Granger-causal relationship between macroeconomic variables and stock prices: evidence from South Africa

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15 November 2017

Granger-causal relationship between macroeconomic variables and stock prices: evidence from South Africa

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Abstract

This paper investigates the Granger-causal relationship between the South African stock index and selected macroeconomic variables using the standard time series techniques. The tests of cointegraion, long run structural modeling (LRSM), VECM and VDC tend to indicate that industrial production is the most leading determinant of stock market prices. This suggests that the South Africa stock market is very sensitive to the industrial production of the country. Money supply, Inflation, exchange rates are the other determinants of stock index of South Africa but to a lesser extent compared to the industrial production. The findings have implications for the policy makers in the sense that any changes in the macroeconomic policy should take into consideration the impact of such changes on the most important institution in the country which is stock market.

Key Words: Stock price, macro economic variables, South Africa, Cointegration, VECM, VDC

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1.0 Introduction

Understanding the factors that influence the behavior of stock market in a country has been debated for quite a long time and has attracted the attention of economists, policy makers, and other interested parties and they still pay attention to this issue until recent time. This is due to the significance of the stock market behavior to the whole economy and economic development of countries. Studies on the impact of macroeconomic variables on stock market have been dealt with extensively in the developed markets and it is growing in a great way in the emerging and developing countries (for example Kutty, 2010 in Mexico; Ali et al., 2010 in Pakistan). Contributing to the literature on this issue, this study will explore such relationship in the context of South Africa market. The driving motivation behind this study is that South Africa stock market is considered as the most active and largest stock market in the Africa continent and among the important and large markets in the world and therefore, an understanding of the determinants of its behavior is important for the policy makers, investors and other stakeholders (Adjasi and Biekpe, 2006).

So far only a handful of studies have been devoted to investigating the role of fundamental macroeconomic variables on stock markets in developing and emerging countries such as South Africa. As South Africa stock market continues to undergo some technical changes, which likely increases the efficiency of the market and thus increasing its response to macroeconomic events, there is a need to investigate the impact of macroeconomic variables on stock prices taking into consideration the changes that have been done. Even though there are a few studies in South Africa content that examine the issue, however, these studies have been conducted using data that seems to be not recent and hence it may not capture the impact of substantial changes made in South

Africa after 1994 until recent times (examples of these studies; Jefferis and Okeahalam, 2000; Van Rensburg, 2000). Moreover, studies that have been undertaken in South Africa were centered and focused on one variable and its cointegration with stock prices, however, this study will consider comprehensively a number of variables including inflation, money supply, exchange rate and industrial production and its impact on stock prices of South Africa and hence contribute to inconclusive literature using another dimension and environment.

In addition, a time series technique has been used as a method of study which will add rigor to the results of the study. As such this study aims to provide new evidence on the relationship between stock prices and economic determinants and in which the results would have an implication to the authoritative bodies and other stakeholders. In the following section, literature review will be presented. It follows in section three with discussion on theory and hypotheses development. Section four will deal with the methodology of the study. The results of the study will be provided in section five. The paper finally will conclude with section six.

2.0 Literature Review

A wide range of studies have been undertaken in order to determine the economic forces that have an influence on stock market of countries. However, most of these studies have been conducted in the developed countries. The leading and established study in this regards was introduced by Fama (1970) when he proposed the capital asset pricing model. Following this studies various studies conducted and found inconclusive results on the relationship between stock prices and macroeconomic variables. As already mentioned that studies on developed countries are well developed, the literature review in this study will focus mainly on developing countries.

Maysami et al (2004) examine the long run relationship between stock prices in Singapore and a set of economic variables including exchange rate, money supply, inflation and industrial production. They found that stock market index form a cointegration relationship with changes in the short and long term interest rate, industrial production and prices level and exchange rate and money supply. Other studies in developed counties that found long run relationship between macro economic variables and stock prices include Ratanapakorn\ and Sharma (2007) on money supply and stock prices in US; Humpe and Macmillan (2009) on stock prices and industrial production in US and Japan.

Studies in developing and emerging market countries have been rapidly grown in the last few years. Kutty (2010) examines the relationship between stock prices and exchange rates in Mexico using the Granger causality test. He documented interesting finding in which shows that stock prices lead exchange rates in the short run, and there is no long run relationship between these two variables. Similarly, Ali et al. (2010) has investigated the relationship between macroeconomic indicators and stock prices in Pakistan. Their results pinpointed that stock prices cointegrate with industrial production; however, no causal relationship is documented with other macroeconomic variables. Ahmet and Hasan (2010) examine the long relationship between stock prices and a set of economic variables namely inflation, exchange rate, industrial production and money supply and they found that there is long run causality between those determinants and stock prices in Turkey. Apart from the above mentioned studies, investigated the same issues and they found cointegraion relationship among the macroeconomic variables and stock prices Gay (2008) in Brazil and Eita (2011) in Namibia; Adjasi et al. (2008) in Ghana.

As far as South Africa concern, Jefferis and Okeahalam (2000) test the influence on economic fundamental or drivers on stock return in South Africa South Africa, Botswana and Zimbabwe adopting cointegration and error correction techniques and utilizing quarterly data throughout the period of 1985 to 1995. The finding of the study revealed that stock market is influenced by economic growth and other variables such as exchange rate and interest rate. It is indicated that exchange rate has positive relationship with stock prices and real GDP and negatively related to interest rate. Van Rensburg (2000) has undertaken study to uncover the expected influence on macroeconomic variables on South Africa stock exchange in Johannesburg using data from 1980 till 1994. The vector autoregressive (VAR) technique has bee been employed and the result of the study reported that stock returns are mainly following the industrial sectors.

Apart from the above two studies, Moolman (2004) investigated whether there is relationship between stock return and macro economic variables using Markov switching model. The findings documented that stock return is influenced by economic variables. Following these studies there was scant literature in this issue and specially the literature that used recent data.Among the recent scant literature is the study conducted by Arjoon et al. (2010) in South Africa using Structural bivariate vector autoregressive (VAR) methodology. In their study, they test the long run association between inflation and stock prices. The results of the study indicated that stock prices are invariant to permanent changes in inflation rate. The impulse responses reveal a positive real stock price response to a permanent inflation shock in the long run which implies that any deviations in short run real stock prices will be corrected towards the long run value. Furthermore, Ocran (2007) found that there is cointegration relationship between South Africa stock prices, US stock prices and exchange rate.

As it can be observed that the data used in this literature on South Africa were very old data and therefore, investigating such issue by using recent data could add new evidence on the relationship between stock market and macroeconomic variables. This is very important since the South Africa has undergone many substantial changes in their market following the year 1994. As the few studies on South Africa used data prior to 2000, this study will fill the gap by studying the impact of macro economic variables on stock returns using a recent data and employing cointegration and Vector Error Correction Model (VECM). Further, it is evident from the literature review that the issue of causality between stock market performance and economic determinants has remained inconclusive either theoretically or practically and thus, the paper contribute to literature on stock prices and its determinants by providing new evidence to the interested parties such as government and investors.

3.0 Theory and Hypotheses Development

3.1 Inflation Rate

The vast literature on the theoretical relationship between the rate of inflation and stock prices in an economy has shown varied predictions about the long run effects of inflation on real stock prices (Arjoo et al. 2011). A large body of literature provides evidence for the movement of financial asset prices in response to inflation changes, but conclusions have been widely debated. Different explanations and theories have been provided for the relationship between stock prices and inflation such proxy hypothesis by Fama (1981) and nominal contract hypothesis (Daiz and

Jareno, 209). An increase in inflation rate is expected to relate negatively with stock prices. This is because the rising of inflation is more likely to lead the policy makers to tight the policies. This has an impact on the nominal risk free rate and hence lead to increase in the discount rate used in valuation (Maysami et al, 2004). Therefore, the hypothesis is that the higher inflation rate the more likely the stock prices will go down.

3.2 Exchange rate:

There is wide debate among researchers, policy makers and economists as to whether stock prices influence exchange rates or vice versa and empirically the literature were inconclusive and unable to find unique findings. This is quite true due different institutional and environmental forces that each country adapted to. In classical economic theory side, it is argued that the deprecation of a certain currency will lead to increasing the demand for the country export and consequently leading to increase in cash flow and profit of companies and by turn it will drive the stock prices to higher level (Kutty, 2010; Maysami et al, 2004; Phylasktis and Ravazzolo 2005). Conversely, according to tradition approach the appreciation in the currency is considered a bad news for local firms as it will drives the competitive advantages of export to lower rate and therefore, leading to decline in firm's profitability and hence stock prices decline. Thus, according to this view a negative relationship would exist between stock prices and exchange rate. Other like (Maysami et al, 2004) suggest an alternative way and explanation and they argue that appreciation in the currency would attract the investment and thus push up the stock market prices to rise up. As such conflicting results, in line with finding from Phylaktis and Ravazzolo (2005) this paper hypothesize that there is positive relationship between stock market and exchange rate

3.3 Industrial Production

This factor usually used to measures the real economic activity Maysami et al. (2004). In the theory, the productive capacity of an economy indeed depends directly on the accumulation of real assets, which in turn contributes to the ability of firms to generate cash flow. As results of this argument the stock prices will go up. This is because the industrial production index is an indicator of real output. In line with studies conducted by Humpe and Macmillan (2009) on stock prices and industrial production, the positive relationship between stock price and industrial production is hypothesized.

3.4 Money Supply

An increase in money supply growth would indicate excess liquidity available for buying securities, resulting in higher security prices. The modern quantity theory of money developed by Brunner (1961), assumed investors reaches an equilibrium position in which they hold a number of assets including money in their portfolio. A monetary disturbance, such as an increase in rate of money supply, causes disequilibrium in portfolios of assets. As a result, asset holders adjust the portion of their portfolio (Quoted in Alkhudairy, 2008). This adjustment alters the demand for other assets that compete with money balances, including stocks. Due to the increase in the money supply, there would be an excess demand from investors for stock and hence the prices of stocks will rise up and vice versa. Even though the literature and empirical evidence did not reach the agreement on the effect of money supply on stock prices, the paper hypothesizes that increase in money supply will lead to increase in stock prices as argued in the discussion above.

4.0 Research Methodology

This study aims to investigate the impact of certain economic variables described in a previous section on the stock market behavior of South Africa using monthly data. Therefore, to achieve this objective, the study employs time series techniques or vector Autoregression (VAR) framework.

By adopting such techniques, it is argued that the weakness of traditional regression can be overcome. Using such time series method which includes granger cointegration, error correction model, and variance decomposition allows the researchers to take the consideration for the problems faced in the regression. The main problem of regression centers on the idea that economic variables are non stationary and hence the results of t-test and f-test could be invalid. The researchers tried to solve such problems by differencing the variables, however, such approach has another implication on the data as it will remove the long run relationship or the theoretical part. Apart from the above, the application of this method helps to deal and account for the problems of endogeneity as it can be dealt with a suitable manner and as such the variables are considered to be endogenous and the data will determine whether the variable is endogenous or exogenous (Ang and Mckibbin, 2007).

The VAR method has several steps to be followed namely unit root test, cointegration test, Error Correction Model, Impulse Response Function persistence profile. In brief, the importance of these tests is described in the next sections:

4.1 Unit Root Test

Most of the time series data are non-stationary, meaning that the mean and variance are not constant over time. As we mentioned previously elsewhere that when the data are non stationary, it will lead to wrong conclusion in classical regression and hence spurious results will be produced.

Therefore, in cointegrarion analysis we have to test the variable whether it is non stationary or not in order to proceed with the next step of testing cointegration. The variable should be I(1) or non stationary in its level form and stationary in its difference form. Many tests have been suggested in the literature to test the non stationary of the variables such as Augmented Dickey-Fuller (ADF) and Phillip Pirron (PP). For the purpose of the study ADF is utilized to test each variable in its level and difference form.

4.2 Determination of the Order of the VAR

The second step in time series cointegration is that the VAR order should be selected. In selection of the VAR or the number of leg to be used when the test of cointegration is conducted. There are different methods adopted in selection of the VAR, however, in this study, Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC). The rule of thumb in this step is that to select the maximum value under each method which give the order of the lag and usually the AIC maximize the lag and SBC minimize the lag.

4.3 Testing for Cointegraion and Long structural Modeling

According to Masih and Masih (1997), conitegration plays essential rule in determining the presence or absence of Granger causality. In other words, this test is useful for estimating a long-run relationship between time series macroeconomic. If two or more variables are found to be non-stationary, the linear combination of these variables is most likely to occur. Two variables are said to be cointegrated that is they experience long run relationship. In relation to this study, the cointegration technique has been used to analyze the long-run relationship and stock prices and some fundamental macroeconomic variables (Alkhudairy, 2008). For the purpose of this study, Johansen cointegration technique will be applied based on its Eigen value and trace statistics. Once the estimated cointegration vectors is determined, then it is to be subjected to exactly identification and over identification restrictions based on theoretical expectations and prior information of the market (Masih et al. 2009). The test of cointegration as mentioned by Masih et al (2009) is aimed to test the long run theoretical relationship and rule out any spurious relationship.

4.4 Vector Error Correction Model (VECM)

Once we confirm that there is long run relationship between the variables as indicated from previous step, and then VECM comes to play another rule in determining the exogeneity and endogneity of the variables under investigation. This method is another way to investigate the relationship among variables and it can determine the direction of Granger causality in the short and long run (Masih et al., 2009) For example, ECM combines the short run and the long run relationships of the variables in one equation (Masih and Masih, 2001).

4.5 Variance Decompositions (VDC)

While in the VECM, we can determine which variable is exogenous and which endogenous, however, it is through VDCs we can know the relative endogeneity and exogeneity of the variables. In other words, we can determine which variable is most leading and which is lagging behind (masih et al, 2009). This can be done by portioning the variance of forecast error of a a variable into proportions attributable to shock in each in each variable in the system including its own. The variable that explains its own shock more than other is considered leading variable and the variable that explained less of its own shock is considered lagging variable.

4.6 Impulse Response Functions (IRFs)

The IFRs present the same information contained in VDCs, however, the IFRs map out the results in graphical form for the dynamic respond path of the variable to one period standard deviation in another variable (Masih and Masih, 1997).

4.7 Persistence Profile

Finally, this step is designed to estimate how long the variables take to get back to equilibrium when there is a wide system shock.

5.0 Data, Empirical Results and Discussions

As we mentioned previously that the objective of this study is to find whether the economic variables under investigation have an influence on the behavior of the stock market of South Africa. The variables of the study include the stock market index of South Africa (SA), Money supply (M2), Inflation (INFL), exchange rate (EX); and finally the industrial production (IP).

5.1 Result of testing for the Unit Root

As we know performing stationary/ non stationary test require that the variables to be transformed to log for the level for and then to take the difference of log form.

Log of level form variables:

LSA= log(SA); LM2 = log(M2); LINFl = log(INF); LIP = log(IP); LEX = log(EX);

Then we have to difference as follows

DLSA = LSA - LSA(-1); DLM2 = LM2 – LM2 (-1); DINLF = LINLF - LINFL (-1); DLIP = LIP - LIP (-1); DLEX= LEX - LEX (-1);

The summary of the variables and the results of ADF are shown in the table 1 below:[1]

TABLE 1: Stationary and non stationary results

Variable	Abbreviation for level form	Stationary of the variables	
		Level form	Difference form
South Africa stock index	LSA	Non stationary	Stationary
Money Supply	LM2	Non stationary	Stationary
Inflation	LINF	Non stationary	Stationary
Exchange Rate	LEX	Non stationary	Stationary
Industrial Production	LIP	Non stationary	Stationary

Based on our test of ADF (Appendix A1-A10) for the level form and difference form, it is shown in the above table that all variables are I(1). Concluding that, we accept the null hypothesis of non stationary (i.e the variables are stationary).

5.2 Selection the order of VAR

The aim of this step is to determine the optimal order for the VAR, therefore, at this stage according to Pesarana nd Pesaran (2009), it is important to select a high enough order in the sense that it will confident that the optimal order will not exceed it. Hence, Lag 6 was entered into the order of the VAR. The results of this process are presented in appendix B. Based on the table in the appendix B, it is indicated that the order for VAR according to AIC and SBC is 2 and 1 (the highest value

[1] For more details results see appendices A1-A10

is 2183.3 and 2128.6), however, the LR and adjusted LR test reject the VAR of 1 and does not reject the VAR of 2, therefore, VAR order of 2 has been selected as the lag order for the VAR. This conclusion of the above results is based on Pesaran and Pesaran (2009) page.278. Furthermore, as the data observation is quite long, the VAR order of 2 is justifiable. For more results see appendix B.

5.3 Testing cointegration

Following the determination of VAR, we have to test the cointegration. It is to determine whether there is cointegration among the variables or not. Based on evidence from different market and based on the theory, the intuition said that there is at least on cointegration equation. Multivariate with VAR order 2 to get the results based on 'eigen values' and the 'trace' statistics to determine the value of r (cointegrating relationship). If r = 0 is accepted, there is no cointegration among the variables. If r = 0 is rejected, there is cointegration among the variables.

As shown in below table 2 Panel A and Table 2 Panel B as well as appendix C, the test statistics based on calculated maximal eigenvalue of the stochastic shows a value of 42.6030 which is greater than the critical value at 95 percent level of significant 37.8600 suggesting the null hypothesis of no cointegration or zero cointegration is rejected and therefore, the alternative hypothesis of one (1) cointegration is accepted. Furthermore, it is also shown that null hypothesis of r<= 1 cointegration cannot be rejected whereas the alternative hypothesis of r>= 2 is rejected. This is because the maximal eigenvalue (23.1095) in this case is less than critical value (31.7900) at 95 % level of significance. Similarly, the results of trace test shown in the second table of cointegration indicate same conclusion as the drawn results o maximal eigenvalue. Based on the above results and discussion, it can be said that there is cointegration between the variables and hence rejecting the null of noncointgration.

Table 2: Results of cointegration

H0	H1	Statistics	95% Critical value	90% Critical value
Panel A eigenvalue				
r = 0	r = 1	42.6030	37.8600	35.0400
r<= 1	r = 2	23.1095	31.7900	29.1300
Panel B Trace statistic				
r = 0	r>= 1	95.8365	87.1700	82.8800
r<= 1	r>= 2	53.2335	63.0000	59.1600

5.4 Long Run Structural Equation Modeling

LRSM is important step in the analysis in the sense that we can compare the theoretical expectation with the generated statistics. In other words, LRSM allows estimating long rum model based on theory by imposing identifying and over identifying on the parameters (Masih and Winduss, 2006). Since the main purpose of the article is to know the influence of economic variables on South Africa stock index, we impose restriction on the LSA or South Africa stock index. This means that we have to normalize the dependent variable and hence we can see the significance of the variables as determined by its T-ration statistics. The summary of results of exact identification is depicted in table 3 below.

Table 3: Results of exact Identification

	Vector 1	T-Ratio
LSA	1.0000 (*NONE*)	
LM2	-.12773 (.27905)	Insignificant (0.457) T-ratio less than 2
LEX	2.3328 (1.0195)	significant (2.130) T-ratio more than 2
LINFL	-17.5841 (10.9759)	insignificant (1.602) T-ratio less than 2
LIP	7.9777 (5.3386)	Insignificant (1.494) T-ratio less than 2
Trend	.053349 (.041690)	

****
LL subject to exactly identifying restrictions= 2269.8
****

$$LSA_t - 0.1277\ LM2_t + 2.3328\ LEX_t - 17.5841\ INFL_t -+ 7.9777\ LIP_t \sim I(0)$$
$$\qquad (0.279) \qquad (1.01) \qquad (10.97) \qquad (5.3386)$$

Based on the results of the table 6, it is shown that only foreign exchange rate (LEX) is significant and the other variables are insignificant as indicated by T-ratio calculated in the above table 3. Following exact identification restriction, we imposed restriction on other variables. In this regards, the author applied one restriction on money supply (LM2); inflations (LINFL) and industrial Production (LIP) variables at once. Then to check the robustness of such restriction, there was one restriction applied on each variable. The results of restriction on all variables at once are shown in the table 4 below.[2]

[2] For the results of individual restriction on each variable see appendix D3 to D5

Table 4 : the results of over identification restriction

	Vector 2
LSA	1.000 (*NONE*)
M2	.0000 (*NONE*)
LEX	1.2423 (19937)
LINFL	.0000 (*NONE*)
LIP	-.0000 (*NONE*)
Trend	-.011134 (.9885E-3)
LR Test of Restrictions CHSQ(3)= 20.2314[.000] DF=Total no of restrictions(4) - no of just-identifying restrictions(1) LL subject to exactly identifying restrictions= 2269.8 LL subject to over-identifying restrictions= 2259.7	

Looking to the above table, it is shown that the restrictions imposed on the variables are rejected by Chi Square of 0 .000 and hence we proceed with the Vector 1 for the reminder of the paper. The rejection of the restrictions means that the variables are entered the cointegrarion relationship significantly. However, as it mentioned previously, to check the robustness of restriction, the researcher imposed restriction for each variable separately. The results of each restriction are shown in **the appendix D3-D5**. To summarize the results of those additional restrictions, it can be said that on one hand the restriction is only valid for two variables namely LINF (inflation) and LIP (industrial production) and on the other hand, the separate restriction on M2 (money supply) is not valid or it stands. In other words, the restrictions on variables namely LINF (inflation) and LIP (industrial production) is rejected with Chi Square of 0 .000 and therefore, the two variable enter the cointegration relationship significantly, With regards to M2 or money supply restriction cannot be rejected with Chi Square of 0.672 and therefore, we would have to drop that variable, however, based on the theoretical foundation underpinning the impact of money supply on the stock market behavior and empirical evidence reported by literature, the researcher prefers to proceed with vector 1 for the reminder of the paper.

5.5 Vector Error Correction Model (VECM)

VECM shows further information on the relationship between variables. As we know cointegration, cannot tell the direction of Granger causality as to which variable is endogenous and which is exogenous. Thus, for revealing which variable is dependent and which is independent VECM is used for that purpose. The table 5 below summarizes the results of VECM.[3]

Table 5: results of VECM

Variable	ECM(-1) t-ratio p-value	Implication
LSA	-3.27 [.001]	Variable is endogenous
LM2	-.95779[.339]	Variable is exogenous
LINFL	3.0483[.003]	Variable is endogenous
LEX	2.1513[.033]	Variable is endogenous
LIP	1.2559[.211]	Variable is exogenous

Looking to the table and particularly to the significant of ECM or other wise the error correction coefficient we can draw up conclusion on which variable is endogenous and which is exogenous and therefore, the policy makers and related parties can know which variable should pay attention to when they make their decision as it may need certain actions to be taken in order to have an influence on one variable to get the required results or impact on other. **In the table 5**, it is shown that LSA or stock market behavior is dependent variable according to T-ratio of more than 2 and that is come with the expectation. For money supply (LM2), and industrial production (LIP), it

[3] For details refer to appendices E1-E5.

is evident from the above table that they independent variables which also proved through the empirical evidence which shed light on the relationship between stock return and those variables. Lastly, exchange rate (LEX) and inflation (LINF) is shown to be dependent variable.

Variance Decompositions (VDCs)

The results of the previous step do not tell the relatively endogneity and endogeneity of the variables. Therefore, the VDCs is designed to draw conclusion on such matter. There are two types of VDCs tests, the first is the orthogonalzed forecast error variance decomposition and the second one is generalized forecast error variance decomposition.

The **table 6** below shows a summary of the results from orthogonalzed forecast error variance decomposition. It is indicated in the table that the most leading variable is the industrial production which confirm the results of VECM in which the industrial production (IP) is found to be exogenous variable as it explain about 97% of its own shocks. This is consistent with the theory and previous empirical evidence from other countries (see for example, Maysami et al., 2004, Humpe and Macmillan, 2009). For South Africa as industrial country is growing fast in this field and this could be due to the changes made in political atmospheric as well as the country reputation in the gold industry. So, the implications for those things are that the market reacts to industrial events very sensitively.

Table 6 also shows that money supply follows industrial production in its effect on stock markets. This results shows that M2 (explains 97% of its own shock) is the second leading variable which also in line the results of VECM in which the money supply was exogenous variable and this is according to the theory of money supply is correct relationship as the access liquidity lead to high demand for stock shares which push the prices upward due to high demand. However, the surprising results here is that the stock market of South Africa is the third leader variable even it was shown that its endogenous in the VECM test (explain 91% of its own shock). The least leading variable or we can say the dependent variable is exchange rate which is contradictory to the theory. However, the results of orthogonalzed forecast error variance decomposition sometimes is misleading as it is subject the assumption that when one variable is shocked the other variables is switched off. Furthermore, it is much affected by the ordering of the variable as it may get other results if you change the order of the variables. For those reasons, the paper proceeds to analyze the generalized forecast error variance decomposition as it may reflect better results. [4]

Table 6: Orthogonalized forecast error variance decomposition

	LSA	M2	LEX	LINFL	LIP	Total
LSA	91.6%	0.02%	7.7%	0.05%	.00%	100%
M2	0.03%	97%	2.5%	.002%	.03%	100%
LEX	32.1%	0.04%	65.8%	1%	0.02%	100%
LINFL	1.8%	1.6%	12.8%	83.7%	0.01%	100%
LIP	0.8%	0.4%	0.1%	1.3%	97.2%	100%

Relative exogeneity and endogeneity according to orthogonalzed VDCs

[4] The detail results are shown in the appendices F1-F10

LIP	M2	LSA	LINFL	LEX
Industrial production	Money supply	Stock market south Africa	Inflation	Exchange rate

Table 7 below shows the results of the generalized forecast error variance decomposition and it may reflect the true picture than of orthogonalzed forecast error variance decomposition it does not consider the issue of ordering of the variable. As it is reported in table 7, the stock market of the South Africa is the least leading variable which confirms our expectation and the results of VECM in which the South Africa stock market was endogenous variable and in the sense that stock market performance is dependent on different economic determinants and not the opposite. Again the industrial production is the most leading variable. Similarly money supply is shown to have leading role in guiding the market behavior. [5]

Table 7: Generalized forecast error variance decomposition

	LSA	M2	LEX	LINFL	LIP	Total
LSA	58%	0.09%	40.2%	0.07%	0.03%	100%
M2	0.33%	95%	2.2 %	0.0189%	2.19%	100%
LEX	24.55%	0.03%	73.44%	1.53%	0.44%	100%
LINFL	1.8%	1.7%	12.9%	83.6%	0.000	100%
LIP	0.88%	0.53%	0.09%	0.02%	98.46%	100%

[5] For more results refer to appendix F1-F10

Relative exogeneity and endogeneity according to orthogonalzed VDC

LIP	M2	LEX	LINFL	LSA
Industrial production	Money supply	Inflation	Exchange rate	Stock market south Africa

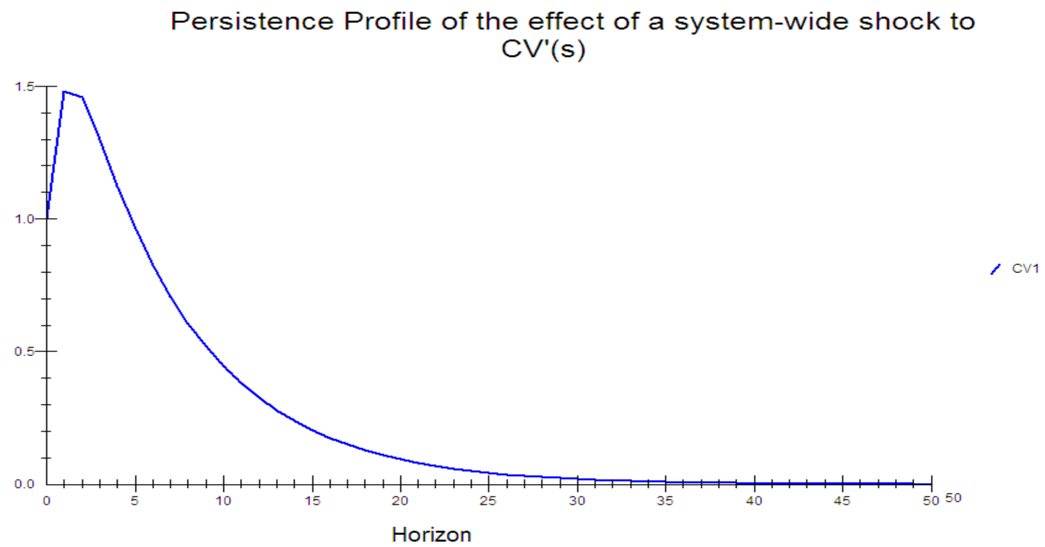
5.7 Impulse Response Function (IRF)

The results of VDCs is similar to the results of impulse response function, however, in the IRF the results are depicted in the graphical form. The drawn conclusion from all graphical representation of the shock in any variable is that the industrial production (LIP) is the only variable that does not react to other variables shock, however, when it shocked all other variables react positively and negatively indicating its exogeneity feature of that variable. The reaction for stock prices to the shock on other variables varies according to the nature of the variable (For more details about the IRF refer to appendix Figure A1-figure A10). For example, LSA or stock prices of South Africa react positively to shock M2 indicating the positive relationship between both variables as indicating by theory which states that the access liquidity will lead to increasing the demand for stock prices in the long run. Inflation and stock prices is proved to have negative relationship in the long run. All in all, all variables are cointegrated in the long run and not in the short run as indicated by VECM and thus, we can say that the shock of one variable has different impact on the cointegration relationship as some of the variables react sensitively and other not.

5.8 Persistence Profile

This test designs to show how long the entire cointegration equation takes to get back to equilibrium when the wide system is shocked. Figure 1 shows the system wide shock result and it is graphically shown that it takes about two and half years or 30 periods (months) to get back to equilibrium

Figure 1



6.0 Conclusion

This study employs the standard time series technique, in particular, cointegration, error correction modelling and variance decomposition, in order to find empirical evidence of the nature of relations between the stock prices and macroeconomic variables. The findings of this study revealed that South Africa market formed significant relationship with all macroeconomic variables included in this study. Precisely, South African stock market is more sensitive to the variable industrial production than other variables which their important come behind the industrial production. As it is evident from the study such relationship is considered as long run relationship. The presence of cointegration support the opponents of efficient market hypothesis in which they argue that the market reflects the available information. This study would guide the policy makers of South Africa in reassessing their policy regarding those macroeconomic variables influence on stock market.   The policy makers should think wisely when they decide to alter or change their policies regarding the macroeconomic variables. They should be aware that any changes in their policies for those variables would have its impact on the operation of stock market of South Africa. Finally, it is worthwhile to note that the study has some limitations due to the problems encountered in time series such as, the order of lag selection and its impact on other results. Other avenues of research could be in developing a model to predict the above relationship using non linear techniques.

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