The Export-Led Growth Hypothesis: New Evidence and Implications

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For

my parents,

France & Lydia Bosupeng

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Abstract

Previous studies on economic growth have shown that countries that relied on exports to propel their economies have been successful in achieving robust economic growth. This study considers Botswana's mineral exports production from 2003Q1 to 2012Q4 and relates each export commodity with the GDP. This study applies the Johansen cointegration test and the Granger causality test to determine the applicability of the export-led growth hypothesis for the Botswana economy. The cointegration test shows that there is long run comovement between GDP and four of Botswana's mineral exports namely: matte; diamonds; copper; nickel and soda ash. In addition, the Granger causality test shows that Botswana's economy propels exports production. From these results, the study nullifies the export-led growth hypothesis and postulates that the Botswana economy rather follows the growth-driven exports hypothesis (GDE). The study further postulates recommendations and also potential areas of research.

Keywords: export-led growth; growth-driven exports; mineral exports.

JEL Classification: F41; F43; F14; E23

Introduction

According to Tang et al. (2015), for decades economies that relied on exports to drive their economies have achieved considerable success in accelerating their economic growth. Thus in Asia, several countries have deployed this idea to achieve impressive economic growth since the 1960's. Such economies include South Korea, Taiwan, Hong Kong, Malaysia, Thailand and notably China and India. The success of these exports oriented Asian economies has thus made a breakthrough in empirical research that investigated the function of exports on economic growth (Tang et al., 2015). Studies on economic growth generally propose 2 hypotheses to explain economic growth. The extant literature postulates the export-led growth hypothesis, in which exports propel economic growth. The World Bank (1987) study showed that exports–promotion strategy may flourish economies of the Less Developing Countries (LDC's) in their attempt to industrialize and transform into robust economies. Nonetheless, the relationship between exports and economic growth can reverse hence affirming the growth-driven exports hypothesis (GDE). Following Konya (2006), the GDE hypothesis is focused on the fundamental that economic growth itself induces trade flows. Thus according to Konya (2006), this can create comparative advantage in some sectors of the economy which will later propel specialization and facilitation of exports production.

While China has generally been termed as an export-led economy, a study conducted by He & Zhang (2010) showed that China's exports dependency is comparatively lower than implied by the headline–exports to GDP ratio. In fact, the total factor productivity effects have been found to have significant impact on the Chinese economy. Relatively, previous studies focused on exports variety while not focusing intently on a single export commodity and its trade patterns. Limaei et al. (2011) attempted to fill this void by focusing on Iran's wood import and exports and its relations with a number of macroeconomic factors. Conclusively, the study found out that there were notable relations between wood production and domestic economic growth. However, in the examination between exports and GDP growth, exchange rates have to be brought into this analysis. Chaudhry & Bukhari (2013) have thus suggested that exchange rate depreciations are associated with an expansion of a country's exports.

This paper is a contribution to the extant literature by focusing on the production quantities of Botswana's mineral exports and their contribution to economic growth instead of focusing on exports revenue. The extant literature uses varying techniques in the examination of the relationship between exports and economic growth but fails to account for production quantities especially in mineral exporting economies like Botswana. This paper attempts to fill this gap by focusing on production quantities rather than sales revenue of Botswana's mineral resources and relates it with the country's economic growth. Botswana has started as one of the poorest economies in the world and today is an upper middle income economy. Generally, Botswana has been known well for her diamonds. However, there are other significant mineral exports such as copper, copper nickel, soda ash, gold, coal, and salt.

An overview of Botswana's exports shows that the country's principal merchandise is mostly mineral exports. An analysis of the country's data on exports shows that between 2006 and 2013 diamonds contributed about 80% to Botswana's total exports revenue. Thus this study aims to explore the significance of variations of mineral exports production on economic growth. In addition, this paper attempts to find out if Botswana may also be suffering from the natural resource curse handicap. From this premise, this study is structured as follows. Next is a detailed review of previous multiple studies. This will be followed by research hypotheses, data description and research methodology. Next will be hypothesis test results and a discussion of the findings. Finally, a conclusion of the study follows with recommendations.

Literature Review

In general terms, the extant literature provides evidence of the positive relationship between exports commodities and economic growth (He & Zhang, 2010; Balassa, 1978; Edwards, 1993; and Crespo-Cuaresma & Worz, 2005). Even so, there are potential factors that can inhibit the exportability of commodities such as exchange rates and energy consumption (Mishra et al., 2009; and Chaudhry & Bukhari, 2013). From this foundation, this study considers 3 perspectives which will explain in detail the current stand of the extant literature on the relations between exports and GDP. The perspectives are: the GDP and exports relationship standpoint; the dynamics of exchange rates and energy consumption viewpoint, and exports specialization and repercussions of the natural resource curse perspective. Next is an analysis on the relationship between exports and GDP.

GDP and Exports Relationship- Economic Growth Implications

He & Zhang (2010) noted that after 30 years of economic transformation, China has emerged as one of major economies to date and also a robust trading nation globally. While there has been a plethora of literature pertaining to China's exponential economic growth, He & Zhang (2010) noted that there is quite an insignificant examination of the relationship between foreign trade and China's domestic economy. He & Zhang (2010) on this backdrop, aimed to fill this void by determining the linkages between foreign trade and the domestic economy in China's remarkable story of reform and economic breakthrough. While several debates arose on the basis of China's economic growth, it has been argued that although the role of economic growth in China has been high, the growth pattern has been unbalanced. The Chinese economy has been suggested to be too export dependent and thus vulnerable to business cycle fluctuation and hence the need to switch to a domestic demand-led growth model (He & Zhang, 2010). Lardy (2007) claimed that excessive reliance on net exports has been an important factor prompting the Chinese economy to such a more consumption-driven growth pattern. From this argument, He & Zhang (2010) took a different approach by conducting econometric analysis of provincial level data to examine causality between the growth of foreign trade and components of domestic demand and also causality between the growth of foreign trade and total factor productivity. The results showed that China's export dependency is significantly lower than implied by the headline-exports to

GDP ratio. Furthermore, He & Zhang (2010) noted that the contribution of exports to economic growth in China came mainly from its total factor productivity rather than the multiplier effect from a demand perspective. However, the relationship was found to be stronger in more developed Chinese coastal areas than in less developed inland provinces.

Konya (2006) added to the extant literature by investigating the possibility of Granger causality between the logarithms of real exports and real GDP in 24 OECD economies from 1960-1997. It was noted that since the early 1960's policy makers have sparked great interest in the possible relationship between exports and economic growth. Conclusively, exports promotion was found to push further specialization in order to reach economies of scale and comparative advantage drawing from Konya (2006). Nonetheless, increased exports may allow the importation of high quality products and technologies which in turn may have positive impacts on technological changes, labor productivity, capital efficiency and eventually the nation's overall productivity (Konya, 2006). However, the growth-driven hypothesis postulates a reverse relationship since it is founded on the assumption that economic growth itself induces trade flows (Konya, 2006). On this backdrop, Konya (2006) examined Granger causality between exports and GDP in 24 OECD countries. The study applied a bivariate model *(GDP-exports)* and a trivariate model *(GDP-exports-openness)* model with a linear time trend. The results indicate one-way causality from exports to GDP in Belgium, Denmark, Iceland, Ireland, Italy, New Zealand, Italy, Spain and Sweden and one-way causality running from GDP to exports in Austria, France, Greece, Japan, Mexico, Norway and Portugal. Furthermore, a two-way causality between exports and economic growth was registered in Canada, Finland, and Netherlands. In the case of Australia, Korea, Luxembourg, Switzerland, the UK and US, there was no evidence of causality in either direction.

While several studies focused on a variety of exports, Limaei et al. (2011) took a different approach by investigating wood tradeability in Iran and also its relations with major macroeconomic variables such as population, GDP, world oil price, and the amount of domestic wood production using multivariable regression analysis (MRA). Limaei et al. (2011) evidenced that there were significant relations between wood exportation and population; GDP and the amount of domestic wood production and world oil prices. Extensively, time series analysis and autoregression procedure were then used to predict wood exports via a first order autoregression model. However, Tang et al. (2015) has notably challenged the impact of exports on economic growth. Drawing from the study, it was noted that nations that relied on exports to drive their economies achieved considerable success in propelling their economic growth. Thus in Asia, several countries have taken this channel to generate considerable economic progress since the early 1960's (Tang et al., 2015). Such countries include South Korea, Taiwan, Hong Kong, Singapore, Malaysia, Thailand, and more recently China and India. The notable success of these economies has made a breakthrough in empirical research that examines the role of exports in generating economic growth. Accordingly, the World Bank (1987) showed that exports-promotion strategy is the best option for Less Developing Countries (LDCs) attempting to industrialize and transform into economic giants. Therefore Tang et al. (2015) investigated the export-led growth hypothesis for Asia's Four Little Dragons (Hong Kong, South Korea, Taiwan and Singapore) using cointegration and rolling causality analysis. Employing both bivariate and trivariate models, the study revealed that exports and GDP were cointegrated for all the economies examined implying that there is a long run relationship between the variables (Tang et al., 2015). Still, Tang et al. (2015) noted that the MWALD tests supported the export-led growth hypothesis. Policy makers were further advised to search for alternative catalysts of economic growth in their efforts to promote long term economic growth rather than focusing intently on exports.

In extension to the literature, Chakrabarty & Chakravartry (2012) recently noted a plunge in India's export earnings since 1970. The authors noted that for a few years, a rising trend was observed but from 1973/74 this was followed by dramatic upward plunge. This gravitation continued up to 1985 but it was further followed by a sharp decline. However, periods after liberalization were marked by an impulsive increase in exports value (Chakrabarty & Chakravartry, 2012). The growth in the value of imports however in the last 40 years was more intense as its increase was much acute than exports during the same period. Thus Chakrabarty & Chakravartry (2012) attempted to analyze the export and import of Indian black gold (oil). The study extensively captured the trends in the last 4 decades and focused on the real GDP, exports, imports and the share of exports. On this notation Chakrabarty & Chakravartry (2012) considered three variables- oil exports, importation of oil and GDP at constant prices. The results showed that all three time series were integrated. In this regard, cointegration analysis was done to show that the bivariate relations between exports and imports of oil were however negative (Chakrabarty & Chakravartry, 2012).

It is clear that exports have positive implications on economic growth, but there is still a gap in the extant literature in terms of why developing countries still rely on primary exports as their main source of export income, despite the fact that several studies argue that countries that emphasize manufacturing exports grow faster than those that emphasize primary exports (Sheridan, 2014; Hausmann et al., 2007; Jarreau & Poncet, 2012; Crespo-Cuaresma & Worz, 2005; and Berg et al., 2012). Sheridan (2014) noted that the underlying idea is that countries that export products particularly with relatively high technological content benefit from positive externalities that help their economies grow in ways that would otherwise not take place. The positive externalities are derived from knowledge spillovers and economies of scale (Sheridan, 2014). Thus by participating in the international market, a country may learn more efficient production techniques and benefit from increased specialization in production (Sheridan, 2014). Nonetheless, many economists have argued that a country needs to be relatively developed before it can fully reap the benefits of increasing its manufacturing exports. However, economic development is a multifaceted issue that also infringes on socio-economic sectors like education, domestic income, and human capital investment.

In an empirical study conducted by Sheridan (2014) using data from 1970-2009 it was found out that although increasing manufacturing exports is important for sustained economic growth, this relationship only holds once a threshold level of development is reached. The results of the endogenous sample technique revealed that a country needs to achieve a minimum human capital threshold before its transition from reliance on primary exports to manufacturing exports. However, Feenstra & Kee (2008) provide evidence on monopolistic competition model with heterogeneous firms and endogenous production using a well-defined GDP function for over 48 countries from 1980-2000. It was shown that the average export variety of the United States increased by approximately 3.3% per year.

Comparatively, the economic performance of Switzerland over the long run has been paradoxical. Kohli (2004) noted that Switzerland's growth rate is significantly lower than most industrialized nations, however in terms of average living standards the country ranks among the top nations. Conversely, Antipa et al. (2012) argued that governments and central banks need to have accurate and timely assessment of the Gross Domestic Product (GDP) growth rate for each quarter, as this is essential for providing an analysis of current economic situations. It will not be sagacious however to put emphasis on exports to drive the economic growth without venturing into economic diversification. Literature on the relationship between economic diversification and development established that diversification raises economic development only up to a point (Klinger & Lederman, 2011). Economists have postulated that market failures hamper private transitions that are necessary to find out whether a new product can be exported profitably, thus implying that the threat of entry can reduce exports discoveries and consequently cut off diversification. Evidence brought forth by Klinger & Lederman (2011) suggests that exports diversification and exports discoveries are correlated over the course of development. In caution, Klinger & Lederman (2011) held that barriers to entry should not be used to protect innovations from threats of imitation.

The Dynamics of Exchange Rates, Energy Consumption and Exports

Economists have generally noted that trade is a crucial component of any economy. Chaudhry & Bukhari (2013) have noted that trade as a percentage of Pakistan's GDP has risen from approximately 26% in 1999-2000 to roughly 33% in 2010-2011. It has been stated that between 60 and 70% of Pakistan's exports are accounted for by the textile and garment industry which also accounts for about 8.5% of the GDP and 38% of the employed labor force. In consequence, Chaudhry & Bukhari (2013) aimed to create a structural vector autoregression model which focuses on particular factors that impact the export of Pakistan's textiles and to determine how textile exports react to changes in these factors. According to Chaudhry & Bukhari (2013) the reason for focusing on the textile industry is because over the past 3 decades, Pakistan's exports have grown at an average of 12% per year which about 60% of the growth in exports being accounted for by the textile industry. On this backdrop, Chaudhry & Bukhari (2013) further aimed to determine how both high-value added finished and low-value unfinished textiles exports are affected by various macroeconomic factors. The study also focused on the effects of income shocks of Pakistan's major trading partners; the impact of an increase in exports of Pakistani's major competitors in the area of textile exports; and the impact of exchange rate depreciations. The results showed that unfinished or low-value added Pakistan textile exports were positively impacted by aggregate consumption of trading partners while finished or high-value added textiles were negatively affected by such shocks.

Furthermore, a real depreciation of the Pakistan exchange rates was found to induce a temporary increase in unfinished textile exports. In conclusion, positive shocks in textile exports of competitors led to a temporary plunge in both unfinished and finished Pakistan textile exports (Chaudhry & Bukhari, 2013). On the other hand, energy use and consumption have to be factored in the relations between exports and GDP. Mishra et al. (2009) evidenced these relations by investigating the energy–GDP nexus in Pacific Island economies. The study revealed that Pacific Island countries were dependent on energy for growth and development however, highly susceptible to climatic changes. Thus the relationship between energy consumption and GDP is crucial in realizing their future development and growth objectives including exports production. In consequence, Mishra et al. (2009) tested for Granger causality and provided long run structural estimates for the relationship between energy consumption and GDP for a panel of the Pacific Island countries. The study found out that a percentage increase in GDP raises energy consumption by 0.23% (Mishra et al., 2009). The findings according to Mishra et al. (2009) suggest that the Pacific Island countries should increase investment in energy infrastructure and regulatory reforms to improve efficiency. Mishra et al. (2009) further noted that these strategies will help the economies realize their dual objective of reducing the adverse effects of energy use on the environment, while avoiding the negative effects on economic growth.

Exports Specialization and The Natural Resource Curse

According to Rehner et al. (2014) export specialization in a few commodities and the natural resource curse reflect the typical form of the early, commodity–based "division of labor" between industrialized countries and their suppliers of natural resources and primary products (Frobel et al., 1982). Conferring to Rehner et al. (2014) in Latin America, the relationship between development and raw materials has been discussed critically by scholars and politicians and has frequently been related to the "dependency theory" and the structuralism concept. Countries such as Botswana which are focused on driving their economies with mineral exports are vulnerable to be consumed by the natural resource curse. The natural resource curse (resource trap) attempts to explore the dependency of developing countries on their natural resources and the relationship between exports of these resources and economic growth (Davis, 1995; Sachs & Warner, 2001a; 1995b; Ross, 1999; Auty, 2001; Collier, 2008; Rehner et al., 2014). From these studies, it was argued that countries characterized by resource abundance were more likely to be "underperformers" in terms of economic growth than resource–scarce economies (Rehner et al., 2014). According to Rehner et al. (2014) the theoretical basis of the "curse" theory can be summarized by four principal explanations of the concept following Ross (1999). These are: (1) declining real prices for raw materials reflected in worsening "terms of trade" for commodities following the Prebisch-Singer thesis; (2) the high volatility of international markets; (3) weak linkages between the mining sector and other economies; (4) and the Dutch disease (Corden & Neary, 1982; Corden, 1984).

Nevertheless, economists have developed much interest in the Dutch disease because it provides a well-rounded explanation of how successful commodity exports may affect industrial output via the mechanisms of crowding out. Even so, Rehner et al. (2014) evidenced that the resource curse popularity reached greater popularity when Jeffery Sachs and Andrew Warner (Sachs & Warner, 1995b) proved that during 1970-1990, economies whose natural resource exports accounted for a high percentage of their respective GDP's grew more slowly than resource deficient-economies. The problem was there was much controversy surrounding this postulation and econometric evidence later showed that the thesis held no general validity (Van der Ploeg & Poelhekke, 2010; and Davis, 1995). In the study carried out by Rehner et al. (2014), it was found that external factors such as high commodity prices and low US exchange rates, foster specialization and also weaken non-mineral exports on relative terms especially in highly specialized mineral based regions of Chile (Rehner et al., 2014).

From the discussed literature, previous studies generally favor the positive affiliation between exports and economic growth (He & Zhang, 2010; Lardy, 2007; Konya, 2006; Limaei et al., 2011; Tang et al., 2015; World Bank, 1987; Chakrabarty & Chakravartry, 2012; Sheridan, 2014; Hausmann et al., 2007; Jarreau & Poncet, 2012; Crespo-Cuaresma & Worz, 2005; Berg et al., 2012). However, it cannot be overlooked that exports are also affected by several factors. Firstly, exports manufacturing industries require energy for them to process raw material into exportable goods (Mishra et al., 2009). Mishra et al. (2009) suggested that countries should increase investment in energy infrastructure and regulatory reforms. It has also been shown that from the extant literature, exchange rates have to brought in this analysis because a depreciation of the home currency may lead to a rise in exports (Chaudhry & Bukhari, 2013). Perhaps the most important point brought forth by the extant literature is the concept of the natural resource curse (Davis, 1995; Sachs & Warner, 2001a; 1995b; Ross, 1999; Auty, 2001; Collier, 2008; Rehner et al., 2014). Botswana cannot be immune from the natural resource repercussions given the country's dependence on diamonds to achieve economic growth. The literature has thus affirmed the positive relations between exports and economic growth.

Research Hypotheses

The extant literature has provided evidence of the positive relationship between exports and economic growth (He & Zhang, 2010; Lardy, 2007; Konya, 2006; Limaei et al., 2011; Tang et al., 2015; World Bank, 1987; Chakrabarty & Chakravartry, 2012; Sheridan, 2014; Hausmann, et al., 2007; Jarreau & Poncet, 2012; Crespo-Cuaresma & Worz, 2005; Berg et al., 2012). However other factors cannot be ruled out such as exchange rates and energy consumption (Mishra et al., 2009; and Chaudhry & Bukhari, 2013). This study deviates from the extant literature by focusing on production quantities of each commodity and how it relates with the GDP instead of focusing on exports income. The study uses data for the period 2003Q1 to 2012Q4 as provided by the central bank (Bank of Botswana). Botswana's dependency on mineral exports has been quite alarming with 79% of the total export income attributed to diamonds. Accordingly, Botswana is more vulnerable to the natural resource curse (Davis, 1995; Sachs & Warner, 2001a; 1995b; Ross, 1999; Auty, 2001; Collier, 2008; Rehner et al., 2014). Thus for the Botswana economy it is hypothesised that:

H1 Each of Botswana's mineral exports production trends positively with the Gross Domestic Product (GDP);

H2 The quantity produced of each mineral export leads Botswana's GDP.

Data Description

This study used data from 2003Q1 to 2012Q4. The data was obtained from Bank of Botswana (Botswana's central bank) Annual Reports which is one of the primary vehicles for disseminating macroeconomic data for the Botswana economy. This paper deviates from other studies because it focuses on production quantities of each mineral export rather than total export revenue. The quantity produced for coal, cobalt, copper, matte, nickel and soda ash were measured in tonnes while diamonds were in carats. Gold however, was measured in kilograms. From the descriptive statistics, the average quantity for coal produced was 234.66 tonnes for the period under examination. Cobalt was the least produced mineral export with 70.88 tonnes. Data for coal exhibited positive skewness with a coefficient greater than zero (2.79 >0). This was the same for GDP.

Nonetheless, some mineral exports registered negative skeweness coefficients (cobalt = -0.56; copper = -1.16; diamonds = -1.16; gold = -0.12; matte = -1.13; nickel = -1.07 and soda ash = -0.89). Thus the data showed variations in terms of minimum and maximum values. Noted from the descriptive statistics is that the data set showed disparities in terms of peakedness. Mineral exports which revealed flat distributions were coal (k_1= 13.50 >3); copper (k_1 = 3.71 >3); diamonds (k_1= 5.15 >3); matte (k_1 = 3.21 >3); and soda ash (k_1= 4.32 >3). These mineral exports were hence platykurtic. Nonetheless, data for the quarterly GDP, exhibited a peaked distribution with kurtosis coefficient less than 3 (k_1 = 1.90 < 3). This was the same with data for cobalt and gold. Thus this data set was statistically leptokurtic. The general conclusion from the descriptive statistics is that the data set does not exhibit normal distribution properties. There were no modifications to the data set. The total number of observations for each component under examination was 40. Table 1-4 reveals descriptive statistics as well as stationarity test results of the data set.

Table 1: Descriptive Statistics of The Data Set as from 2003Q1-2012Q4

STATISTIC	COAL[1]	COBALT[1]	COPPER[1]	DIAMONDS[2]	GOLD[3]
Mean	234,666	70.88	5,570	6,926	460.68
Median	227,318	82.50	6,161	7,535	446
Max.	551,074	134	7,672	9,609	1,064
Min.	96,496	2	445	0	0
Std.Dev.	70,137	29	1,761	1,931	299
Skewness	2.79	-0.56	-1.16	-1.16	-0.12
Kurtosis	13.50	2.81	3.71	5.15	2.18
Jarque-B.	235	2.17	9.74	17	1.20
Prob.	0	0.34	0	0	0.55
Sum	9,386,645	2,835	222,816	277,040	18,427
Values	40	40	40	40	40

Table 2: Descriptive Statistics of The Data Set as from 2003Q1-2012Q4

STATISTIC	MATTE[1]	NICKEL[1]	SODA ASH[1]	GDP (in Pula millions)
Mean	11,881	6,258	68,123	17,804
Median	13,729	7,319	72,103	17,313
Max.	16,544	8,971	104,619	28,487
Min.	800	353	4,807	8,975
Std.Dev.	3,884	2,131	19,149	6,170
Skewness	-1.13	-1.07	-0.89	0.25
Kurtosis	3.50	3.21	4.32	1.90
Jarque-B.	9	7.76	8.20	2.50
Prob.	0.01	0.02	0.02	0.29
Sum	475,244	250,312	272,497	712,178
Values	40	40	40	40

[1]in tonnes
[2]in carats
[3]in Kg's

Table 3: Augmented Dickey-Fuller (ADF) Test Results

	ADF test statistic	Critical level	Critical values	ρ-values
Null Hypothesis (H_o): Soda ash has a unit root (2003Q1-2012Q4)				
	ADF test statistic	**Critical level**	**Critical values**	**ρ-values**
Soda ash	4.524	1% level	-(4.211)**	(0.0045)***
		5% level	-(3.529)**	
		10% level	-(3.196)**	
Null Hypothesis (H_o): Salt has a unit root (2003Q1-2012Q4)				
	ADF test statistic	**Critical level**	**Critical values**	**ρ-values**
Salt	-3.816	1% level	-(4.211)**	(0.0235)***
		5% level	-(3.529)	
		10% level	-(3.196)	
Null Hypothesis (H_o): Nickel has a unit root (2003Q1-2012Q4)				
	ADF test statistic	**Critical level**	**Critical values**	**ρ-values**
Nickel	5.713	1% level	-(4.211)**	(0.0002)***
		5% level	-(3.529)**	
		10% level	-(3.196)**	
Null Hypothesis (H_o): Gold has a unit root (2003Q1-2012Q4)				
	ADF test statistic	**Critical level**	**Critical values**	**ρ-values**
Gold	-2.264	1% level	-(4.211)**	(0.4424)***
		5% level	-(3.529)**	
		10% level	-(3.196)**	
Null Hypothesis (H_o): Botswana's GDP has a unit root (2003Q1-2012Q4)				
	ADF test statistic	**Critical level**	**Critical values**	**ρ-values**
GDP	4.24	1% level	-(4.211)**	(0.0091)***
		5% level	-(3.529)**	
		10% level	-(3.196)**	
Null Hypothesis (H_o): Cobalt has a unit root (2003Q1-2012Q4)				
	ADF test statistic	**Critical level**	**Critical values**	**ρ-values**
Cobalt	5.462	1% level	-(4.211)**	(0.0003)***
		5% level	-(3.529)**	
		10% level	-(3.196)**	

Table 4: Augmented Dickey-Fuller (ADF) Test Results

Null Hypothesis (H_o): Coal has a unit root (2003Q1-2012Q4)				
	ADF test statistic	**Critical level**	**Critical values**	**ρ-values**
Coal	-0.6889	1% level	-(4.211)**	(0.9669)***
		5% level	-(3.529)**	
		10% level	-(3.196)**	
Null Hypothesis (H_o): Diamonds have a unit root (2003Q1-2012Q4)				
	ADF test statistic	**Critical level**	**Critical values**	**ρ-values**
Diamonds	4.46	1% level	-(4.211)**	(0.0052)***
		5% level	-(3.529)**	
		10% level	-(3.196)**	
Null Hypothesis (H_o): Copper has a unit root (2003Q1-2012Q4)				
	ADF test statistic	**Critical level**	**Critical values**	**ρ-values**
Copper	-2.401	1% level	-(4.211)**	(0.3541)***
		5% level	-(3.529)**	
		10% level	-(3.196)**	

Notes. ***based on the MacKinnon (1996b) ρ-values
**represents the presence of a unit root

Methodology

Feenstra & Kee (2008) introduced the notation A_{ix} as a shift parameter for the exports demand curve. By implication, this notation depends on the foreign CES price index P_i^F, foreign expenditure E_i^F, and the transport costs incurred in sector i. Accordingly, Feenstra & Kee (2008) obtained revenue from domestic exports trade in sector i as:

$$R_{id} = M_i A_{id} \int_{\varphi_i^*}^{\infty} q_i\,(\varphi_i)^{\frac{\sigma_i - 1}{\sigma_i}} \mu_i(\varphi_i) d\varphi_i \tag{1}$$

$$R_{ix} = M_i A_{ix} \int_{\varphi_{ix}^*}^{\infty} q_{ix}\,(\varphi_i)^{\frac{\sigma_i - 1}{\sigma_i}} \mu_i(\varphi_i) d\varphi_i \tag{2}$$

Still, the dynamic relationship among relevant macroeconomic variables can be used in this empirical analysis. Moreira (2014) used a dynamic autoregressive and stochastic model with forward-looking components. The aggregate production function for an economy like Botswana was then defined as:

$$y_t = \sum_{j=1}^{n} \alpha_{-j} y_{t-j} - \sum_{j=1}^{n} b_{-j}\, i_{t-j} - E_t \sum_{j=0}^{n} \beta_j i_{t+j} + \vartheta_1 e_{t-1} + \vartheta_2 {p^{comm}}_{t-1} + u_t \tag{3}$$

If y is the output an i is the (nominal) basic interest rate, e is allowed to be exchange rate dynamics, p^{comm} is the commodities price index and u is the demand shock representing the white noise term. This model encompasses all the factors which are bound to affect the production and sale of exports. Technically speaking, even though the models from these previous studies are suitable for this analysis, they do not provide the long run relationship assessment between the production quantities of each export commodity and GDP.

Following Harrigan (1997) the assumption made in this paper is that Botswana's GDP follows a translog function across all economic sectors. Thus Harrigan (1997) and Feenstra & Kee (2008) introduced the superscript $h = 1 \dots, H$ and time subscript t. Subsequently, by denoting the factor movements by the vector $V_t^h = (V_{1t}^h, \dots, V_{Kt}^h)$ the Botswana translog GDP function will then be:

$$lnR_t^h(\psi_t^h, V_t^h) = \alpha_0^h + \beta_{0t} + \sum_{i=1}^{N+1} \alpha_i \, ln\psi_{it}^h + \sum_{k=1}^{K} \beta_k \, lnV_{kt}^h + \frac{1}{2}\sum_{i=1}^{N+1}\sum_{j=1}^{N+1} \gamma_{ij} ln\,\psi_{it}^h ln\psi_{jt}^h + \frac{1}{2}\sum_{k=1}^{K}\sum_{\ell=1}^{K} \delta_{k\ell} \, lnV_{kt}^h lnV_{\ell t}^h + \sum_{i=1}^{N+1}\sum_{k=1}^{K} \phi_{ik} \, ln\psi_{it}^h lnV_{kt}^h. \quad (4)$$

Cointegration Analysis

Hypothesis 1 postulated that each of Botswana's mineral exports commodities trend positively with the GDP. The current literature is prolific in a variety of cointegration tests. The Johansen cointegration test will be applied for this study since it provides long run examination of the variables. Following Johansen (1988), the idea of using cointegrating vectors in the study of non-stationary time series comes from the works of Granger (1981); Granger & Weiss (1983); Engle & Granger (1987); and Granger & Engle (1985). Nonetheless, Engle & Granger (1987) suggested estimating the cointegrating relations using regression analysis. Such estimates have been examined by Stock (1987); Phillips (1985); Phillips & Durlauf (1986); Phillips & Park (1986); Phillips & Ouralis (1986); Stock & Watson (1987). Following Johansen (1988), the process X_t for Gaussian random variables will then be defined as:

$$X_t = \Pi_1 X_{t-1} + \cdots \Pi_k X_{t-k} + \varepsilon_{t,} \quad \text{if } t = 1, 2, \dots,$$

Cointegration of the variables will then defined by the vector autoregressive model

$$\Delta x_t = \alpha\beta' x_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-1} + \Phi D_t + \varepsilon_t \quad (5)$$

Following Pesavento (2003), define Π as $\overline{\alpha}\beta'$, and $\overline{\alpha} = (\rho - 1)\Phi(1)\alpha = [(\rho - 1)\Phi_{12}(1)'(\rho - 1)\Phi_{22}(1)]'$ such that the number of lags in the model is denoted by k. Then under the trace test null of no cointegration the assumption is $\rho = 1$ and $r = rank(\Pi) = 0$. When x_t and y_t are cointegrated, $\rho < 1$ and $r = rank(\Pi) = 1$. The local alternative for the rank test suggested by Johansen (1995) is of the form:

$$H_a = \Pi = \overline{\alpha}\beta' + \overline{\alpha}_1\beta_1{}'/T \tag{6}$$

To gauge the number of cointegrating vectors, both the trace test and the maximum eigenvalue tests were applied. The trace test was computed as:

$$LR_{tr}(r|k) = -T\sum_{i=r+1}^{k}\log(1-\lambda_i) \tag{7}$$

The computation of the maximum eigenvalue test followed the order:

$$LR_{max}(r|r+1) = -Tl\,og(1-\lambda_{r+1}) \tag{8}$$

$$= -T\sum_{i=r+1}^{k}\log(1-\lambda_i) - \big(LR_{tr}(r+1|k)\big) \tag{9}$$

$$= LR_{tr}(r|k) - LR_{tr}(r+1|k) \tag{10}$$

Causality Analysis

Hypothesis 2 postulated that the quantity produced of each mineral export leads Botswana's GDP. The Granger causality test will be applied to test for the leading or lagging relationship between the variables. If we let GDP_t to be GDP at time t and EXP_t to be any of the mineral exports at time t with zero means the simple causal models generated will then be:

$$GDP_t = \sum_{j=1}^{m} a_j GDP_{t-j} + \sum_{j=1}^{m} b_j\, EXP_{t-j} + \varepsilon_t \tag{11}$$

$$EXP_t = \sum_{j=1}^{m} c_j GDP_{t-j} + \sum_{j=1}^{m} d_j\, EXP_{t-j} + \eta_t \tag{12}$$

Granger (1969) stated that ε_t and η_t have to be taken as uncorrelated white noise term series. Then GDP_t will then Granger cause EXP_t if some c_i is not zero following Granger (1969). If we allow for instantaneous causality, the models will then be:

$$GDP_t + b_0 EXP_t = \sum_{j=1}^{m} a_j GDP_{t-j} + \sum_{j=1}^{m} b_j\, EXP_{t-j} + \varepsilon_t \tag{13}$$

$$EXP_t + c_0 GDP_t = \sum_{j=1}^{m} c_j GDP_{t-j} + \sum_{j=1}^{m} d_j\, EXP_{t-j} + \eta_t \tag{14}$$

However, the causal models 11-14 above do not assume cointegration between the variables. By employing error correction models and following Granger et al. (2000) failing to reject the null of causality $(H_0): \alpha_{21} = \alpha_{22} \cdots = \alpha_{2k} = 0$ implies that GDP_t does not Granger cause exports (EXP_t). Similarly, failing to reject the $(H_0): \beta_{11} = \beta_{12} \cdots \beta_{1k} = 0$ will then signify that exports (EXP_t) do not Granger cause GDP_t. Consequently, if cointegration exits between GDP_t and EXP_t as stipulated by hypothesis 1 the error correction models for testing causality will then be:

For GDP and Gold production

$$\Delta GDP_t = \alpha_0 + \delta_1(GDP_{t-1} - \gamma GOLD_{t-1}) + \sum_{i=1}^{k} \alpha_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \alpha_{2i}\Delta GOLD_{t-i} + \varepsilon_{1t} \qquad (15a)$$

$$\Delta GOLD_t = \beta_0 + \delta_2(GDP_{t-1} - \gamma GOLD_{t-1}) + \sum_{i=1}^{k} \beta_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \beta_{2i}\Delta GOLD_{t-i} + \varepsilon_{2t} \qquad (15b)$$

For GDP and Matte production

$$\Delta GDP_t = \alpha_0 + \delta_1(GDP_{t-1} - \gamma MAT_{t-1}) + \sum_{i=1}^{k} \alpha_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \alpha_{2i}\Delta MAT_{t-i} + \varepsilon_{1t} \qquad (16a)$$

$$\Delta MAT_t = \beta_0 + \delta_2(GDP_{t-1} - \gamma MAT_{t-1}) + \sum_{i=1}^{k} \beta_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \beta_{2i}\Delta MAT_{t-i} + \varepsilon_{2t} \qquad (16b)$$

For GDP and Diamonds production

$$\Delta GDP_t = \alpha_0 + \delta_1(GDP_{t-1} - \gamma DIA_{t-1}) + \sum_{i=1}^{k} \alpha_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \alpha_{2i}\Delta DIA_{t-i} + \varepsilon_{1t} \qquad (17a)$$

$$\Delta DIA_t = \beta_0 + \delta_2(GDP_{t-1} - \gamma DIA_{t-1}) + \sum_{i=1}^{k} \beta_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \beta_{2i}\Delta DIA_{t-i} + \varepsilon_{2t} \qquad (17b)$$

For GDP and Copper production

$$\Delta GDP_t = \alpha_0 + \delta_1(GDP_{t-1} - \gamma COP_{t-1}) + \sum_{i=1}^{k} \alpha_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \alpha_{2i}\Delta COP_{t-i} + \varepsilon_{1t} \qquad (18a)$$

$$\Delta COP_t = \beta_0 + \delta_2(GDP_{t-1} - \gamma COP_{t-1}) + \sum_{i=1}^{k} \beta_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \beta_{2i}\Delta COP_{t-i} + \varepsilon_{2t} \qquad (18b)$$

For GDP and Cobalt production

$$\Delta GDP_t = \alpha_0 + \delta_1(GDP_{t-1} - \gamma COB_{t-1}) + \sum_{i=1}^{k} \alpha_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \alpha_{2i}\Delta COB_{t-i} + \varepsilon_{1t} \qquad (19a)$$

$$\Delta COB_t = \beta_0 + \delta_2(GDP_{t-1} - \gamma COB_{t-1}) + \sum_{i=1}^{k} \beta_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \beta_{2i}\Delta COB_{t-i} + \varepsilon_{2t} \qquad (19b)$$

For GDP and Coal production

$$\Delta GDP_t = \alpha_0 + \delta_1(GDP_{t-1} - \gamma COAL_{t-1}) + \sum_{i=1}^{k} \alpha_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \alpha_{2i}\Delta COAL_{t-i} + \varepsilon_{1t} \qquad (20a)$$

$$\Delta COAL_t = \beta_0 + \delta_2(GDP_{t-1} - \gamma COAL_{t-1}) + \sum_{i=1}^{k} \beta_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \beta_{2i}\Delta COAL_{t-i} + \varepsilon_{2t} \qquad (20b)$$

For GDP and Nickel production

$$\Delta GDP_t = \alpha_0 + \delta_1(GDP_{t-1} - \gamma NIC_{t-1}) + \sum_{i=1}^{k} \alpha_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \alpha_{2i}\Delta NIC_{t-i} + \varepsilon_{1t} \qquad (21a)$$

$$\Delta NIC_t = \beta_0 + \delta_2(GDP_{t-1} - \gamma NIC_{t-1}) + \sum_{i=1}^{k} \beta_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \beta_{2i}\Delta NIC_{t-i} + \varepsilon_{2t} \qquad (21b)$$

For GDP and Salt production

$$\Delta GDP_t = \alpha_0 + \delta_1(GDP_{t-1} - \gamma SALT_{t-1}) + \sum_{i=1}^{k} \alpha_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \alpha_{2i}\Delta SALT_{t-i} + \varepsilon_{1t} \qquad (22a)$$

$$\Delta SALT_t = \beta_0 + \delta_2(GDP_{t-1} - \gamma SALT_{t-1}) + \sum_{i=1}^{k} \beta_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \beta_{2i}\Delta SALT_{t-i} + \varepsilon_{2t} \qquad (22b)$$

For GDP and Soda Ash production

$$\Delta GDP_t = \alpha_0 + \delta_1(GDP_{t-1} - \gamma SODA_{t-1}) + \sum_{i=1}^{k} \alpha_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \alpha_{2i}\Delta SODA_{t-i} + \varepsilon_{1t} \qquad (23a)$$

$$\Delta SODA_t = \beta_0 + \delta_2(GDP_{t-1} - \gamma SODA_{t-1}) + \sum_{i=1}^{k} \beta_{1t}\Delta GDP_{t-i} + \sum_{i=1}^{k} \beta_{2i}\Delta SODA_{t-i} + \varepsilon_{2t} \qquad (23b)$$

Allow δ_1 and δ_2 to denote speeds of adjustment. Following Engle & Granger (1987) the existence of cointegration will then imply a causal relation among the set of the variables as manifested by $|\delta_1| + |\delta_2| > 0$.

Hypotheses Test Results

Trace Test Results

Hypothesis 1 postulated that each of Botswana's mineral export commodity trends positively with the GDP. The trace test results showed that gold registered ρ-values of 0.58 and 0.90 which are both greater than the critical level of 0.05 thus registering no cointegration (ρ = 0.58 >0.05 & ρ = 0.90 >0.05). Matte on the other hand, registered ρ-values of 0.02 and 0.88 thus revealing one cointegrating equation at a critical level of 0.05. This was the same with diamonds registering ρ-values of 0.02 and 0.71. Similarly, copper registered only one cointegrating equation. This uniformity also applied to soda ash and copper nickel both registering one cointegrating equation at a critical level of 0.05. Other commodities namely cobalt, coal, and salt revealed no cointegration at a critical level of 0.05. In summary, trace test cointegration was only registered for matte, diamonds, copper, nickel, and soda ash. Table 5 shows results of the trace test.

Table 5: Cointegration Trace Test Results

Coint. Vectors	Eigenvalue	Trace Test Statistic	Critical Value[1]	ρ-values[2]
		Gold		
$r = 0$	0.17	6.94	15.50	(0.58)
$r \leq 1$	0	0.01	3.84	(0.90)
		Matte		
$r = 0$	0.38	18.50	15.50	(0.02)**
$r \leq 1$	0	0.02	3.84	(0.88)
		Diamonds		
$r = 0$	0.38	18.30	15.50	(0.02)**
$r \leq 1$	0	0.13	3.84	(0.71)
		Copper		
$r = 0$	0.45	23	15.50	(0.0001)**
$r \leq 1$	0	0.02	3.84	(0.88)
		Cobalt		
$r = 0$	0.27	12.20	15.50	(0.15)
$r \leq 1$	0	0.02	3.84	(0.90)
		Coal		
$r = 0$	0.08	3.35	15.50	(0.95)
$r \leq 1$	0	0.01	3.84	(0.94)
		Nickel		
$r = 0$	0.33	15.60	15.50	(0.048)**
$r \leq 1$	0	0.02	3.84	(0.89)
		Salt		
$r = 0$	0.22	9.43	15.50	(0.33)
$r \leq 1$	0	0	3.84	(0.96)
		Soda Ash		
$r = 0$	0.34	15.92	15.50	(0.04)**
$r \leq 1$	0	0.03	3.84	(0.86)

[1]critical level of 0.05
[2]based on the MacKinnon-Haug-Michelis (1999a) ρ-values
**represents trace test cointegration at 0.05 critical level

Maximum Eigenvalue Test Results

In an extension to the trace test, the maximum eigenvalue test was also carried out. The results of the test revealed ρ-values of 0.50 and 0.90 for gold thus affirming no cointegration at a critical level of 0.05. However, matte registered one cointegrating equation with ρ-values of 0.01 and 0.88. This extended to diamonds also registering one cointegrating equation. Copper also recorded only one cointegrating equation. Nickel and soda ash correspondingly registered one cointegrating equation at a critical level of 0.05. Nevertheless cobalt, coal, and salt registered no cointegrating equation at a critical level of 0.05. Thus cointegration was only registered for matte, diamonds, copper nickel and soda ash. Table 6 shows results of the maximum eigen value test.

Table 6: Maximum Eigenvalue Test Results

Coint. Vectors	Eigenvalue	Max-Eigen Statistic	Critical Value[1]	ρ-values[2]
		Gold		
$r = 0$	0.17	6.93	14.30	(0.50)
$r \leq 1$	0	0.01	3.84	(0.90)
		Matte		
$r = 0$	0.38	18.46	14.30	(0.01)**
$r \leq 1$	0	0.023	3.84	(0.88)
		Diamonds		
$r = 0$	0.38	18.14	14.30	(0.01)**
$r \leq 1$	0	0.13	3.84	(0.71)
		Copper		
$r = 0$	0.45	22.97	14.30	(0.0001)**
$r \leq 1$	0	0.024	3.84	(0.90)
		Cobalt		
$r = 0$	0.27	12.17	14.30	(0.10)
$r \leq 1$	0	0.01	3.84	(0.90)
		Coal		
$r = 0$	0.08	3.35	14.30	(0.92)
$r \leq 1$	0	0.01	3.84	(0.94)
		Nickel		
$r = 0$	0.33	15.60	14.30	(0.03)**
$r \leq 1$	0	0.02	3.84	(0.89)
		Salt		
$r = 0$	0.22	9.43	14.30	(0.25)
$r \leq 1$	0	0	3.84	(0.96)
		Soda Ash		
$r = 0$	0.34	15.92	14.30	(0.03)**
$r \leq 1$	0	0.03	3.84	(0.85)

[1]critical level of 0.05
[2]based on the MacKinnon-Haug-Michelis (1999a) ρ-values
**represents maximum eigenvalue test cointegration at 0.05 critical level

Causality Test Results

Hypothesis 2 postulated that the quantity produced of each mineral export leads Botswana's GDP. For causality running from GDP to gold the ρ-value registered was 0.71 thus the hypothesis was rejected. The reverse causality running from gold to GDP also did not hold. Matte registered causality running from GDP to matte with a ρ-value of 0.04 which is less than the critical level of 0.05. Causality running from GDP to diamonds registered a ρ-value of 0.02 which is statistically less than the critical level of 0.05. Nonetheless, the reverse causality was rejected. The Granger causality also revealed that GDP Granger causes the production of copper with a ρ-value of 0.01 which is significantly less than the critical level of 0.05. Consequently, the causality test results registered a leading relationship running from GDP to matte, diamonds, copper, and soda ash. Table 7 shows results of the Granger causality test.

Table 7: Pairwise Granger Causality Test Results

Causality	Observations	F-Statistic	ρ-values[1]
	Gold (2003Q1-2012Q4)		
GDP → GOLD	38	0.34	(0.71)
GOLD → GDP	38	0.11	(0.89)
	Matte (2003Q1-2012Q4)		
MATTE → GDP	38	0.15	(0.86)
GDP → MATTE	38	3.64	(0.04)**
	Diamonds (2003Q1-2012Q4)		
DIA → GDP	38	2.35	(0.11)
GDP → DIA	38	4.19	(0.02)**
	Copper (2003Q1-2012Q4)		
COPPER → GDP	38	0.19	(0.83)
GDP → COPPER	38	4.83	(0.01)**
	Cobalt (2003Q1-2012Q4)		
COBALT → GDP	38	0.10	(0.91)
GDP → COBALT	38	1.83	(0.18)
	Coal (2003Q1-2012Q4)		
COAL →GDP	38	0.39	(0.68)
GDP→ COAL	38	1.32	(0.28)
	Nickel (2003Q1-2012Q4)		
GDP → NICKEL	38	3	(0.06)
NICKEL → GDP	38	0.08	(0.92)
	Salt (2003Q1-2012Q4)		
GDP →SALT	38	2.41	(0.11)
SALT→ GDP	38	2.88	(0.92)
	Soda Ash (2003Q1-2012Q4)		
SODA→ GDP	38	0.73	(0.49)
GDP →SODA	38	6.73	(0.001)**

[1]critical level of 0.05
**represents a causal relation

Discussion

Hypothesis 1 postulated that each of Botswana's mineral commodities trend positively with GDP in the long run. The results of the trace test provided evidence for long run affiliations between GDP and production quantities of matte, diamonds, copper, nickel, and soda ash. This was the same with the maximum eigen value test. He & Zhang (2010) noted that it has often been argued that while the rate of economic growth in China has been robust, the growth pattern has been unbalanced and scholars have ran away with the idea that the Chinese economy has become too export dependent. However, He & Zhang (2010) later evidenced that China's export dependency is significantly lower than implied by the headline–exports to GDP ratio. The study further provides evidence that the contribution of each export commodity to economic growth mainly came from impacts of total factor productivity rather than by the multiplier effect from a demand perspective. Botswana's economy is an upper middle income economy, but the dependency on mineral exports is quite alarming with approximately 80% of the government's exports revenue coming from diamonds between 2006 and 2013. Thus the economy can be said to be dependent on mineral exports.

However, unlike the Chinese economy, Botswana largely exports minerals while China exports a variety of goods. Thus it is plausible to agree with the claims of He & Zhang (2010) that the Chinese economy is not heavily export-led as the general consensus holds. Nonetheless, while He & Zhang (2010) focused on exports as a whole for the Chinese economy, Limaei et al. (2011) focused intently on wood exports and imports and its relations with the major macroeconomic variables in Iran. The results of the study showed that there is a significant relation between GDP and the amount of domestic wood production. Thus the cointegration tests reported above for the Botswana scenario between GDP and mineral exports are not far-fetched. The major difference between the 2 studies will then be that Iran has as an advantage because it exports renewable exports while mineral exports in the case of Botswana are finite and are highly susceptible to business cycle fluctuations as in the recent Global financial crises of 2008. The results of this study are further supported by Tang et al. (2015). The trivariate and bivariate models used for empirical analysis revealed that in the case of Asia's Four Little Dragons, exports and GDP are cointegrated implying a long run relationship between the variables. However, cointegration between exports production and GDP does not translate into sustainable economic growth.

Botswana will have to shift from mineral exports and focus on manufacturing exports since studies have shown that countries that emphasize manufacturing exports tend to grow faster than those that emphasize exports of primary goods (Sheridan, 2014; Hausmann et al., 2007; Jarreau & Poncet, 2012; Crespo-Cuaresma & Worz, 2005; Berg et al., 2012). Nonetheless, hypothesis 2 postulated that the quantity produced of each mineral export lead Botswana's GDP. The results of the Granger causality test showed that we have to reject this null as the causality supported was the one running from GDP to mineral exports (matte, diamonds, copper, and soda ash). From the Granger causality test conducted by Konya (2006), the study revealed causality running from GDP to exports in Austria, France, Greece, Japan, Mexico, Norway and Portugal.

Accordingly, the results of causality test are also plausible given the affirmed cointegration between GDP and mineral exports. Nevertheless, Botswana will have to take note of the claims of Imbs & Wacziarg (2003). The scholars noted that economic development is not just only associated with increasing exports diversification, but also the diversification of employment across industries and relevant sectors. From this premise, it is now clear that Botswana follows the growth-driven hypothesis as evidenced by the Granger causality test.

Conclusion

The results of this study have provided evidence for long run comovement between GDP and the production of matte, diamonds, nickel and soda ash. However, the results of the Granger causality test only supported causality running from GDP to mineral exports (matte, diamonds, copper, and soda ash). Conversely, the reverse causality did not surface. The principles of the export-led growth hypothesis postulate that exports lead economic growth. However, from this study, the Botswana scenario supports the growth-driven hypothesis (GDE) which postulates that economic growth induces trade flows (Konya, 2006). The expectation was that since Botswana is quite dependent on mineral exports then the production of such exports should propel economic growth for the period under examination. Economic research has shown that between 2006-2013 diamonds contributed approximately 80% to the total exports revenue. Coming from the export-specialization angle, there are some repercussions of this dependency on exports. Rehner et al. (2014) addresses the concept of the natural resource curse and also the dependence of developing economies on their natural resources and economic growth as also evidenced by previous studies (Davis, 1995; Sachs & Warner, 2001a; 1995b; Ross, 1999; Auty, 2001; Collier, 2008; Rehner et al., 2014). The Botswana economy has been booming since independence in 1966, starting as one of the world’s meager economies to transform into an upper middle income economy. This is quite impressive, when considering also the rising GDP per capita. Currently, the government has other income drivers such as customs and excise, and taxes (property taxes; vehicle taxes and sales taxes) but exports variation is still a key concern.

It has been argued that countries characterized by resource abundance were more vulnerable to poor performance in terms of economic growth than resource deficient economies. However, the government has to be applauded for its drive in propelling economic diversification plans to reduce the dependency on mineral exports. Drawing from Sheridan (2014), Botswana will be better off exporting manufacturing goods as countries that do so have been proven to experience accelerated economic growth as compared to countries that export only primary goods. This study has not considered the effects of exchange rates dynamics on exports tradeability and economic growth. Hence following Konya (2006), a future study can be conducted encompassing exports, GDP and exchange rates dynamics. This could be done by running the following trivariate models:

$$y_{1,t} = \propto_{1,1} + \sum_{l=1}^{mly_1} \beta_{1,1,l} y_{1,t-1} + \sum_{l=1}^{mlx_1} \gamma_{1,1,l} x_{1,t-1} + \sum_{l=1}^{mlz_1} \eta_{1,1,l} z_{1,t-1} + \varepsilon_{1,1,t} \quad (24)$$

$$y_{2,t} = \propto_{1,2} + \sum_{l=1}^{mly_1} \beta_{1,2,l} y_{2,t-1} + \sum_{l=1}^{mlx_1} \gamma_{1,2,l} \gamma_{1,2,l} x_{2,t-1} + \sum_{l=1}^{mlz_1} \eta_{1,2,l} z_{2,t-1} + \varepsilon_{1,2,t}$$

$$\vdots$$

$$y_{N,t} = \propto_{1,N} + \sum_{l=1}^{mly_1} \beta_{1,N,l} y_{N,t-1} + \sum_{l=1}^{mlx_1} \gamma_{1,N,l} x_{N,t-1} + \sum_{l=1}^{mlz_1} \eta_{1,N,l} z_{N,t-1} + \varepsilon_{1,N,t}$$

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