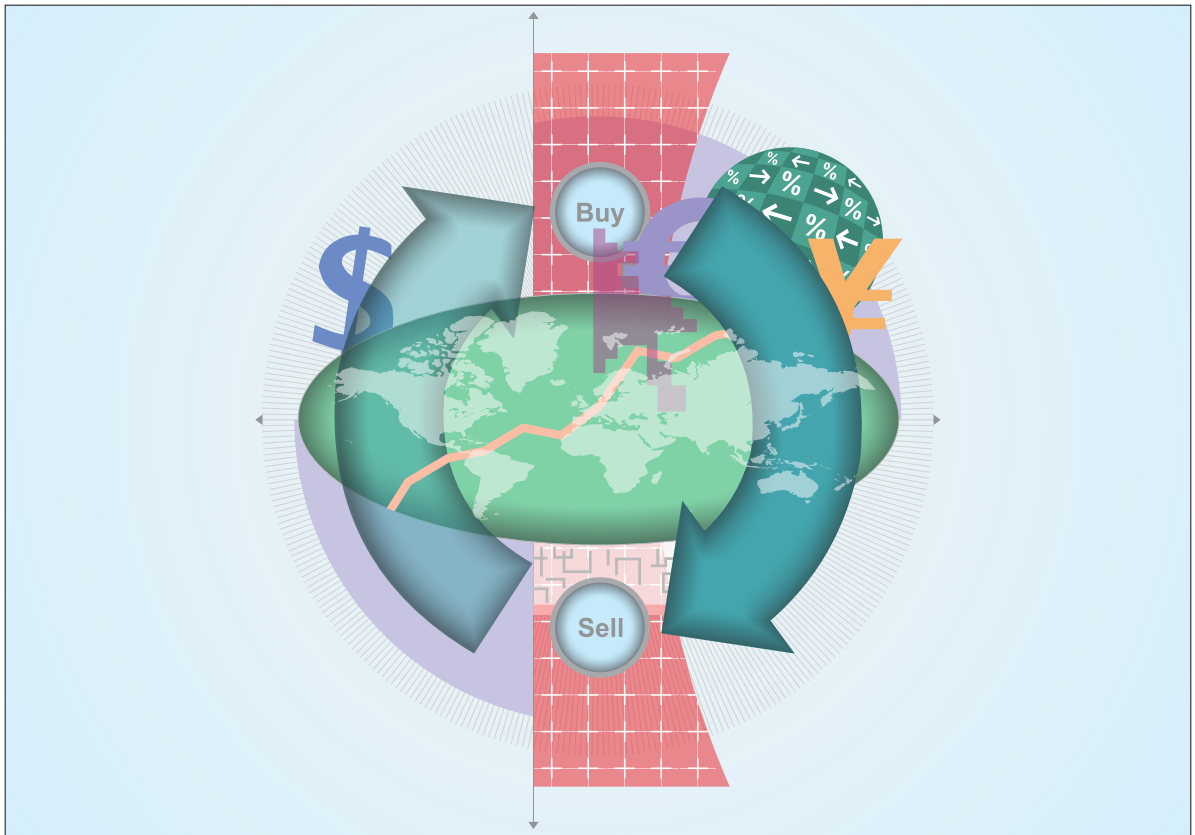




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A Bounds Testing to Cointegration: An Examination of Natural Disasters and GDP Relationship in Southern Africa Region

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ABSTRACT

The spillover affects due to calamities caused by climate change has been distressing especially in the African countries and particularly in the Southern Africa states. The rising degree of calamities in this region affects not only the agricultural sector but also erodes the economic resources of families and communities. Previous studies have focused on the economic effects of natural disasters without differentiating neither between the types of disasters nor between the sectors of the economy. Pooling all natural disasters together would fail to consider the vast range of possible effects and could be misleading. Using the bonds testing or the Autoregressive Distributed Lags (ARDL) approach, this study investigated the long run effects of four types of natural disaster on the proportional GDP from three different sectors for five selected Southern Africa countries (Botswana, Lesotho, Namibia, South Africa and Swaziland). The results showed that drought, epidemic and storm have a negative effect on the agricultural GDP while flood affects positively the agricultural and manufacturing GDP in the long run. Meanwhile, the epidemic has a positive effect on the proportional GDP from services and negative sign with manufacturing sector in the long run. The estimated results suggested that the selected countries need to invest in developing and structuring flood protection systems as well as building water storage for water supply in drought periods as well as developing water resource management. The type of natural disasters is important key in determining the losses or gain of natural disasters in the long run.

Key words: Climate change, natural disasters, agricultural sector, macroeconomic, autoregressive distributed lag approach (ARDL)

INTRODUCTION

Climate change and natural disasters are obstacles that tighten the economic growth and sustainable development in Africa. They also curtail the achievement of the Millennium Development Goals (United Nations, 2010). Africa and particularly the southern Africa region, is vulnerable to climate change and natural disasters because most of the households in this region are involved in agricultural activities. The dependency of rain fed agriculture, lack of access to assets and high rate of poverty put them at risk at most times (Lee and Neves, 2010). While impairing the agricultural sector, climate change and natural disasters both have equally a negative impact on food and water security and trigger spread of diseases and migration. All these consequences eventually spark a possible breakdown of economic growth (Mwiturubani and van Wyk, 2010).

Although many studies have investigated the potential threat on economic growth by natural disasters, they give us very palpably different findings. Some of previous studies found natural disasters to have a short term negative impact on economic growth and its immediate recovery was substantially serving to straighten the ruined economy (Sadeghi *et al.*, 2009; Hallegatte and Dumas, 2009; Noy and Vu, 2010). Others found that climate change, such as increase temperature and CO₂ and natural disasters such as floods and droughts, has negative effects on crop farming and livestock (Vaghefi *et al.*, 2011; Mwang'ombe *et al.*, 2011; Gholipoor, 2008). Also natural disasters decrease soil moisture (Matouq, 2008) which lead to decrease farm income as well as the future food supply. This lead in declining per capita GDP from agriculture as well as from other economy sectors. But catastrophic disasters are recognized to cause a short and long run economic paralysis in its growth (Cavallo *et al.*, 2009; Sadeghi *et al.*, 2009; Amiri and Eslamian, 2010). Many other studies revealed that natural disasters were a catalyst to the economic growth and that they were opening the space to upgrade capital stock and adopt new technologies (Skidmore and Toya, 2002). Cuaresma *et al.* (2008) found that the degree of catastrophic disasters was the determinant of the volume of knowledge spillovers between the developed and developing counties. Their findings reported that only the developed countries could benefit the capital upgrading by a post-natural disaster trade. Lis and Nickel (2009) and Banuri (2005) demonstrated that the aftermath of disasters brought burdens and serious shortages on national budget of developing nations than the developed countries. Bergholt and Lujala (2010) had carried out a comparative research on dramatic economic implications caused by both natural disasters and domestic armed conflict. Their findings showed that natural disasters reflected some serious consequences that may cripple economic growth of a country but never increase the likelihood of armed civil conflict.

Therefore, the natural disaster-generated economic effect is conditioned by a country's degree of development. Many studies report that countries with high rate of literacy, high per capita income, improved financial systems and high degree of opening, experience less damages caused by natural disasters (Toya and Skidmore, 2007; Noy, 2006). Kirigia *et al.* (2004) found that in African countries, capital, educational enrollment, life expectancy and exports were helping economic growth while imports and disaster mortality were producing negative outcomes on GDP. Their estimation showed that a single person's disaster mortality was minimizing GDP by over US\$0.018. There are no similar findings from previous studies about natural disasters impact on economic growth in long term. Some researchers conclude that a short run effect of natural disasters would be mended by an updating of capital stock and adopting new technologies which lead to a rapid restoration of long term equilibrium. Others view that the losses of human lives, destruction of social order and devastation of economic capacity may deter the long term economic growth of a nation, especially when a nation has few instruments to cope with these disasters.

The above studies focused only on the effect of natural disasters on economic growth without differentiating neither between the types of disasters nor between the sectors of the economy. Pooling all natural disasters together may provide a vague understanding on how these natural disasters would cause crisis for the economy growth. Also disaggregating the GDP to its sectors gives more robust and clear picture on post disaster losses. The present study tries to fill this research vacuum by exploring the effect sporadically caused by four major types of natural disasters (flood, drought, epidemic and storms) on three economic sectors of agriculture, manufacturing and services of southern Africa countries of Botswana, Lesotho, Namibia and South Africa.

METHODOLOGY

To investigate the long run effect of natural disaster on different sectors of the economy for the five selected southern Africa countries during 1980-2006, a simple model disasters (Xi) influencing the gross domestic product (Yi) has been carried out. In this model the proportional gross domestic product GDP from agriculture, manufacturing and services are influenced by natural disasters.

To acquire a clear understanding of natural disasters impact on the proportional GDP, this study has examined the effect of Flood (FL), Drought (DR), Epidemic (EP) and Storm (ST) on the proportional GDP in the fields of Agriculture (AG), Manufacturing (MN) and Services (SE) of these selected countries during the period between 1980 and 2006. Therefore:

$$Y_i = f(FL, DR, EP, ST) \quad (1)$$

$$Y_{it} = \alpha_0 + \alpha_1 FL_t + \alpha_2 DR_t + \alpha_3 EP_t + \alpha_4 ST_t + \epsilon_i \quad (2)$$

While Y_i is AG, MN and SE.

Therefore, Eq. 2 can be written as the following specific forms:

$$AG_t = \delta_0 + \delta_1 FL_t + \delta_2 DR_t + \delta_3 EP_t + \delta_4 ST_t + \epsilon_{1t} \quad (3)$$

$$MN_t = \lambda_0 + \lambda_1 FL_t + \lambda_2 DR_t + \lambda_3 EP_t + \lambda_4 ST_t + \epsilon_{2t} \quad (4)$$

$$SE_t = \phi_0 + \phi_1 FL_t + \phi_2 DR_t + \phi_3 EP_t + \phi_4 ST_t + \epsilon_{3t} \quad (5)$$

In order to prevent the spurious regression, it is required to conduct unit root tests. Table 1 indicates the results of unit root test based on dickey-fuller test statistics. According to Table 1, all the independents variable (FL, DR, EP and ST) are stationary at their level i.e., I (0). And the dependents variables (AG, MN and SE) are stationary at first difference i.e., I (1). Due to the series not being integrated to the same order, it is required to use an Autoregressive Distributed Lags (ARDL) approach for estimating Eq. 3, 4, 5. The ARDL approach is the appropriate method of estimation of the relationship where the dependents and independents variables are mixture of I (1) and I (0) (Pesaran *et al.*, 2001). Also it is more efficient in small sample data size as in the case in this study.

As the samples of this study is less than 100, the Schwarz-Bayesian Criteria (SBC) was employed in order to determine the optimal number of lags to be included in the conditional ECM models (Sadeghi *et al.*, 2009). According to Pesaran and Smith (1998), the Schwarz-Bayesian Criteria (SBC) is the best test among the other criteria due to this test defining more parsimonious specification.

Table 1: Results of unit root test based on dickey-fuller test statistics

Variables	Level (with intercept)	First difference (with intercept)
AG	-2.99	-6.62**
MN	-1.72	-4.60**
SE	-1.84	-3.82**
FL	-5.22**	-8.24**
DR	-5.69**	-3.71**
EP	-5.05**	-8.49**
ST	-5.54**	-12.78**

McKinnon critical value of test at the level 5%: -3.69. (**) denote stationary at the level 5%

In order to estimate the study models by employing ARDL approach, the existence of any long-term relationship among the variables of interest is determined using an F-test. In testing the existence of the long run relationship (cointegration), the error correction versions of the ARDL framework for Eq. 2 is given by Eq. 6:

$$\Delta Y_t = \theta_1 + \sum_{i=1}^{k1} \gamma_{1i} \Delta Y_{t-i} + \sum_{i=0}^{k2} \gamma_{2i} \Delta fl_t + \sum_{i=0}^{k3} \gamma_{3i} \Delta dr_t + \sum_{i=0}^{k4} \gamma_{4i} \Delta ep_t + \sum_{i=0}^{k5} \gamma_{5i} \Delta st_t + \beta_0 Y_{t-1} + \beta_1 dr_{t-1} + \beta_2 ep_{t-1} + \beta_3 fl_{t-1} + \beta_4 st_{t-1} + \epsilon_t \quad (6)$$

where, ϵ_t is the white noise errors, β_i are the long run multipliers, θ_1 is the drift

The null hypothesis proposed is that the five series for the three models (AG, MN and SE) are not cointegrated:

$$H_0: \beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0 \quad (7)$$

$$H_1: \beta_0 \neq \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0 \quad (8)$$

The null hypothesis was tested with F-statistic which has the non-standard asymptotic distribution under both H_0 and H_1 . Appropriate critical values are reported in Pesaran *et al.* (2001) for different numbers of regressors (4 in present case) and whether the ARDL model contains intercept and/or trend terms (with intercept only in our case). Two sets of critical values are given, one set assumes that all variables are I (1) and the other assumes they are all I (0), providing a band covering all possible classifications of the variables into I (1) and I (0). Values of the calculated F-statistic above the upper level of the band (4.01 in present case) indicate rejection of the null of no cointegration, whereas values below the lower level of the band (2.86 in present case) support the conclusion of no cointegration. The test is inconclusive if the F-statistic falls within the band, in which case we resort to the traditional practice of conducting unit root tests followed by other tests for cointegration.

Once cointegration is established the conditional ARDL long-run model for Y_i can be estimated as:

$$Y_t = \theta_2 + \sum_{i=1}^{k1} \theta_{1i} Y_{t-i} + \sum_{i=0}^{k2} \theta_{2i} fl_t + \sum_{i=0}^{k3} \theta_{3i} dr_t + \sum_{i=0}^{k4} \theta_{4i} ep_t + \sum_{i=0}^{k5} \theta_{5i} st_t + \epsilon_t \quad (9)$$

This involves selecting the orders of the ARDL models in the five variables using Schwarz-Bayesian Criteria (SBC). In the third and final step, we obtain the short run dynamic parameters (ECM) by estimating an error correction model associated with the long run estimates. This is specified as follows:

$$\Delta Y_t = \theta_3 + \sum_{i=1}^{k1} \varphi_{1i} \Delta Y_{t-i} + \sum_{i=0}^{k2} \varphi_{2i} \Delta fl_t + \sum_{i=0}^{k3} \varphi_{3i} \Delta dr_t + \sum_{i=0}^{k4} \varphi_{4i} \Delta ep_t + \sum_{i=0}^{k5} \varphi_{5i} \Delta st_t + \delta ec_{t-1} + \epsilon_t \quad (10)$$

where, $\varphi_{1i}, \varphi_{2i}, \varphi_{3i}, \varphi_{4i}$ and φ_{5i} are the short run dynamic coefficients of the model's convergence to equilibrium and δ is the speed of adjustment.

Data analysis: The collected data were analysed using Eviews statistical software version 7. Time series data analysis was used to generate the coefficients, t-statistics and F-statistics, which were presented in Table 3, 4a-c and 5a-c. Data was presented as percentage (%) of GDP of the economic sectors and the number of people per 1000 affected by the four types of natural disaster variables that investigated in this study.

Data collection and measurement: Data of the natural disasters for the five selected southern Africa countries is available from the international disaster database EM-DAT for the period from 1980 to 2006. Data on the proportional GDP from Agriculture (AG), the proportional GDP from Manufacturing (MN) and the proportional GDP from Services (SE) are available from Earthtrends environmental information database also for the period from 1980 to 2006.

The four types of natural disasters are measured with total number of affected people measured in per 1000 persons. Proportional Gross Domestic Product (GDP) from agriculture represents the proportion of an economy's total domestic output of goods and services which are a result of value added by the agricultural sector. Proportional Gross Domestic Product (GDP) from manufacturing reflects the proportion of an economy's total domestic output of goods and services which are a result of value added by the manufacturing sector. Proportional Gross Domestic Product (GDP) from services makes up the proportion of an economy's total domestic output of goods and services, which are a result of value added by the service sector.

RESULTS AND DISCUSSION

Before the estimation of long term coefficients and Error Correction Model (ECM), diagnostic tests of serial correlation, functional form, normality of residuals, structural stability and heteroscedasticity are indispensable for the accuracy of the model (Pesaran *et al.*, 2001). Table 2 indicates that at 5% level of significance, the three models of the present study (3, 4 and 5) are not subject to any problem of serial correlation, functional form and normality of residuals, structural stability and heteroscedasticity. Also the CUSUM and CUSUMSQ tests (Fig. 1a, b, c) indicate no evidence of misspecification and structural instability for the period estimated for the three models (AG, MN and SE).

Following Pesaran *et al.* (2001), the presence of long run relationships in Eq. 3, 4 and 5, using Eq. 6 was estimated. Table 3 indicates the results of the calculated F-statistics for the three models presented in this study. The calculated F-statistics for the model 3, 4 and 5 (which is equal to 4.855, 4.781 and 6.990, respectively) are higher than the upper bounds critical value 4.01 at the 5% level. Therefore, the null hypotheses of no cointegration are rejected, implying long run cointegration relationships amongst the variables when the regressions are normalized on AG, MN and SE variables (Table 3).

Once the long run cointegration relationship is established and confirmed, Eq. 9 for the three dependent variables (AG, MN and SE) was estimated using the following ARDL (2, 2, 2, 1, 1); (1, 2, 2, 3, 2) and (2, 0, 0, 0, 0) specification, respectively. The results estimated by normalizing on the proportional GDP from agriculture, manufacturing and services are reported in Table 4a-c.

The results from Table 4a showed that in the long run, drought, epidemic and storm have a significant negative impact on the proportion of GDP from agriculture. While flood is positively affecting the proportional GDP from agriculture in the long run. An increase of 1000 people affected by drought, epidemic and storm leads to decrease the proportion of GDP from agriculture

Table 2: Results of diagnostic tests for AG, MN and SE

Test	AG	MN	SE
Serial correlation (LM)	0.509 (0.614)	1.202 (0.337)	2.389 (0.124)
Functional form (Rest)	1.538 (0.145)	0.831 (0.461)	0.015 (0.984)
Normality (JBN)	3.240 (0.192)	2.163 (0.338)	2.650 (0.265)
Heteroscedasticity (ARCH)	1.756 (0.192)	0.295 (0.747)	1.313 (0.291)

p values are given in parentheses

Table 3: Results from bounds tests on Eq. 6

Dep. Var	SBC optimal lags	F-statistic	Outcome
F _{AG} (AG, FL, DR, EP, ST)	(1, 0, 0, 1, 0)	F (5,13) = 4.85568**	Cointegration
F _{MN} (MN, FL, DR, EP, ST)	(1, 1, 0, 0, 0)	F (5,13) = 4.78133**	Cointegration
F _{SE} (SE, FL, DR, EP, ST)	(2, 0, 0, 0, 0)	F (5,14) = 6.9900***	Cointegration

Asymptotic critical value **,*** Indicate significant at 5 and 1% level respectively, for k = 4 by Pesaran *et al.* (2001), p. Lower bounds I(0) = 2.86 and Upper bounds I(1) = 4.01 at 5% significance level

Table 4a: Estimated long run coefficients using the ARDL approach. Dependent variable is AG

Equation (9): ARDL (2, 1, 1, 2, 2) selected based on SBC. Dependent variable is AG

Variable	Coefficient	Std. error	t-Statistic	Prob.
C	3.45377***	0.886301	3.869845	0.0010
FL	0.016385***	0.006085	2.69289	0.0098
DR	-0.00156**	0.00084	-1.86340	0.0435
EP	-0.078992***	0.025694	-3.07432	0.0048
ST	-0.001354**	0.000786	-1.72300	0.0500

*, **, ***Indicate the significance at the 10, 5 and 1% level, respectively

Table 4b: Estimated long run coefficients using the ARDL approach. Dependent variable is MN

Equation (9): ARDL (1, 0, 1, 1, 1) selected based on SBC. Dependent variable is MN

Variable	Coefficient	Std. error	t-Statistic	Prob.
C	0.910978	3.127508	0.291279	0.3887
FL	0.024754***	0.008489	2.916000	0.0085
DR	-0.000054	0.000078	-0.68265	0.2559
EP	-0.076635**	0.035761	-2.14290	0.0303
ST	-0.001007	0.001763	-0.57148	0.2980

*, **, ***Indicate the significance at the 10, 5 and 1% level, respectively

Table 4c: Estimated long run coefficients using the ARDL approach. Dependent variable is SE

Equation (9): ARDL (2,0,0,0,0) selected based on SBC. Dependent variable is SE

Variable	Coefficient	Std. error	t-Statistic	Prob.
C	12.35874***	3.079858	4.012764	0.0012
FL	-0.037306***	0.008089	-4.6117	0.0005
DR	-0.000076	0.000085	-0.89117	0.1969
EP	0.149471***	0.032904	4.542670	0.0005
ST	-0.003031***	0.001059	-2.86313	0.0084

*, **, ***Indicate the significance at the 10, 5 and 1% level, respectively

Table 5a: Short run error correction elasticity estimates. Dependent variable AG

Variable	Coefficient	Std. error	t-statistic	Prob.
C	-0.147914	0.143192	-1.032978	0.1580
D(FL)	-0.000853	0.001904	-0.447675	0.3300
D(DR)	-1.46E-05	2.88E-05	-0.508408	0.3083
D(EP)	0.005701	0.009643	0.591183	0.2811
D(ST)	-0.001032**	0.000435	-2.371670	0.0149
ECM1(-1)	-0.764516**	0.391477	-1.952903	0.0337
Statistical analysis	Values	Statistical analysis	Values	
R-squared	0.349122	Adjusted R-squared	0.119400	
F-statistic	1.519759	S.D. dependent var	0.652831	
Akaike info criterion	2.096344	Schwarz criterion	2.439943	

*, **, ***Indicate the significance at the 10, 5 and 1% level, respectively

Table 5b: Short run error correction elasticity estimates. Dependent variable MN

Variable	Coefficient	Std. error	t-statistic	Prob.
C	0.100354	0.119758	0.837973	0.2071
D(FL)	0.001668	0.001823	0.915363	0.2087
D(DR)	-2.31E-05	2.71E-05	-0.853637	0.2033
D(EP)	-0.009758	0.009141	-1.067557	0.1513
D(ST)	-0.002256***	0.000744	-3.031736	0.0042
ECM2(-1)	-0.318930***	0.095579	-3.336803	0.0042
Statistical analysis	Values	Statistical analysis	Values	
R-squared	0.627346	Adjusted R-squared	0.453441	
Schwarz criterion	2.353471	S.D. dependent var	0.762062	
Akaike info criterion	1.958516	F-statistic	3.607410	

*, **, ***Indicate the significance at the 10, 5 and 1% level, respectively

Table 5c: Short run error correction elasticity estimates. Dependent variable SE

Variable	Coefficient	Std. error	t-statistic	Prob.
C	0.053760	0.192397	0.279419	0.2917
D (FL)	-0.003097	0.001717	-1.803937	0.0405
D (DR)	-9.56E-06	4.34E-05	-0.219945	0.4143
D (EP)	-0.033096**	0.014327	-2.310141	0.0172
D (ST)	-0.000212	0.000637	-0.333028	0.3717
ECM3 (-1)	-0.439363***	0.165080	-2.661506	0.0085
Statistical analysis	Values	Statistical analysis	Values	
R-squared	0.555699	Adjusted R-squared	0.361318	
F-statistic	2.858807	S.D. dependent var	1.138816	
Schwarz criterion	3.303393	Akaike info criterion	2.910708	

*, **, ***Indicate the significance at the 10, 5 and 1% level, respectively

by 0.0015, 0.0782 and 0.0013 percent respectively. This indicates that epidemic is the most hazardous that resulted in highest proportional agricultural loss. When the droughts, storms and epidemic befell, many people, if not most, will experience high impact in term of assets loss. It may even be detrimental to people crops and livestock therefore causing a severe rate of poverty and outmigration. These results are similar with findings of Salami *et al.* (2009), Stefanski (2007) Shafiq and Kakar (2007), Bollinger *et al.* (1999) and Loayza *et al.* (2009). The losses of assets cause in declining the economic activities due to the decrease of production, investment and

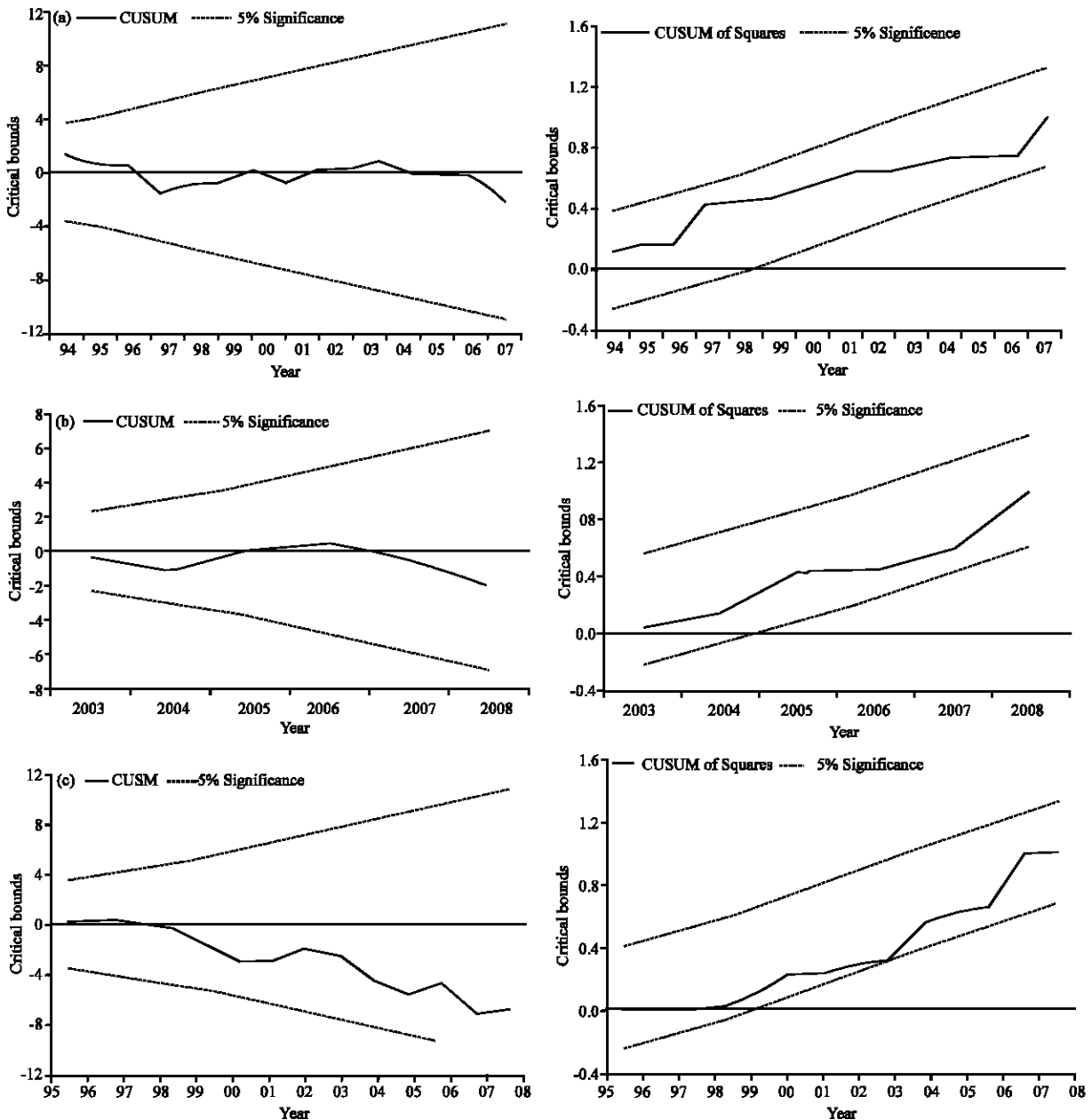


Fig. 1: (a) Plot of CUSUM and CUSUMSQR for coefficients stability for (a) AG model, (b) MN model and (c) SE model

employment. People may sell their productive assets in order to cope with disasters and then make them more vulnerable in the future, therefore less productive. They may migrate searching for better place to live leaving their properties behind. Because most of the population in the southern Africa countries are engaged in agricultural activities, migration of the labor force of the agriculture sector and the loss of productive assets such as animals and land lead to decrease the per capita production in the agricultural sector. Also the impact of demand and supply can be present as most of the households cannot afford to buy food consequently became more vulnerable and poorer.

Floods have positive effect on the proportion of GDP from agriculture in the long run. This positive development between floods and GDP from agriculture in the selected southern Africa countries is indisputably echoed by findings of previous studies. In his study of flood effects on agriculture in Bangladesh, Banerjee (2010) found that normal flood yielded positive results on the agricultural sector, but in the case of severe floods, the effect is significantly negative. The results in Table 4a indicated that an increase of 1000 people affected by floods lead to increase the AG variable by 0.016%. In the short run, when flood occur, it causes a decline in agricultural production due to crops loss, decrease the percentage labor force. But thereafter, the availability of water resources due to the floods increase the agricultural production capacities, increase agricultural productivity therefore increase the proportion of GDP from agriculture (Loayza *et al.*, 2009).

Considering the impact of natural disasters on the proportional GDP from manufacturing in the long run, Table 4b showed that epidemic variable is statistically significant with the correct sign. These results are compatible with findings of Lee and Warner (2005, 2006) and Bollinger *et al.* (1999). Meanwhile, Brainerd and Siegler (2002) results contradict the above finding. Their results indicated that epidemic was generating positive outcomes for economic growth which was agreeing with the prediction of standard neoclassical and some endogenous model growth. As a result, Biggs and Shah (1997) arrived at very pragmatic conclusion that there was no indication for any potential negative effect of epidemic on manufacturing sector. The results of the present study indicated that an increase of 1000 people affected by epidemic led to decrease MN by 0.076%. Severe spread of epidemic causes very high level of morbidity and mortality (WHO, 2010). The labor force involved in manufacturing sector will dramatically decrease due to absenteeism and death of staffs. Firms that experience high number of absenteeism due to death and sickness of its staff will experience low productivity and profit. In the same time the cost, incurred by training and recruiting new staff, medication, sick leave and funerals, will increase. Also the death of breadwinners will cause in increase the number of orphaned children. Those children will drop from schools to work with very poor education and skills they have a poor chance of getting a good job in high tech industries. In the long run, factories and firms will experience difficulties to find skilled and well-educated labor force. The lack of high quality qualified labor will increase the cost of recruitment and reduce firms' productivity again. Therefore, the low productivity and high costs will decrease the profits of firms, thus, declining in the proportional of GDP from manufacturing.

Surprisingly, Floods seem to have a positive effect on manufacturing sector. The results in Table 4b indicated that an increase of 1000 people affected by flood leads to increase in the GDP from manufacturing by 0.024%. This positive development between floods and GDP from manufacturing sector has not reinforced the findings of Loayza *et al.* (2009). Whereas the impact of drought and storm in the present study do not seem to show any significance signs on the proportional GDP from manufacturing, while some studies demonstrated a negative impact of drought and storm on manufacturing sector (Salami *et al.*, 2009; Dolfman *et al.*, 2007) and positive effect of storm on manufacturing sector (Loayza *et al.*, 2009). The increase water resources due to flooding led to stimulating to agricultural sector in the long run. Many households engaged in agricultural activities which led to increase agricultural productivity and production. The agricultural production provides raw material for industrial activities in very competitive prices, therefore, decrease the costs of raw materials. Also the increase of household income due to the

increase of agricultural productivity and production lead to increase the demand for the industrial and manufacturing goods and services. Therefore, the proportional GDP from manufacturing will increase.

The results from Table 4c indicate that flood and storm have significant negative effect on the proportional GDP of the services sector. An increase in 1000 people affected by flood and storm lead to decrease the proportional GDP from services by -0.037 and -0.003%, respectively. The occurrence of floods and storms in the short run destroys the people capacities in term of assets and belongings (Dolfman *et al.*, 2007). Many will stop using various services such as transportation, health and education. Also, in the short to medium term, the service sector may be threatened through the loss of power supplies, labour and communications infrastructure, even when productive capital (factories and inputs) are undamaged (Pelling *et al.*, 2002). The indirect losses due to the storms and floods include decline in the production of services due to the destruction of equipments, decline in educational and healthcare value added since most of the people will reduce or even stop using these service since they also lose their assets due to natural disasters. Surprisingly, epidemic seems to have a significant positive impact on the proportional GDP of services sector. These results had no parallels with findings of Lee and Warner (2005, 2006) results that found that SARS epidemic has a negative impact on the manufacturing and services sectors. The results of the present study indicated that an increase of 1000 people affected by epidemic lead to increase the proportional GDP from services by 0.149%. When the epidemic spread among the population, many people will stop working. Therefore, the only source of income for them has demolished. Many people work in the different type of jobs in service sector. This will affect the service sector negatively in the short run. In order to cope with that epidemic people sell their properties to seek treatment in various healthcare centers and services and this will lead to an increase in the demand of medicines and demand for telecommunication services in order to ask about their families, this lead to increase the value added from communication. In this way, the negative effect of epidemic in the short run will be converted to positive impact.

The results of short run dynamic coefficients associated with the long run relationships obtained from the ECM Eq. 10 are given in Table 5a-c. The equilibrium correction coefficients ecm_1 , ecm_2 and ecm_3 estimated are -0.76, -0.31 and -0.43 for AG, MN and SE models respectively are significant and have the correct sign. The coefficients for MN and SE models indicate that in each period 31 and 43% of disequilibrium, respectively are adjusted which imply of medium speed of adjustment in the last two models. The coefficient of AG model indicates that in each period 76% of disequilibrium is adjusted which imply a very high speed of adjustment.

CONCLUSION

This study has investigated the effect of four types of natural disasters (flood, drought, epidemic and storm) on the economic performance of five selected southern Africa countries. To make a distinction between the effect on different sectors of the economy, the proportional GDP from agriculture, manufacturing and services were investigated. By using the bounds testing (ARDL) Autoregressive Distributed Lags approach the long run effect of the four types of disasters were estimated. The bounds test suggested that the present study's variables for all the three models are bounds together in the long run. The results also indicate that drought and storm have a negative effect on the agricultural GDP; while epidemic has negative impact on both AG and MN variables and flood affect positively both AG and MN variables. The service sector was affected negatively by floods and storms and positively by epidemic. Therefore, the type of natural disasters

is important key in determining the losses or gain of calamities in the long run. Developing the agricultural sector is a fundamental in order to bust the poor economy for countries such as Botswana, Namibia, Lesotho and Swaziland. Present and future policies in the five selected southern Africa countries should focus on how to develop programs and schemes in order to prevent and build up assets accumulation for its population. So that household will be able to manage and cope with disasters in short run, therefore, gain in the long run. Also, the selected countries need to invest in developing and structuring flood protection systems as well as building water storage for water supply in drought periods as well as developing water resource management.

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