike info criterion	4.848313
Sum squared resid	177.1871	Schwarz criterion	5.296393
Log likelihood	-39.4831	Hannan-Quinn criterion	4.935783
Durbin-Watson stat	1.701014		

Annex (5) ARCH Test

F-statistic	2.026762	Prob. F(1,17)	0.1726
Obs*R-squared	2.023911	Prob. Chi-Square(1)	0.1548

Annex (6) Pairwise Granger Causality Tests

Date: 09/28/16 Time: 00:00			
Sample: 1995 2015			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
Y does not Granger Cause V	18	0.32054	0.7313
V does not Granger Cause Y		5.13146	0.0228
MSDOT does not Granger Cause V	18	0.07681	0.9265
V does not Granger Cause MSDOT		3.57883	0.0578
INF does not Granger Cause V	18	0.34899	0.7118
V does not Granger Cause INF		0.74392	0.4944
REER does not Granger Cause V	18	0.94042	0.4155
V does not Granger Cause REER		1.28425	0.3098
MSDOT does not Granger Cause Y	18	0.55151	0.589
Y does not Granger Cause MSDOT		1.36705	0.2892
INF does not Granger Cause Y	18	0.57756	0.575
Y does not Granger Cause INF		8.72063	0.004
REER does not Granger Cause Y	18	5.01656	0.0243
Y does not Granger Cause REER		6.91713	0.009
INF does not Granger Cause MSDOT	18	0.05043	0.951
MSDOT does not Granger Cause INF		2.13343	0.158
REER does not Granger Cause MSDOT	18	3.20243	0.074
MSDOT does not Granger Cause REER		0.71761	0.5063

REER does not Granger Cause INF	18	18.4825	0.0002
INF does not Granger Cause REER		2.17806	0.1528

Figure (1)

Date: 09/29/16 Time: 15:14						
Sample: 1995 2014						
Included observations: 20						
Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
.** .	.** .	1	-0.322	-0.322	2.4064	0.121
. **.	. *.	2	0.241	0.152	3.8208	0.148
. .	. *.	3	-0.029	0.098	3.8431	0.279
*** .	*** .	4	-0.349	-0.425	7.1858	0.126
. **.	. *.	5	0.315	0.149	10.101	0.072
.** .	. .	6	-0.271	0.024	12.409	0.053
. .	.* .	7	0.062	-0.194	12.540	0.084
. *.	. *.	8	0.15	0.136	13.370	0.1
.** .	. .	9	-0.243	-0.017	15.731	0.073
. *.	.** .	10	0.161	-0.206	16.875	0.077
.* .	. .	11	-0.151	-0.002	17.994	0.082
. .	. *.	12	0.043	0.159	18.094	0.113