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THE EFFECT OF NATURAL CAPITAL ON ECONOMIC GROWTH IN BOTSWANA

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ABSTRACT: *This study empirically analyses the effects of natural capital on economic growth in Botswana using annual data from 1994 until 2016. In contrary to the existing literature, the study employed the mineral asset value as a proxy for natural capital deduced from the newly developed Mineral Accounts and Macroeconomic Indicators of Sustainable Development Frameworks. This proxy provides the inclusive wealth index of natural capital by taking into account the estimated economic value of minerals in the ground and their depletion overtime. The Autoregressive Lag Model (ARDL) employed indicates that mineral asset value used as a proxy for natural capital significantly and positively affect Botswana's economic growth. Other determinants of growth used as regressors including human capital and foreign direct investment also have a similar effect on economic growth over the period under review. Despite government efforts to diversify the economy from minerals, the mining sector is still the backbone of the economy. The study, therefore recommends that the country should continue using its mineral revenues to diversify its assets portfolio to improve physical and human capital to achieve sustainable economic growth. The country should also adopt a new growth model where technology will be at the forefront of economic development.*

KEYWORDS: Natural Capital, Mineral Asset Value, Economic Growth, Autoregressive Distributive Lag model

INTRODUCTION

The role of natural capital in economic growth has been studied extensively. The findings derived from those studies remain inconclusive. When investigating the relationship between the two, empirical researches found mixed results. Auty (1993), Sachs and Warner (1997), Glyfason (1999, 2001) were among first authors who found an inverse relationship between natural resources and economic growth. Natural resources abundance does impact economic growth through diverse channels which can translate into a curse or a blessing for some countries. Natural capital such as minerals, water, and land and others that forms the abiotic part of nature are considered as determinants of growth. Studies have indicated that natural resources boosts economic growth if they are well managed (Gerlagh and Papyrakis, 2004). Further, they boost economic growth if mineral resource revenues are reinvested in other forms of capital. On the contrary, others have indicated that natural resources particularly in resource rich countries have fueled natural resource curse. This was evidenced by stagnant economic growth in those countries as compared to their peers (Sachs and Warner, 1997), low quality of life and low level of per capita income (Amini, 2018). On a different note, Botswana has hailed

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as a beacon of success where it avoided the "resource curse" through appropriate policy and governance choices (Dunnning, 2008).

Botswana used to be one of the poorest nations in the world at independence (1966). At the time, Agriculture mainly farming was the mainstay of the economy, supporting the livelihoods of many Batswana. However, after the discovery of minerals particularly diamonds, Botswana was classified as an upper-middle economy by 1998 (Elsgård, 2014) moving from an agricultural led economy with fears of unfavorable conditions (dry climate landlocked country) for economic growth. The contribution of Agriculture to economic growth was significantly surpassed by the mining sector. The country is endowed with diamonds, copper-nickel, soda ash, coal, and Gold. Diamonds are the main driver of the mining sector growth and earnings while other commodities' contribution is relatively small (Botswana Geoscience Institute, 2018).

Ever since the discovery of diamonds, the mining sector has consistently contributed to economic development. On average, the sector contributed 49.0 percent in 1986, 34.0 percent in 1996, 35.0 percent in 2006 and 22.0 percent towards GDP in 2016 (Wealth Accounts report, 2016). Contribution of the non-mining sector to economic growth over the years grew due to the country's efforts to diversify the economy away from minerals alone and hence percentage share of the mining sector dropped. On a 10 year average, non-mining grew by 3.1 percent and 5.5 percent in 2016 (Unpublished Wealth Accounts report, 2016). The country's economic diversification emphasizes the promotion of industrialization; hence, the manufacturing and tourism sectors were identified as conduit to economic diversification. Despite the country's efforts to diversify the economy, minerals still remain the backbone of the economy.

Research Justification

Existing literature when investigating the effect or relationship between natural resources and economic growth especially for resource led nations, have often times considered the primary share of the mining sector in total exports (Mainardi (1997), Ploeg (2011), and Hlavová (2015), or contribution to GDP (Atkinson et al (2003), Bhattacharyya (2014) and Farhadi et al., (2015). These trade measurement as a proxy for natural capital have been criticized by many scholars, indicating that they pose a problem of endogeneity (Danielle, 2011) and are not accurate measures of natural capital. Moreover, these measures provides limited information about the future flows of stocks or income in the long run hence, cannot address issues of sustainable development/sustainable economic growth. By using those proxies to investigate the relationship between natural resources and economic growth, scholars found inconclusive results. Motivated by those disparate findings from voluminous literature, this study uses the mineral asset value derived from the newly developed Mineral Accounts and Macroeconomic indicators of Sustainable Frameworks to emphasize the relationship between natural capital and economic growth in Botswana. According to our knowledge this proxy has never been used in any empirical literature to investigate the relationship between natural capital and economic growth. This proxy is deemed as an inclusive measure of natural capital as it takes into account the stocks, life of mines, depletion and the estimated economic value of minerals in the ground. Furthermore, this study uses the ARDL model which has lesser problems of endogeneity to determine both the short run and long run effects of natural capital on economic growth. Conducting this study is necessary to determine the effects of natural capital on economic growth to aid in policy decision making that promotes sustainable economic growth.

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This study is structured as follows: section two reviews literature on natural resources and economic growth, Section three focuses on the empirical methodology, the ensuing chapter discusses findings and section five provides conclusion and recommendations of the study.

LITERATURE REVIEW

Natural capital can be a blessing by being a source of national wealth or a curse by bringing conflicts. In empirical research, the relationship between natural capital and economic growth remain inconclusive. Empirical literature using different econometric models and specifications drew disparate outcomes when investigating the relationship between the two. Scholars found out that resource abundance brings harm to natural resource countries, this is commonly dubbed '*resource curse'* (Sachs and Warner: 1997, Glyfason: 1999, 2001). Resource curse or the paradox of natural resources is whereby natural resource rich countries fail to fully benefit from their natural wealth. Countries with a resource curse tend to have lower growth rates, fail to meet public welfare needs, high corruption, rent seeking, conflicts which may lead to civil wars and other problems associated with natural resources (John, 2010). For example, Angola which is one of the resource rich countries in Africa suffered from a resource curse as it was prone to conflicts which ended up reducing both economic efficiency and social equality (Cameron, 2017).

According to Auty (1998), since 1960 resource rich countries have performed unsatisfactorily as compared to resource scarce countries. Scachs and Warner (1997) has held the same ground in their cross country study countries between 1970 and 1980. They found an inverse relationship between natural resource endowments and economic growth. This inverse relationship holds true even after controlling for variables that are deemed key to economic growth such as trade, government institutions and investment rates. Gylfason and Zoega (2001) has also affirmed the negative correlation of natural resources and economic growth by stating that it can hamper the development of the national economy, primarily through the Dutch disease, rent seeking and neglect of education.

Akanni and Omadadepo (2013) studied the Oil wealth in Nigeria and Norway, with human capital as a transmission channel of resource curse. They used VAR model to analyze data for both countries from 1970 to 2007. In their study they found out that oil wealth reduces human capital in Nigeria whilst it increases human capital in Norway. Gerlagh and Papyrakis (2004) found out that natural resource abundance has negative impacts on economic growth in the United States from 1986 to 2001. Further, they indicated that natural resource abundance reduces investment, schooling, Research and Development and increases corruption.

In principle, natural resources should increase national wealth, a country's investment and economic growth, however, this has not always been the case. Natural resource rich countries failed to prosper due to certain problems associated with natural resources such as the Dutch disease. This disease came about in the 1960's when Netherlands had a crisis that was caused by the discovery of huge deposits of natural gas (Taguchi, 2016). Dutch disease has symptoms of an overvalued currency with sectors other than natural resources likely to suffer from real appreciation of the national currency, because natural resource earnings are in part absorbed by the domestic non-tradable sector (e.g., Corden and Neary, 1982). Michael Lewin (2011) explains in detail the volatility, governance curse and exhaustibility of natural resources related to the Dutch disease theory. He argues that as Mineral prices tend to be volatile, it destabilizes

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the economy and affecting it through the exchange rate, which appreciates in the boom and depreciates in the bust. Minerals are also known to be windfall, even in the long run, in the sense that they are finite and that when they are depleted an economic slump will occur.

According to Pereira (2008), in most cases countries affected by Dutch disease have not achieved economic diversification. The notion of economic diversification stipulates that all economic sectors should be promoted to contribute to the economic growth of a nation. Overdependence in one sector of the economy without diversification often leads to Dutch disease. This is due to the fact that in most resource rich countries, revenues accrued from natural resources are often used to increase spending rather than diversifying the economy (Bature, 2013). Lack of economic diversification reduces economic activities of other economic sectors. For instance, the natural gas boom in the Netherlands led to the shrinking the competitiveness of the Manufacturing sector and service sectors. This problem was not only unique in the Netherlands but also in other countries particularly petroleum exporting countries such as Saudi Arabia and Venezuela (Pereira, 2008).

On a different note, natural resource rich countries such as Botswana and Norway have defied the Dutch disease theory (Stevens, 2003 and Torvik, 2009). The former has experienced high growth rates while the later has high per capital income. These countries are termed as beacons of success because they have successfully managed their natural resources due to investing resource revenues into other forms of capital (human and physical capital) and good institutional quality. According to Vandycke (2013) natural resource rich countries can only realise a positive effects of natural resource on economic growth, escape poverty trap if they use resource revenues to further development outcomes.

Natural resources cannot be divorced from institutional quality as institutions plays an imperative role in management of those resources. That is, Institutions matter whether natural resources are a blessing or a curse. Due to this linkage, scholars investigated the relationship between natural resources, institutional quality and economic growth (Acemoglu, 2001: Isham et al, 2003, Collier, and Hoeffler, 2005). These authors found out that natural resources have a negative relationship on economic growth when they are associated with weak Institutions. Weak institutions in natural resource rich countries sparks illegal rent seeking and creates the elite who are likely to resist political and economic reforms (Isham et al, 2005). On the other hand, when institutional quality is strong, natural resources play an important role as resource revenues will be channeled to economic development.

Literatures investigated the relationship between natural resources and economic growth using diverse variables. For instance, Mainardi (1997), Daniele (2011), Ploeg (2011), and Hlavová (2015) used total export component of the economy whereas Atkinson et al (2003), Bhattacharyya (2014) and Farhadi et al., (2015) used total export as a share of GDP as a proxy for natural resources. These proxies pose a problem of endogeneity as poor countries are more dependent on natural resources than rich economies (Danielle, 2011). Furthermore, he indicated that trade measurements as a proxy of natural resources represent contingence of a country on natural resources not abundance of those resources. According to Brunnschweiler and Bulte (2006), the resource dependence proxies does not positively impact growth whilst the resource abundance do affect institutional quality and economic growth. Given this critique, other studies used resource intensity which indicates endowment of natural capital (Elliot et al, 2007) and Chambers and Guo (2007) used ecological footprint which they viewed as an

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inclusive measure of productive natural resources Ecological footprint provides an indicator of natural resource consumption, that is how much nature people require to sustain themselves. Using this proxy, Chambers and Guo (2007:5) found out that it was statistically significant and positively related to economic growth. Therefore, this indicates that more natural resource wealth or an extraction of natural resources for production can be associated with an increased economic growth.

Contrary to others, this study analyses the effects of natural capital on economic growth in Botswana using mineral asset value as a proxy for natural capital.

METHODOLOGY

Data and Descriptive Statistics

To investigate the effects of natural capital on economic growth in Botswana, this study uses annual time series data covering the period 1994 to 2016. Data used has been retrieved from different sources such as Mineral Accounts Framework compiled by Botswana Geoscience Institute (BGI), Macroeconomic Indicators of Sustainable Development (MISD) Framework compiled by Ministry of Finance and Economic Development, and World Bank. Mineral Accounts Framework measure the mined mineral commodities physical and monetary accounts. The framework has considered five commodities (Diamonds, Copper-nickel, Coal, Gold and Soda Ash & Salt) that has been mined in the country to date. The framework values environmental assets by taking into account the depletion or degradation of minerals overtime. Mineral value is derived from the monetary account and feeds into the MISD Framework as a proxy of natural capital. MISD Framework computes Wealth Accounts/National Balance Sheet for Botswana. It compiles information from different sources such as Mineral Accounts, Statistics Botswana and Bank of Botswana; and estimates the country's wealth position by summing up all forms of capital which includes natural, human, produced and financial capital. The whole purpose of the Framework is to complement the conventional measure GDP by integrating environmental with economic information. It goes beyond GDP by using other composite measures and adjusted macroeconomic indicators such as Adjusted Net National Income (ANNI) and Adjusted Net National Savings (ANNS/Genuine Savings) to track the sustainability of a particular economy.

Using forms of capital derived from the MISD framework, this study builds on the empirical growth model to analyse the effects of natural capital on economic growth. It estimates the model in the form of:

$$GDP = \beta 0 + \beta 1mv + \beta 2cs + \beta 4hc + \beta 5FDI + e \qquad (1)$$

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Table 1: Description of variables

GDP	Dependent variable, which denotes annual economic growth of Botswana over a period of 26 years.
Mv	Denotes mineral asset value which is a proxy for natural capital.
Hcg	Human capital is an important factor of economic growth. Education expenditure is related to investment in human capital has been used as a proxy for human capital.
Csg	considers capital stock data as a proxy of physical capital
Fdi	Indicates the investment in mining sector by foreign investors.

Mineral Asset value which is used as a proxy of natural capital has adopted the System of Environmental and Economic Accounts (SEEA) methodology that had been approved by the UN Statistical Commission (UNSC) in February 2012. The mineral asset value is computed using the Net Present Value (NPV) formula as follows:

$$\text{NPV}= \frac{RX((1+R)^n-1)}{r(1+r)^n} \quad (1)$$

Where R is per unit rent; X= annual output, r = real discount rate, n= lifetime of deposit

The mineral asset value takes into account the five-year moving average economic rent of natural resources, the commodities reserve estimates, annual production rate and estimates the value of the mineral deposit inclusive of the life of the mine. The economic rent enables for the calculation of the depletion component of rent. Jefferis (2016) distinguishes the definition of economic value of minerals and mineral rent in the sense that, the economic value of any mineral in the ground is the flow of future income that it can generate. Income in this case is the rent that will be generated, over and above the costs of producing the mineral (i.e. the costs of turning it from a sub-soil deposit to a marketable commodity).

Table 2: Descriptive statistics

	CSG	FDI	GDP	MR	TOT	HCG
Mean	7.063478	3.136470	2.391472	81508.68	91.67178	18.09130
Median	6.950000	2.671376	2.389384	76016.80	91.26310	16.45000
Maximum	9.470000	8.742550	2.434079	162284.3	100.0000	48.26000
Minimum	4.990000	-0.332319	2.342566	21747.25	82.63914	10.13000
Std. Dev.	1.005998	2.291906	0.027975	40363.44	6.218915	7.741498
Skewness	0.336860	0.694584	-0.038513	0.336077	-0.068532	2.590232
Kurtosis	3.463992	2.952121	1.857862	2.350939	1.605343	11.15289
Jarque-Bera	0.641305	1.851577	1.255811	0.836694	1.882028	89.41908
Probability	0.725675	0.396219	0.533708	0.658134	0.390232	0.000000
Sum	162.4600	72.13881	55.00385	1874700.	2108.451	416.1000
Sum Sq. Dev.	22.26472	115.5623	0.017218	3.58E+10	850.8478	1318.477

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Table 2 above indicates the basic features of the data that has been used in this study. For all variables their mean and median are very close which shows symmetry. For all variables except HCG, the Jacque-Bera probability value is higher than 0.05 percent therefore it satisfies the normality test. HCG has a Jacque-Bera probability value of 0.00 which is less than 5%, hence this value is not normally distributed.

Unit root test

In order to ascertain the stationarity of variables, the Augmented Dickey-Fuller (ADF) and the Phillips- Perron unit root were employed.

Table 3: Unit root test

Variables	Augmented Dickey-Fuller	Phillips- Perron	Conclusion
GDP	-2.849130 (0.0067)	-2.849130 (0.0067)	I(1)
MR	-4.657525 (0.0001)	-4.657525 (0.0001)	I(1)
CSG	-4.625132 (0.0001)	-4.625158 (0.0001)	I(1)
HCG	-7.462700 (0.0000)	-5.880527 (0.0001)	I(0)
FDI	-5.067962 (0.0007)	-9.977347 (0.0000)	I(1)
TOT	-4.709000 (0.0001)	-4.723837 (0.0001)	I(1)

The ADF and the Phillips- Perron unit root test in table 3 above exhibits that GDP, MR, CSG, FDI and TOT are non-stationary in their level form and became stationary at first difference, that is, I(1). Conversely, HCG is stationary in its level form in both the ADF and the Phillips-Perron unit root, which is I(0).

Since variables are stationary at I(1) and I(0), this allows the use of Autoregressive Distributive Lag (ARDL model). This is an Ordinary Least Squared based model developed by Pesaran, Shin and Smith (2001) which can be used if variables have mixed order of integration except for I(2) variables. ARDL has been used for many years to model the relationship between variables in a single equation (Kripfganz and Schneider, 2016). The merit of this model is that it is free of residual correlation hence there is less problem of endogeneity. This model which consists of lagged values of dependent variable, the current and lagged values of regressors as explanatory variables is expressed as:

$$\Delta GDP_t = a_0 + a1GDP_{t-1} + a2MR_{t-1} + a3CSG_{t-1} + a4HCG_{t-1} + a5FDI_{t-1} + a6TOT_{t-1} + \sum\varphi t\Delta GDP_{t-1} + \sum\varphi t\Delta MR_{t-1} + \sum\varphi t\Delta HCG_{t-1} + \sum\varphi t\Delta FDI_{t-1} + \sum\varphi t\Delta TOT_{t-1} + \mu_t \quad (2)$$

Where Δ is the differenced operator and μ_t is the residual term in period t. In order to select the appropriate lag length criteria, akaike information criterion (AIC) was followed. According to (Adediran and Olayungbo, 2017), the suitable calculation of F- statistics depends upon the appropriate lag order selection of the series to be included in the model. The null hypothesis

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states that long run relationship does not exist between variables stipulated in equation (1) is H_O: $a1 + a2 + \alpha3 + \alpha4 + \alpha5 + \alpha6 = 0$ against the alternate hypothesis of long run relationship exists i.e, H_O: $a1 \neq a2 \neq \alpha3 \neq \alpha4 \neq \alpha5 \neq \alpha6 = 0$. The null hypothesis stipulates that coefficients of the long run are all equal to zero hence there is no cointegration whilst the alternate states that coefficients are not equal to zero indicating that there is cointegration. To establish if there is cointegration, a bound test was undertaken. If the calculated F-statistics is greater than the upper critical value then there is cointegration, however, if it is below the critical value it can be concluded that there is no long run relationship between the variables. In a situation where the upper critical bound is less than the calculated F-statistics the Error Correction Model which is the long run model can be estimated.

EMPIRICAL RESULTS AND DISCUSSION

TEST STATISTIC	VALUE	K
F-STATISTIC	6.28	4
Significance	I(0)	I(1)
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37
NOTE: *K signifies the number of the regressors in the model*		

Table 4: Bound Testing to Cointegration

Table 4 above indicates that the computed F-statistics of 6.28 is greater than the upper critical value, hence the null hypothesis of no level relationship is rejected. This implies that there is cointegration between the variables. Moreover, it can be concluded that there is a long run relationship between economic growth, natural resources, capital stock, human capital and foreign direct investment over the period under review. Given the existence of long run relationship between the variables, an Error Correction Model (ECM) was estimated. ECM can be specified as follows:

$$\Delta GDP\ t = a_0 + a1GDP_{t-1} + a2MR_{t-1} + a3CSG_{t-1} + a4HCG_{t-1} + a5FDI_{t-1} + a6TOT_{t-1} + \sum \varphi t \Delta_{GDPt-1} + \sum \varphi t \Delta MR_{t-1} + \sum \varphi t \Delta HCG_{t-1} + \sum \varphi t \Delta FDI_{t-1} + \sum \varphi t \Delta TOT_{t-1} + \lambda ECT_{t-1} + \mu_t \quad (3)$$

Equation 3 above is a combination of short run and long run representations with ECT also knows as the speed of adjustment parameter denoting the long run representation. The error correction coefficient signifies how much of the previous errors are being adjusted in subsequent periods. A positive error correction coefficient shows divergence whilst a negative one shows convergence. That is, a significant and negative error correction coefficient indicates that any short run disequilibrium between the independent variable and regressors will converge back to the long run equilibrium relationship (Iheanacho, 2016).

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ARDL(2, 1, 1, 2, 0) Dependent variable: GDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-0.554422	0.123953	-4.472842	0.0012
D(MR)	0.000013	0.000025	5.094031	0.0005
D(FDI)	0.000590	0.000159	3.720963	0.0040
D(HCG)	0.001135	0.000461	2.459573	0.0337
D(HCG(-1))	-0.000302	0.000082	-3.663739	0.0044
CointEq(-1)*	-0.189371	0.025195	-7.516295	0.0000

Table 5: The short and long run results

The results of the short run and long run model are exhibited in table 5 above. These results indicates that economic growth is significantly explained by the mineral asset value at 5% significance level. This means that, keeping other things constant, a 1% increase in mineral value increases GDP by 0.0000130 in the short run. These findings are consistent with (Kazmi e.t al 2017) findings who found a positive correlation between natural resources and economic growth. From this findings it can be concluded that natural resources is a blessing in Botswana as it promotes economic growth. Hence, it is suffice to say that Botswana is not suffering from a resource curse. Botswana's growth miracle would have not been possible without good institutional quality. Thanks to Botswana' Fiscal Rule which proposes that recurrent budget be financed 100 percent from Non-Mineral Revenue, while splitting the spending of Mineral Revenue with 60 percent invested in new capital, and 40 percent saved for future generations (Unpublished Wealth Accounts report, 2016). Among other policies, conservative fiscal policies and governance choices has helped the country to escape Dutch disease and achieve exceptional economic growth over the years.

The impact of foreign direct investment on economic growth is significant and positive. This conforms economic theory that posits that FDI spurs economic growth. Further, this is consistent with the results found by (Hayat, 2014; and Lee, et al, 2015) when analysing the impacts of natural resources on economic growth. Ceteris paribus, a 1% increase in FDI leads to 0.000590 increase in economic growth. The results further reveals that human capital in the current period is statistically significant at 5% level and has a positive impact towards economic growth. These findings are consistent with Ali et al, (2017) paper that showed that human capital promotes economic growth. According to Mohtadi (2017), natural resource rents tends to increase human capital particularly in natural resources countries with good institutional quality. This is true for Botswana as mineral resource revenues are reinvested into other forms of capital being human, financial and physical capital. In terms of investing in education by increasing expenditure, Botswana is among top Southern African countries which has high education expenditure (UNICEF Botswana, 2017). On the other hand, the results of the negative lagged human capital contest with Solow model augmented with human capital which holds that human capital is a critical contributor to economic growth (Ali et al, 2017). The error correction coefficient is statistically significant and negative ascertaining the long run relationship between variables. Its value of -0.189371 shows an adjustment process, implying that the short run deviations are adjusted by 18.94 percent towards long run equilibrium.

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To ascertain the fitness of the model, the cusum test, hetoreskadacity, and serial correlation were carried out. The results therefore, reveals that the model is robust (see appendix 1).

Implication to Research and Practice

This study is critical because the country is currently mainstreaming natural resources through natural capital accounting into national accounts and aligning NCA to policy documents such as Sustainable Development Goals. Therefore, this study will be useful to policy makers in the Ministry of Finance and Economic Development (MFED), National Strategy Office, Botswana Geoscience Institute and other line Ministries. It will also be useful to academia in the field of macroeconomists, resource economics and environmental economics. Information generated by this study will enable policy makers to make informed decision making with regards to prudent management of natural resources and promotion of sustainable economic growth. Academia on the other hand, will benefit from a larger pool of academic material that will further more research on natural capital and economic growth as well as use the same datasets to exhibit the usefulness of measures that complement GDP in economic planning.

CONCLUSION

The results derived from ECM indicated a significant and positive relationship between natural capital and economic growth. Other variables including foreign direct investment and human capital have also proven to significantly influence economic growth. These results represent a true picture as Botswana depends on natural capital, which has consistently contributed to economic growth. Botswana has done well over the years to manage its natural wealth due to its strong institutional quality and conservative fiscal policies. Numerous economic diversification initiatives have been put in place to diversify the economy from the volatile mining sector which is vulnerable to economic shocks. Despite those efforts the country is still highly reliant on mineral resources, therefore, the Government has to enhance its economic diversification efforts. The country should continue to diversify its asset portfolio by using mineral revenues to improve its physical and human capital. The country should also adopt a new growth model where technology will be in the forefront of economic development.

Future research

This study used data derived from Mineral Accounts and Macroeconomic Indicators of Sustainable Development, which are relatively new data frameworks which complement the conventional GDP by taking into account the depletion component of natural resources. Hence, this study encourages future research to utilize the data generated by these frameworks to inform policy decision making.

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APPENDIX 1: The Cusum, Hetoreskadacity, and Serial Correlation Test Results

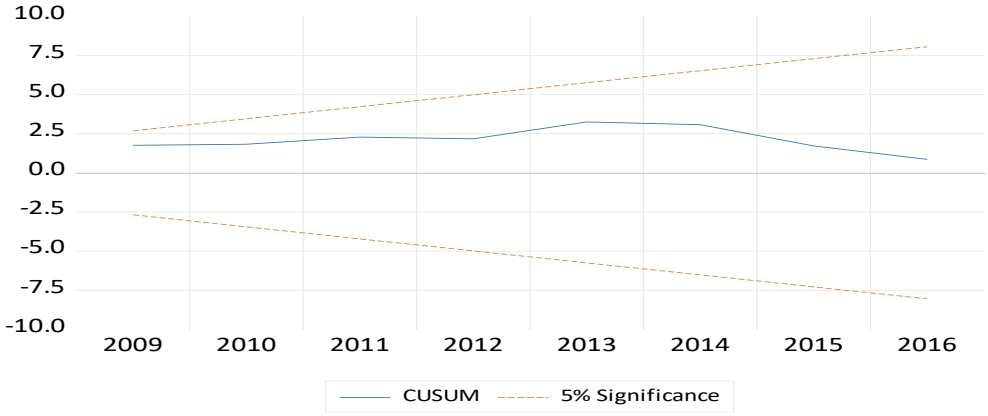

Figure: 1 **Cusum test**

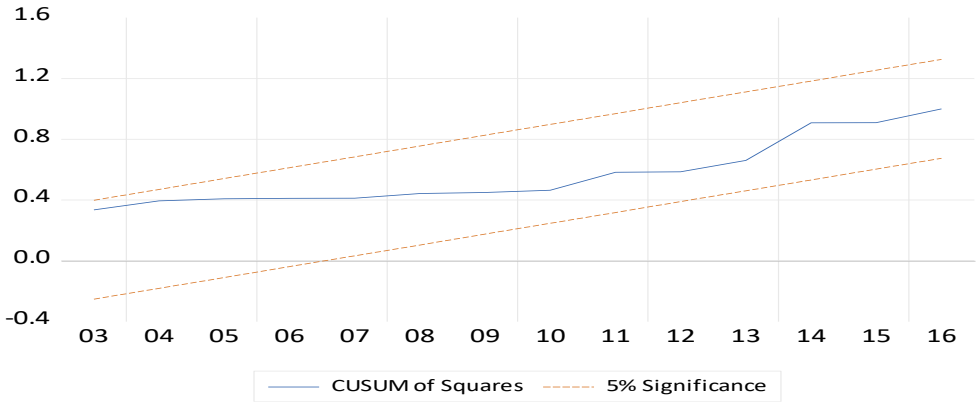

Figure: 2 Cusum of Squares Test

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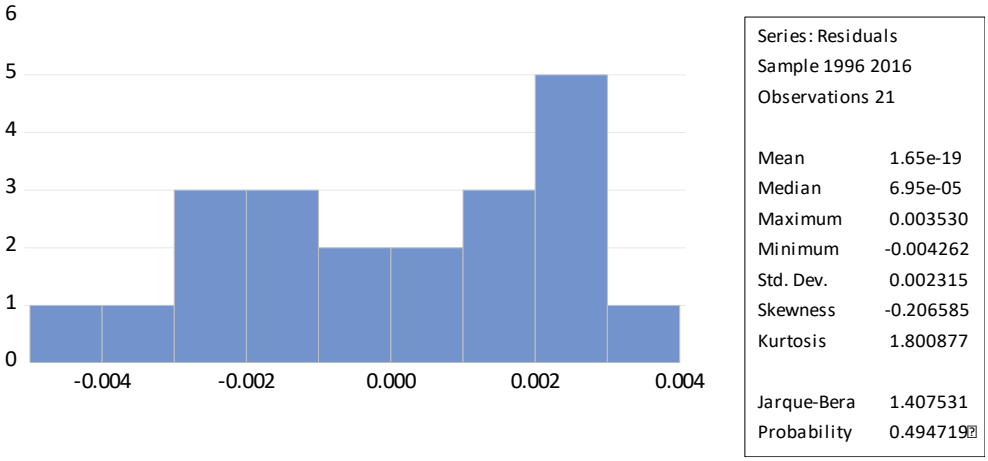

Figure: 3 Correlation Test Results

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	1.660062	Prob. F(6,14)	0.2034
Obs*R-squared	8.729740	Prob. Chi-Square(6)	0.1894
Scaled explained SS	1.553654	Prob. Chi-Square(6)	0.9559

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 1 lag

F-statistic	0.198467	Prob. F(1,13)	0.6633
Obs*R-squared	0.315779	Prob. Chi-Square(1)	0.5742

Table 6: Heteroskedasticity Test: Breusch-Pagan-Godfrey

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