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# Modelling Asymmetric Relationship between Exports and Growth in a Developing Economy: Evidence from Namibia

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**Abstract**

This study investigates the asymmetric relationship between the main export sectors and economic growth in Namibia. Nonlinear autoregressive distributive lag (NARDL) was used to estimate the asymmetric relationship between the main export sectors and the economic growth of Namibia. The study used quarterly data for the period 2009 – 2018. The data were sourced from the Bank of Namibia and Namibia Statistics Agency. The results indicate that there is an asymmetric relationship between the main export sectors and the economic growth of the Namibian economy. The results show that an increase (positive values) in the export of the three main export products will cause economic growth to improve. A decrease (negative values) in export will cause economic growth to deteriorate. The results suggest that estimating the nonlinear relationship for different sectors of the economy (instead of estimating the relationship at an aggregate level for total exports) will ensure that economic policies are sector-specific. The results further suggest that when exports are declining, expansionary policies will be the appropriate responses.

**Keywords:** Asymmetric; NARDL; export; economic growth; Namibia

**JEL Classification:** C50; C53; F14; F17

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## 1. Introduction

The relationship between export and economic growth has received considerable attention in the literature. This relationship is important in the sense that it addresses central questions of how a country can accelerate economic growth through an increase in exports (Rangasamy, 2009). Studies such as Salvatore (2011) argued that most countries are subject to a weakening strategy of industrialisation. The problem of a weakening strategy of industrialisation can be overcome through import substitution. It is important to mention that most economies have been moving away from import substitution to industrialisation strategy that is export-oriented.

The Keynesian demand-side theory postulates that export is very important for economic growth. This postulation has been supported by studies such as Helpman and Krugman (1985), and Aladejare and Saidi (2014). According to these studies, export is a key driver of economic growth. Countries can expand their domestic market by exporting more products. This will accelerate their economic growth. Rangasamy (2009) also support the role of exports in accelerating economic growth, by stating that an increase in exports helps developing countries that have smaller and limited domestic markets to gain from economies of scale. This argument is relevant especially for countries that have a smaller population. It is also important to mention that if a country produce and export products where it has a comparative advantage, local industrialisation will be sped up. Dritsakis (2006) also argued that developing countries which have more open economies and export more to the rest of the world will have opportunities to absorb the necessary technologies and innovation. These are technologies and innovation that come from advanced economies and can help developing economies to prosper through an increase in exports.

There are many studies that support an export-led strategy. These studies argue that an outward-oriented export strategy is very important for economic growth and industrialisation (World Bank, 1993; Dollar and Kraav, 2005). According to these studies, countries which are open to international trade tend to achieve higher economic growth. Economies that are less open to international trade experience low economic growth. The views in favour of export-led growth are reinforced by the experience of countries in East Asia. These countries adopted an export-led industrialisation strategy and experienced high economic growth. The experience of East Asian countries led to many developing countries to adopt export-led growth strategies. Namibia is among developing countries which adopted an export-led growth strategy after attaining its independence in 1990 from South Africa's colonial occupation. Namibia has a limited domestic market because of its smaller population which is currently 2.4 million. Hence, it adopted an export-led growth strategy in order to expand its limited domestic market and accelerate its economic growth.

Namibia is richly endowed with natural resources such as gold, diamond, copper, coal, uranium and other rare earth minerals. Despite the fact that Namibia is endowed with natural resources and world-class infrastructure, its economy is not properly diversified. The country relies on the export of a few products [such as diamonds, manufactured products (processed fish, beverages meat), food and live animals]. Namibia is an open economy where trade accounts for a significant proportion of its GDP. Phiri and Bhatia (2017) state that the countries openness (sum of import and export to GDP) increased from 104.6% in 2014 to 111.5 in 2015. Data from Namibia Statistics Agency (NSA) show that the main destination of Namibia's exports in South Africa. South Africa accounted for 24% of Namibia's exports in 2017. Other main trading partners are Botswana (13% of Namibia's exports) and Switzerland (10% of Namibia's exports). Countries such as Belgium, China and Spain accounted for 5% of Namibian export.

Empirical studies on the relationship between exports and economic growth in Namibia are limited. However, there are some notable studies such as Amavilah (2003), Jordaan and Eita (2007), and Ogbokor and Meyer (2016). These studies estimated a linear or symmetric relationship between exports and economic growth. These studies estimated the relationship between economic growth and export and at an aggregate level (total exports). With the exception of Amavilah (2003), these studies concluded that there is a positive relationship between export and economic growth in Namibia. These studies did not test the nonlinear relationship between export and economic growth in Namibia. They also did not test the relationship between export and economic growth at sectoral level. That is because estimating the relationship between these variables at an aggregate level may not be appropriate. That is because it may lead to blanket policies for all sectors. That is because sectors are different. For example, the mineral or diamond sectors may require policies that are different from that of food and live animals.

This study will differ from previous studies and make a contribution in the following ways. It will investigate the asymmetric (nonlinear) relationship between export and economic growth using nonlinear autoregressive distributive lag (NARDL) estimation technique. It will estimate the relationship between export and economic growth at the sectoral level. Estimating the relationship between export and economic growth for different sectors ensures that there will be no blanket economic policies. It will ensure that the policies are sector-specific.

To our best knowledge, this is the first study in Namibia to test the asymmetric relationship between export and economic growth in Namibia. It is also the first study to test the relationship between the two variables for different export sectors. The advantage of the asymmetric relationship between these variables is that it allows for an investigation of the impact of negative and positive effects of exports on economic growth in the long run. That means negative and positive values of exports will have different effects on economic growth. Therefore, the following research questions are to be investigated in this study. The first is whether there is an asymmetric relationship between exports and growth in Namibia. This will be tested for the main export sectors of the Namibian economy. The second question is on the magnitude and size of economic growth due to changes in exports in the long run. This will also be investigated for the main export sectors of the Namibian economy. The rest of this paper is structured as follows. Section 2 discusses briefly Namibia's export-led growth policy. Section 3 presents empirical literature. Section 4 provides methodology, empirical model, and estimation technique and data description. Section 5 presents the empirical results. Section 6 concludes the study.

## 2. A brief review of Namibia's export-led growth policy

Namibia adopted outward-looking or export-led growth strategy since its independence in 1990. Namibia is an open economy and has been historically integrated with South Africa through its membership of the Southern African Customs Union (SACU). Namibia formally became a member of SACU immediately after its independence from South Africa. It also joined the World Trade Organisation (WTO) in 1995. According to the United Nations Conference on Trade and Development or UNCTAD (2016), Namibia joined the European Economic Community –

Cotonou agreement as a matter of priority. This agreement granted Namibia access to the European market. This enabled Namibia to have access to the export quota of 13000 tonnes of beef duty-free into the European market. A little duty-free beef export quota to Norway was also granted to Namibia. Namibia has a limited market size and the government acknowledged that export is important for accelerating economic growth.

Due to the small market, it was therefore decided that it is important to shift the development strategies of Namibia from inward to outward-looking. Among the outward strategies are the Export Processing Zones (EPZ) established in 1995, export development strategy of 1998, Vision 2030 and National Development Plans, industrial and competition policies, and Trade Management Act. The EPZ was established in 1995 and its aim is to attract investment in production for export. Transfer of skills to Namibians was also another aim of the EPZ. EPZ offers incentives tax exemption, protection from pressures of trade unions and incentives related to training. According to Jordaan and Eita (2007), firms in EPZ that manufacture and export products are exempted from paying import duties on intermediate inputs. The EPZ is still existing and has assisted Namibia in expanding its exports. However, there have been concerns that its contribution to the Namibian economy was minimal. It generated limited jobs than anticipated. Exports from the EPZ were lower than anticipated. This led to Offshore Development Company (ODC) under the Ministry of Industrialisation, Trade and SME Development to commission a study in 2012 on the performance, cost and benefit of the EPZ. Among others, the commissioned study was expected to covers the EPZ programme, institutional review and realignment, cost and benefit (of the EPZ). The study has not yet been made public, but it is expected to be released in 2019.

The Export Development Strategy of 1998 prioritised the processing minerals, marine-culture, and agriculture. The emphasis of this strategy is ensuring that Namibia moves away from exports of primary to processed or secondary products. Other sectors such as tourism, which have the potential to generate high income, are also considered as priorities.

Vision 2030 was adopted in 2004. Vision 2030 is an aspirational policy document, which set out Namibia's industrialisation tone. The country's trade policy is hinged on this aspirational policy document. The objective of this aspirational document is to attain stability, regional integration and international relations that are democratised. According to Vision 2030, manufacturing and the service sectors are expected to account for 80 percent of Namibia's GDP, and processed products should dominate export. Agriculture, tourism, mining, and logistics are identified by Vision 2030 as priority sectors. These priority sectors will be strengthened by improved infrastructure such as road, rail, port and telecommunications. These will transform Namibia into an industrialised economy that will have GDP per capita equivalent to that of advanced economies. Namibia also has medium terms plans. These medium-term plans are called National Development Plans. The Fourth and Fifth National Development Plans consider logistics, agriculture, tourism and manufacturing as keys to industrialising Namibia. These priority sectors are complemented by an improved education that will enhance the country's capacity to trade and improve economic development. Concerted investment aimed at creating a pool of expertise to complement Namibia's export and economic development. Vision 2030 is an ambitious policy document, but

Namibia's exports are still dominated by commodities with limited or basic processed products. However, UNCTAD (2016) statistics from the Bank of Namibia indicated that the services sector accounts for a substantial component of Namibia's GDP.

The country has launched Namibia's Industrial Policy in recent years (UNCTAD, 2016). According to Namibia's Industrial Policy document, industrialisation is important for accelerating inclusive economic growth and development, job creation, wealth and poverty alleviation. This will take place in the context of an open economy that is integrated within its region, compliance with World Trade Organisation (WTO) and protection of infant industries. Market integration, development of infrastructure, fair competition, incentives to manufacturers for export and skills development are considered as key instruments of Namibia's Industrial Policy document. The Namibian government also launched the Growth at Home Strategy in 2015. The Growth at Home is the execution strategy for achieving Namibia's industrialisation as outlined in its Industrial Policy of 2012. It connects the country's industrial policy to its socio-economic development. It emphasises an increase in diversified production as very important for regional integration. It focuses on supporting value addition and diversification for growth that is sustainable. It is expected that these will improve the local investment climate and secure the market at home and abroad. The expectation is that if this policy is successfully implemented, there will be an increase in value-added export. According to Growth at Home Strategy, this can only be achieved if the government enhance capacity in priority sectors such as agro-processing, fish processing, manufacturing of steel, fabrication of metals, chemicals and beneficiation of minerals. The plan is to have value-added export growing by 10 percent per year. It is also expected that valued or processed exports will account for at least 10 percent of exports. Despite that, it is important to mention that it will not be easy for Namibia to have its exports dominated by value-added or processed products. That is because Namibian export is still dominated by primary products (although there has been an increase in some value-added products).

## 3. Empirical literature

The relationship between exports and growth in developing countries has attracted a considerable extent in the literature (such as Busse and Königer, 2012); Aladejare and Saidi, 2014). Internationally, a cross-section of study by Din (2004) examines the export-led growth hypothesis for the five largest economies of the South Asian region. The study used a multivariate time-series framework for the study period of 1960 to 2002. The results show that there is a long-run relationship between exports, imports, and output for Bangladesh and Pakistan. However, for India, Nepal, and Sri Lanka, no evidence of a long-run relationship was established. Furthermore, Busse and Königer (2012) examine the causal linkage between trade and growth in a group of 108 countries. The study uses GMM estimation technique for a sample covering the period 1971-2005. The results provided evidence that the growth of trade through its associated access to additional technologies has a significant impact on income growth.

There are also empirical studies in the literature that are country-specific. Mishra (2011) attempted to investigate the dynamics of the relationship between exports and economic growth for India

over the period 1970 to 2009. The study applied the popular econometric techniques of cointegration and vector error correction estimation techniques. The findings indicate the existence of the cointegration between exports and real GDP in India. Shihab and Abdul-Khaliq (2014) examined the causal relationship between economic growth and exports in Jordan. The study used the Johansen cointegration test for the period covering 2000 to 2012. The results show that there is evidence causality between export and economic growth in Jordan and the direction of causality runs from economic growth to exports. Gurgul and Lach (2010) studied the linear and nonlinear causalities between international trade and economic growth in the Polish economy. The study examined two samples for the period (Q1 1996–Q3 2009) and pre-crisis sample (Q1 1996–Q3 2008). The results of the study indicate that feedback exists between the real growth rate of GDP and the real growth rate of exports. In addition, Mtaturu (2016) analysed the relationship between export and economic growth in Tanzania using the Engle-Granger cointegration technique. The study found that there is no indication of cointegration between exports and economic growth in Tanzania. Aladejare and Saidi (2014) examined the impact of aggregate non-oil sector and its determinant on the economic growth of Nigeria. The bound test approach was employed to examine the phenomena for the sample period of 1970 to 2012. The results show strong support for a long-run relationship between non-oil export and economic growth in Nigeria. Molapo and Damane (2016) empirically examined the relationship between mining exports and economic growth in Lesotho. The study tested the export-led growth hypothesis using annual time series data covering the period 1970-2013. It applied the ARDL technique and revealed that there is a long-run relationship between mining exports and economic growth.

There are also a few empirical studies on the relationship between export and economic growth in Namibia. Amavilah (2003) maintained that for Namibia, domestic export supply factors are more important to growth than external demand factors. This was followed by Jordaan and Eita (2007) who studied the relationship between exports and economic growth in Namibia for the period 1970 to 2005. This study used the Johansen cointegration technique to investigate the relationship between export and economic growth. The study found that there exists a long-run relationship between exports and economic growth. This was supported by Niishinda and Ogbokor (2013), who investigated the export and economic growth relationship for Namibia. The study applied the Johansen co-integration test for the period 1972 to 2010 to examine the nature of the relationship. The findings show that through various measures to increase export can enhance its economic growth in Namibia. Promotion of export has been the catalyst in modern economies to sustain economic growth in most developing nations. The study by Simasiku and Sheefeni (2014) engaged in a study to determine how changes in terms of trade have an effect on growth in Namibia. The results showed an indirect relationship between terms of trade and economic growth in the Namibian. Ogbokor (2015) studied the impact of foreign trade on the growth in the Namibian economy. The study applied two modern econometric time series methods which are the vector autoregressive (VAR) and autoregressive distributed lag (ARDL) models. The study revealed that the economy of Namibia can be expanded potentially by means of foreign trade. Simasiku and Sheefeni (2017) investigated the nexus between agricultural export and economic growth in Namibia for the period 1990-2014. The study confirmed that the co-integration test indicated that there is a long-run relationship between agricultural export and economic growth in Namibia.

Many previous studies on Namibia (such as Amavilah 2003; Jordaan and Eita, 2007; Niishinda and Ogbokor, 2013; Ogbokor and Meyer, 2016; Simasiku and Sheefeni, 2017) have modelled the relationship between export and economic growth using a linear approach. However, this approach may seem inappropriate especially when the economic variables integrate non-linear characteristics of the business cycle in exports over time. According to Hatem-and Uddin (2012), it is important to allow for an asymmetric or non-linear relationship between the variables of interest in the study. This study further indicated that allowing for asymmetric relationship is crucial in the sense that the effect of negative shock of exports can be different from the positive shocks of exports on growth. Therefore, the main contribution of this study is to explore the asymmetric effect of exports on growth in Namibia. The analysis of this study will not be for aggregate exports but will be done for the main export sectors of the Namibian economy. To the best of the current study's knowledge, this might be the first study to apply NARDL to examine export and growth in Namibia. It will also be the first study to investigate the nonlinear relationship for the main export sectors of the Namibian economy. An investigation of the nonlinear relationship between export and growth at the sectoral level will ensure that there will be no blanket economic policies for all sectors. The economic policies will be sector-specific.

## 4. Methodology and data description

### 4.1 Empirical Model

Following an extensive review of the empirical literature on exports and economic growth, the long-run relationship between the two variables is specified as follows:

$$GDP_t = \beta_0 + \beta_1 XPOT_t + \mu_t \quad (1)$$

Where $GDP_t$ is the gross domestic product (representing economic growth), $XPOT_t$ represents disaggregate exports (of manufactured products, diamonds and food and live animals), $\beta_1$ is the long-run coefficient for disaggregated exports and $\beta_0$ is the intercept. The variable $\mu_t$ represents error term respectively. Equation (1) will be estimated at a disaggregated level. That means the equation will be estimated for manufactured, diamond, and food and live animals. This is contrary to previous studies which estimated the relationship between export and economic growth at an aggregate level.

### 4.2 Estimation Technique

To capture for asymmetries Shin, Yu and Greenwood-Nimmo (2014) developed the Non-linear Autoregressive Distributive Lag (NARDL) model where exports can be decomposed into negative and positive partial sums. Then, equation (1) is re-specified in non-linear form as follows:

$$GDP_t = \beta_0 + \beta_1 GDP_{t-1} + \beta_2^- XPOT_{t-1}^- + \beta_3^+ XPOT_{t-1}^+ + \mu_t \quad (2)$$

According to equation (2), the long-run relationship between economic growth and disaggregated decrease in exports is measured by $\beta_2^-$. The relationship between economic growth and disaggregated increase in exports is captured by $\beta_3^+$. In the long run, both disaggregated increase and decrease in exports are expected to have a positive effect on economic growth. Therefore, the long-run relationship between disaggregated exports and economic growth presented in equation (2) reflects asymmetric characteristics. Following the presentation of equation (2) in non-linear form, there are some properties which are determined in equation (3) and (4) to give the partial sums of positive and negative changes in $XPOT_t$.

$$XPOT_t^+ = \sum_{i=1}^{t} \Delta XPOT_t^+ = \sum_{i=1}^{t} \max(\Delta XPOT_J, 0) \quad (3)$$

and

$$XPOT_t^- = \sum_{i=1}^{t} \Delta XPOT_t^- = \sum_{i=1}^{t} \min(\Delta XPOT_J, 0) \quad (4)$$

Equation (2) is augmented with control variables and re-specified (in the NARDL form) in equation (5). The variables $IMP_t$ and $INF_t$ are imports and inflation. Other variables are as previously defined.

$$\Delta GDP_t = \beta_0 + \beta_1 GDP_{t-1} + \gamma_1^- XPOT_{t-1}^- + \gamma_2^+ XPOT_{t-1}^+ + \gamma_3^- IMP_{t-1}^- + \gamma_4^+ IMP_{t-1}^+ + \gamma_5^- INF_{t-1}^- + \gamma_6^+ INF_{t-1}^+ + \sum_{i=1}^{p-1} \theta_i \Delta GDP_{t-1} + \sum_{i=0}^{q} \pi_1^+ \Delta XPOT_{t-1}^+ + \sum_{i=0}^{q} \pi_2^- \Delta XPOT_{t-1}^- + \sum_{i=0}^{q} \pi_3^+ \Delta IMP_{t-1}^+ + \sum_{i=0}^{q} \pi_4^- \Delta IMP_{t-1}^- + \sum_{i=0}^{q} \pi_5^+ \Delta INF_{t-1}^+ + \sum_{i=0}^{q} \pi_6^- \Delta INF_{t-1}^- + \mu_t \quad (5)$$

Where $q$ and $p$ are lag orders, and long-run coefficients are computed as $\beta_2 = {}^{\gamma^-}/_{\beta_1}$ and $\beta_3 = {}^{\gamma^+}/_{\beta_1}$. In addition, $\sum_{i=0}^{q} \pi_i^+$ captures the short-run impact of the disaggregated increase in exports on economic growth, while $\sum_{i=0}^{q} \pi_i^-$ captures the short-run impact of the disaggregated decrease in exports on economic growth in Namibia. To examine the long-run cointegration between disaggregated exports and GDP growth, the paper applies the stepwise OLS model to estimate equation (5) which uses general-to-specific procedure. After estimating NARDL, the study performs a test for long-run cointegration using the bounds testing approach (Pesaran, Shin and Smith, 2001). This approach uses the Wald F-testing with the null hypothesis, $\gamma_1 = \cdots .. = \gamma_6 = 0$ which implies "no cointegration". Then finally, the paper also uses Wald F-test to determine the asymmetric cointegration between disaggregated exports and economic growth in Namibia. However, before determining whether there exists a long-run relationship between the variables, the study needs to investigate the non-linearity for each variable. It uses the BDS test to determine non-linearity. The test was developed by Brock, Dechert, Scheinkman and LeBaron (1996). It can be used for testing against a variety of possible deviations from linear and non-linear dependence. Following, the study adopts unconventional non-linear unit root test of Kapetanios, Shin and Shell (KSS) by Kapetanios, Shin and Snell (2003) and Breitung nonparametric unit root by Breitung (2002).

### 4.3 Data description

The paper uses quarterly data from the period 2009 - 2018. Data were obtained from Bank of Namibia (BON) and Namibian Statistics Agency (NSA). This period was chosen because of data availability. The main export sectors of the Namibian economy were chosen due to consistent data availability. Table 1 provides a data description for variables that are used in the study

TABLE 1: DATA DESCRIPTION

| Abbreviation | The measure of the variable description |
|---|---|
| GDP | Gross Domestic Product at constant 2010 in Namibia dollars (N$) millions. This variable represents economic growth. This value excludes exports. |
| XPOT | Disaggregated Exports:<br>MNEXT : manufactured exports in N$ millions<br>DEXT : diamond exports in N$ millions<br>FHEXT: food and live animals exports in N$ millions |
| IMP | Imports of machinery, mechanical, electrical appliances in N$ millions |
| INF | Inflation rate |

Source: Authors own compilation

## 5. Empirical results

Before the discussion of univariate characteristics, nonlinearity and empirical results, it is important to present descriptive statistics. Descriptive statistics are used to describe the basic characteristics of the data that are employed in the study. They make available summaries about what the data are and what they show. The descriptive statistics are presented in Table 2. The variable that has the lowest mean value is INF with a rate of 5.72. The variable that has the highest mean is GDP with a value N$ 24298.68 million. In addition to preliminary analysis, the study examined each variable at levels and first difference. The study explored the time series plots of variables in levels and first difference (The letter "L" at the beginning of each variable such LGDP shows that the variable in logarithm). Figure 1 and 2, therefore present all the variables in the analysis in levels and first difference. Figure 1 shows that exports and economic growth seem to be moving in the same direction, but the movement seems not to be more linear. The same applies to Figure 2 where the variables are in differenced form.

TABLE 2: DESCRIPTIVE STATISTICS

| Variables | Mean | Maximum | Skewness |
|---|---|---|---|
| FHEXT | 1807.975 | 2787.000 | 0.395520 |
| GDP | 24298.63 | 28302.00 | -0.367368 |
| IMP | 2638.187 | 4782.794 | 0.350690 |
| INF | 5.725000 | 11.00000 | 0.783023 |
| DEXT | 2053.100 | 3918.000 | -0.014899 |
| MNEXT | 3938.350 | 5967.000 | 0.429103 |

FIGURE 1. VARIABLES IN LEVELS

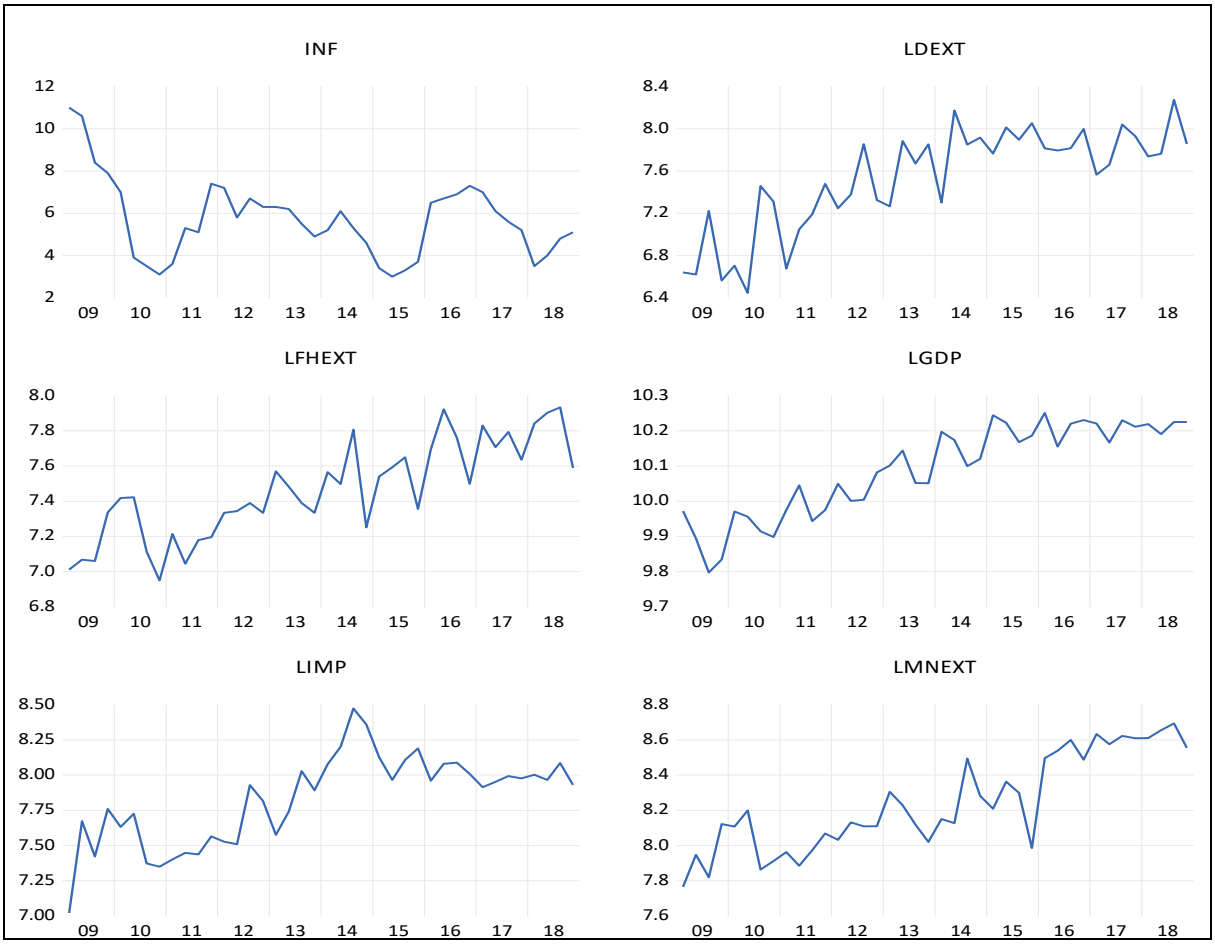

FIGURE 2. VARIABLES IN FIRST DIFFERENCE

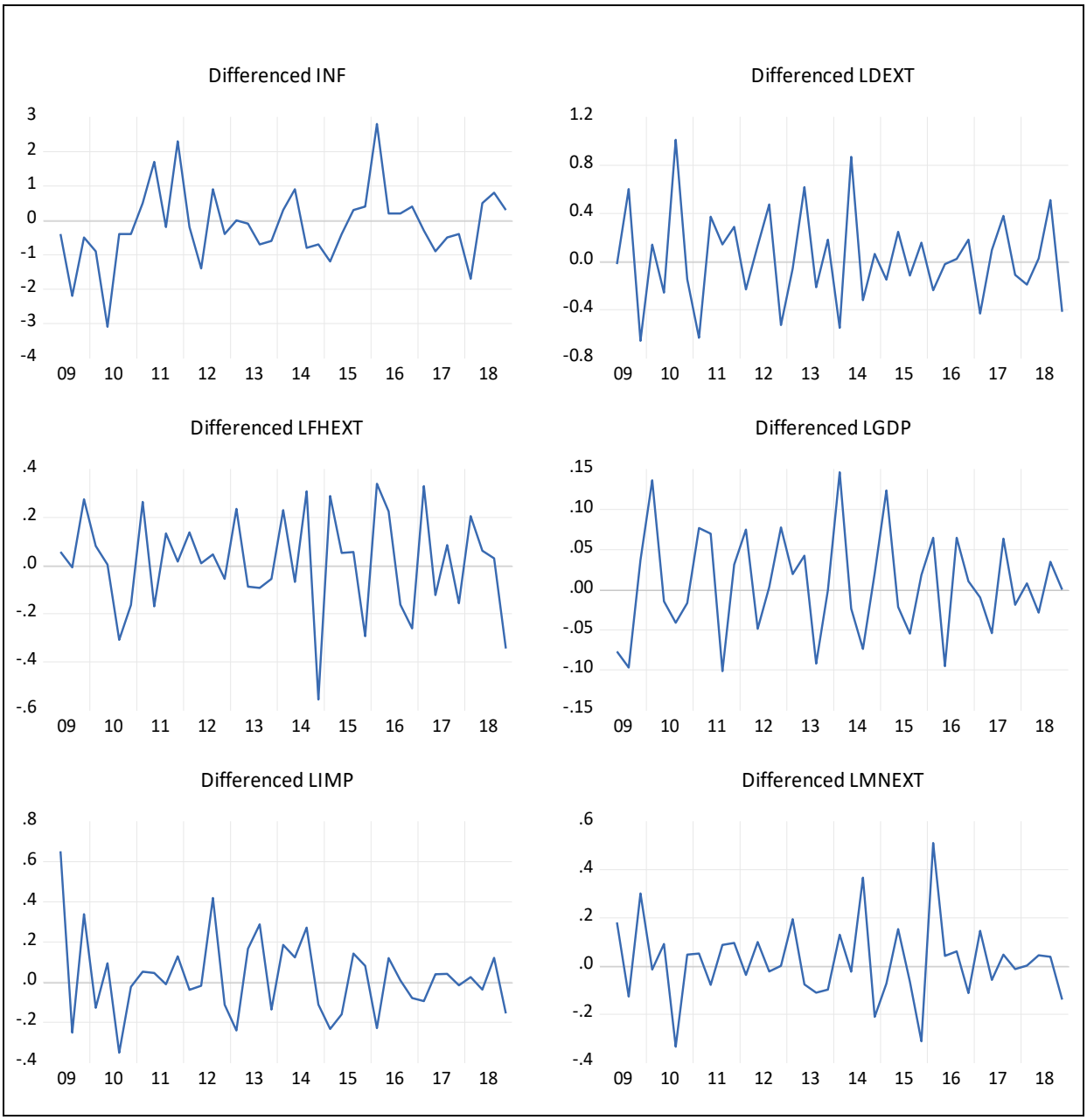

TABLE 3: BDS TEST FOR NON-LINEARITY

| Variable | Dimension | BDS statistics | Probability |
|---|---|---|---|
| LMNEXT | 2 | 0.112 | 0.000 |
| | 3 | 0.173 | 0.000 |
| | 4 | 0.212 | 0.000 |
| | 5 | 0.224 | 0.000 |
| | 6 | 0.215 | 0.000 |
| LDEXT | 2 | 0.085 | 0.000 |
| | 3 | 0.140 | 0.000 |
| | 4 | 0.204 | 0.000 |
| | 5 | 0.253 | 0.000 |
| | 6 | 0.276 | 0.000 |
| LFHEXT | 2 | 0.078 | 0.000 |
| | 3 | 0.116 | 0.000 |
| | 4 | 0.132 | 0.000 |
| | 5 | 0.147 | 0.000 |
| | 6 | 0.166 | 0.000 |
| INF | 2 | 0.134 | 0.000 |
| | 3 | 0.211 | 0.000 |
| | 4 | 0.242 | 0.000 |
| | 5 | 0.255 | 0.000 |
| | 6 | 0.268 | 0.000 |
| LGDP | 2 | 0.117 | 0.000 |
| | 3 | 0.210 | 0.000 |
| | 4 | 0.292 | 0.000 |
| | 5 | 0.351 | 0.000 |
| | 6 | 0.392 | 0.000 |
| LIMP | 2 | 0.102 | 0.000 |
| | 3 | 0.181 | 0.000 |
| | 4 | 0.227 | 0.000 |
| | 5 | 0.264 | 0.000 |
| | 6 | 0.275 | 0.000 |

To test for the presence of non-linearity in the variables, this paper employs the BDS test developed by Brock *et al* (1996). It is conventional for any non-linear analysis to investigate the non-linearity in the variables used in the study. Table 3 presents the results of BDS test. The results show that the null hypothesis of independently and identically distributed (i.i.d) has been rejected. This can be observed by all the t-statistics that are significant for each variable. This was confirmed that the null hypothesis on non-linearity cannot be rejected since all the associated probability values are not greater than either 1%, 5% and 10% significance levels. These test results imply the non-normal distribution of data which shows the behaviour of non-linearity. The next step is to test the univariate characteristics (unit root) in the variables. The study uses an unconventional test of a unit root. These are tests which are suitable for the data that depict the non-normality over time. The study used KSS and Breitung non-linear unit root tests. To apply the KSS test, it is important to determine the lag length using Akaike information criterion (AIC), Shwartz information criterion (SIC) and Hannan quinine (HQ). The three criteria selected the optimum lag of 1. Therefore, this lag of 1 was used to estimate the t-statistics for the KSS procedure. The results are

presented in Table 4. The results in Table 4 shows that the variable is non-stationary at levels. This is confirmed by comparing the t-statistics in KSS table with KSS critical values. This further demonstrates that the null hypothesis of non-stationarity in the presence of non-linearity is present for all the variables.

TABLE 4: KSS NON-LINEAR UNIT ROOT RESULTS

| Variable | estimate | t-statistics | p-value | KSS critical value |
|---|---|---|---|---|
| INF | 0.0021 | 2.091 | 0.043 | |
| LMNEXT | 0.0020 | 3.521 | 0.001 | 1% = -3.55 |
| LGDP | 0.0010 | 3.201 | 0.002 | |
| LFHEXT | 0.0036 | 4.768 | 0.000 | 5% = -2.95 |
| LDEXT | 0.0041 | 5.363 | 0.000 | |
| LIMP | 0.0024 | 3.323 | 0.002 | 10% = -2.66 |

Notes: *** 1% significance level, **5% significance level, *10% significance level

**T**ABLE 5: BREITUNG NON-LINEAR UNIT ROOT

| variable | Test- statistics | p-value |
|---|---|---|
| INF | 0.0146 | 0.2000 |
| LMNEXT | 0.0804 | 0.8000 |
| LGDP | 0.0868 | 0.8667 |
| LFHEXT | 0.0708 | 0.7000 |
| LDEXT | 0.0367 | 0.9000 |
| LIMP | 0.0535 | 0.3000 |

This paper also employs Breitung non-linear unit root test. The tests only examine the intercept and the results are presented in Table 5. The results confirm that all variables are non-stationary at levels in the presence of non-linearity. It is now appropriate to estimate the NARDL cointegration between the main exports sectors and economic growth in Namibia. The results are presented in Table 6.

TABLE 6: NARDL BOUND TEST COINTEGRATION RESULTS

| **MODELS** | **F-statistics** | **10% critical value** | **5% critical value** | **1% critical value** |
|---|---|---|---|---|
| MODEL I | 27.694*** | I(0) 2.592<br>I(1) 3.454 | I(0) 3.100<br>I(1) 4.088 | I(0) 4.310<br>I(1) 5.544 |
| MODEL II | 11.174*** | I(0) 2.592<br>I(1) 3.454 | I(0) 3.100<br>I(1) 4.088 | I(0) 4.310<br>I(1) 5.544 |
| MODEL III | 16.603*** | I(0) 2.592<br>I(1) 3.454 | I(0) 3.100<br>I(1) 4.088 | I(0) 4.310<br>I(1) 5.544 |

Notes: *** 1% significance level, **5% significance level, *10% significance level
Null hypothesis: no cointegration
Alternative hypothesis: cointegration
Rejection rule: reject the null hypothesis if F-statistics is upper than the upper limit.

Table 6 present the results for NARDL cointegration test. As explained earlier, the relationship between export and economic growth (in equation 5) is estimated at a disaggregated level. The paper has estimated equation (5) in three different variations for the bound test procedure. Model I estimates the relationship between manufactured exports and economic growth. Model II estimate the relationship between diamond exports and economic growth. Model III estimate the relationship between food and live animals exports, and economic growth. The critical values in Table 7 are extracted from Narayan (2005). The results indicate that the computed F-statistics for all the models is greater than the upper bound critical value of 5.544 at 1% significance level. This implies that there is a long run nonlinear relationship between exports (disaggregated products) and economic growth in Namibian.

TABLE 7: NARDL LONG RUN ESTIMATION RESULTS

Dependent variable: DLGDP

| Variables | Model I | Model II | Model III |
|---|---|---|---|
| INTERCEPT | 20.178 | 13.605 | 21.667 |
| | (10.761)*** | (7.726)*** | (10.604) |
| LGDP | -2.043 | -1.370 | -2.204 |
| | (-10.642) | (-7.625)*** | (-10.572) |
| LIMP_N(-1) | -0.464 | 0.147 | -0.043 |
| | (-3.450)*** | (1.782)** | (-0.438) |
| LIMP_P(-1) | 0.213 | 0.094 | 0.324 |
| | (4.700)*** | (1.562) | (5.971)*** |
| INF_N(-1) | 0.001 | 0.008 | -0.015 |
| | (0.147) | (0.885) | (-2.699)*** |
| INF_P(-1) | 0.046 | 0.008 | 0.017 |
| | (6.216)*** | (1.038) | (2.491)*** |
| LMNEXT_P(-1) | -0.703 | …….. | …….. |
| | (-6.600)*** | | |
| LMNEXT_N(-1) | -0.164 | …….. | …….. |
| | (-1.101) | | |
| LDEXT_P(-1) | …… | 0.134 | …….. |
| | | (1.855)** | |
| LDEXT_N(-1) | ……. | 0.064 | …….. |
| | | (0.622) | |
| LFHEXT_P(-1) | ……. | …… | -0.318 |
| | | | (-3.401)*** |
| LFHEXT_N(-1) | ……. | …… | -0.138 |
| | | | (-1.422) |
| R-squared | 0.974 | 0.946 | 0.941 |
| Adjusted R-squared | 0.922 | 0.840 | 0.850 |

Notes: *** 1% significance level, **5% significance level, *10% significance level
Notes: _N describes disaggregated decrease in exports and _P is disaggregated increase in exports.

Table 7 presents long-run NARDL between export and economic growth. The results in Model I indicate that a decrease in exports of manufactured products has a coefficient of -0.164, and it is not statistically significant. In addition, an increase in manufactured products has a coefficient of -0.703 and is statistically significant. Therefore, in the long run, a 1% increase in exports of

manufactured products will lead to 0.344% increase in economic growth. However, a 1% decrease in exports of manufactured products will lead to 0.080% decrease in the economic growth of Namibia. In the long run, a 1% decrease in imports of machinery and other appliances will lead to 0.227% decrease in economic growth. However, in the long run, a 1% point increase in imports of machinery will lead to 0.104% increase in economic growth. In both cases, the parameters for imports of machinery are statistically significant. The last, control variable which is the inflation rate has the following impact. A 1% decrease in the inflation rate will lead to 0.0003% decrease in economic growth. However, in the long run, a 1% increase in inflation will lead to 0.022% increase in economic growth and it is statistically significant.

Model II presents the results of exports of diamonds and economic growth. The results show that a reduction in exports of diamonds will have a coefficient of 0.064, and an increase in exports of diamonds will have a coefficient of 0.134. Therefore, in the long run, a 1% increase in exports of diamonds will have a 0.098% increase in economic growth and is statistically significant at 5% level. On the other hand, a 1% point decrease in exports of diamonds will have a 0.080% in economic growth, but not statistically significant. The results also show that a 1% decrease in imports of machinery will cause 0.107% decrease in economic growth. A1% increase in imports of machines and appliances will cause economic growth to decrease by 0.069%. In both cases, only the parameter for import of machinery is statistically significant at 10%. A 1% decrease in the inflation rate will lead to 0.005% decrease in economic growth. Alternatively, a 1% increase in inflation will lead to 0.006% increase in economic growth, but this coefficient is not statistically significant.

Model III presents the results for exports of food and live animals and economic growth. The result indicates that a decrease in exports of food and live animals have a coefficient of -0.138, and it is not statistically significant. In addition, an increase in exports of food and other products has a coefficient of -0.318 and it is statistically significant. Therefore, in the long run, a 1% increase in exports of food and live animals will lead to 0.144% increase in economic growth. A 1% decrease in exports of food and live animals will lead to 0.062% decrease in economic growth. A 1% decrease in imports of machinery, mechanical and electrical appliances will lead to 0.019% decrease in economic growth. A 1% increase in imports of machinery, mechanical and electrical appliances will cause economic growth to increase by 0.147%. If the inflation rate decreased by 1% economic growth will decrease by 0.007%. However, a 1% increase in inflation will lead to 0.008% increase in economic growth. The coefficients of both increase and decrease in inflation rates are s are statistically significant at 1% level. All the estimated models have an acceptable adjusted R-squared of more than 81%.

It is important to test whether there exists asymmetry in the relationship between variables. The presence of asymmetry will simply indicate that the computed “positive” and “negative” series have different effects on the dependent variable. The study makes use of the Wald test to determine the asymmetry. The results are presentment in Table 8. Table 8 demonstrates that the null hypothesis of “no asymmetry” is rejected for Model I and Model III.

TABLE 8: LONG-RUN ASYMMETRIC TEST

| Asymmetric null hypothesis | MODEL I | MODEL II | MODEL III |
|---|---|---|---|
| $-\gamma_1^-/\beta_1 = -\gamma_2^+/\beta_1$ | 32.401 (0.000)*** | 1.515 (0.241) | 14.553 (0.001)*** |

Notes: F-statistics (p-value)

After estimating NARDL model for equation (5) with its disaggregated exports (Model I, II & II) the diagnostic tests were carried out to assess the validity of the models. The results show that the null hypothesis of normality of residuals cannot be rejected. The model also passed the test for heteroskedasticity and stability (see Table 7).

TABLE 7: DIAGNOSTIC TEST RESULTS

| Residual and Stability tests | Model I | Model II | Model III |
|---|---|---|---|
| Normality- Jarque-Bera | 1.615 (0.445) | 1.597 (0.449) | 2.456 (0.292) |
| Heteroskedasticity Test | 21.751 (0.594) | 30.449 (0.170) | 28.081 (0.173) |
| Ramsey RESET Test (stability) | 3.441 (0.065) | 0.461 (0.716) | 0.551 (0.657) |

## 5. Conclusion

This study investigates the asymmetric (nonlinear) relationship between exports and economic growth in Namibia. This study differs from previous studies in the sense that it does not just investigate the relationship between the two variables at an aggregate level, but for the main export sectors of the Namibian economy. The nonlinear relationship between export and economic growth was investigated for exports of manufactured products, diamonds, food and live animals. These are the main export sectors of the Namibian economy and were selected because of the availability of consistent time series data. The study used quarterly data and covers the period 2009 - 2018. The study applied the NARDL model to capture the long-run asymmetric relations between disaggregated exports and economic growth. The results show that in the long run there is evidence of an asymmetric relationship between disaggregated exports and economic growth in Namibia. The results indicated that a decrease in exports of manufactured products, diamonds, food and live animal products will significantly cause economic growth to deteriorate. An increase in exports of these products will cause economic growth to improve significantly. The results, therefore, indicate that increase and decrease in exports of these products will have different effects on economic growth. The main contribution of this study is that it did not just test the nonlinear relationship between the two variables (export and economic growth). It investigated the relationship between the two variables for the main export sectors of the Namibian economy. This will ensure that we do not come up with only one economic policy for all sectors. It will ensure that economic policies are sector-specific. For example, an economic policy which is good for the diamond sector may not be appropriate for the food and live animal sectors. The study further recommends that when there is a decrease in export, it will be appropriate to pursue expansionary policies in order to improve economic growth.

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