EXAMINATION OF THE EFFECTS OF MACROECONOMIC SHOCKS ON THE NAMIBIAN ECONOMY

A DISSERTATION SUBMITTED IN FULFILMENT OF THE REQUIREMENTS

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Abstract

This Dissertation is structured on three stand-alone objectives which investigated the effects of macroeconomic shocks on the Namibian economy between 1980 and 2018. Firstly, the study estimated the dynamic effects of fiscal policy shocks through the SVAR approach. IRFs results reveal that a positive spending shock immediately increases output and interest rates while decreasing inflation. A positive tax revenue shock increases inflation two years after impact while decreasing interest rates at impact.

Secondly, the effects of external shocks were examined through the VAR technique. IRFs show that global output shock positively affects domestic output growth and interest rate, whereas the impact on inflation is negative immediately. A positive US monetary policy shock raises domestic interest rates and inflation while simultaneously exerting a negative influence on domestic economic growth. A positive oil price shock in the first period yields a decline in domestic GDP growth while raising the interest rate, albeit marginally. The impact on inflation is muted in the first year though it is negative beyond the second period. FEVDs reflect that domestic real GDP growth is significantly influenced by global output shocks whereas variations on both interest rate and inflation are explained largely by US monetary policy shock.

Thirdly, it investigated the impacts of mineral commodity (copper and uranium) price shocks (positive and negative changes) on Namibia's business cycles (real GDP). To determine cointegration and presence of asymmetric effects, a new stepwise-least-squares NARDL model was adopted. Outcomes reveal a long-run cointegration among real GDP, commodity prices, investment and exports shares of GDP. Moreover, the study unveiled that both copper and uranium prices have asymmetric impacts on Namibia's business cycle. Positive changes for both commodity prices have the greatest impact on real GDP than negative variations.

The study recommends the following: first, to spur sustainable economic growth, thereby significantly contributing towards the achievement of the country's socio-economic development, expansionary fiscal policy especially increasing public (productive) spending is recommended. Pursuance of counter-cyclical fiscal policy is commended specifically during low-growth periods to smoothen the business cycle. Second, increased integration with the global economy and industrialisation/diversification are recommended to ensure output growth while simultaneously cushioning the economy from external shocks and serving as a buffer against volatile commodity prices. Third, to mitigate fluctuations from external shocks, robust macroeconomic policy intervention is strongly recommended.

Keywords: External Shocks, Fiscal policy shocks, Vector Autoregressions, Structural Vector Autoregressions, Impulse Response Functions, Forecast Error Variance Decomposition, NARDL, Business Cycles, Commodity Prices

JEL classifications: E32, E62, F41, F42, F43, Q31, Q33

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Dedication

This dissertation is dedicated to my parents, Ba Benjamin Chika Mabuku and Ba Albertina Njala Limbo-Mabuku, my wife and all my children.

Declarations

I, Mubusisi Mac Beath Mabuku, hereby declare that this study is my work and is a true reflection of my research and that this work or any part thereof has not been submitted for a degree at any other institution.

Mubusisi Mac Beath Mabuku		October 2023
Name of Student	Signature	Date

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List of Abbreviations and Acronyms

ADF	Augmented Dickey-Fuller
AEs	Advanced Economies
ARDL	Autoregressive Distributed Lag
BoN	Bank of Namibia
CBS	Central Bureau of Statistics
CMA	Common Monetary Area
CPI	Consumer Price Index
EMDEs	Emerging Market and Developing Economies
FEVD	Forecast Error Variance Decomposition
GDP	Gross Domestic Product
GRN	Government of the Republic of Namibia
GVAR	Global Vector Autoregression
IMF	International Monetary Fund
IRFs	Impulse Response Functions
MoF	Ministry of Finance
N$	Namibia Dollar
NARDL	Nonlinear Autoregressive Distributed Lag
NPC	National Planning Commission
NSA	Namibia Statistics Agency
PP	Phillips-Peron
SACU	Southern African Customs Union
SADC	Southern African Development Community
SVAR	Structural Vector Autoregression
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
US	United States
VAR	Vector Autoregression
VECM	Vector Error Correction Model
ZAR	South African Rand

Chapter One: Introduction

1.1 Introduction

This part of the thesis introduces the macroeconomic shocks and selected macroeconomic variables of interest to the study. Specifically, the dynamic fiscal policy shocks, external shocks and commodity prices, including macroeconomic variables of interest, i.e., GDP growth, inflation and interest rate, are introduced. Sims (1980) equated innovations with macroeconomic shocks where innovation is the residuals from a reduced form vector autoregression model (VAR) or instrument. The word *'shock'* is usually used to denote a change or an unexpected change in a variable or perhaps simply the value of the error term during a particular period (Brooks, 2008). Generally, shocks have some salient characteristics. To this end, Ramey (2016) argued that shocks should have three key characteristics: first, they should be exogenous with respect to the other current and lagged endogenous variables in the model; second, they should be uncorrelated with other exogenous shocks; otherwise, we cannot identify the unique causal effects of one exogenous shock relative to another; and thirdly, they should represent either unanticipated movements in exogenous variables or news about future movements in exogenous variables.

Fiscal policy shocks have been defined differently by several scholars. Favero (2002) offered an econometric definition where fiscal shocks can be considered as the residuals of estimated fiscal rules. Fiscal policy shocks are in the simplest terms defined as surprises (unanticipated) change in fiscal policy and are viewed as existing in a two-dimensional space: government revenue and spending shocks (Mountford & Uhlig, 2009). Damane *et al*. (2016), on the other hand, posit another view by defining fiscal shocks as positive shifts in government expenditure and government revenue,

respectively, which is done in order to examine and conclude the different effects of each shock on identified macro variables together with their mutual influence. Other key macroeconomic shocks of consideration are external shocks which Chaiyindeepum (1992) defined as unanticipated changes in the external environment that directly or indirectly affects the economic well-being of a country. Moreover, as Varangis et. al., (2004) observed, an external shock is deemed by an international institution such as the International Monetary Fund (IMF) to denote an exogenous or unanticipated variation from an expected and/or normal trend. The effect of external shocks on macroeconomic variables and their associated propagation channels on any economy is one of the cornerstones in macroeconomics.

Furthermore, as Sedegah and Odhiambo (2021) argued, the extent and the degree to which external shocks are transmitted to the domestic economy substantially depend on a plethora of features. These includes the absence of exchange rate flexibility; a strong export concentration, especially with respect to commodities; the level of global economic integration; restricted capacities of production; the absence of competitiveness in exports; over-reliance on foreign aid; foreign reserves that are not adequate and capital account openness. Thus, an important task of open-economy macroeconomics is to enumerate how much of the macroeconomic variation in small open economies originates abroad (Maćkowiak, 2005). Yet, literature in the past decades and at present (2010s to 2020s) has not yielded consensus on the effects of external shocks, despite the wide swings in key macroeconomic variables (Patrick & Adeleke, 2018; Younas & Khan, 2018; Sedegah & Odhiambo, 2021; amongst others). Additionally, empirical studies on the impact of external shocks have, however, produced mixed results (Glenn, 1997; Senhadji, 2003; Mishra & Montiel, 2012;

among others). To this effect, the first strand of scholars (Kose, 2002; Kose & Reizman, 2001; Uribe & Yue, 2006; Mackowiak, 2007; Nguyen et al., 2014; Petrevski et al., 2015; Nizamani et al., 2017; among others) established that external shocks significantly affect variations in key macroeconomic variables i.e. output, inflation etc. The second strand of literature (Hoffmaister & Roldos, 2001; Sissoko & Dibooğlu, 2006; Raddatz, 2007; Lorde et al., 2009; inter alia) found that fluctuations in macroeconomic variables are caused largely by internal rather than external shocks. Notwithstanding these dimensions, however, the third group of scholars (Gerlach-Kristen, 2006; Rasaki & Malikane, 2015; among others) found that both internal and external shocks impact domestic macroeconomic variations.

Studies on external shocks are largely concerned with developments in the open-economy. Within the open-economy macroeconomics literature, the generally accepted definition of a small open economy is that it takes exogenously external variables. In other words, China is considered to be a large open economy as opposed to a small open economy. The main difference between these two types of economies is that: the variables of the rest of the world are exogenous in a small open economy, while this is not the case in a large open economy (Zhao et al. 2016). Generally, small open economies are extremely susceptible to external shocks (Clancy, Jacquinot and Lozej, 2014).

It is also worthwhile to consider the commodity price – business cycle nexus to be among the key macroeconomic shocks impacting largely commodity-rich countries. Commodity prices, especially in mineral-rich countries, play a significant role in business cycles of those economies. This is particularly so considering the significant impact commodity prices exert on real GDP growth of mineral and resource-rich

economies. The impact of commodity prices on business cycles (reflected by business cycle indicators, i.e., GDP etc.) for different economies has been established in the literature. Yet, the debate about the direction of the effects of commodity prices on business cycles remains lively.

Hamilton (1983), in his seminal work, documented that that there is a significant negative relationship between commodity prices (specifically oil price increases) and economic activity. The researcher specifically postulates that oil shocks were a contributing factor in at least some of the U.S. recessions prior to 1972. This strand of literature has been supported by other scholars (Burbidge & Harrison, 1984; Gisser & Goodwin, 1986; Bjørnland, 2000; Hamilton, 2009, 2011; and Stock & Watson, 2012; among others) in view of different countries. Besides, Roberts (2009) studied the fluctuations in real metal prices, specifically trying to uncover whether they are simply random variations or whether they display some degree of cyclicality. The researcher identified peaks and troughs in the inflation adjusted prices for 14 metals, using monthly average data from January 1947 through December 2007. The study established that contractions generally persist longer than expansions (in contrast to macroeconomic cycles) that long-term real prices have been trendless, and that the amplitude of price changes over the phases has little regularity.

On the impact of commodity price shocks, Kose (2002) found that world price shocks account for a significant fraction of business cycle variability in developing countries. Additionally, Houssa, Mohimont and Otrok (2015) established that commodity shocks are an important driver in business cycles in both Ghana and South Africa. Jégourel (2018), on the other hand, contended that cyclicality is one of the key properties of

commodity prices, no matter their type and commodity cycles vary in their duration and amplitude and are often asymmetrical. The author also postulates that commodity prices are both a cause and a consequence of business cycles, depending on the country, and thus require dedicated measures to ensure that public investment in exporting countries can be sustained. Recently, Mohtadi and Castells-Quintana (2021) asserted that for every country, the extent of a commodity shock depends on the array of commodities exported and the share of each commodity in the country's total exports.

Academic discourse still rages on whether the impact of commodity prices on business cycles is either linear or nonlinear. Camacho and Perez-Quiros (2014), in view of seven South American economies[1], proffered evidence on the nonlinear responses of output growth to commodity prices and that their effects on output growth are contingent on the state of the economy, the size of the shock and the sign of the shock. Fossati (2014) documented evidence of a positive and linear relationship between real GDP growth and the growth rate of commodity prices for selected Latin American countries. Liu and Serletis (2022), on the other hand, argued that there is a common belief postulating a close link between commodity prices and economic growth, yet it is not clear whether there exists nonlinear and tail dependence in that relation.

Namibia's commodity prices-business cycles nexus developments reveal that the mining sector realised unprecedented increase in its GDP value added from N$8.1 billion in 2009 to N$27 billion in 2018. Additionally, mining exports (as % of total exports of goods and services) recorded an average of 43.0% between 2010 and 2018 (Chamber of Mines, 2017; 2018; 2019). Accordingly, Namibia has been classified

[1] Argentina, Brazil, Colombia, Chile, Mexico, Peru and Venezuela.

among resource-intensive economies (whose non-renewable natural resources represent at least 25.0% of total exports). Namibia has been recognised as the fourth largest exporter of non-fuel minerals in Africa (Shindondola-Mote, 2008).

Production-wise, Namibia ranks fourth and first globally and regionally (sub-Saharan Africa), correspondingly, in terms of uranium during the period from 2011 to 2020. Yet, the country has two significant uranium mines capable of providing 10% of world's mining output (World Nuclear Association,2014). Also, in view of copper production, Namibia has been ranked fourth in Africa during 2000-2019. The study zeroed on uranium and copper prices motivated largely by two grounds: (i) they are among the largest in terms of exports (as % of total exports of goods and services). Specifically, between 2010 and 2018, the share of uranium and copper exports to total exports of goods and services averaged 9.5% and 4.5%, in that order; (ii) their international prices are available for the study period. Diamonds, the largest mineral commodity evidenced by its 17.1% exports share of total exports between 2010 and 2018 have not been included owing to unavailability of its international prices.

This study takes cognisance of the fact that apart from mineral (fuel and non-fuel) commodity prices, other commodity prices often investigated in the commodity price-business cycle nexus debate include agricultural commodity prices (i.e. Cashin, Liang & McDermott 2000; Olakojo, 2015; Danladi, 2020). However, for Namibia the contribution to GDP from mining sector has been the most significant compared to that of the agriculture sector. Hence, the performance of the mining sector has been key growth economic driver and contributor to GDP for Namibia. To this end, time series data from NSA reveal that between 1980 and 2018, the average mining sector's

contribution to GDP (13.9%) was more than double that of the agriculture sector (5.6%). Growth-wise, over the same period, the mining sector's average real GDP growth was 3.2%, which was almost two-fold the 1.8% mean growth registered by the agriculture sector (NSA, 2019). Overall, the contribution of Namibia's mining sector to the GDP as well as being a significant economic growth driver presents an area warranting close examination. Hence, the focus on studying the dynamics around international commodity prices and their impact on business cycles for Namibia, a developing resource-rich economy.

This chapter is arranged as follows: firstly, the background of the study is presented, where a synopsis of the relationship between macroeconomic shocks and selected macroeconomic variables is discussed. Secondly, the problem statement is presented, where brief information of the effects of macroeconomic shocks, the knowledge gap in the literature as well as the implications of the effects accruing from macroeconomic shocks are revealed. Thirdly, the objectives of the study are presented, followed by fourthly, the research hypotheses. Fifthly, the significance of the study is outlined, followed by the presentation of the limitations and delimitations of the study. Lastly, the outline of the rest of the chapters in this study is presented.

1.2 Background of the study

Namibia is a small, open economy richly endowed with mineral resources. It inherited a dual economy with the four inter-related challenges of low economic growth, a high rate of poverty, inequitable distribution of wealth and income, and high unemployment at independence in 1990 (Government of the Republic of Namibia, 2012). Moreover, it has been classified as an upper middle-income country by the World Bank in 2009 (NPC, 2012). The economy has been relatively stable, though like its peers on the

African continent, has been negatively impacted by several macroeconomic shocks from time to time. Some notable examples of effects of such shocks on Namibia are as follows.

The Global Financial Crisis (GFC) that started in 2007 in the United States of America and Europe plunged the global economy in a deep, lasting recession late in 2008. Consequently, most central banks globally responded immediately by pursuing accommodative monetary policies by sharply lowering their policy rates and by instituting measures to stabilize the strains in their financial systems (Bank of Namibia, 2011). Accordingly, the Bank of Namibia, lowered its repo rate from a high of 10.5% in December 2009 and continued to do so in phases to ultimately reach 6.0% in December 2010, the lowest rate since in 1990 (BoN, 2011). This is a typical external shock whose impact was felt by both the developed and developing economies globally.

One of the tools for influencing an economy's macroeconomic dynamics is fiscal policy, which can be defined as the management of government's budget (which consists of inflows of tax revenue and outflows of expenditure) to affect the level and composition of aggregate demand in the economy (Nattrass & Varma, 2014). Regarding fiscal policy landscape in Namibia, the public sector has been a key driver of economic growth over the years and the expansionary fiscal policy stance post-2008/09 GFC sustained the relatively high level of economic growth for the period 2010 to 2015, with real GDP growth averaging over 5% (NPC, 2017). Yet, fiscal aggregates have been rising beyond established national thresholds, albeit steadily and depending on circumstances and shocks. To this end, in 1990/91, total public revenue, expenditure and budget balance were 34.9, 36.2 and 0.3% of GDP (BoN, 1990).

Owing to different shocks and other developments which drove fiscal aggregates above nationally adopted caps, fiscal consolidation measure was introduced in 2015/16 and cemented in 2016/17 to steer the path of such aggregates towards sustainable trajectory (MoF, 2016). By 2017/18, public revenue, expenditure and budget balance were recorded at 33.1, 38.4, -5.4% of GDP (MoF, 2018). Specifically, the emergence and settlement of a large stock of outstanding spending arrears represented a temporary setback for the fiscal consolidation programme and adversely impacted on the fiscal indicators, with the budget deficit as a ratio of GDP rising from the initial budget estimate of 3.6% to 5.4%, while debt to GDP ratio rose to 43.0% (MoF, 2018). Namibia's debt-to-GDP dynamics reveal a worsening scenario. Between 2015 and 2018, the public debt ratio has almost doubled and remained on a rising path (IMF, 2019). This development started raising questions about debt sustainability.

Namibia has always enjoyed strong ties with South Africa dating back to pre-independence era (before 1990). In view of this, International Monetary Fund (2017) postulated that the Namibia economy was closely linked to South Africa through three main channels: (i) SACU revenue, (ii) imports of goods and services, and (iii) highly interconnected financial systems. Developments in the South African economy, which are significant for Namibia owing to the close economic linkages between the two countries, were unfavourable in 1990. Therefore, economic activity was sluggish in Namibia for the second year in succession, hence real GDP growth slowed by about 1.0% in 1990. Inflation, on the other hand, which peaked at almost 16.0% in the middle of 1989 slowed down moderately during the subsequent 12- month period reflecting the tight monetary policy stance adopted (BoN, 1990).

Namibia is a member of the Common Monetary Area (CMA) together with Lesotho, Eswatini and South Africa. These countries are in a fixed exchange rate arrangement, whereby currencies of the three smaller economies are tied one-to-one with the South African Rand (ZAR). Regarding Namibia's membership of the Common Monetary Area (CMA), Alweendo (2000) asserted that there are both benefits and costs. On the upside, he reasoned that benefits include price stability, constraining monetary expansion, restraining excessive government spending, and sending out credible signals about prospects for inflation. However, the challenges include the limited scope for a discretionary monetary policy as well as the suitability and stability level of the exchange rate that should support economic growth in the country.

Namibia, by virtue of being a resource-rich economy has always been negatively impacted by the trend in mineral commodity prices owing to their characteristic volatilities. To this end, BoN (1990) articulated that the effects of depressed mineral prices, among others, at the beginning of the decade resulted in the slowdown in the general economic activity thereby leading to registering marginal and negative growth rates between 1981 and 1985. From 1981 to 1985, the mining and quarrying sector recorded a n average contraction of 6.2% (NSA, 2019). Fluctuations in international commodity prices especially for metals have continued to characterise the economic performance of Namibia's mining sector. During the early 1980s, Rossing Uranium mine which opened in 1976, started producing at capacity. Notwithstanding the declining ore grades and hence increasing cost of production at the mine, uranium became the single most important contributor to total mining production. This was notwithstanding the fact that prior to the opening of the uranium mine, the mining industry was dominated by diamond production, in terms of value added (BoN, 1990).

Furthermore, during 2009/10, the uranium global thirst significantly buffered the economy from mining commodity price shocks. Diamond output declined and production had to be suspended temporarily due to low commodity demand. Overall, the mining sector is estimated to have contracted by 29.4% in 2009 because of the plummeting prices of copper and diamond as demand became affected in the USA and Europe (NEPRU, 2010). However, a prolonged period of low uranium market prices led to mine closures and reduced exploration in Namibia. Subsequently, as uranium and diamond prices and demand fell, so did Namibia's GDP growth which has been in recession since 2016 (Obeid, 2021). Namibia's economy is highly dependent on earnings generated from exports which are dominated by minerals. Therefore, this makes mining the mainstay of the Namibian economy. This is evidenced by the fact that after the Namibian economy posted a strong real GDP growth of 12.3% in 2004, the highest during the period 1980 to 2018, the mining sector grew by 45.0% that year (NSA, 2019). Moreover, the mining sector contributed approximately 10% of GDP in 2020 and more than 50% of export income.

Despite being a small commodity-dependent economy exposed to external shocks, between 2010 and 2015, Namibia's annual GDP growth averaged 5.5% and subsequently living standards improved. This robust growth performance was underpinned, in large part, by the construction of large mines and an expansionary fiscal policy that temporarily boosted investment. However, vulnerabilities have risen, and structural challenges remain (International Monetary Fund, 2017). This affirms the fact that commodity prices for Namibia's mineral commodities i.e., copper, diamonds, uranium etc, have a bearing on output dynamics. Overall, these

developments aroused an interest of quantifying the effects likely to emanate from several macroeconomic shocks on the Namibian economy.

1.3 Problem Statement

There are several aspects through which macroeconomic shocks affect the Namibian economy and some of these aspects constitute this study's problem statement as discussed below.

1.3.1 Gaps in literature on the effects of macroeconomic shocks

This study is cognisant of several gaps in the Namibian economy which it sought to bridge. Firstly, notwithstanding the fact that effects of macroeconomic shocks have been established in literature, to the knowledge of the author, there is no comprehensive study focusing exclusively on shocks in three dimensions: fiscal policy and external shocks as well as commodity price-business cycle nexus in a mineral-rich developing country. Moreover, most of the studies in literature were conducted in isolation. To this end, the effects of fiscal policy shocks have been established by scholars (Blanchard & Perotti, 2002; Perotti, 2004; Mountford & Uhlig, 2009; Tahri & Karim, 2018; etc.) whereases researchers (Krznar & Kunovac, 2010; Casal et al., 2016; Feldkircher & Huber, 2016; amongst others) established the impacts accruing from external shocks. Additionally, the commodity prices – commodity prices nexus was established by scholars (Deaton & Miller, 1995; Raddatz, 2007; Collier & Goderis, 2012; Camacho & Perez-Quiros, 2014; amongst others).

In spite of the several literatures, some divergencies on the outcomes from shocks still persist. For example, findings on the effects of fiscal policy shocks on macroeconomic variables remain polarised. On the one hand, scholars (Burriel et al., 2010; Alkahtani, 2013; Jooste, Liu & Naraidoo, 2013; etc) established that fiscal policy shocks have

Keynesian effects as they found that government spending shocks have positive effects on GDP whereas the second strand of researchers (Aslund & Jenish, 2006; Gunasinghe et al., 2020; Holland, Marçal & Prince, 2020; among others) established non-Keynesian effects of fiscal policy or in other words as they found negative or neutral effects.

Secondly, there appears to be a dearth in literature on the effects of fiscal policy shocks; external shocks and commodity price – business cycle nexus, especially for resource-rich small open developing economies such as Namibia. This is in view of limited studies undertaken to quantify the effects arising from such shocks. Scholars in support of this fact include, amongst others, the following: on fiscal policy shocks (Restrepo & Rincón, 2006; Baddi & Lahlou, 2013; Honda, Miyamoto & Taniguchi, 2020) and external shocks (Seleteng, 2016; Younas& Khan, 2018). Furthermore, regarding the commodity price-business cycle nexus, only a few works have been devoted to estimating the nonlinear dependence and excess co-movement between commodity prices and output growth (Liu & Serletis, 2022). Yet, it is evident that the quantified effects of different shocks on the developed/advanced economies are significantly different to Namibia and her peers in sub-Saharan Africa, considering the different economic characteristics and salient features between the two groups of economies. Therefore, the need to quantify such impacts for developing economies such as Namibia to provide basis for evidence-based decision making is urgently required.

Thirdly, the absence of a comprehensive examination, diagnosis and quantification of the effects of macroeconomic shocks in totality, as is the case for Namibia, constrains and affects the accuracy of forecasts, projections and targets established in view of National Development Plans (NDPs). Essentially, in developing NDPs, targets are set

without specifically quantifying the exact effects of macroeconomic shocks in the projections with respect to setting national goals and targets. This an important gap that warrants a thorough investigation considering that it creates a challenge in that the macroeconomic projections developed will be deficient as they will not be informed by complete information about the impacts emanating from such macroeconomic shocks. Although projections and national targets have been set in the country's long-term blueprint – Vision 2030 (GRN, 2004) and NDPs, a thorough and comprehensive examination of the effects of macroeconomic shocks on the Namibian economy has not been carried out. These are important gaps in literature not only for Namibia but also for her peers within the sub-Saharan African region that this study sought to bridge.

1.3.2 Implications of effects from macroeconomic shocks

A comprehensive diagnosis of the ramifications arising from different macroeconomic shocks is required to devise appropriate strategies and policies to mitigate such shocks. Several macro-econometric models have been developed for the economy of Namibia. For example, one of the most frequently used macroeconomic model (!NAMTRIMO – Namibia Treasury Integrated Model) or simply MacroABC model was developed in series by Micromacro Consultants as early as 2006. This model has been used in developing chapters in National Development Plans (NDPs) as well as Macroeconomic Framework (MEF), which is an important tool that informs the preparation of the national budget, the MTEF. This model has been and is still being used as a forecasting tool by the MacroEconomic Working Group (MEWG) whose membership comprise of the Bank of Namibia, the Ministry of Finance, the Namibia Statistics Agency and the National Planning Commission.

According to the model developers, Micromacro Consultants (undated), the MacroABC model can be used for, among others, fiscal and socio-economic policy simulations of scenarios (what if/ impact analysis), formulation of long-term Vision, budget and medium-term poverty reduction papers. However, the MacroABC model is only used in the forecasts rather than in comprehensively modelling the effects of previous macroeconomic shocks (i.e., fiscal, external and commodity price-business cycle nexus). Thus, it is important to construct a model that can capture the previous effects of shocks and then use it for forecasting or comparison with MacroABC model results.

Wrong or inappropriate policy prescriptions for Namibia and her peers within the African continent and the sub-Saharan African region may not yield the required inclusive and sustainable growth, structural transformation, reduction of poverty, inequality and unemployment, socio-economic challenges inherent in these economies. Therefore, it is critically important for policymakers, economists and researchers to understand the subsequent reaction of Namibia's macroeconomic variables to several macroeconomic shocks to better mitigate against such shocks.

1.3.3 Problems emanating from macroeconomic shocks

As macroeconomic shocks affect the real economy and overall price level, the authorities (central banks and governments) face policy challenges in stabilizing the price level and output concurrently whilst spurring inclusive and sustainable economic development. The problem for Namibia is that a thorough assessment of the effects of macroeconomic shocks has yet to be undertaken to ascertain the impacts of several shocks on key macroeconomic variables, for Namibia, a resource-rich, emerging and developing economy. Thus, such effects have not been accounted for accurately in macroeconomic policy and planning frameworks. Therefore, this implies that

macroeconomic policy formulation is constrained as it is not informed by thorough econometric analyses where the effects accruing from such shocks are adequately modelled and quantified. Hence, the policies developed may not be robust enough to withstand effects likely to ensue from macroeconomic shocks. Additionally, failure to devise relevant policies to mitigate impacts from macroeconomic shocks in addition to lack of comprehensive diagnosis of such impacts can be detrimental to the Namibian economy.

Understanding the effect of macroeconomic shocks on macroeconomic variables is necessary as this allows the authorities to have a guided view on policies being formulated to either eliminate or lessen the impact from such impacts or create buffers. Moreover, the significance of understanding the sources of macroeconomic fluctuations is that policymakers can formulate appropriate policies to mitigate the effects of adverse shocks on their economies (Rasaki & Malikane, 2015). Some of the problems likely to be exerted by macroeconomic shocks on the economy include the following. Fiscal policy shocks have been documented to exert influence on real output, price level and interest rates. In response to the Global Financial Crisis (GFC) of 2008-09 which drove many economies globally into deep recessions, various governments from both advanced and developing economies adopted fiscal policy to steer their respective economies out of the economic downturn (Rena & Kefela, 2011; Morita, 2017; Honda, Miyamoto & Taniguchi, 2020; etc). However, the GFC underscored the difficulty for fiscal policy makers to react quickly in real time. The most significant parts of the fiscal policy stimulus in Germany have occurred with some lag to the diagnosis of the problem and the sharp contraction in GDP. Specifically, while the crisis was at its peak in the last quarter of 2008 and first quarter

of 2009, the greatest part of the stimulus occurred as of late spring 2009 and continues up to 2010 (Tenhofen et. al., 2010).

Feldkircher and Huber (2016), in view of external shocks, argued that the rise in international trade and cross-border financial flows over the last few decades implies that countries are more than ever exposed to economic shocks from abroad. The authors also maintained that Global Financial Crisis (GFC) has recently demonstrated how a local shock can spread out very quickly, ultimately engulfing the world economy. In reinforcing this view, time series data from Namibia Statistics Agency (2019) reveal that real economic growth of the Namibian economy averaged 4.2% between 1990 and 2007 after which it characteristically slowed to 2.6% and 0.3% in 2008 and 2009, respectively, owing in large part, to the effects of the GFC.

Regarding the commodity prices – business cycle nexus, volatility in commodity prices causes instability in exchange rate and fluctuations in growth for developing countries. Commodity price instabilities make the commodity-dependent economies, mostly in Africa, more vulnerable to commodity price shocks (UNDP, 2010). One central tenet of these economies, although richly endowed with abundant mineral resources or commodities, is that they generally have narrow and limited manufacturing bases and as such export commodities in raw form with very limited or no value addition at all (NPC, 2020). Fornero et al. (2016) maintained that commodity price shocks are an important driver of business cycles in six commodity-exporting countries (Australia, Canada, Chile, New Zealand, Peru and South Africa); and that such shocks affect output significantly through their impact on mining investment. Yet, In Namibia mineral commodity prices have been noted to be among the leading

key drivers for economic performance, albeit depending on global demand and reduced global supply for minerals i.e., diamonds, copper, uranium etc. (BoN, 2018; 2020).

In a bid to mitigate adverse effects of several macroeconomic shocks on the Namibian economy to ensure macroeconomic stability whilst supporting sustainable growth to achieve other national priorities such as high and sustainable growth as well as reduction of poverty, inequalities and unemployment, fiscal and monetary policies, among others, have been pursued. To this end, fiscal policy has been the most effective policy instrument that the Namibian government employed over the period 1990 to 2019 to influence and balance the economy through taxation and public spending (First Capital Namibia, 2019). As an example, expansionary fiscal policy was introduced in 2011/12 to fund the three-year *"Targeted Intervention Programme for Employment and Economic Growth (TIPEEG)",* which sought to support strategic growth driving sectors while simultaneously tackling the high and persistent unemployment rate, especially among the unskilled youth (NPC, 2011).

Moreover, the Bank of Namibia's Monetary Policy Committee (MPC) is responsible for the formulation of monetary policy with a primary goal being to ensure price stability in the interest of sustainable economic development of the country while utilizing the repo rate, as the main policy tool to influence monetary conditions in the country (BoN, 2020). Herein, the repo rate, the interest rate at which commercial banks borrow money from the Bank of Namibia, affects other interest rates in the economy. The repo rate is aligned to the South African Reserve Bank's repo rate. In view of this, all major economic and financial indicators (i.e., the liquidity of the banking system, inflation and exchange rate trends, financial market developments, the foreign exchange reserve position, real sector indicators, the balance of payments, and fiscal

trends) are monitored and presented to the MPC when monetary policy decisions are announced (BoN, 2020).

Notwithstanding the pursuance of these policies, however, challenges still linger. For example, the targets of the country's long-term Vision 2030 include annual average GDP growth of 6.2%; low unemployment level of 2.3% by 2030; income inequality as measured by the Gini coefficient at 0.3 by 2030, among others (GRN, 2004). However, the outturns have not been in tune with expectations. Precisely, after the Namibian economy recorded an average real growth of 5.7% between 2010 and 2015, the annual growth characteristically slowed to an average of 0.1% between 2016 and 2018 (NSA, 2019a). Yet, unemployment stood at 34.0% and 33.4% in 2016 and 2018, respectively, from 27.9% in 2014 (NSA, 2019b) while income inequality (Gini-coefficient) was recorded at 0.56 in 2015/16, a marginal improvement from 0.603 in 2003/04 (NSA, 2016).

The achievement of these targets is contingent on, amidst others, formulating robust policies informed by comprehensive diagnosis and analysis of the likely effects to accrue from macroeconomic shocks. To circumvent the problems associated with effects of macroeconomic shocks requires development of robust and responsive policies. It is thus these effects that this study sought to quantify and contribute to macroeconometric modelling literature in the African continent, sub-Saharan African region and Namibia in this field as well as informing policymaking in the face of uncertainty or unpredictability, increased globalisation and regional integration. The new knowledge from this study's perspective and the contribution thereof is that it adopts rarely investigated, though important macroeconomic shocks, to quantify their impacts on the small, open and resource-rich developing Namibian economy.

1.4 Research Objectives

The principal objective of this study is to examine the effects of Macroeconomic Shocks on the Namibian economy. The three specific objectives are as follows:

- to estimate dynamic effects of fiscal policy (government spending and tax revenue) shocks on economic activity, price level and interest rates in Namibia,
- to examine the effects of external shocks (global output growth, US monetary policy and oil prices) on key macroeconomic variables (output growth, interest rate and inflation), and
- to examine the effects of commodity price (copper and uranium) shocks on Namibia's business cycles (real GDP).

1.5 Research Hypotheses

In view of the three specific objectives above, the hypotheses of the study are shown below:

Hypothesis 1

H_{01}: Fiscal policy (government spending and tax) shocks have no effect on output, inflation, and interest rate in Namibia

H_{11}: Fiscal policy (government spending and tax) shocks have effects on output, inflation, and interest rate in Namibia

Hypothesis 2

H_{02}: External shocks (global output, US interest rate and oil prices) have no impact on Namibia's output, inflation, and interest rate

H_{12}: External shocks (global output, US interest rate and oil prices) impact Namibia's output, inflation, and interest rate in Namibia

Hypothesis 3

H_{03}: Commodity prices (copper and uranium) have no influence on Namibia's business cycles (real GDP)

H_{13}: Commodity prices (copper and uranium) influence Namibia's business cycles (real GDP)

1.6 Significance of the Study

Understanding the effects of macroeconomic shocks on key macroeconomic variables is important in an economy. In this view, Caldara et al. (2016) indicated that financial shocks have a significant adverse effect on economic outcomes and that such shocks have been important sources of cyclical fluctuations since the mid-1980s. The role and linkage of external shocks are important in any economy. In alignment with this, Kharas and Shishido (1985) asserted that the link between shocks and adjustment implies that dynamic programming of the optimal adjustment path is critical in determining the impact of any shock. For instance, external shocks have been found not to be the ones affecting real activity in low-income countries and are thus inconclusive. Accordingly, Raddatz (2006) found that although external shocks have an economically meaningful effect on real activity, especially when compared with the average economic performance of low-income countries, they account for only a small fraction of the volatility of these countries' real GDP. To the extent that these shocks cover the most important external contingencies faced by low-income countries, the results suggest that the economic instability experienced by these countries is largely the result of internal factors.

Moreover, spill overs from advanced economies have been found to be transmitted to smaller sub-Saharan African countries. Drummond and Liu (2013) studied spill overs from changes in China's investment to Sub-Saharan Africa's export. They found that a one percentage increase (decline) in China's domestic investment growth is associated with an average 0.6 percentage increase (decline) in Sub-Saharan Africa's exports. From a policy perspective, the results of Alejandro, Randall, and Ernesto (2008) suggested that external factors play a key role in accounting for economic fluctuations in Latin America. Therefore, given the importance of external factors in Latin America's business cycle fluctuations, policy evaluation should be conducted keeping these factors in mind, or otherwise, there may be substantial room for misjudgement. Against the backdrop that the effects of Macroeconomic Shocks in the Namibian economy have not been examined thoroughly before presents an urgent need to cover this important area of literature. This study is the first of its kind to comprehensively examine the effects of macroeconomic shocks on the Namibian economy. Therefore, it is pioneering work for the Namibian economy.

1.7 Limitations of the Study

Time series data for Namibia dating back to the 1970s on selected macroeconomic variables are non-existent; therefore, this period was not be included in the study. A complete understanding of cyclical and other turbulent dynamic movements might need even higher frequency observation, i.e., weekly, daily, or real-time (Klein & Ozmucur, 2005). Macroeconometric modelling in developing countries has been subject to criticism on a greater scale because of the presence of an additional adverse factor of data unreliability. Apart from data problems which are inevitable, however, there are some specific modifications which should be implemented in constructing a

macroeconometric model for each developing country to capture its specific structural peculiarities (Valadkhani, 2004). This study will be conducted within these limitations.

1.8 Delimitations of the Study

Following the afore-mentioned limitations, this study only covered time series data for the period 1980 to 2018. In view of the absence of high-frequency data on the selected macroeconomic variables, low-frequency annual time series data was adopted, and the coverage was in view of addressing the study objectives.

1.9 Chapter Outline

The remainder of the thesis contains five chapters presented as follows: Chapter two presents the literature review with emphasis on both theoretical foundations and empirical works in view of fiscal policy and external shocks, commodity prices and business cycles. Chapter three reveals Namibia's fiscal, monetary, external, commodity prices and business cycle developments. This chapter elucidates how these dimensions have evolved since 1980.

Chapter four outlines the dynamic effects of fiscal policy shocks on Namibia's output, inflation and interest rate. In this chapter, the results of the Structural Vector Autoregressions (SVAR) econometric technique are presented. Chapter five reflects the effects of external shocks on output, inflation and interest rate modelled through the Vector Autoregression (VAR). Results from the econometric tests (VAR estimation) are discussed.

Chapter six, on the other hand, provides a synopsis of the effects of commodity price shocks on Namibia's business cycles. Herein, theoretical and empirical literature

reviewed informs the implementation of a new econometric approach, the Nonlinear Autoregressive Distributed Lag (NARDL) model, to examine the commodity prices-business cycle nexus. Chapter seven elucidates the study's conclusion whereas policy recommendations based on the findings of the study coupled with suggestions for further research are also presented.

Chapter Two: Literature Review

2.1 Introduction

Theories about different macroeconomic shocks have been and continue to be the subject of debate among several economic schools of thought. This chapter, therefore, provides a comprehensive literature review covering both theoretical and empirical works on fiscal shocks, external shocks and macroeconomic variables, as well as on commodity prices and business cycles. Specifically, for fiscal policy shocks, the Keynesian, Neo Classical, Monetarist School, Twin-Deficits and Mundell-Fleming theories are reviewed. Moreover, several empirical works on effects of fiscal policy on macroeconomic variables are also reviewed. Yet, the chapter also provides background of fiscal policy shocks with a view to highlighting the different identification schemes for Fiscal Policy shocks.

The reviewed theoretical underpinnings for external shocks include the Harbeger-Laursen-Metzler effect, the Mundell-Fleming Model, the Intertemporal models to transmission of monetary policy, and the Dornbusch overshooting model. A brief background on how external shocks is often viewed by various scholars is also provided as well as modelling of external shocks and their proliferation. These are augmented by several empirical studies on the impact of external shocks on macroeconomic variables. For the commodity prices-business cycle nexus, theories such as the Prebisch-Singer Hypothesis, the Dutch Disease, the Real Business cycle, the Keynesian Business cycle as well as synopsis of business cycles are presented. Additionally, empirical works on the commodity prices-business cycle nexus are discussed. These lay the foundation for empirical methodologies adopted in estimating the effects of fiscal and external shocks and impacts of commodity prices on business cycles as informed by theoretical foundations and empirical works.

2.2 Literature Review on Fiscal Policy Shocks and Macroeconomic Variables

2.2.1 Theoretical foundations of Fiscal Policy Shocks

- **Keynesian Theory:** In terms of fiscal policy shocks, the Keynesian Theory states that an increase in government expenditure and a cut in taxes results in an increase in the real wage, private consumption and ultimately an increase in aggregate demand. These increases will stimulate the economy in view of the conventional policy prescription for an economic downturn as postulated by Keynes in the 1930s. Specifically, Keynes (1936) reasoned that a change by the government in the level of government expenditure and taxation positively influences aggregate demand, which then influences economic activities. According to Burda and Wyplosz (1997), the Keynesian view predicts that the countercyclical fiscal policy may be a corrective device to keep unemployment at its equilibrium level and output near its trend growth path. Moreover, Diab, Atlam and Nimer (2016), in light of Keynesian models, argued that either tax cuts or increased government spending can increase total demand and, therefore total output and employment. Broadly, the Keynesian theory is based on assumptions of price rigidity (Perotti, 2007; Bank, 2011; and Mathewos, 2015).

- **Neo-Classical Theory:** According to the neoclassical school of thought (Aiyagari *et al.*, 1992; Christiano & Eichenbaum, 1992; Baxter & King, 1993; and Burnside & Eichenbaum, 1996), an exogenous increase in government purchases specifically financed by lump-sum taxes leads to upsurges in output and real interest rate whereas it reduces consumption and real wages. Moreover, Baxter and King (1993) advanced that in the standard neoclassical dynamic general equilibrium model, the short-run effects of fiscal policy depend on a number of

factors, i.e., the type of taxation, the size and persistence of the discretionary fiscal impulse, the elasticity of labour supply. Neoclassical Theory generally postulates that consumption will fall in response to a temporary spending shock. Moreover, according to Neoclassicals, variations in government spending, both permanent and temporary, generate a negative income effect and therefore decrease household consumption and increase their labour supply and, ultimately, output.

- The neoclassical theory aligns more with a supply-side than demand-side approach in establishing the effect of fiscal policy on GDP and other macroeconomic aggregates. Precisely, this school of thought's general equilibrium model generates outcomes that are contrary to the Keynesian aggregate demand model. The responses of private consumption and the real wage rate to a shock in government spending vary depending on which model is adopted (Alami et al., 2021). Moreover, Tanchev and Mose (2023) postulated that neoclassical economists require governments to pursue a budget-neutral policy. Thus, a neutral fiscal policy is connected with tax decreases and government expenditure limitations. The primary consideration is that the budget is balanced and does not allow the use of a deficit. According to classicals, low tax rates and limited government expenditure increase the activity of the private sector, which leads to increased economic growth.

- **Monetarist school**: The monetarists' view claim that while it is not possible to have full employment of the labour force all the time (as classical economists reasoned), it is better to leave the macroeconomy to market forces. Diab, Atlam and Nimer (2016) advanced that monetarism underscored that the use of fiscal

policy is largely ineffective in adjusting output and employment levels as it only leads to crowding out. Monetary policy, on the other hand, is effective, albeit with the condition that monetary authorities do have adequate knowledge to manipulate the money supply successfully. Hence, the monetary school advocates that neither monetary nor fiscal policy should be used in an attempt to stabilize the economy because this may lead to greater instability in the economy, and therefore the money supply should be allowed to grow at a constant rate (Diab, Atlam & Nimer, 2016). Generally, the monetarist view aligns closely to the Classical than Keynesian.

- **Twin-Deficits Hypothesis/Theory:** Baxter (1995); Erceg, Guerrieri, and Gust (2005); and Kollmann (1998), in view of the twin-deficit hypothesis, postulated that when government spending increases with no matching increases in tax revenues (fiscal deficit), Ricardian consumers, rationally expecting a tax hike in the near future, reduce consumption (increase saving) and increase labour hours. The twin deficits hypothesis argueds that fiscal deficits, or negative public savings, induce current account deficits (Sobrino, 2013). In addition, as Ogbonna (2014) postulates, the Twin deficits hypothesis proclaims that an increase in the budget deficit will cause a similar increase in the current account deficit.

- **Mundell-Fleming View:** In addition to other theoretical foundations on fiscal policy shocks, the Mundell-Fleming view hypothesises that an expansionary fiscal policy raises prices, interest rates and economic activity (output) while concurrently worsening the trade balance. Specifically, an expansionary fiscal policy in a small open economy causes an increase in interest rates, attracts foreign capital and leads to national currency appreciation (if the exchange rate regime is

flexible). Han (2014) posited that the Mundell-Fleming model is a standard open macroeconomic theory that tries to describe the effects of fiscal and monetary policies. It is believed that, under assumptions of the small country and perfect capital mobility, fiscal policy is strong under a fixed exchange rate, while monetary policy is strong under a floating exchange rate. Moreover, the Mundell-Fleming model suggests that capital mobility and the exchange rate regime in place (factors lacking in Keynesian theory) determine the effectiveness of fiscal policy (Alami et al., 2021).

2.2.2 Synthesis of theoretical review on fiscal policy shocks

This section provides a synopsis of reviewed theoretical literature in view of fiscal policy shocks. According to the Keynesian Theory, Keynes (1936) reasoned that a change by the government in the level of government expenditure and taxation positively influences the aggregate demand, which then influences economic activities. These views are contrary to the Neo-Classical School of thought (Aiyagari *et al.*, 1992; Christiano & Eichenbaum, 1992; Baxter & King, 1993; and Burnside & Eichenbaum, 1996), which argued that variations in government spending, both permanent and temporary, generate negative income effect and therefore decreasing household's consumption and increasing their labour supply and ultimately output.

The monetarist school, on the other hand, advances that the use of fiscal policy is largely ineffective in adjusting output and employment levels as it only leads to the crowding out. Therefore, this theory argues against adopting fiscal policy, among others, in an attempt to stabilize the economy considering that this may lead to greater instability in the economy. The Twin-Deficits Hypothesis (Baxter, 1995; Erceg,

Guerrieri, & Gust, 2005; and Kollmann, 1998) argued that when government spending increases with no matching increases in tax revenues (fiscal deficit), Ricardian consumers, rationally expecting a tax hike in the near future, reduce consumption (increase saving) and increase labour hours. Lastly, the Mundell-Fleming view assumes that an expansionary fiscal policy raises prices, interest rates and economic activity (output) while concurrently worsening the trade balance.

2.2.3 Identification schemes for Fiscal Policy shocks

Literature suggests that macroeconomic effects of fiscal policy shocks have been estimated using four main identification schemes: *first*, the recursive approach as pioneered by Sims (1980), which theorised that this approach to identification in SVAR models is designed so as to avoid problems associated with dynamic simultaneous equation models which often lead to "incredible" identifying restrictions. This approach uses a k-dimensional identity matrix to restrict B, whereas the lower triangular matrix is an identity (includes 1's in the main diagonal), thereby showing the decomposition of the variance-covariance matrix. The recursive approach assumes that the lower triangular and the structural shocks are uncorrelated, which, in other words, implies that a numerical method for estimating a recursive system is the Cholesky decomposition or triangularization.

The recursive method is arguably the most used identification method in macroeconomics and imposes alternative sets of recursive zero restrictions on the contemporaneous coefficients. The variance-covariance matrix is obtained from Cholesky decomposition. The most common variant of the Cholesky decomposition identification method, in relation to other schemes, is that it assumes that the policy

variable does not respond contemporaneously (within the month, quarter or year) to the other endogenous variables in the system (Kemp, 2020). To this end, the causal ordering of the model variables is implied by the recursive approach. The recursive approach was initially adopted by Fatas and Mihov (2001).

Second, the narrative approach is based on sign-restrictions on the impulse responses to identify shocks established by Mountford and Uhlig (2005, 2009), Romer and Romer (2009), and Enders et al. (2008). The narrative approach entails the construction of a series of historical documents to identify the reason and the quantities associated with a particular change in a variable. Caldara and Kamps (2008) suggested that, unlike the recursive and the Blanchard-Perotti (BP) approaches, the sign-restrictions approach does not require the number of shocks to be equal to the number of variables, and it does not impose linear restrictions on the contemporaneous relation between reduced-form and structural disturbances.

Third, the event study approach or dummy variable approach was proposed by Ramey and Shapiro (1998) specifically in view of studying the isolated effects of unexpected increases in government spending for defence purposes. This approach makes use of military build-ups as exogenous shocks to identify fiscal policy shocks. To this end, they identify dates at which relevant military initiatives were first announced, after which they trace the dynamic response of the economy to those announcements using dummy variables, as such events are seen to be a truly exogenous source of variation in government spending. This approach tried to avoid the identification problem inherent in structural VAR analysis and instead looked for fiscal episodes which can be seen as exogenous with respect to the state of the economy. Accordingly, Ramey and Shapiro (1998) postulated that the large increases in military spending associated with the onset of the Korean war, the Vietnamese war and the Reagan military build-

up can be seen as such exogenous events. This approach was also used by Ramey (2011) and Edelberg et al. (1999), among others.

Fourth, the Structural Vector Autoregression (SVAR) approach (known to nest the Cholesky decomposition) introduced by Blanchard and Watson (1986) and Bernanke (1986) specifically assumes either economic theory or outside estimates to constrain parameters. This approach was familiarized by Blanchard and Perotti (2002), and as such, it is often referred to as Blanchard-Perotti SVARs or BP SVARs and relies heavily on institutional information about the tax and transfer system to identify shocks or, in other words, the automatic reactions of government expenditure and revenue to an economy. This approach assumes that government spending is predetermined within the quarter while identification is achieved by restricting the contemporaneous relationships between the fiscal and other variables in the VAR. the reduced-form residuals from the regression of government spending on the lags of all other variables in the VAR are identified as structural government spending shocks.

According to Caldara and Kamps (2008), the SVAR identification scheme relies on a two-step procedure: in the first step, institutional information is applied to estimate cyclically adjusted taxes and government expenditures, while in the second step, estimates of fiscal policy shocks are obtained. Overall, all identification approaches used in the literature yield very similar results in respect of the effects of government spending shocks (Caldara & Kamps, 2008).

2.2.4 Empirical studies on the impact of Fiscal Policy shocks on Macroeconomic Variables

There exists a plethora of literature on the effects of fiscal policy shocks on macroeconomic variables, especially for high-income industrialised economies. For

these economies, Blanchard and Perotti (2002), through Structural Vector Autoregression (SVAR) approach for the US economy (1947Q1 to 1997Q4) find the following: (i) positive shocks to government spending led to a positive impact on output; (ii) positive tax shocks have a negative effect on output; and (iii) positive shocks to government spending and revenue lead to a crowding out of private investment.

Krusec (2003) implemented a Structural Vector Error Correction Model (SVECM) on four European Economic and Monetary Union (EMU members – Germany, Austria, Italy & Finland) and four non-EMU OECD Countries (USA, Great Britain, Canada & Australia) in estimating the effects of fiscal policy (government spending and taxation) on output. The researcher establishes that fiscal shocks are heterogenous across the sampled countries. Accordingly, the scholar posits that government spending shock has varying effects (and occurs at different times) on the output (GDP) of the selected countries. Herein, a positive 1% government spending shock increases real output at most by 0.5% at the impact in Finland; 0.5% after 8 quarters in Austria; 0.3% after 4 quarters in Italy; 0.21% at the impact in the USA; 0.7% at the impact for Australia and 0.5% two years after impact in Canada and 0.5% one year after impact in Great Britain. On the contrary, however, a positive tax shock has a rather insignificant effect on output.

For the Germany economy during the period 1974Q1 – 2004Q4, Heppke-Falk, Tenhofen and Wolff (2006) employed the SVAR method and established that: (i) direct government expenditure shocks increase output and private consumption on impact with low statistical significance while they decrease private investment insignificantly; (ii) government investment has a positive effect on the output which is

statistically significant until 12 quarters ahead; (iii) effects of expenditure shocks are only short-lived; and (iv) government net revenue shocks do not affect output with statistical significance.

Giordano, Momigliano, Neri and Perotti (2007), while adopting the SVAR methodology for Italy for the period 1982Q1 – 2004Q4, established that positive shocks to government spending led to a positive impact on output, employment, private consumption, investment and inflation. Miyazawa and Nutahara (2013) made three conclusions for the Japanese economy for the period 1975Q2 – 2007Q4 through Vector Autoregressive (VAR) approach: (i) an increase in government spending has positive effects on consumption and wages in the short run, but these effects are not persistent, and the effects on GDP are almost zero; (ii) an increase in government revenue has significant positive effects on GDP, consumption, and investment in the medium and long run although it has negative effects in the short run; (iii) the balanced-budget spending policy scenario is better than deficit-spending and deficit-financed tax-cut policy scenarios.

The foregoing literature and the empirical works on sub-Saharan African economies that follow are concisely presented in Table 2.1. Whilst literature on the effects of fiscal policy shocks on macroeconomic variables in industrialised economies is vast; the same cannot be said about the developing middle-income sub-Saharan African (SSA) economies, where there appears to be a dearth given the limited number of empirical studies undertaken. Some of the studies executed in SSA include the following: Ocran (2011) applied the VAR approach to the South African economy during the period 1990Q1–2004Q4, postulates that: (i) government consumption expenditure and gross fixed capital formation have a positive effect on economic

growth; and (ii) positive shocks to tax receipts have a positive effect on economic growth.

Oseni and Onakoya (2012) adopted the SVAR methodology in respect of the Nigerian economy for the period 1980Q1 – 2010Q4 and establish that the expansionary fiscal policy shock has a positive effect on output, exchange rate and negative impacts on current account balance and interest rate. Jooste and Naraidoo (2013) implemented a Structural Vector Error correction Model (SVECM) and Time-Varying Parameter VAR (TVP-VAR) and made three-fold conclusions in view of the South African economy for the period 1970Q1–2010Q4: (i) the impulse responses indicate that increases in government expenditure have a positive impact, albeit (at times) less than unity, on GDP in the short run; (ii) over the long run, the impact of government expenditure on GDP is insignificant; and (iii) increases in taxes decrease GDP over the short run, while having negligible effects over longer horizons.

Chileshe (2015), in view of the Zambian economy, implemented the SVAR using monthly time series data for the period January 1995 to June 2015 and established that fiscal policy shocks have significant effects on prices and economic activity. Specifically, positive innovations to the government wage bill significantly raise both consumer prices and economic activity, whereas positive shocks to tax revenue yields a significant fall in output. Yet, innovations in the expenditure on goods and services have no significant effects on prices and output.

Damane, Hlaahla and Seleteng (2016) applied the SVAR technique to Lesotho (1982 – 2015) and claimed that a positive shock to government expenditure leads to a significant positive response in inflation, while a positive shock to government revenue has no impact on the output gap and interest rate spread but results in an increase in

consumer prices, government expenditure as well as public and private gross fixed capital formation.

For the Namibian economy, only two studies have attempted to examine the effects of fiscal policy shocks. These are Nkhalamo and Sheefeni (2017), who implemented the VAR technique for the period 2001Q1 to 2015Q4 and claimed that taxation has an immediate negative effect on economic growth and these effects appear to be permanent in nature. Manuel, Eita, Naimwaka and Nakusera (2019), on the other hand, employed an Autoregressive Distributed Lag (ARDL) approach for the period 2008Q2 to 2017Q4 and showed evidence of a long-run positive effect of fiscal deficit on inflation in Namibia. This study differs from the two earlier papers on the Namibian economy in three ways: *firstly*, it adopts a different set of variables.

Secondly, it presents a longer time horizon and low frequency (annual data) which is congruent with the view that policy shock effects generally take time by way of implementation lags owing to the fact that fiscal policy decision-making is a rather long process, involving many agents in parliament, government and civil society, as advanced by Blanchard and Perotti (2002). *Thirdly*, it implements a different econometric approach (SVAR), a technique that literature has proven to best model fiscal policy shocks. All these aspects ultimately offer new insights into the effects of fiscal policy shocks which have thus far not been econometrically established for Namibia. Considering these features, therefore, this study is more comprehensive.

Notwithstanding this, however, this dissertation aims to augment such studies for the Namibian economy and is as such complementary in that regard. This study, therefore, seeks to cover this gap in the literature for Namibia in particular and sub-Saharan

Africa, by extension. Though this is the first paper that uses the SVAR technique for the Namibian macro-economy, literature has demonstrated the widespread usefulness of the SVAR approach in quantitatively analysing effects of fiscal policy shocks abroad.

Table 2.1: Summary of empirical studies on the effects of fiscal policy shocks

Author, Year & Methodology	**Country & Period**	**Variables**	**Key Findings**
Blanchard and Perotti (2002) SVAR	US: 1947Q1 – 1997Q4	• Government spending. • Government tax; and • GDP.	• Positive shocks to government spending led to a positive impact on output. • Positive tax shocks have a negative effect on output; and • Positive shocks to government spending and revenue lead to a crowding out of the private investment.
Krusec (2003) SVEC	Four EMU (Germany, Austria, Italy & Finland) and four non-EMU OECD Countries (USA, Great Britain, Canada & Australia):[2]	The 3-variable set: • Real government spending. • Real net taxes. • Real output The 5-variable set (includes): • Inflation; and • Interest rate.	• A positive 1% government spending shock increases real output at most by: o 0.5% at impact in Finland. o 0.5% after 8 quarters in Austria. o 0.3% after 4 quarters in Italy. o 0.21% at impact in the USA up to 1983. o 0.7% at impact for Australia. o 0.5% two years after impact in Canada; and o 0.5% one year after impact in Great Britain.
Heppke-Falk *et al*. (2006) SVAR	Germany: 1974Q1 – 2004Q4	• Real GDP. • Inflation (GDP-deflator). • Nominal short-term interest rate. • Real government direct expenditure; and	• Direct government expenditure shocks increase output and private consumption on impact with low statistical significance while they decrease private investment insignificantly. • Government investment has a positive effect on the output which

[2] **Australia:** 1963Q2 – 2001Q2; **Austria:** 1964Q1 – 1998Q4; **Canada:** 1961Q1 – 2001Q4; **Finland:** 1970Q1 – 1996Q4; **Great Britain:** 1963Q1 – 2001Q2; **Germany:** 1966Q1 – 1998Q4; **Italy:** 1960Q1 – 1998Q4; and **USA:** 1960Q1 – 2001Q4.

		• Real government net revenue.	is statistically significant until 12 quarters ahead. • Effects of expenditure shocks are only short-lived; and • Government net revenue shocks do not affect output with statistical significance.
Giordano *et al.* (2007) SVAR	Italy: 1982Q1 – 2004Q4	• Government spending. • Government revenue. • Private GDP. • Inflation; and • Long-term interest rate.	• Positive shocks to government spending led to a positive impact on output, employment, private consumption, investment and inflation; and • Positive shocks in government revenue have negligible effects on all selected variables.
Miyazawa and Nutahara (2013) VAR	Japan: 1975Q2 – 2007Q4	• Real GDP. • Real consumption. • Real government expenditure. • Real government revenue. • Real investment. • GDP deflator. • Government bond yields. • Monetary base. • Corporate goods price index; and • Real wage.	• An increase in government spending has positive effects on consumption and wages in the short run, but these effects are not persistent, and the effects on GDP are almost zero. • An increase in government revenue has significant positive effects on GDP, consumption, and investment in the medium and long run, although it has negative effects in the short run; and • The balanced-budget spending policy scenario is better than deficit-spending and deficit-financed tax-cut policy scenarios.
Ocran (2011) VAR	South Africa: 1990Q1– 2004Q4	• Government gross fixed capital formation. • Tax expenditure. • Government consumption expenditure. • GDP; and • Budget deficit.	• Government consumption expenditure and gross fixed capital formation have a positive effect on economic growth; and • Positive shocks to tax receipts have a positive effect on economic growth.
Oseni and Onakoya (2012) SVAR	Nigeria: 1980Q1 – 2010Q4	• Real GDP. • Fiscal deficit as % of GDP. • Current account as % of GDP. • Real interest rate; and • Exchange rate.	• The expansionary fiscal policy shock has a positive effect on output, and exchange rate and negative impacts on current account balance and interest rate.
Jooste and Naraidoo (2013) SVECM and TVP-VAR	South Africa: 1970Q1– 2010Q4	• General government expenditure and taxes per capita. • GDP per capita. • Interest rates on debt. • Inflation (CPI); and • Household consumption.	• The impulse responses indicate that: o first, increases in government expenditure have a positive impact, albeit (at times) less than unity, on GDP in the short run.

			○ Second, over the long run, the impact of government expenditure on GDP is insignificant; and ○ Third, increases in taxes decrease GDP over the short run while having negligible effects over longer horizons.
Chileshe (2015) SVAR	Zambia: Monthly. 1995M1 – 2015M6	• Real GDP. • CPI. • 3-month TB rate. • Expenditure on Goods. • Wage Bill. • Tax. • Federal Funds Rate. • Copper price; and • Oil price.	• Results from the IRFs and FEVD show that fiscal policy shocks have significant effects on prices and economic activity: ○ Specifically, positive innovations to the government wage bill significantly raise both consumer prices and economic activity, while positive shocks to tax revenue yield a significant fall in output. ○ However, innovations in the expenditure on goods and services have no significant effects on prices and output.
Damane *et al*. (2016) SVAR	Lesotho: 1982 – 2015	• Output gap. • Consumer prices. • Private & public gross fixed capital formation; and • Interest rate spread.	• A positive shock to government expenditure leads to a significant positive response in inflation; and • A positive shock to government revenue has no impact on the output gap & interest rate spread but results in an increase in consumer prices, government expenditure as well as public & private gross fixed capital formation.
Nkhalamo and Sheefeni (2017) VAR	Namibia: Quarterly data from 2001 – 2015	• Tax; and • Economic growth.	• The impulse response function test shows that taxation has an immediate negative effect on economic growth and these effects appear to be permanent in nature.
Manuel *et al.* (2019) ARDL	Namibia: 2008Q2 – 2017Q4	• Fiscal deficit. • CPI. • Prime lending rate; and • South Africa's inflation.	• Empirical results showed evidence of a long-run positive effect of fiscal deficit on inflation in Namibia. This suggests that fiscal deficit has a direct effect on inflation in Namibia.

Source: Author's cited literature

Two studies offer general characteristics for developing and African economies. Firstly, Carmignani (2010) found two empirical regularities for a selected group of

African economies: (i) fiscal policy has Keynesian effects, and (ii) fiscal policy instruments are often pro-cyclical (and practically never counter-cyclical); hence these indicate major policy failure as they imply that instead of being a macroeconomic stabilization tool, fiscal policy, is rather a cause of macroeconomic instability (volatility) in these economies. Secondly, Moustapha (2011) established that, in some ways fiscal policy shocks have a different effect in developing countries compared to their industrialised counterparts. Though the effects of a government spending shock can be positive for a developing economy in the sense that it brings growth and induces more consumption, on the one hand, the effects seem to be the same after government revenue shock on the other. But the second aspect of these results means that there is a weak (or a less strong) private sector in the developing world.

2.3 Literature Review on External Shocks and Macroeconomic Variables

2.3.1 Theoretical foundations of External Shocks

This section presents some of the key theories on external shocks which provided the basis for their usability and shaped how these are viewed in the modern macroeconomy. Some of the external shocks reviewed are as follows:

- **Harberger-Laursen-Metzler (H-L-M) effect:** Harberger (1950) and Laursen and Metzler (1950) developed the Harberger-Laursen-Metzler (H-L-M) effect, which is used to investigate the effects of terms of trade (TOT) shock on the economy. In their view, the deterioration (improvement) in the TOT reduces (increases) a country's real income [that is, lowers (raises) the purchasing power of its exports in the world market], the consequence of which is a reduction in savings through consumption smoothing behaviour. Also, in view of the HLM effect, a temporary exogenous upsurge in the terms of trade leads to an improvement in the current

account balance. However, Sachs (1981) challenged the postulations of the HLM effect in a dynamic framework and contended that it is dependent on the duration of the price shock (terms of trade change). Thus, only if the shock is temporary does the HLM effect appear. On the contrary, however, if such shock is permanent, the result is ambiguous.

- **Mundell-Fleming Model:** Another influential open macroeconomic model (commonly known as the Mundell-Fleming model), as developed by Mundell (1961) and Flemming (1962), provides two propositions in respect of economies with flexible and fixed exchange rates. For a flexible exchange rate regime, the model postulates that an expansionary fiscal policy in a small open economy leads to an increase in interest rates, attracts foreign capital and results in national currency appreciation. Consequentially, this leads to a change in relative prices of domestic goods, net exports are discouraged, and the current account balance worsens. For the fixed exchange rate regime, on the other hand, fiscal expansion in a small open economy raises the levels of both income and prices, which also discourages net exports and worsens the current account balance.

  Mundell (1963) and Fleming (1962) contend that when a small open economy attempts to maintain a fixed exchange rate in a world of perfect capital mobility, money stock becomes endogenous, which thus makes the monetary policy completely ineffective as a stabilization policy instrument. Also, the Mundell-Fleming model postulates that once the exchange rate has taken care of foreign influences, the domestic interest rate is all that is needed to achieve the internal policy target, output stabilization (Mundell, 1963; Fleming, 1962).

- **Intertemporal models to the transmission of monetary policy:** Svensson and Van Wijnbergen (1989) and Obstfeld and Rogoff (1995), in view of intertemporal models on monetary policy advanced that monetary expansion in a large open economy, i.e., the United States (US), decreases world real interest rates and stimulate global aggregate demand both in the U.S. and non-U.S. countries.

- **The Dornbusch overshooting model:** According to Kenneth Rogoff's 2002 lecture on this model titled *"after twenty-five years"*, two relationships underpin Dornbusch's overshooting (1976) model: first, the uncovered interest parity (UIRP) condition, which states that home interest rates on bonds i plus the expected rate of depreciation of the exchange rate can be expressed as follows:

$$i_{t+1} = i^* + E_t(e_{t+1} - e_t) \quad (2.1)$$

Where $i_{t+1}$is the nominal interest rate; e is the logarithm of the exchange rate (home currency price of foreign currency) and E_t represents market expectation based on time t. If home and foreign bonds are perfect substitutes and international capital is fully mobile, then the two bonds can only pay different interest rates if agents expect there will be compensating movement in exchange rate. The assumption is that the home country is small in capital markets hence the foreign interest rate i^* is exogenous. The second fundamental relationship of the Dornbusch model is the money demand equation:

$$m_t - p_t = -\eta i_{t+1} + \phi y_t \quad (2.2)$$

Where m_t is the money demand; p_t is the domestic price level while y_t is domestic output, all in logarithms; η and ϕ are positive parameters. One of the striking features of this hypothesis, which is acknowledged because of the sticky price assumption, is overshooting of the exchange rate in its adjustment process towards the new

equilibrium pertinent to the new and changed economic fundamentals. Overshooting is observed by incorporating the two equations/relationships above, that is, the uncovered interest rate parity into the demand for money function, in conjunction with a kind of exchange rate expectations formation. All in all, as Wang (2009) postulates, the Dornbusch model (Dornbusch 1976) has the mixed features of the Mundell-Fleming and the monetary models, though it stems from the former and, is sometimes called the Mundell-Fleming-Dornbusch model.

2.3.2 Synthesis of theoretical literature on external shocks

The Harberger-Laursen-Metzler effect (Harberger, 1950; and Laursen & Metzler, 1950) holds the view that the deterioration (improvement) in the terms of trade reduces (increases) a country's real income, thereby consequently reducing savings through consumption smoothing behaviour. The Mundell-Fleming view (Mundell, 1961; and Flemming, 1962), on the other hand, relates the conduct of fiscal policy in flexible and fixed exchange regimes and makes two arguments: firstly, for economies with flexible exchange rate regimes, an expansionary fiscal policy in a small open economy leads to an increase in interest rates, attracts foreign capital and results in national currency appreciation. Consequentially, this results in a change in relative prices of domestic goods; net exports are discouraged, whereas the current account balance worsens. Secondly, for fixed exchange rate regime economies, fiscal expansion in a small open economy raises the levels of both income and prices, which also discourages net exports and worsens the current account balance.

The Intertemporal models to the transmission of monetary policy (Svensson & Van Wijnbergen, 1989; and Obstfeld & Rogoff, 1995) postulate that monetary expansion

in a large open economy, i.e., the United States, decreases world real interest rates and stimulates global aggregate demand globally, that is, both in the U.S. and non-U.S. countries. The Dornbusch overshooting model (Dornbusch, 1976) is concerned with the relationship between uncovered interest parity (UIRP) and the money demand equation. Following this, it assumes that if home and foreign bonds are perfect substitutes and international capital is fully mobile; then the two bonds can only pay different interest rates if agents expect there will be compensating movement in the exchange rate.

2.3.3 Background on External Shocks

Literature on external shocks reflects that they are often generally viewed as international shocks (Liu, 2010; Yilmazkuday, 2012; Liu, Mumtaz & Theophilopoulou, 2014; Dungey & Vehbi, 2015; Faryna & Simola, 2018); global shocks (Mercer-Blackman & Melgarejo, 2013; Charnavoki & Dolado, 2014; Anh, 2017); trade shocks or terms-of-trade (TOT) shocks (Agenor & Aizenman, 2004; Eicher, Schubert & Turnovsky, 2006; Santos-Paulino, 2007; Chowdhury, 2015).

External shocks are also often considered from different angles. Gafar (1996) postulated that external shocks are manifested in different dimensions, i.e., fluctuations in the terms of trade, movements in the world interest rate and exchange rates in the developed countries, as well as the volatility of capital flows to the developing countries. Kose and Riezman (2001), in their framework, view external shocks being two-dimensional: (i) trade shocks which are modelled as fluctuations of the prices of exported primary commodities, imported capital goods and intermediate inputs, and (ii) financial shocks, modelled as fluctuations in the world real interest rate. Vegh (2013), on the other hand, postulated that external shocks may be decomposed

into two (2) aspects: (i) nominal external shocks, which represent changes in the foreign inflation rate; and (ii) external real shocks, which are regarded as shocks to terms of trade.

Scholars who view external shocks as terms of trade (TOT) shocks have often examined their association with the current account balance. To this end, Harberger (1950) and Laursen and Metzler (1950) posited that the relationship between the two can be explained in three different ways: *first*, according to the consumption tilting effect, the current price of imports relative to their future price decreases owing to a favourable transitory TOT shock. *Second*, an exchange rate effect occurs if the price of tradables decreases relative to the price of non-tradables. *Third*, the consumption-smoothing effect, commonly known as the Harberger-Laursen-Metzler (HLM) effect, induces current income to increase relative to future income (Harberger, 1950; Laursen & Metzler, 1950). The effects of terms of trade shocks on a small open economy have been widely studied since the pioneering prediction by Harberger (1950) and Laursen and Metzler (1950) that a deterioration in the terms of trade would reduce real income, thus lowering savings and investment to cause a deterioration of the current account balance.

2.3.4 Modelling of external shocks and their propagation

The effect of external shocks on macroeconomic variables is an area which has received considerable interest by scholars globally. Yet, there appears to be divergent findings for different countries and country-groups. Hence, external shocks have been and continue to be modelled by different econometric techniques. These include, among others, VAR (Canova, 2005; Genberg, 2005; Onguamobi et al., 2015), structural VAR (Maćkowiak, 2007; Sato et al., 2009), Global VAR (Oyelami & Olomola, 2015; Pelipas, et al., 2016), Bayesian VAR (Utlaut & van Roye, 2010) and

Computable General Equilibrium (CGE) model (Jemio & Wiebelt, 2002; Ahmed & O'Donoghue, 2010).

The propagation channels of external shocks vary from country to country, and there appears to be divergence in their propagation. To this end, Krznar and Kunovac (2010) observed that literature about small open economies reflects that their aggregate supply, aggregate demand and henceforth, also their economic activity and price movements greatly depend on the dynamics of large economies. Similarly, Kabundi and Loots (2009) claimed that supply and demand shocks in developed economies do not necessarily have similar effects in emerging market economies. They specifically establish that a German supply (demand) shock has more of a demand-shock (monetary policy) effect on the South African economy, which implies that the policy response in emerging market economies should not necessarily be the same as in developed economies. However, another strand of literature establishes insignificant responses of small developing economies' domestic variables to external shocks. Herein, Onguamobi et al. (2015) found that Ghanaian macroeconomic variables respond insignificantly to shocks from foreign variables (precisely from the United States), thereby implying that the huge macroeconomic volatility experienced is home-made.

Oil, by virtue of being a key energy source and engine of economic growth globally, is an indispensable input in the production process, and thus its consumption has increased significantly with the modernization of economies (Basher & Sadorsky 2006). Against the foregoing, it is accordingly not surprising that ever since the pioneering work of Hamilton (1983), studies on external shocks with a bias specifically on oil price shocks have gained traction. These include Burbidge and Harrison (1984); Bjørnland (2000); Kilian (2008); Khan and Ahmed (2014); Zhao et

al. (2016); and Khan et al. (2019), amongst others. Boheman and Maxén (2015), on the other hand, studies on the effects of oil price shocks in respect of developing two-country groups [Organisation of Petroleum Exporting Countries (OPEC) and non-OPEC] with a view to establishing whether economic growth in OPEC countries is more sensitive to oil price fluctuations than the non-OPEC countries. To this end, they conclude that OPEC and non-OPEC oil exporting countries' economic growth demonstrated nearly identical responses to oil price shocks, and therefore the two country-groupings are equally sensitive to oil price shocks. Ajmi et al. (2015), in view of the oil-importing South African economy, established that oil prices have asymmetric effects on price levels, though only in the short run. However, as Altansukh et al. (2017) observed, the significance of oil prices for inflation partly reflects the sizable share of energy in consumer baskets and, therefore, headline CPI inflation.

Notwithstanding the fact that a large body of literature has focused more on oil price shocks, however, it would appear as if these were the only external shocks affecting macroeconomic variables. To this end, Oyelami and Olomola (2016), in respect of the Nigerian economy, contended that it is imperative to take cognisance of the importance of fiscal and monetary policy shocks of key trading partners especially developed and emerging economies in any serious discussion of the effects of external shocks. Against this, they also argued that it is thus crucially important to examine other sources of shocks vis-à-vis oil price shocks within the interdependent global framework and, more importantly, to determine the relative contribution of external and internal shocks to the country's macroeconomic performances.

Moreover, Oyelami and Olomola (2016) and Oladunni (2019) argued in the case of the Nigerian economy, that most of the studies on the effects of external shocks on macroeconomic variables have overwhelmingly focused largely on individual foreign shocks and, as such, zeroed mainly on oil price shocks which tend to obscure other potentially important external shocks to which the Nigerian economy may be susceptible. In view of this, the later cautioned that zeroing in only on oil price shocks may lead to inaccurate inferences and inappropriate policy prescriptions. Against this backdrop, the researcher adopts a unified approach achieved through block identification of three external shocks: global demand, oil price and US monetary policy shocks. Accordingly, in addition to oil price shocks, this study adopts other significant external shocks (i.e., global output and US real interest rate - monetary policy) to examine their effects on Namibia's macroeconomic variables.

2.3.5 Empirical evidence of the effects of external shocks on macroeconomic variables

At the empirical level, scholars have documented varying effects of external shocks on the macroeconomy of different countries through the adoption of several econometric techniques. Notwithstanding the advances on the theoretical front, existing empirical evidence on the effects of external shocks has largely been scant in the past decades (pre-2000), predominantly for small open developing economies such as Namibia and peers within the SSA region. However, encouragingly, studies on the effects of external shocks within SSA economies have gained traction, especially since 2010. Following this, Abdel-Latif and Bolhuis (2022) suggested that SSA countries have varying exposures to external shocks. The researchers contend that three factors largely shape the degree to which these countries are vulnerable to shocks: (i) the

strength of trade ties with the global economy; (ii) the degree of integration with international financial markets; and (iii) the availability of policy buffers to respond to shocks, such as accumulated international reserves. Table 2.2 summarises the cited empirical works on the effects of external shocks, which are briefly discussed below.

Some scholars conducted multi-country studies to ascertain the effects of external shocks on macroeconomic variables. In pursuit of this, Maćkowiak (2007) adopted a SVAR technique for eight countries (six in east Asia and two in Latin America) and establishes that external shocks are an important source of macroeconomic fluctuations in emerging markets. Also, U.S. monetary policy shocks affect interest rates and the exchange rate in a typical emerging market quickly and strongly. These findings are consistent with the claim that *''when the U.S. sneezes, emerging markets catch a cold.''* Majuca and Pagaduan (2015) assumed a VAR approach with a view to analysing the impact of external demand (proxied by global GDP) on four ASEAN economies. They uncovered that a 1% shock to global GDP results in a 0.4 percentage point increase in ASEAN GDP contemporaneously at impact and to approximately 0.9 percentage points two years later. Also, Singapore is found to be more susceptible to external shocks than other ASEAN member states which are less integrated in the global economy. Variance decomposition affirms this result as it reflects that about 30% of Singapore's output is explained by the variations in the GDP of the rest of the world.

O'Grady, Rice and Walsh (2017) implemented a global VAR (GVAR) approach for twenty-five countries (comprising advanced and emerging economies) and found that a 25-basis point spike in the US policy rate results in long-term output declines of 0:31 and 1.0% in the UK and the US, correspondingly. Similarly, Abdel-Latif and Bolhuis

(2022) employed a multi-country GVAR model where most SSA countries are included and find that a tightening of US monetary policy and an increase in energy prices severely impact economic growth. Specifically, an unanticipated 25 basis points rise in the US 10-year rate correlates with an average decline in regional (SSA) real GDP of about 0.25 percentage points in the first year (as higher rates lower growth and demand in trading partners). However, a 10-percentage point increase in oil prices, on the other hand, generates an average decline in regional growth by 0.5 percentage points. The impact also varies by country sub-groups. Nonetheless, a positive oil price shock affects oil importers the most.

On the other extreme, other researchers undertook single-country studies to determine country-specific effects. In reinforcing this, Krznar and Kunovac (2010) pursued a VAR model for the Croatian economy and posited that world prices account for the largest proportion of domestic price variation, including both producer and consumer price indices. Specifically, the spillover effect of a 1% increase in world prices on domestic prices is reflected in a positive, significant reaction of the producer price index (PPI) and consumer price index (CPI). An increase in world prices by 1 percentage point within a period of two years leads to an increase in PPI by 0.17 percentage points and to an immediate increase in CPI by 0.07 percentage points. Moreover, EU GDP shocks are the key determinants of the domestic economic activity reaction and the main source of Croatian GDP fluctuations.

There has generally been a dearth of literature for single-country studies in respect of SSA economies especially during the pre-2010 era. However, empirical works have gained traction during the post-2010 period, and such studies have unveiled interesting findings. Herein, one strand of scholars adopted the SVAR technique to quantify the effects of external shocks. In favour of this technique, Chileshe et al. (2018), in respect

of the Zambian economy, documented that a positive standard deviation shock to global output leads to a rise in domestic output, a fall in consumer prices, a depreciation of the exchange rate; an immediate fall in money supply; and a fall in both Bank of Zambia (BoZ) policy rate and average lending rate. Copper price shocks contribute 6.5% to output fluctuations at two-quarter horizons, rising to 9.5% in the 4th quarter, followed by US GDP at 2.3% and 3.0%, respectively. Moreover, commodity prices account for 4.0% and 4.2% at the same horizons, followed by the federal funds rate at 1.9% and 2.0%, respectively.

Regarding the Namibian economy, Mushendami and Namakalu (2016) documented that oil price pass-through is higher than the exchange rate pass-through both on imported and consumer inflation. Also, the exchange rate pass-through to inflation is low and incomplete. Specifically, the exchange rate pass-through on consumer inflation and imported inflation is estimated at 0.01 and 0.04, respectively, in the first quarter; these were both reported at 0.02 after the eighth quarter. During the second quarter, the oil price pass-through elasticity on consumer inflation and imported inflation was estimated at 0.18 and 0.22, correspondingly; and the pass-through of South African food prices is high on consumer inflation (estimated at 0.96) but low on the imported inflation (estimated at 0.22) in the first quarter.

Damane (2018), in view of the South African economy, uncovered that a positive shock to the US federal funds rate (a contractionary monetary policy) yields a rise of the 91-day T Bill rate by 0.21% in period 3. Also, a positive shock in the US federal funds rate is transmitted mainly through the inflation channel, with 17.0% of the variation in domestic prices explained by changes in the US federal funds rate. Moreover, Dlamini (2020) for the Eswatini economy proffered that the South African

variables (representing external shocks) contributed immensely to the variations in domestic GDP, accounting for a combined 27.2% from the twelfth quarter and a significant portion of the domestic GDP growth rate variation (10.5%) can be attributed to SACU receipts shock.

Other scholars utilised different econometric approaches in modelling the impacts of external shocks. To this end, Fowowe (2014) employed a Generalized Autoregressive Conditional Heteroscedasticity (GARCH) autoregressive conditional jump intensity model for South Africa and concluded that a 10% increase in the oil price will lead to a 1.4% depreciation of the South African Rand (ZAR). This result clearly displays the fact that South Africa being an oil-importing country, implies that an oil price increase will lead to a transfer of wealth from oil-importing countries to oil-exporting countries. In contrast, Abradu-Otoo and Walley (2019) performed a Bayesian VAR analysis and proclaimed that a standard deviation shock to external demand conditions proxied by US GDP growth leads to a 0.015 percentage point increase in Ghana's real GDP growth for about two quarters before declining sharply thereafter. Also, about 40 and 30% of the variation in Ghana's real GDP growth and inflation, respectively, is accounted for by external influences.

This study's examination of the effects of external shocks contrasts with the earlier paper by Mushendami and Namakalu (2016) on the Namibian economy in two ways: firstly, the analyses are performed on a longer period, albeit at low frequency. Secondly, it employs a different set of rarely investigated yet equally important external variables, which eventually offers new insights on the effects of external shocks which have thus far not been econometrically quantified in Namibia.

Table 2.2: Summary of empirical studies on the effects of external shocks

Author, Year & Methodology	**Country & Period**	**Variables**	**Key Findings**
O'Grady, Rice and Walsh (2017) Global Vector Autoregressive Model (GVAR)	Global model of 25 countries. Quarterly. Q1: 1980 – Q1: 2016	• Domestic and foreign variables: o GDP; and o CPI-based inflation. • Policy variables: o Short-term interest rate. o Real dollar exchange rate. o Index of equity prices; and o Long-term interest rates on government bonds. • Global variables: o International oil prices. o Metals prices; and o Materials prices.	• The 25-basis point spike in the US policy rate was estimated to result in a long-term output decline of between -0:31% (in the UK) and -1% (in the US).
Maćkowiak (2007) SVAR	8 Emerging Markets – East Asia (Hong Kong, Korea, Malaysia, Philippines, Singapore, Thailand) and Latin America (Chile and Mexico). Emerging market assumed to be a small open economy. Monthly. M1: 1986 – M12: 2000.	• Variables in the emerging market: o Short-term interest rate. o exchange rate. o Real aggregate output; and o Aggregate price level. • External variables: o Federal Funds rate. o World commodity prices. o U.S. money stock. o U.S. real aggregate output; and o U.S. aggregate price level.	• U.S. monetary policy shocks affect interest rates and the exchange rate in a typical emerging market quickly and strongly. o The price level and real output in a typical emerging market respond to U.S. monetary policy shocks more than the price level and real output in the U.S. itself. o These findings are consistent with the idea that *''when the U.S. sneezes, emerging markets catch a cold.''* • At the same time, U.S. monetary policy shocks are not important for emerging markets relative to other kinds of external shocks.
Majuca and Pagaduan (2015)	ASEAN / AMS'S economies – Singapore, Indonesia, the	• Foreign variables: o Global GDP. o ASEAN GDP	• A 1% shock to global GDP results in a 0.4 percentage point increase in ASEAN GDP contemporaneously at

VAR	Philippines, and Viet Nam. Quarterly.	• Domestic variables: Domestic GDP	impact and to approximately 0.9 percentage points two years later. • Singapore is found to be more susceptible to external shocks than other member states, which are less integrated into the global economy; and • Variance decomposition affirms this result as it reflects that about 30% of Singapore's output is explained by the variations in the GDP of the rest of the world.
Krznar and Kunovac (2010) VAR model	Croatia. Quarterly Q2: 2000 – Q1: 2010	• External block: o Foreign demand shock – GDP (for 27 EU Member States). o World prices. • Domestic block: o GDP (Croatia). o PPI; and o CPI.	• World prices account for the largest proportion of domestic price variation, including both producer and consumer price indices: o The spill over effect of a 1% increase in world prices on domestic prices is reflected in a positive, significant reaction of the PPI and CPI. o An increase in world prices by 1 percentage point within a period of two years leads to an increase in PPI by 0.17 percentage points and to an immediate increase in CPI by 0.07 percentage points. • Moreover, EU GDP shocks are the key determinants of the domestic economic activity reaction and the main source of Croatian GDP fluctuations.
Dlamini (2020) SVAR	Eswatini. Quarterly Q1: 2000 – Q4: 2018	• External (RSA variables) o GDP growth, o Inflation, and o SACU receipts). • Domestic variables: o GDP growth, o Inflation, o Reserves, and o Budget balance.	• A shock on the RSA variables does have an impact on the domestic variables: o Although a one percentage shock on RSA GDP does not significantly impact domestic GDP in the short term, it leads to a significant response on domestic CPI and foreign exchange reserves. • Variance decomposition estimates suggest that RSA shocks are the key variability determinants of domestic variables observed in the last twelve quarters: and • From this analysis, it is evident that RSA variables contributed immensely to the variations in domestic GDP, accounting for a combined 27.2% from the twelfth quarter, and a significant portion of the domestic GDP growth rate variation (10.5%) can be attributed to SACU receipts shock.

Damane (2018) SVAR	South Africa. Quarterly. Q1: 1981 – Q4: 2014	• Foreign: o US federal funds rate. • Domestic (South African): o Output gap. o Consumer prices. o 91-day Treasury bill rate; and o Exchange rate	• A positive shock to the US federal funds rate yields a rise of the 91-day T Bill rate by 0.21% in period 3. • A positive shock in the US federal funds rate (a contractionary monetary policy) is transmitted mainly through the inflation channel, with 17% of the variation in domestic prices explained by changes in the US federal funds rate.
Abradu-Otoo and Walley (2019) Bayesian VAR	Ghana. Quarterly. Q3: 2003 – Q4: 2018	• External variables: o U.S real GDP growth, o China's GDP growth, o U.S inflation rate, o US effective policy rate, o EMBI global yield, and o Oil price • Internal variables: o Domestic real GDP growth, o domestic inflation rate, o rate of appreciation of the economy's real exchange rate vis-a'-vis the U.S. dollar and the o Domestic interest rate.	• A standard deviation shock to external demand conditions proxied by US GDP growth leads to a 0.015 percentage point increase in Ghana's real GDP growth for about two quarters before declining sharply thereafter. • Results show that about 40 and 30% of the variation in Ghana's real GDP growth and inflation, respectively, is accounted for by external influences.
Fowowe (2014) GARCH	South Africa. Daily data. 2 January 2003 – 27 January 2012		• The empirical results showed that increases in the price of oil have led to a depreciation of the South African rand relative to the US dollar. Specifically, they found that a 10% increase in the oil price will lead to a 1.4% depreciation of the rand. • This result clearly displays the fact that South Africa is an oil-importing country and implies that an oil price increase will lead to a transfer of wealth from oil-importing countries to oil-exporting countries.

Chileshe et al. (2018) SVAR	Zambia. Quarterly. Q1: 2000 – Q1: 2016	• Foreign variables: o Federal Funds Rate. o US GDP. o Real copper prices. • Domestic variables o GDP. o M2. o Average lending rate. o BoZ policy rate; and o Exchange rate	• Results show that a positive standard deviation shock to global output leads to: o a rise in domestic output. o fall in consumer prices. o a depreciation of the exchange rate. o an immediate fall in money supply; and o a fall in both the BoZ policy rate and o average lending rate. • Copper price shocks contribute 6.5% to output fluctuations at two-quarter horizons, rising to 9.5% at the 4th quarter, followed by US GDP at 2.3% and 3.0%, respectively. • Also, commodity prices account for 4.0% and 4.2% at the same horizons, followed by the federal funds rate at 1.9% and 2.0%, respectively.
Mushendami and Namakalu (2016) SVAR	Namibia. Quarterly. 2000 – 2014	• Oil prices. • Output gap. • Nominal effective exchange rate. • Import price inflation; & • Consumer price inflation.	• Oil price pass-through is higher than the exchange rate pass-through both on imported inflation and consumer inflation. o The exchange rate pass-through to inflation is low and incomplete. The exchange rate pass-through on consumer inflation and imported inflation is estimated at 0.01 and 0.04, respectively, in the first quarter; these were both reported at 0.02 after the 8th quarter. o During the second quarter, the oil price pass-through elasticity on consumer inflation and imported inflation was estimated at 0.18 and 0.22, correspondingly; and o The pass-through of South African food prices is high on consumer inflation (estimated at 0.96) but low on the imported inflation (estimated at 0.22) in the first quarter.
Abdel-Latif and Bolhuis (2022) A multi-country GVAR model	71 countries, including most sub-Saharan African countries. Annual. 1980 – 2021	• Domestic variables: o Real GDP. o Inflation rate. o Interest rate. o exchange rate. • Foreign variables: o Cross-sectional weighted averages of domestic variables in other countries; and • Global variable: o US 10-year rate; and	• An unexpected 25 basis points increase in the US 10-year rate is associated with an average decline in regional real GDP of about 0.25 percentage points in the first year. • A 10-percentage point increase in oil prices will lead to an average decline in regional growth by 0.5 percentage points: and • The impact also varies by country sub-groups; a positive oil price shock affects oil importers the most.

		○ oil price.	

Source: Author's cited literature

2.4 Literature Review on Commodity Prices and Business Cycles

2.4.1 Theoretical foundations of Commodity Prices and Mineral Commodities

This section elucidates the theoretical underpinnings of commodity prices and mineral commodities according to the literature. These theories include the following, amongst others:

- **The Prebisch-Singer Hypothesis (PSH):** The Prebisch-Singer hypothesis (hereafter, PSH) claims that the terms of trade of economies dependent on primary commodities tend to worsen in the long run as a result of the secular decline of primary commodity prices relative to the prices of manufactured goods (Singer, 1950; Prebisch, 1950). According to UNCTAD and FAO (2017), the chief reason for this is that manufactured goods have a higher income elasticity of demand than primary goods, which implies that with rising incomes, smaller shares of income are spent on primary goods. Thus, developing countries' reliance on commodity exports is not a viable basis for a long-term development strategy since the relative value of these exports follows a downward trend. The PSH provides a generally accepted and highly influential perspective on long-run trends in commodity terms of trade, elucidating a clear policy message for commodity-dependent developing countries (commodity-export-dependent developing countries – CDDCs), namely that they need to diversify (UNCTAD & FAO, 2017).

- **The Dutch Disease macroeconomic theory:** Literature on whether mineral resources are a blessing or curse to different economies rages on, especially within

the realm of the Dutch disease phenomenon. Mahama and Gakpe (2015) proclaim that the *"Dutch disease"* derives its name from the development, discovery and exploitation of natural gas in the Netherlands (the Dutch) and the accompanying effects on different economic sectors. Moreover, the Dutch disease can be viewed as the contraction in the domestic non-commodity tradable sector following the increase in income generated by the commodity sector (García-Cicco & Kawamura, 2015). Thus, the Dutch disease refers to the potential negative effects that natural resource windfalls and accompanying appreciations of exchange rates can have on the rest of the economy. Following the mineral resource (natural gas) discovery, the Netherlands is said to have experienced an export boom which led to an appreciation/ strengthening of the currency, thereby making other sectors less competitive and consequently recording declines in the late 1970s (DeKorne, 2011).

The aspect of whether mineral resources are a blessing or curse is polarized in literature. Following this, Collier and Goderis (2012) assert that empirical evidence on the long-run effect of natural resources on economic growth is ambiguous. However, some scholars (Alexeev & Conrad, 2009; Brunnschweiler & Bulte,2008; Lederman & Maloney, 2007) argue that mineral resources are a blessing, while others (Sachs & Warner, 2001; and Sala-i-Martin & Subramanian, 2003; on the contrary), contend that they are a curse.

2.4.2 Theoretical foundations of Business Cycles

Some of the business cycles theories are as follows:

- **Real Business Cycle (RBC) Theory:** The pioneering seminal works of Kydland and Prescott (1982) and Long and Plosser (1983) were the first to build a business cycle model that included market clearing without monetary factors and economic policy served as the foundation of what has become known as Real Business Cycle (RBC) theory. According to the RBC theory, recessions and booms are viewed as efficient responses to exogenous changes in the real economic environment. In this vein, Knoop (2010) posited that recessions and expansions are driven by cyclical variations in aggregate output, for which when some negative shocks from various sources occur simultaneously, the output is likely to fall to a permanently lower level. Also, the more recurrent and larger these shocks, the bigger the effect on output will be. The Real Business Cycle Theory specifically postulates that volatility in the aggregate economy is attributable to the impact of total factor productivity shocks, i.e., to technology and to factor prices.

  The RBC theory holds the view that the economy's level of output at any point maximises the expected utility of the economy-wide agents. Thus, the model is premised on rational expectations and expected utility maximization. Chugh (2015) asserted that Real Business Cycle (RBC) theory views prices as fully flexible, which implies that all prices can be and are re-set very frequently. The RBC theory does not view exogenous shifts in consumption demand as a good description of data but rather "shifts in supply" as the principal reason for macroeconomic fluctuations. Notwithstanding these, however, the RBC theory, like other theories, has been criticised in literature. To this end, Mankiw (1989) contended that the RBC theory does not provide an empirically plausible explanation of economic fluctuations. Yet, Greenwald and Stiglitz (1993)

proffered another criticism of around RBC's failure to explain the large negative shocks that cause a recession.

- **Keynesian Business Cycle Theory:** This school of economic thought is premised on the view that the economy is inherently unstable, given that the level of economic activity overshoots and undershoots the growth path (Cloete, 1990). The Keynesian school points out that the existence of a business cycle is evidence of the failure of the price mechanism to coordinate demand and supply in the markets for goods and services and factors of production (Cloete, 1990). It argues that prices respond with a time lag to changes in demand. This results in a level of economic activity which tends to be continually above or below its equilibrium level. The Keynesians believe that the business cycle is mainly endogenous; the cyclical fluctuations in economic activity are generated by time lags and by the multiplier and accelerator relationships between economic variables, which are part of the internal structure of the economy. The economy reacts to stimuli because of the presence of time lags and multiplier-accelerator relationships. The result of this is cyclical fluctuations.

  Generally, aggregate demand is volatile and is the source of business cycle fluctuations chiefly due to unstable expectations and their effect on investment, consumption, and the stock market. However, erratic fiscal or monetary policy can also contribute to aggregate demand unpredictability (Blinder, 1988). This school of thought believe that capitalist economies are inherently volatile and need macroeconomic management in order to avoid destabilizing business cycles that are extremely costly and persistent (Knoop, 2010).

Keynes advanced that the inefficiency and ineffectiveness of the invisible hand to correct imbalances in the system is the major source of business cycles. Considering this, he submits that deliberate fiscal, and monetary policy actions are necessary to correct any such imbalances. To this end, Keynes documents that when an economy is experiencing a recession, aggregate demand (AD) can be stimulated by instituting deliberate economic expansion through increased government spending or tax cut. During the recession, Keynes opined that deliberate economic expansion through increased government expenditure or tax cuts could be used to stimulate aggregate demand. Nevertheless, nominal rigidities associated with wage policy or liquidity trap make the Keynes hypothesis defective.

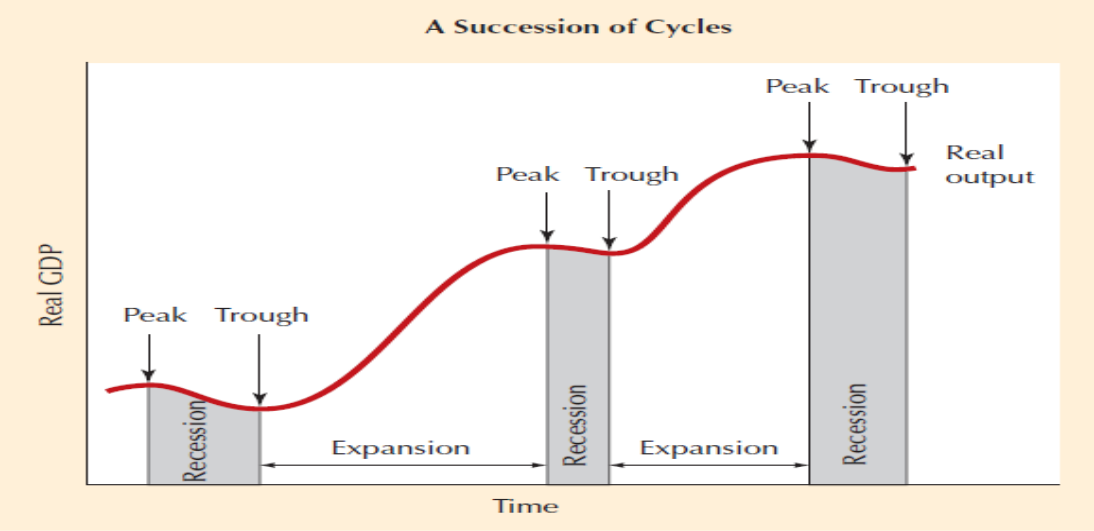
2.4.3 Background on Business Cycles

Business cycles have been defined and discussed in numerous works of literatures given their importance in the macroeconomy. Burns and Mitchell (1946), in their seminal work, provided a standard definition of business cycles. Accordingly, they postulate that business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; in duration, business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar characteristics with amplitudes approximating their own. Moreover, Diebold and Rudebusch (1996) posited that Burns and Mitchell's definition of business cycles has two key features: (i) the co-movement between individual economic variables and (ii)

their separation of business cycles into separate phases or regimes. A business cycle comprises four stages, namely: first, expansion (increase in production and prices, low-interest rates); second, crisis (stock exchanges crash and multiple bankruptcies of firms occur); third, recession (drops in prices and in output, high-interest rates); and fourth, recovery (stocks recover because of the fall in prices and incomes) as proclaimed by Schumpeter (1954). However, Miles and Scott (2005), on the other hand, proffered a simpler definition by proclaiming that a business cycle means the fluctuations in output around its trend. Briefly, business cycles are the recurring fluctuations that occur in real GDP over time or simply movements in output around its trend.

Figure 2.1 depicts the business cycles for an economy from which the real output (red) line exhibits a typical succession of business cycles. In view of this, the peak is the highest point reached by real output in each cycle, while the lowest point is the trough. Expansion refers to the period between the trough and the next peak, whereas recession is the period between the peak and trough (Gordon, 2012).

Figure 2.1: Depiction of business cycles

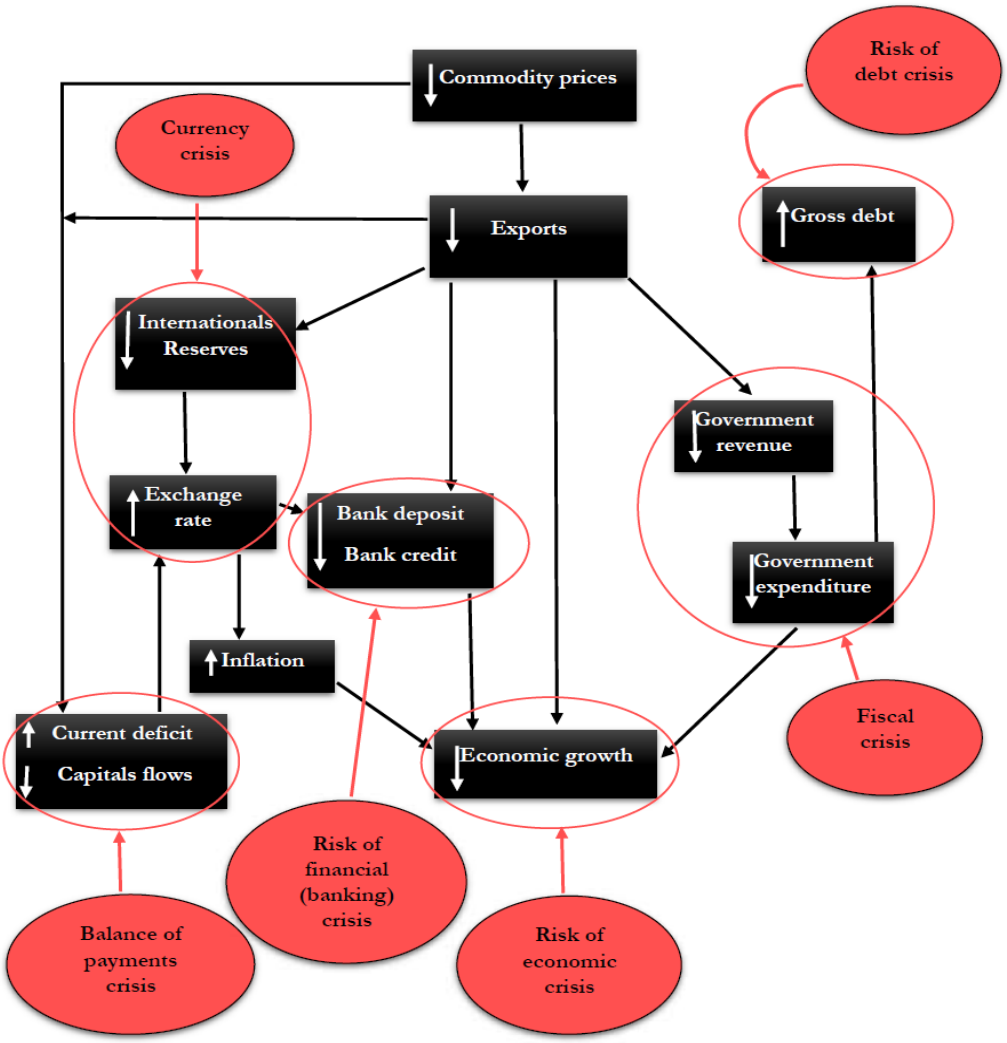


Source: Gordon (2012)

Important key questions about business cycles include, why do they matter? Or why must economies be concerned? Can they be predicted accurately and with precision? In view of these, Knoop (2010) declared that the global financial crisis that began in 2007 led many to wonder whether economies are going to suffer through a second Great Depression and also whether there are new lessons to be learned and time-tested policies to combat business cycles to be rethought. Many of the key developments in macroeconomic theory, both before and after Keynes, have centred on the following two questions: 1) Why are economies subject to periods of negative output growth (recessions)? 2) How do you explain severe economic contractions (depressions)? However, as the author argued, the most significant question is that after more than 200 years of debate, there is still no consensus about what causes recessions and depressions. This is notwithstanding the fact that there have been multiple competing models of business cycles used among economists. Yet, there is a large disconnect between the models used by academics and those used by private-sector economists. Henceforth, the debate over the root causes of business cycles continues to be a key question in the development of macroeconomic thought.

When studying the effects of commodity prices on business cycles, it is also important to clearly outline the transmission channels through which commodity prices impact the macroeconomy. To this end, Figure 2.2 reflects such macroeconomic transmission channels. Commodity prices ultimately impact economic growth through the trade channel (exports), financial (international reserves and exchange rate), and government channel (revenue and expenditure), amongst others, which all have significant bearings on economic growth (Pinshi, 2018).

Figure 2.2: Channels of macroeconomic transmission of falling commodity prices



Source: Pinshi (2018)

2.4.4 Synthesis of theoretical review on commodity prices and business cycles

On theoretical foundations of commodity prices, the Prebisch-Singer Hypothesis claims that the terms of trade of economies dependent on primary commodities tend to worsen in the long run because of the secular decline of primary commodity prices relative to the prices of manufactured goods (Singer, 1950; and Prebisch, 1950). According to the Dutch Disease macroeconomic theory, the Dutch disease refers to the potential negative effects that natural resource windfalls and accompanying

appreciations of exchange rates can have for the rest of the economy (Mahama & Gakpe, 2015). Whether mineral resources are a blessing or curse, remain polarised. Some scholars (Alexeev & Conrad, 2009; Brunnschweiler & Bulte,2008; Lederman & Maloney, 2007) reason that mineral resources are a blessing, whilst others (Sachs & Warner, 2001; and Sala-i-Martin & Subramanian, 2003; on the contrary), contend that they are a curse.

Regarding theoretical underpinnings for business cycles, the Real Business Cycle (RBC) Theory following Kydland and Prescott (1982) and Long and Plosser (1983) justified that recessions and booms are viewed as efficient responses to exogenous changes in the real economic environment. Also, recessions and expansions are driven by cyclical variations in aggregate output, for which when some negative shocks from various sources occur simultaneously, the output is likely to fall to a permanently lower level (Knoop, 2010). Moreover, the more recurrent and larger these shocks, the bigger the effect on output will be. The RBC theory holds the view that the economy's level of output at any point maximises the expected utility of the economy-wide agents.

Conversely, the Keynesian Business Cycle Theory is premised on the view that the economy is inherently unstable given that the level of economic activity overshoots and undershoots the growth path (Cloete, 1990). The Keynesian school points out that the existence of a business cycle is evidence of the failure of the price mechanism to coordinate demand and supply in the markets for goods and services and factors of production (Cloete, 1990). The Keynesians believe that the business cycle is mainly endogenous; the cyclical fluctuations in economic activity are generated by time lags and by the multiplier and accelerator relationships between economic variables, which

are part of the internal structure of the economy. The economy reacts to stimuli because of the presence of time lags and multiplier-accelerator relationships. The result of this is cyclical fluctuations.

2.4.5 Empirical works on the effects of Commodity Prices on Business Cycles

Table 2.3 provides a synopsis of the reviewed empirical literature works from which it is evident that at the empirical level, some studies have, through the implementation of varying econometric techniques, established the commodity price–business cycle nexus for different regions and economies. Some scholars have pursued single-country studies to disentangle the effects. Aligning with this, Medina and Soto (2007) assume a Dynamic Stochastic General Equilibrium (DSGE) in view of Chile discovered that if the fiscal policy is conducted using a structural balance fiscal rule, such that the government saves most of the extra revenues from the higher copper price, then a copper price shock of 10% would increase output only by 0.05% and there would be a slight decrease in inflation.

On the other hand, however, scholars posited that when fiscal policy is highly expansive, the same copper price increase implies an output growth of up to 0.7% while inflation will also increase. Fuentes and García (2016) implemented the same econometric approach for Chile and establish similar results. They find that a rise of 1% in the copper price leads to a 0.16% increase in GDP over five years. For the Spanish economy, Cantavella (2020) adopted a Nonlinear Autoregressive Distributed Lag (NARDL) and found that an increase (decrease) in real oil prices has a negative (positive) impact on real per capita GDP. Precisely, the negative effect (oil price decrease) has a greater effect on real per capita GDP than the positive effect (oil price increase).

Other researchers undertook multi-country analyses to unravel the impacts on different regions. Interestingly, polarised findings are established on the commodity price–business cycle nexus by some scholars for Emerging Markets and Developing Economies (EMDEs) in different regions. Following this, Elafif et al. (2017), embraced a NARDL cointegration technique in view of the Turkish (Emerging and Developing Europe) and Saudi Arabian (Middle East) economies and revealed contrasting findings for the two EMDEs. First, they established that an increase (decrease) in the oil price causes a rise (fall) in the real GDP of Saudi Arabia. However, the positive effect (oil price increase) has a greater effect than the negative effect (oil price decrease). Moreover, they found that an increase (decrease) in the oil price causes a fall (rise) in Turkey's real GDP. Yet, the negative effect (oil price decrease) has the greater effect than the positive effect (oil price increase).

Ogundipe (2020) conducted a multi-country study on fifty-three African commodity-dependent countries while employing a System of Generalized Method of Moments (SGMM). The researcher established that about 3.8% variation in real GDP was induced by a 1% change in commodity price volatility. Furthermore, discovered a negative contemporaneous relationship between commodity price volatility and growth. Consequently, confirming the prominent Prebisch-Singer hypothesis that commodity-dependent exporting countries tend to experience worsening macroeconomic conditions in the long run.

World Bank (2021) found that in copper EMDE exporters, economic activity increased statistically significantly after a copper price increase. They also establish asymmetric responses in copper exporters; that is, a copper price jumps increased output in copper exporting EMDEs by 0.07% after two years, but then the effect dissipated. Conversely,

a copper price collapse, on the other hand, lowered output by more than three times as much (0.22%) two years after the shock, and the effect remained significant for three years. However, in contrast to copper, aluminium price shocks were not followed by statistically significant output changes. Overall, these differences may reflect the lower reliance on aluminium exports for aluminium exporters than the copper reliance for copper exporters. Literature on single-country studies globally (including SSA) in support of the commodity price–business cycle nexus remains scanty. Also, to the best of the researcher's knowledge, no empirical study has been undertaken to quantify these effects for Namibia empirically.

Table 2.3: Summary of empirical studies on the effects of commodity price shocks on business cycles

Author, Year & Methodology	**Country & Period**	**Variables**	**Key Findings**
Medina and Soto (2007) DSGE model	Chile.	•	• If the fiscal policy is conducted using a structural balance fiscal rule (government saves most of the extra revenues from the higher copper price), then a copper price shock of 10% would increase output by 0.05%, and there would be a slight decrease in inflation. • However, when fiscal policy is highly expansive, the same copper price increase implies an output expansion of up to 0.7%, an increase in inflation.
Fuentes and García (2016) DSGE model	Chile. Quarterly.Q1: 2003 -Q1: 2013.	• Copper price. • Mining GDP. • GDP. • Consumption. • Real exchange rate; and • Investment.	• A rise of 1% in the copper price leads to a 0.16% increase in GDP over five years.
Elafif et al. (2017) NARDL	Turkey and Saudi Arabia. Annual. 1970 – 2014.	• Real GDP. • Oil price. • Average GDP in the Middle East. • Ratio of Oil Price to Wheat Price.	• For Saudi Arabia: ○ A 1% increase in the oil price causes a 0.17% rise in real GDP. ○ Similarly, a 1% decrease in the oil price causes a 0.086% fall in real GDP.

		• Inflation (Turkey & Saudi Arabia).	○ Consequently, the positive effect (former) has a greater effect than the negative effect (latter) for Saudi Arabia. • For Turkey: ○ A 1% increase in the oil price causes a 0.17% decrease in real GDP. ○ Similarly, a 1% decrease in the oil price causes a 0.22% rise in real GDP. • Consequently, the negative shock (latter) has a greater effect than the positive shock (former).
Cantavella (2020) NARDL	Spain. Annual. 1945 – 2018.	• GDP. • Population. • International oil prices. • Human capital; and • Physical capital.	• A 1% increase in real oil prices has a negative impact on real per capita GDP of 0.110%, whereas a 1% decrease in oil prices will have an increase in per capita GDP of a 0.198%.
Ogundipe (2020) SGMM	Fifty-three African commodity-dependent countries. Annual. 1970 – 2017.	• Real GDP. • Commodity price Volatility. • Financial development. • Education (enrolment). • External debt stock. • International trade openness. • Institution. • Labour; and • Capital.	• Analysed that about 3.8% variation in real GDP was induced by a 1% change in commodity price volatility. • Finds a negative contemporaneous relationship between commodity price volatility and growth. Henceforth, it confirms the prominent Prebisch-Singer hypothesis that commodity-dependent exporting countries tend to experience worsening macroeconomic conditions in the long run.
World Bank (2021)	Emerging Market and Developing Economies (EMDE) exporters		• Finds that copper price jumps increased output in copper exporting EMDEs by 0.07% after two years, but then the effect dissipated. • A copper price collapse, on the other hand, lowered output by more than three times as much (0.22%) two years after the shock, and the effect remained significant for three years. • However, in contrast to copper, aluminium price shocks were not followed by statistically significant output changes.

Source: Author's cited literature

2.5 Summary

This chapter presented the literature review with emphasis on both theoretical and empirical literature on the study's three objectives. In the first objective, the study estimates the dynamic effects of fiscal policy shocks. In accordance with this, theories such as Keynesian, Neo-Classical, Twin-Deficit, Mundell-Fleming as well as Monetarist, which provide theoretical grounding on fiscal policy shocks, are discussed. Overall, the Keynesian theory provide a theoretical framework for the estimated dynamic effects of fiscal policy shocks presented in chapter four. This is followed by empirical works undertaken for different economies through varying econometric techniques. Moreover, a brief background on the identifications schemes for fiscal policy shocks was presented. These empirical works together with the information on identification schemes render support and justify appropriateness of a SVAR approach adopted for this study.

In the examination of the effects of external shocks, the study's second objective, theoretical foundations are laid through the review of the Harberger-Laursen-Metzler (H-L-M) effect; and models such as Mundell-Fleming, Intertemporal and Dornbusch overshooting. Specifically, the theoretical context through which the examination of external shocks is undertaken is that provided by the Intertemporal models of transmission of monetary policy. Moreover, several empirical studies are reviewed for different economies through the adoption of a number of econometric approaches. The VAR econometric technique is employed to examine the effects of external shocks in Namibia following this review.

For the third objective, the study seeks to investigate the commodity prices – business cycles nexus. That is, to examine the effects of commodity prices on Namibia's

business cycles. To this end, the Prebisch-Singer Hypothesis (PSH) and Dutch Disease macroeconomic theory provide a theoretical basis for commodity prices, whereas theories such as Real Business Cycle (RBC) and Keynesian Business Cycle offer theoretical underpinnings for business cycles. Both theories for commodity prices and business cycles lay the theoretical framework for this study's investigation of the commodity prices – business cycles nexus. The cited literature reflects a range of econometric methodologies adopted for the commodity prices – business cycle nexus analyses. This provides justification and suitability of the Non-Linear Autoregressive Distributed Lag implemented in this study.

Chapter Three: Overview of Namibia's Fiscal and Monetary Policies, External Sector, Commodity Prices, and Business Cycles Developments

3.1 Introduction

This chapter provides a synopsis of Namibia's fiscal and monetary developments, external sector developments, commodity price and business cycle developments. It provides key developments in these aspects ever since 1980. In particular, this chapter elucidates fiscal developments i.e., membership to the Common Monetary Area (CMA), trends of fiscal indicators as percent of GDP, evolution of fiscal policy. It also discusses Namibia's inflation and interest rate developments, monetary policy transmission mechanism, changes in trade and exchange rate, international commodity prices, changes in the mining sector, primary-secondary-tertiary industry configurations as well as evolution of business cycle.

3.2 Overview of Fiscal Developments

Namibia is a member of the Common Monetary Area (CMA) and the oldest Customs Union in the World, the Southern African Customs Union (SACU), which was established in 1910. By virtue of its membership to the CMA, Namibia has therefore ceded monetary, exchange rate and trade policy formulation (and related taxes and excises) to South Africa. Herein, Namibia's currency is pegged on a one-to-one basis to the anchor currency (the South African Rand – ZAR). Moreover, by virtue of its membership in SACU, Namibia derives a significant proportion (about a third) of its total revenue from the customs revenue pool (IMF, 2015; NPC & UNDP, 2019). This means that fiscal policy, particularly on expenditures, is the main instrument available to influence macroeconomic outcomes (World Bank, 1995). Additionally, fiscal policy has always been and remains an important macroeconomic policy tool used by the

government to distribute and redistribute income and hence influence welfare in Namibia.

During the pre-independence period (pre-1990), especially starting in the early 1980s, the central government's expenditures (as % of GDP) somewhat reached an unprecedented level. According to Hartmann (1990) central government's total expenditures (as % of GDP) spiked from 37.0 to 53.0% between 1980/81 and 1988/89 owing to four-fold considerations: *firstly*, constitutional developments which culminated in the independence process from 1989 aroused growing expectations among the Namibian population. *Secondly*, efforts were made to, as far as possible, eliminate the backlog in physical and social infrastructure for certain areas and population groups which consequently wielded heavy strain on the treasury. *Thirdly*, certain functions previously administered and financed by the South African government were transferred to Namibia. *Fourthly*, the then system of public finance, which amounted to a federal system, probably contributed to the rapid growth in expenditure, too, partly resulting from duplication of government bodies and functions as well as insufficient control by the central government.

Namibia gained independence in 1990, after which the economy experienced significant structural reforms and policy changes, and as a result of liberalization and openness policies, the economy became more integrated into the world and regional markets. Since independence, the Government of the Republic of Namibia adopted "planning" as a tool in uplifting the living standard of the masses of the Namibian people. The Transitional National Development Plan (TNDP) spanned the period 1990/91 to 1993/94 and became the forerunner of the First National Development Plan (NDP1, 1995/96 – 1999/00). The latter was succeeded by the Second National

Development Plan (NDP2) covering the period 2001/02 to 2005/06. In 2004, Namibia, through His Excellency the then President of the Republic of Namibia (now the Founding Father of the Namibian Nation), initiated and oversaw the formulation of the country's long-term perspective plan – Vision 2030 through which it aspires *"to become a prosperous and industrialised, developed by her human resources, enjoying peace, harmony and political stability"* (Government of the Republic of Namibia, 2004). By implication, the NDP2 (2001/02 – 2005/2006) became the first Medium Term Plan to implement Vision 2030. Subsequent NDPs (NDP3, 2007/08 – 2011/2012 and NDP4, 2013/14 – 2016/2017) followed up to the Fifth National Development Plan (NDP5, 2017/18 – 2021/22). The overall developmental priorities have largely centred on addressing the country's four socio-economic goals: increased and sustainable economic growth, employment creation, as well as reductions of poverty and income inequality.

During the early post-Independence period, the country experienced uneven and modest GDP growth, attributable to, among others, weakening investment (particularly by the private sector) and unfavourable developments in world prices for Namibia's major products (World Bank, 1995). Moreover, the country is heavily dependent on primary products; hence diversification of the economy has not been significant. To redress the status quo, the government introduced a more generous range of tax incentives for Export Processing Zones (EPZ) companies through the Export Processing Zones Act, Act No 9 of 1995, with a view to boosting the performance of the manufacturing sector in 1995 (Republic of Namibia, 1995).

Namibia, just like many of its peers in the developing world, has been experiencing huge fiscal deficits, which present a challenge of satisfying its inter-temporal budget

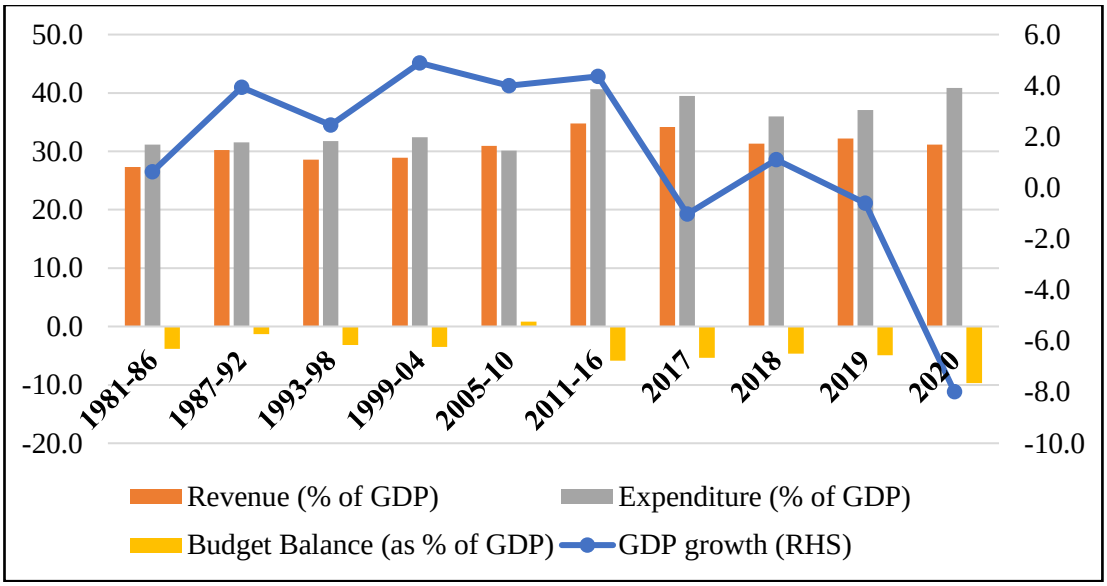
constraint with conventional revenue and public borrowings. In a developmental state like Namibia, fiscal policy could, as it has played a critical role in spurring economic growth and crowd-in private investment (MoF, 2012). During the first decade of post-independence, there were no firm guidelines on fiscal targets except the budget deficit of 3.0%, which was incorporated in NDP1. The absence of the other targets somewhat created uncertainty around the budget and fears that Namibia's rapidly rising debt could lead to it falling into a developing country's debt trap. Notwithstanding the absence of fiscal targets, however, since independence, the Namibian government has consistently managed to maintain fiscal discipline. Henceforth, for the Namibian economy, the overall objective of the government's fiscal policy has always been and continues to be geared at promoting economic growth, efficient service delivery and socio-economic welfare within the ambit of macroeconomic stability and sustainability of fiscal outcomes (MoF, 2012).

Owing to improved economic growth prospects and a boom in commodity prices, the government introduced and implemented a fiscal consolidation programme in 2005/06 to strengthen fiscal fundamentals. To this end, notably, three consecutive budget surpluses were achieved through a combination of revenue enhancement and expenditure restraint during 2006/07, 2007/08 and 2008/09 (MoF, 2012). Henceforth, the government utilised part of the strengthened fiscal space and accumulated cash balances to introduce countercyclical fiscal expansion as the global economic meltdown emerged (MoF, 2012). Moreover, the government strengthened the debt redemption fund and accelerated debt repayment, which consequently lowered the debt burden on future generations whilst simultaneously boosting market confidence.

Following this, public debt, which stood at 34.0% of GDP in 2004/05, was significantly reduced multi-fold to 15.0% by 2009/10. All in all, these developments are suggestive of the fact that Namibia's fiscal policy has, for the most part, been pro-cyclical. This fact corroborates Bova, Carcenac. and Guerguil (2014); First Capital (2019); and Julius, Nyambe and Matundu (2020). According to Mesea (2013), the pro-cyclical status quo deals with higher (lower) budgetary expenditures and lower (higher) tax rates in the boom (recession) periods. In other words, this policy stance aims to strengthen along with the economic cycle; that is, the fiscal policy is expansionary during booms and contractionary in recessions.

National Accounts Time series data from NSA (2020) reflect that during the period 1981 to 2020, economic growth averaged a modest 2.8% with clear traces of volatility, as can be seen evidently in Figure 3.1. Real GDP growth was highest at 4.9% achieved during 1999-2004, supported by construction, wholesale and retail trade and public administration sectors, among others. MoF Budget documents for various years reveal that from 1981 to 2020, revenue (% of GDP) has relatively been stable, whereas expenditure (% of GDP), on the other hand, was trending upwards, especially from 2011 to 2020. Also, revenue and expenditure to GDP ratios averaged 30.0% and 33.1%, respectively, during the same period.

Figure 3.1: Fiscal variables (% of GDP) and economic growth



Source: Author's own construct using NSA and MoF data

According to various MoF budget documents, Namibia has, on average, ran budget deficits for the entirety of the 1981 to 2020 period, except for three financial years (2006/07 – 2008/09), owing to increased financing needs and lower-than-expected revenues, especially from international trade tax (SACU receipts), where it derives approximately a third of its revenue. Debt developments reveal that although the debt to GDP ratio averaged 23.5% between 1981 and 2020, it recently (since 2015) kept rising above the nationally established threshold of 35.0%, attributed to additional borrowing to finance increasing needs. However, there is some relief in that domestic debt accounts for a significantly larger share than foreign debt, thereby implying minimal exposure to exchange rate risk. In particular, Namibia's Sovereign Debt Management Strategy (SDMS) of 2005 outlines the domestic and foreign debt thresholds of 20.0% and 5.0%, respectively (MoF, 2005). The fiscal year 1997/98 was a significant one in Namibia's post-independence debt developments as it witnessed South Africa's decision to formally write off its's pre-independence debt amounting to N$1,130 million, which included debt inherited at independence (from the previous

regime) as well as that accumulated by the post-independence Namibian government (Sherbourne *et al.*, 2002). In the 2011/12 financial year, the government introduced an expansionary fiscal policy primarily aimed at financing the three-year *"Targeted Intervention Programme for Employment and Economic Growth (TIPEEG)"*, which specifically sought to support strategic growth driving sectors as well as tackle the high and persistent unemployment rate, especially among the unskilled youth (NPC, 2011). In view of this, the Bank of Namibia, in conjunction with the Ministry of Finance, devised a comprehensive borrowing strategy to accommodate the noted increasing government borrowing needs to expedite TIPEEG. Ultimately, the devised strategy culminated in the issuance of the first Eurobond by Namibia to the value of US$500 million to mature in 2021, whose primary object was to diversify the country's funding sources by establishing an international pricing benchmark and raising the country's profile among the international investment community (BoN, 2011). The government returned to the international capital markets again in 2015 and issued the second Eurobond, 10-Year Eurobond amounting to US$750 million set to mature in 2025, whose primary objective was to raise funding to finance the budget as well as increase international reserves (BoN, 2015).

Between 2013/14 and 2016/17, average public expenditure growth (11.0%) surpassed average growth in public revenue (6.8%) and nominal GDP growth (8.9%). Public expenditure growth was driven by personnel expenditure (wage bill – civil servants' regrading and salary adjustments) in 2013/14 and 2014/15 (NPC, 2017). During the 2014/15 and 2015/16 financial years, public expenditure (as % of GDP) exceeded the 40% national cap; similarly, the budget deficit and public debt to GDP ratios increased above the 5.0 and 35.0% thresholds, respectively (NPC, 2017). Against these

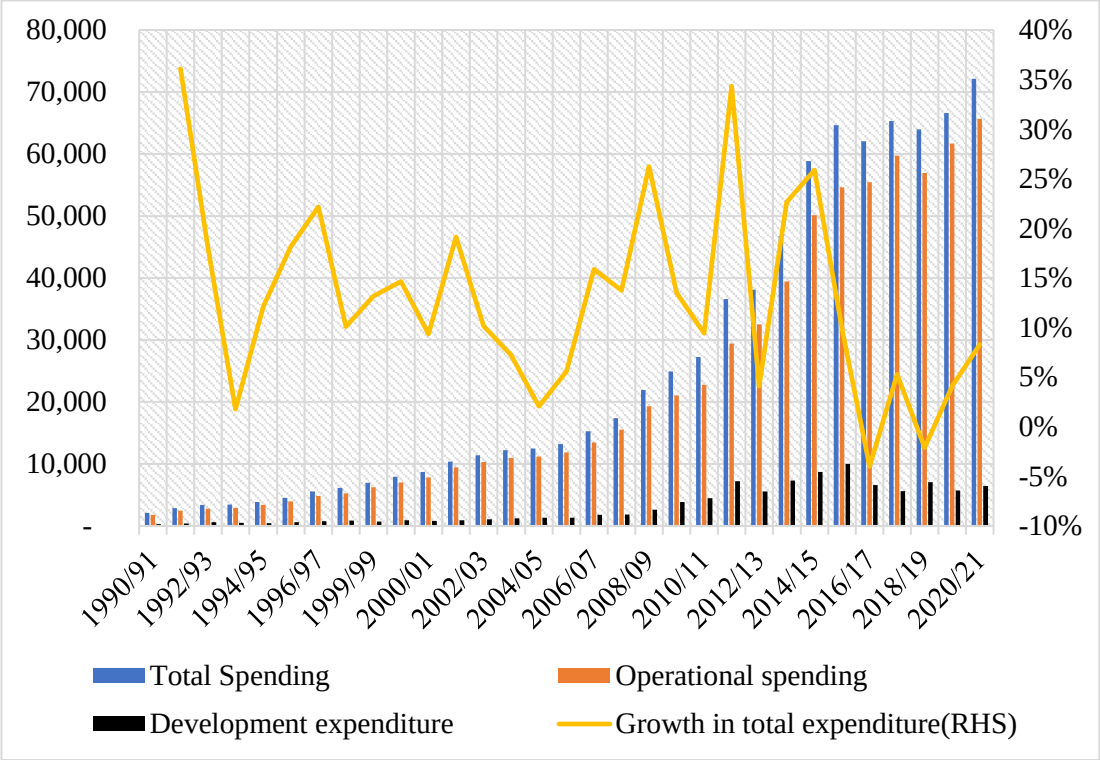
developments, the government introduced fiscal consolidation in the 2015/16 mid-year budget review, which was cemented in the 2016/17 budget with a view to, amongst others, steering the path of fiscal variables to within what is deemed sustainable levels. The central tenet of fiscal consolidation was specifically to curb unnecessary expenditures while focusing on productive spending. In alignment with this, supportive structural reforms aimed at reducing over-reliance on the national budget by seeking alternative financing sources through Public Private Partnerships (PPPs) and private sector investment remained key.

In view of ensuring fiscal sustainability, Namibia has been implementing fiscal rules during different time periods, thereby capturing the changing economic and fiscal dynamics. Accordingly, the latest targets during 2015/16 on expenditure, budget deficit and debt (as % of GDP), were set at 40.0, 5.0 and 35.0%, correspondingly. Recent MoF statistics from 2014/15 to 2018/19 reveal that Namibia's revenue-to-GDP ratio has remained fairly flat at just over 30.0% owing to the reduced and cyclical nature associated with SACU receipts from which the country derives about a third of its revenue, limited fiscal space as well as weaker economic growth, among others. However, at this level, Namibia's revenue (as % of GDP) exceeds both 18.0 and 27.0% averages for sub-Saharan Africa and Emerging Markets and Developing Economies (IMF, 2019). According to various MoF fiscal strategy documents, Namibia's tax revenue represents a significant proportion (approximately over 90.0%) of total revenue. To this end, Besley and Persson (2013) asserted that Namibia's tax system shares an important characteristic with most developing economies, that is, dependence on taxes (i.e., indirect, direct and international trade comprised of SACU receipts).

Expenditure-to-GDP, on the other hand, was recorded at 36.9, 36.8 and 34.6% in 2016/17, 2017/18 and 2018/19, respectively. Consequentially, because of the flat revenue (as % of GDP) ratio and declining expenditure (as % of GDP) ratio, the budget balance (as % of GDP) ratio has seen a mild improvement, having been recorded at -4.8 and -4.4% in 2017/18 and 2018/19, respectively, thereby also remaining within the prudential threshold of -5.0%. These developments are attributed to the introduction of the fiscal consolidation measure. Notwithstanding these successes, however, the debt-to-GDP ratio has been rising beyond the national cap of 35.0%, especially in the last three financial years (2016/17 – 2018/19), on account of increased financing needs (rising need to revive the economy and protection of social spending) and associated interest payments, amongst others (NPC, 2020).

Information from MoF indicates that the budget allocation is skewed more towards operational than development (capital projects) which is, in other words, considered productive spending. In this vein, during the period 1990/91 and 2020/21, the allocations to operational and development averaged 87.5 and 12.6%, correspondingly. Though this skewed distribution in the budget is not by design, it is not ideal in the interest of ensuring the achievement of sustainable growth and development. Figure 3.2 presents government expenditure trend between 1990/91 and 2020/21.

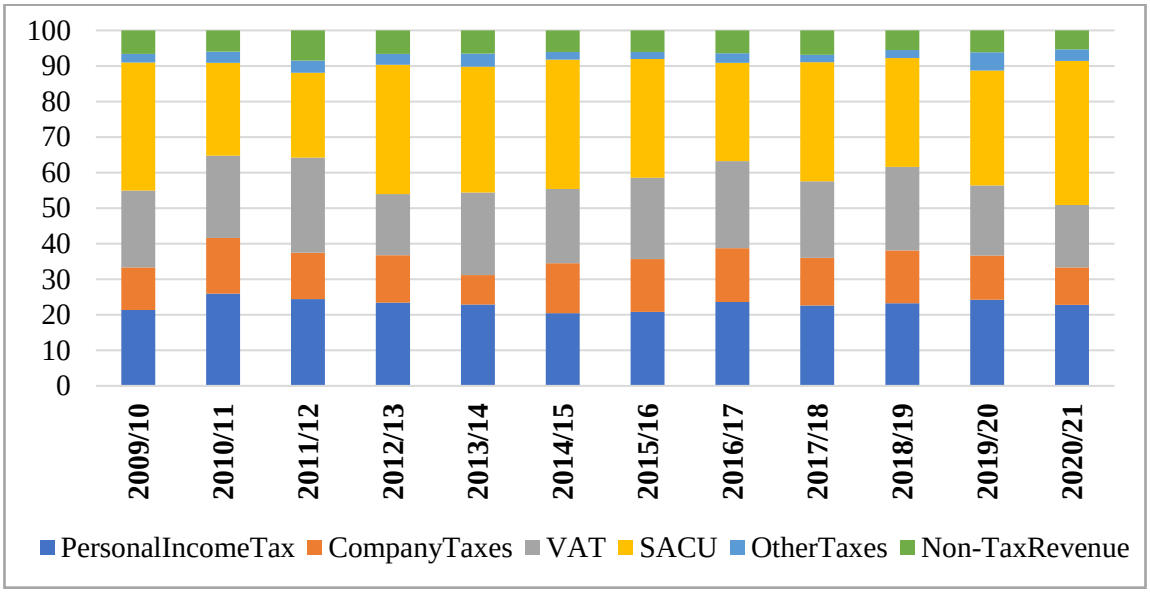
Figure 3.2: Fiscal spending trend



Source: Author's own construct using data from MoF Fiscal Strategy Documents

Data from the MoF Fiscal Strategy documents reveal that, between 2009/10 and 2020/21, government's main revenue drivers were Taxes on International Trade (SACU receipts), Personal Income Tax and Value-Added-Tax (VAT) which recorded average contribution (% of total revenue) of 32.7%; 23.0% and 21.9%, respectively. The three revenue sources jointly registered a combined average contribution to total revenue of almost 80.0%. From these, it is evident that SACU receipts represent the largest revenue source, averaging approximately a third of total revenue. Figure 3.3 presents the government's revenue sources as a percentage of total revenue.

Figure 3.3: Government revenue sources (% of total revenue)



Source: Author's own construct using data from MoF Fiscal Strategy Documents

3.3 Monetary Policy Advances

3.3.1 Price (inflation) and interest rate developments

Inflation has important implications for the redistribution of income and wealth in Namibia. Since independence in 1990, inflation in Namibia has moved in tandem with that in South Africa; however, 1999 saw a divergence between the two countries. Considering this, South Africa's inflation rate is said to have declined faster than Namibia's owing to the exclusion of interest rates from the South African CPI, which was the main force behind low inflation in South Africa (BoN Annual Report 1999). Although the overall price level in Namibia was low and more stable during the post-independence period (1990 – 2000) than in the decade before independence, the inflation rate was largely determined by price developments in South Africa, given that over 80.0% of Namibian imports came from South Africa (BoN Annual Report 2001).

Generally, Namibia has enjoyed a favourably low inflationary environment during both the pre- and post-independence periods. During the study period, inflation averaged 9.1%, with the highest and lowest of 17.7% and 2.3% recorded in 1992 and 2005, respectively (NSA, 2019).

According to BoN (1993), the main reasons ascribed to the sharp annual increase in 1992 were, amongst others, a substantial decline in the production of cereal crops both in the country and in South Africa (the main food supplier to Namibia), about a 12.0% increase in the prices of petroleum products, as well as a substantial rise of 22.0% in the money supply. The lowest inflation registered in 2005 was in basket 1 (housing, water, electricity, gas, and other fuels) and basket 2 (alcoholic beverages and tobacco), whose inflation rates dropped to 1.7 and 7.4% from 6.9 and 9.3%, respectively (BoN, 2006). In the early 2000s, the South African Reserve Bank (SARB) introduced a major monetary policy change by adopting an inflation-targeting regime. To this end, South Africa formally adopted an inflation-targeting monetary policy framework in February 2000, setting an inflation average target range from 3 to 6% in CPIX (, i.e., the overall Consumer Price Index for metropolitan and other urban areas, exclusive of the influence of mortgage interest costs) of between 3 and 6% to be achieved in 2002 (SARB, 2001).

Interest rate developments reflect that data from Quantec (South African data), and Bank of Namibia (Namibian data) indicate that during the study period, interest (lending) rates averaged 14.6% for which pre-independence (1980-1989) and post-independence (1990-2018) periods averaged 16.5 and 13.9%, in that order. Lending rates were lowest (8.3%) and highest (22.5%) in 2013 and 1984, respectively.

3.4 External Sector Developments

3.4.1 Monetary policy transmission mechanism

Namibia has since 1986 been a member of the Common Monetary Area (CMA), joining Lesotho and Swaziland (the present-day Eswatini) prior to becoming independent in 1990. By virtue of this membership, the Namibia Dollar (N$) has characteristically enjoyed a one-to-one fixed currency peg to the South African Rand (ZAR) since its introduction in 1993 (Thompson, 1992). According to Wang et al. (2007), the CMA arrangement is based on a de facto currency union in which the three small member countries (Lesotho, Namibia, and Swaziland/Eswatini) have the right to issue national currencies that are only legal tender in their respective countries, whereas the South African Rand is legal tender throughout the CMA. Namibia's monetary policy regime, as pursued by the Bank of Namibia (BoN), is anchored on the maintenance of the currency peg.

Uanguta and Ikhide (2002) examined the two main channels (interest rates and credit) through which monetary policy gets transmitted into the Namibian economy and found that they are both effective. Thus, they document that a tightening of monetary policy, as demonstrated by an increase in the repo or bank rate, causes lending rates to increase in the domestic economy and is mirrored in the shrinkage of private investment with its associated negative impacts on output and employment in the short-run. The result also confirms the operation of the bank-lending channel, a version of the credit channel in Namibia.

According to the Bank of Namibia (2008), although Namibia's monetary policy framework is underpinned by the fixed currency peg to the ZAR, the achievement of

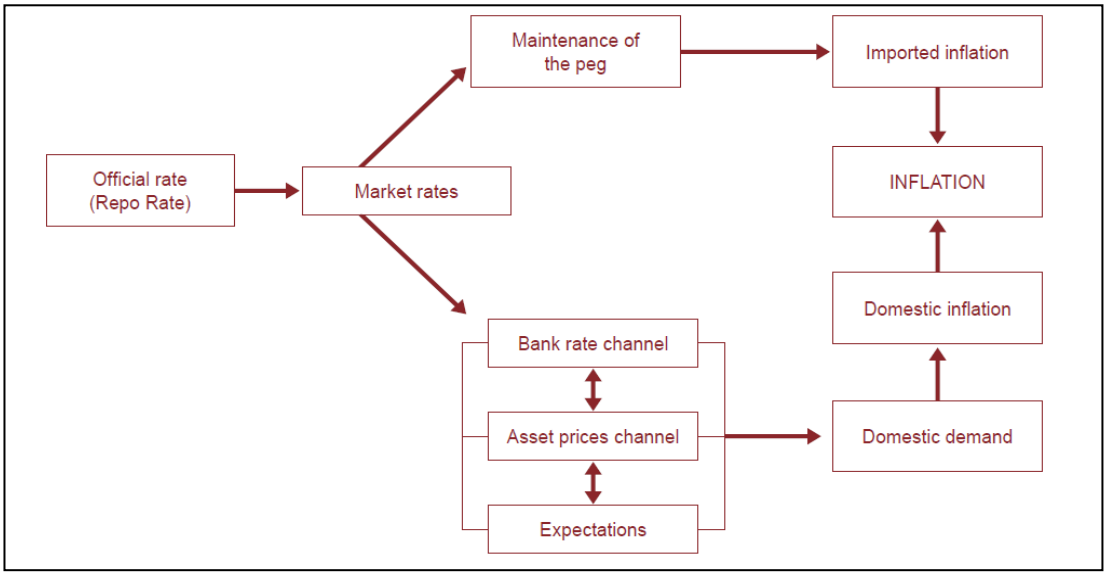
price stability, especially in view of sustainable growth and development, remains its principal goal. The fixed currency arrangement, emanating from the country's membership to the CMA, which compels its currency in circulation to be backed by international reserves, ensures that Namibia imports price stability from the anchor country from where it sources a significant portion of its import needs. The CMA remains the cornerstone of Namibia's monetary and exchange rate policy arrangement (BoN, 2009).

The fixed exchange rate regime implies that Namibia has forgone having a fully independent monetary system though the monetary policy stance can deviate from that of the anchor currency (ZAR) to a certain degree through the use of capital controls and other financial institutions. These empower the Bank of Namibia to maintain a repo rate different from that of the South African Reserve Bank when required and thus allows it the discretion to control the domestic money supply and, consequently domestic-induced inflation (Gaomab, 1998). Notwithstanding the former, however, within the CMA, Ikhide and Uanguta (2010) found that Lesotho, Namibia and Swaziland/Eswatini (LNS) countries are affected by South African Reserve Bank (SARB) monetary policy as confirmed by the effect of monetary tightening on major monetary variables i.e., money supply, private sector credit and prices. Consequently, given the nature of capital flows in the CMA, it appears that the relevant central bank policy rate is the SARB repo rate. The strong impact the repo rate exerts on lending rates, money supply and credit may render such domestic policies ineffective.

Moreover, Odada and Eita (2010) claimed that inflation in Namibia is caused by monetary (specifically growth in the money supply), structural (domestic aggregate

demand for goods and services and the cost of labour or production) and other factors (South African prices as reflected by growth in import prices, South Africa's inflation and growth in South Africa's producer price index). Sheefeni and Ocran (2015) established that the exchange rate channel is operational, implying that, changes in the monetary policy instruments affect the exchange rate variable which in turn transmits the shocks to output and prices but weak and not so significant. Additionally, interest rate and credit channels remain important in the monetary policy transmission mechanism for the Namibian economy (Sheefeni, 2017). Overall, Namibia's monetary policy ensures the achievement of its main goal, price stability, through controlling both domestic and imported inflation via the channels as depicted in Figure 3.4.

Figure 3.4: Schematic illustration of Namibia's monetary policy transmission mechanism



Source: Bank of Namibia (2008)

3.4.2 Trade and exchange rate developments

According to the International Monetary Fund (IMF) direction of trade data (2020), Namibia has increasingly become integrated with the global economy through trade,

amongst others, as evidenced by significant export and import trade shares (%). Namibia is a net importer of goods, which in other words, implies that it imports more than it exports. The export shares with the Advanced Economies (AEs), have been between 40 and 60%, although declining in recent years while those of Emerging Market and Developing Economies (EMDEs) have ranged from 30 to 50%, albeit increasing in recent years ascribed to China's increasing prominence as a key export destination.

Data depict that import shares at both the regional and country levels are generally lower than those of exports, a characteristic of Namibia being a net importer. At the regional level, import shares are highest for (EMDEs followed by Sub-Saharan Africa (SSA). Yet, a striking revelation is the fact that at the country level, import shares from South Africa have generally been the largest, although has since 2016 trended downwards. South Africa is Namibia's largest trading partner especially for imports. This implies that Namibia has benefited from low import inflation (which is significant in Namibia's monetary policy transmission mechanism) from South Africa, an inflation-targeting economy, especially starting from its adoption during the early 2000s. Table 3.1 presents Namibia's export and import shares with selected regions and economies since 2000.

Table 3.1: Export and import shares with selected regions and countries

Region / country	Share (%)	2000	2004	2008	2012	2016	2017	2018
AEs	Exports	59.9	54.9	44.9	48.6	43.1	39.3	47.0
	Imports	10.4	9.4	20.3	16.7	12.6	10.8	16.3
Spain	Exports	9.4	7.9	4.8	3.9	4.1	4.5	6.6
	Imports	0.6	0.7	0.5	0.4	0.5	0.7	1.8
Switzerland	Exports	2.9	0.2	3.9	3.8	18.0	9.5	0.9
	Imports	0.1	0.5	0.8	6.0	0.8	0.4	0.2
UK	Exports	30.6	20.0	13.9	11.5	0.9	0.8	9.7
	Imports	2.0	2.6	8.0	2.4	0.4	0.8	3.7

US	Exports	2.8	8.4	5.1	3.7	2.5	2.6	2.3
	Imports	1.3	0.7	2.0	0.6	1.9	2.0	3.2
EMDEs	Exports	34.0	38.8	48.4	44.9	46.8	53.0	42.1
	Imports	89.5	90.5	79.4	80.6	84.8	88.3	83.1
China	Exports	0.0	1.2	4.9	2.7	3.3	4.8	11.4
	Imports	0.5	1.2	3.3	4.0	2.9	5.1	9.0
SSA	Exports	32.1	35.7	40.5	39.5	40.1	42.8	27.4
	Imports	87.2	86.8	69.7	74.9	69.5	67.0	58.5
South Africa	Exports	23.8	24.1	29.5	17.0	15.3	21.8	12.1
	Imports	86.2	85.2	67.8	69.7	57.1	55.1	39.4
Botswana	Exports	0.6	0.5	0.5	6.7	13.4	12.2	6.7
	Imports	0.3	0.2	0.3	1.6	6.8	6.1	4.4

Source: IMF Direction of Trade (2020)

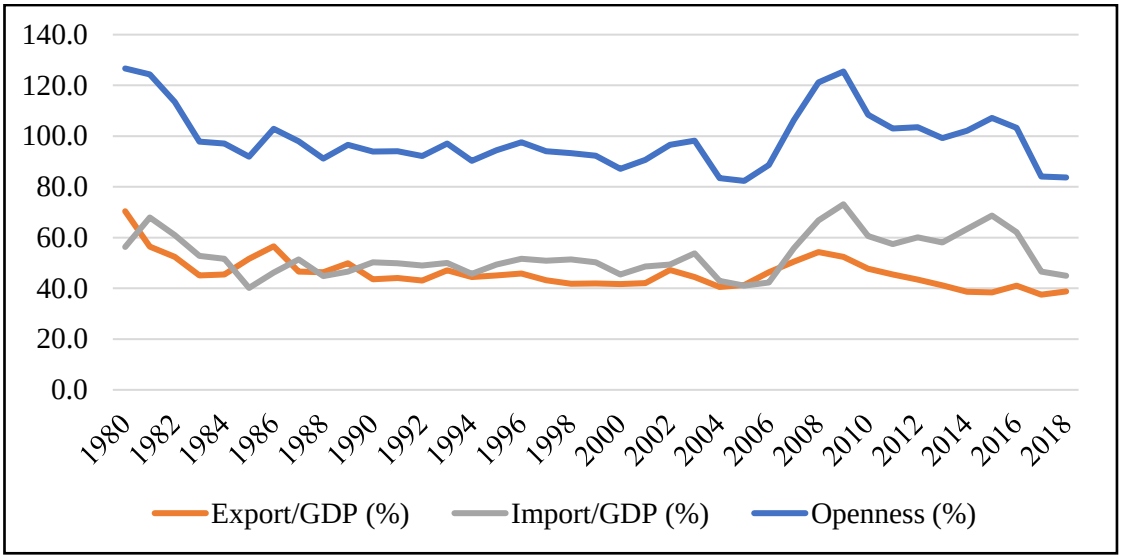
Namibia is an open economy as reflected by its high openness (exports and imports as % of GDP) which averaged 98.8% during the period of review (1980 to 2018). NSA data on export and import (% of GDP) reveal that for the large part, they have moved in tandem together. However, between 2009 and 2016, a large divergence between the two years is evidently clear from Figure 3.5. The divergence is attributable to *"construction boom"* (emanating from government works programme and construction of new mines and expansion of existing ones) experienced during that period which significantly drove imports upwards (BoN, 2017).

Annual trade statistics from NSA show that in 2018, Namibia's export basket was mainly made up of minerals i.e., copper, precious stones and metals (diamonds, gold etc.); ores (uranium, copper, zinc, lead etc.); fish; live animals; beverages and meat as well as re-exports (vessels, industrial machinery; motor vehicles and parts). Clearly, the export basket comprises largely of unprocessed products (mostly exported in raw form) destined to external global markets, characterizing the fact that it has a narrow manufacturing base, like most SSA countries. This is notwithstanding the fact that Namibia's Vision 2030 is anchored on industrialization. Also, the country has an execution strategy for industrialization *("Growth at Home")* whose aim is to increase

manufacturing of available natural resources and to add value to as many raw materials produced.

Imports, on the other hand, comprised of copper, oils and mineral fuels; motor vehicles and parts; industrial machinery, ores and electrical machinery, among others. *Growth at Home* advocates a targeted approach towards industrialization with focus on sectors such as agro-processing, fish processing, mineral beneficiation, steel manufacturing, chemical industry. The Vision 2030 target is that by 2030, the export value of value-added products should account for 70% of total export values (Ministry of Trade and Industry, 2012). Figure 3.5 presents Namibia's trade indicators which confirms its significant openness (%) during the period 1980 to 2018.

Figure 3.5: Export and import as % of GDP and openness (%)

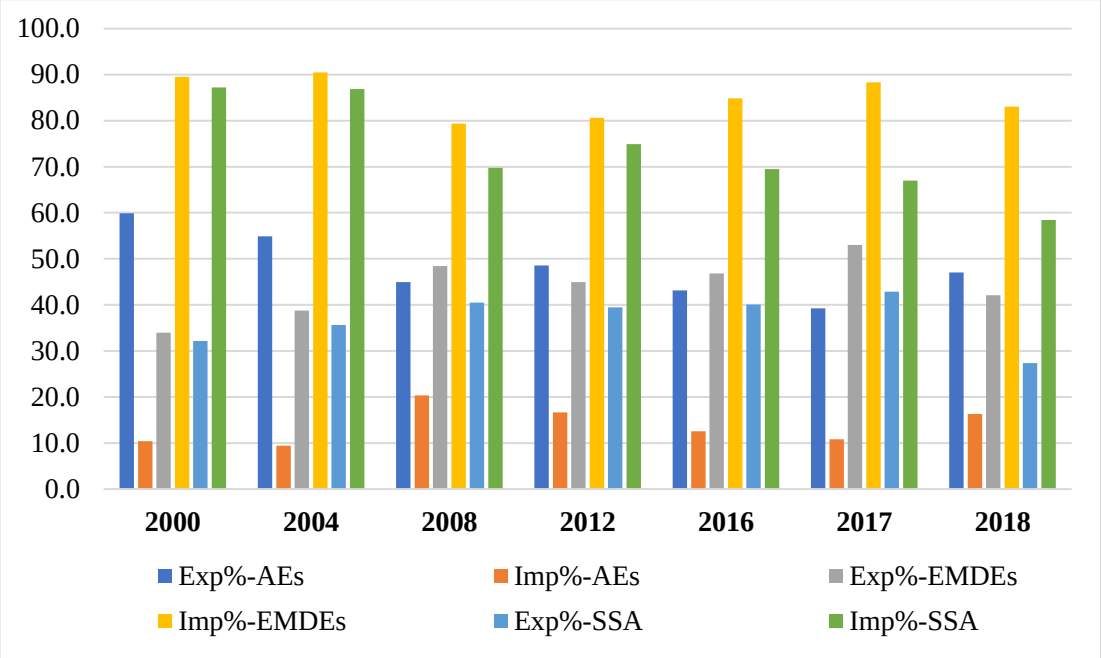


Source: NSA (2019)

Through globalisation, Namibia has increasingly become highly integrated with the global economy through trade, financial flows, global liquidity etc. IMF's direction of trade data (2020) reveals that although Namibia is a net importer of goods and services, it has increasingly become highly integrated with the global economy reflected by export and import shares with selected regions as shown on Figure 3.6. Thus, Namibia

being a small open resource rich economy is affected by developments in the global economy. The global economic growth has a significant bearing on demand for its export products i.e., mineral resources etc. This warrants the inclusion of global output growth shocks in the study to quantify the effects arising from such.

Figure 3.6: Namibia's direction of trade with selected regions (export and import % shares)



Source: IMF (2020)

**Note: AEs – Advanced Economies; EMDEs – Emerging Markets and Developing Economies; and SSA – Sub-Saharan Africa*

External shocks can also be transmitted from advanced economies to small open economies through Foreign Direct Investment (FDI) which UNCTADSTATS defines as an investment made by a resident enterprise in one economy (direct investor or parent enterprise) with the objective of establishing a lasting interest in an enterprise that is resident in another economy (direct investment enterprise or foreign affiliate). According to UNCTADSTATS (2019), FDI flows into SACU countries have

generally been trending in the positive trajectory from 1985 to 2018. Specifically, Namibia's FDI flows rose significantly from US$ 8.8 Million to its highest level of US$ 857.4 Billion before decelerating to US$ 156.9 Million in 2018 (Table 3.2).

Table 3.2: FDI flows (US$ Millions) into SACU countries

	1985-1990	**1991-1996**	**1997-2002**	**2003-2008**	**2009-2014**	**2015**	**2016**	**2017**	**2018**
Botswana	69.3	-28.3	121.2	431.6	241.5	378.6	142.5	260.6	286.0
Eswatini	43.5	61.7	78.0	37.4	72.6	41.3	21.4	-56.0	36.5
Lesotho	10.4	20.7	30.3	39.8	60.6	206.5	159.2	123.1	128.7
Namibia	**8.8**	**112.3**	**152.3**	**433.3**	**702.3**	**857.4**	**368.0**	**373.6**	**156.9**
South Africa	-135.3	450.0	2520.3	4039.6	5668.4	1729.4	2235.0	2008.4	5449.6

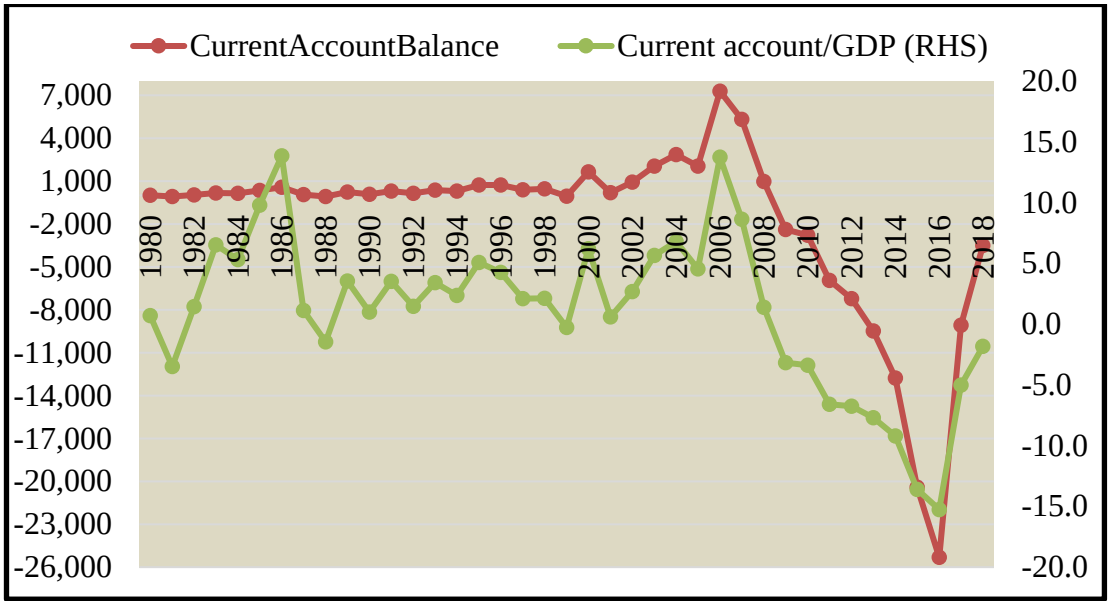
Source: UNCTADSTATS (2020)

Another important metric for the health of the external sector is the current account which the IMF (undated) defines as the record of all transactions in the balance of payments covering the exports and imports of goods and services, payments of income, and current transfers between residents of a country and non-residents. According to data from various BoN annual reports, Namibia's current account balance has been in surplus for the entirety of the period, from 1980 running up to 2008 whereupon it characteristically entered negative (deficit) trajectory.

The current account balance reached its peak in 2006 when it was recorded at N$7.288 billion (translating to 13.7% of GDP) and lowest in 2016 when it stood at minus N$25.321 billion (approximately -15.3% of GDP) as shown in Figure 3.7. According to BoN (2008), the high current account surplus in 2006 was supported by amongst

others, robust mineral export earnings, net inflows in services mainly tourism related, and higher Southern African Customs Union (SACU) receipts. The lowest current account deficit in 2016 is ascribed to amongst others, increasing merchandise trade deficit (BoN, 2016). Notwithstanding the lowest current account deficit recorded in 2016, however, the current account deficit narrowed significantly owing contraction in the import bill and higher SACU receipts (BoN, 2017). Overall, the current account balance averaged a deficit amounting to N$1.815 billion during the review period.

Figure 3.7: Current account balance (N$ million) and current account to GDP (%)

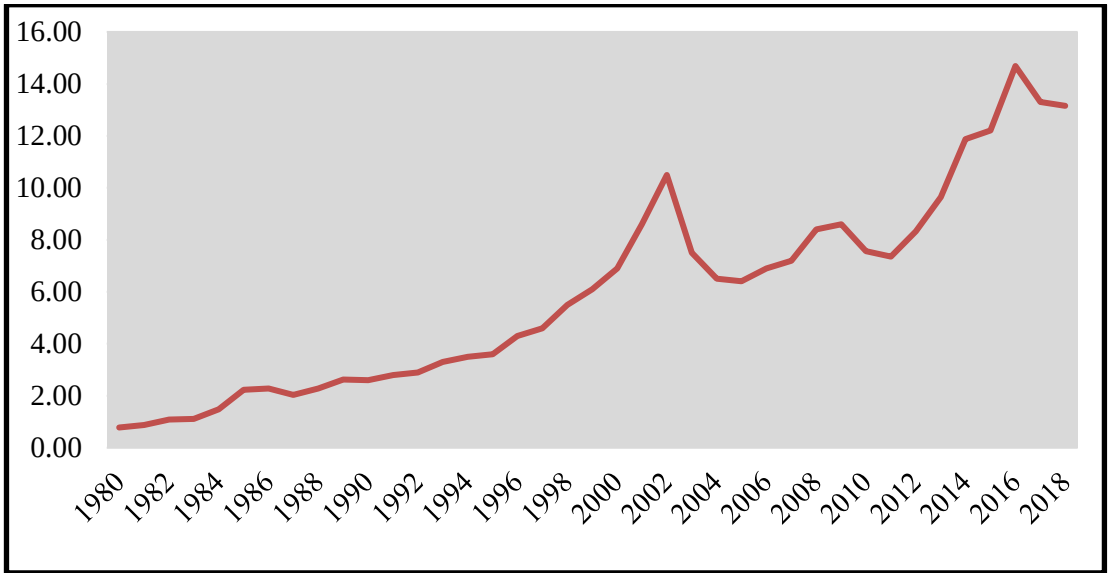


Source: BoN

Exchange rate developments reveal that since the 1980s, the nominal South African Rand (ZAR)/Namibia Dollar (N$) per US$ exchange rate has characteristically been surging in an upward trajectory owing to external and domestic developments in the South African economy (Figure 3.8). Evidently, between 1980 and 2018, the exchange rate surged multi-fold from 0.78 ZAR to 13.15 ZAR per US$ (Figure 3.8). The ZAR/USD exchange rate has been more volatile than other currencies evidenced by

depreciations of 41.5 and 39.2% during the Asian currency and global financial crises, respectively, before recovering most of the losses in the next few years (Hsing, 2016).

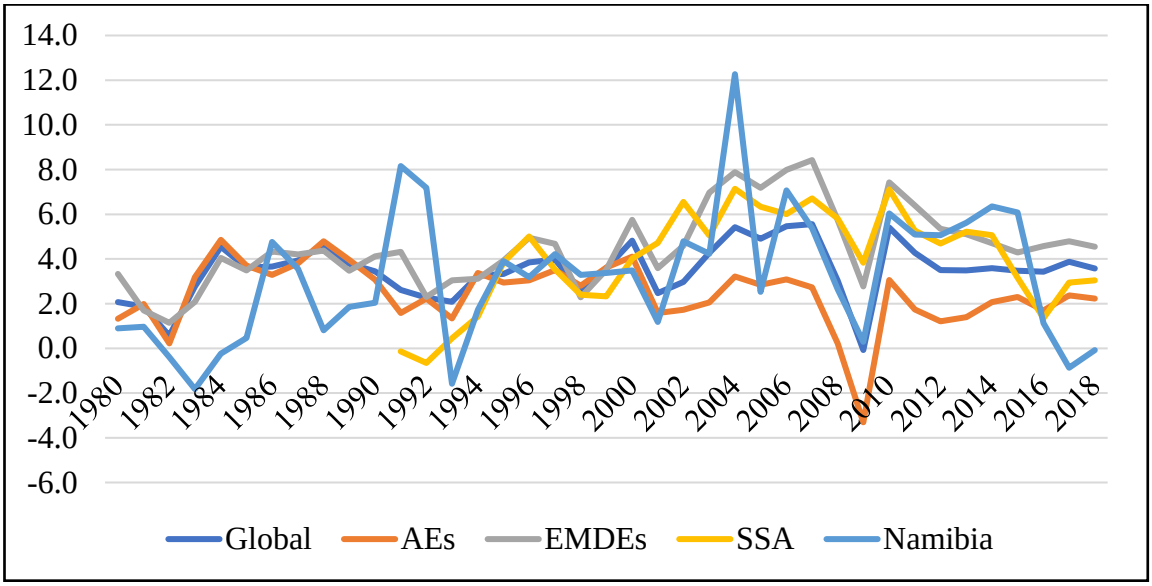
Figure 3.8: ZAR-N$/US$ Exchange rate



Source: BoN

Notwithstanding being a small commodity-dependent economy exposed to external shocks, between 2010 and 2015, Namibia's annual GDP growth averaged 5.5% ascribed to construction boom on the back of construction of large mines and an expansionary fiscal policy which boosted investment albeit temporarily (IMF, 2018). During the review period, Namibia's real economic growth averaged 3.1% and its growth trajectory mirrors those of other regions thereby signalling that it co-moves with others (Figure 3.9). This signifies the importance of global output to demand for its export products, especially mineral resources.

Figure 3.9: Real output growth trends (%) for selected regions



Source: IMF WEO

**Namibia data; NSA Time series data (2020)*

3.5 Overview of Commodity Price – Business Cycles Nexus on Namibia

3.5.1 International commodity price dynamics

Volatility in commodity prices causes instability in exchange rate and fluctuations in growth for developing countries. Commodity price instabilities make the commodity dependent economies, mostly in Africa more vulnerable to commodity price shocks (UNDP, 2010). One central tenet of these economies, although richly endowed with mineral resources or commodities, is that they generally have narrow and limited manufacturing bases and as such export commodities in raw form with very limited or no value addition at all (NPC, 2020). Generally, two strands of literature on drivers of commodity price fluctuations exist, amidst others. The first strand argues that oscillations in commodity prices can be attributed to changes in external global demand (Deaton &d Laroque, 1996; Osborn &d Vehbi, 2015; Stuermer, 2018, among

others). The second strand attributes commodity price variations to be driven by global supply factors which include unpredictable and adverse weather conditions (Hamilton, 2008; Cafiero et al., 2011; and Kamber, McDonald & Price, 2013). Table 3.3 shows selected nominal international commodity prices from which it is evident that all except uranium prices were, trending in an upward trajectory from the 1980s to 2018, on average. Moreover, the period from 2010 to 2015 is characterized by a commodity price boom where most prices surged upward. This echoes the commodities boom in the 2000s (or the commodities super cycle experienced from 2000 to 2014), during which rising export earnings contributed to high GDP growth rates and favourable macroeconomic indicators (UNCTAD & FAO, 2017).

Table 3.3: Selected Commodity Prices (US$ / Unit), annual average

Commodity	**1980-1985**	**1986-1991**	**1992-1997**	**1998-2003**	**2004-2009**	**2010-2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Copper+	1,632	2,268	2,335	1,660	5,415	7,339	4,868	6,170	6,530	6,010	6,174
Crude oil*	31	18	18	23	64	90	43	53	68	61	41
Gold+	424	396	365	299	667	1,384	1,249	1,258	1,269	1,393	1,770
Uranium*	22	13	11	10	51	43	26	22	25	26	29
Zinc+	804	8,810	1,095	954	2,079	2,051	2,090	2,891	2,922	2,550	2,266

Source: +Copper (US$/ metric tonne), Gold (US$/ troy ounce) and Zinc (US$/ troy ounce) prices – the World Bank Pink sheet

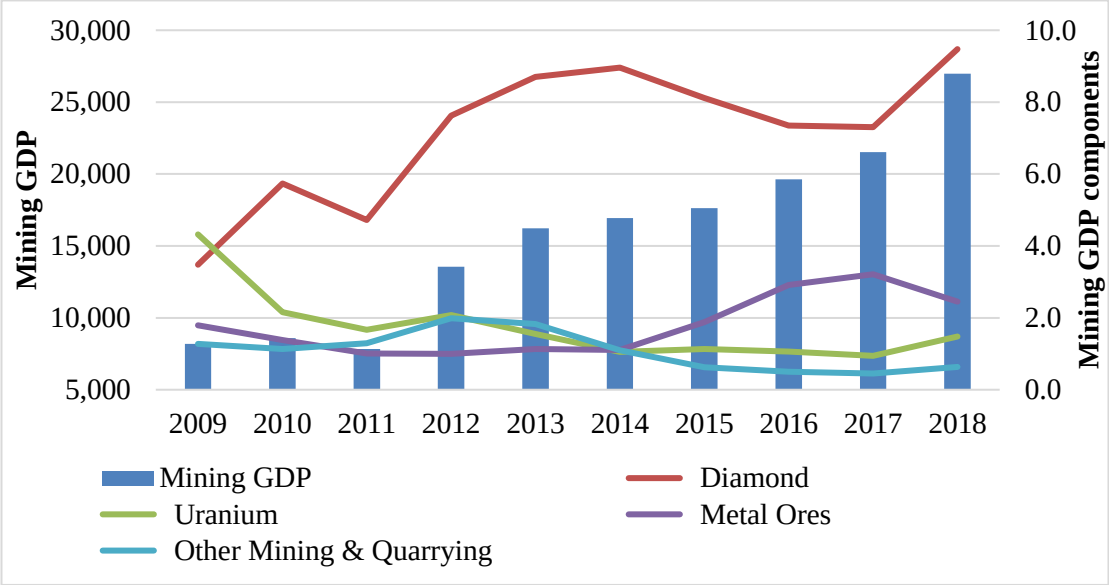
**Crude oil (US$/barrel) and Uranium ((US$/pound) prices – IMF World Economic Outlook Database, April2021*

3.5.2 Mining sector developments

Namibia's mining sector has always been the economy's backbone, evidenced by its multi-fold increase in terms of contribution to GDP, economic growth, and source of government revenue, amongst others. Moreover, the sector contributed significantly to overall economic development through the creation of jobs, housing, and reduction of poverty, among others. Figure 3.10 depicts that the mining sector's GDP increased multi-fold from N$ 8.1 billion to N$ 27.0 billion between 2009 and 2018.

National accounts data (NSA, 2018a) reflect diamond as the single largest contributor to GDP, with a contribution of 3.5% and 9.5% in 2009 and 2018, respectively. This was followed by Uranium which contributed 4.3% and 1.5% in 2009 and 2018, correspondingly. According to national income time series data, as published by the NSA, most mineral commodities (except diamonds) were all classified under mining and not disaggregated between 1980 and 1999. This implies that uranium, metal ores and other mining and quarrying were grouped under "other mining" prior to 2000. Also, uranium was only disaggregated in 2000, while copper has, as of 2020 not yet been disaggregated, and as such, it is classified as part of metal ores. This is notwithstanding the fact that mining in Namibia dates to the pre-1980 period.

Figure 3.10: Mining GDP (N$ Millions) and contribution to GDP (%)



Source: NSA Annual National Accounts Data

Figure 3.11 presents openness (trade % of GDP) and selected mineral commodity exports (% of total exports) spanning the period 1993 to 2018. Namibia is a small open economy whose openness is evidenced by its openness (trade as % of GDP) indicator, which averaged 97.4% between 1993 and 2018. This implies that it trades significantly with the rest of the world. Data from various annual reviews of the Chamber of Mines reflect that since 1993, diamonds have consistently been the largest mineral commodity export. Furthermore, data from the Chamber of Mines (CoM) and the Namibia Statistics Agency (NSA) as shown on Table 3.4 reflect that during the period 2010 to 2018, mining exports averaged 43.0% of total exports of goods and services. Of these, exports (as % of total exports of goods and services) of diamonds, uranium, and copper averaged 17.1%, 9.5%, and 4.5%, in that order.

Table 3.4: Value of exports for selected minerals (N$ Million) and mineral exports as (% of total exports of goods and services)

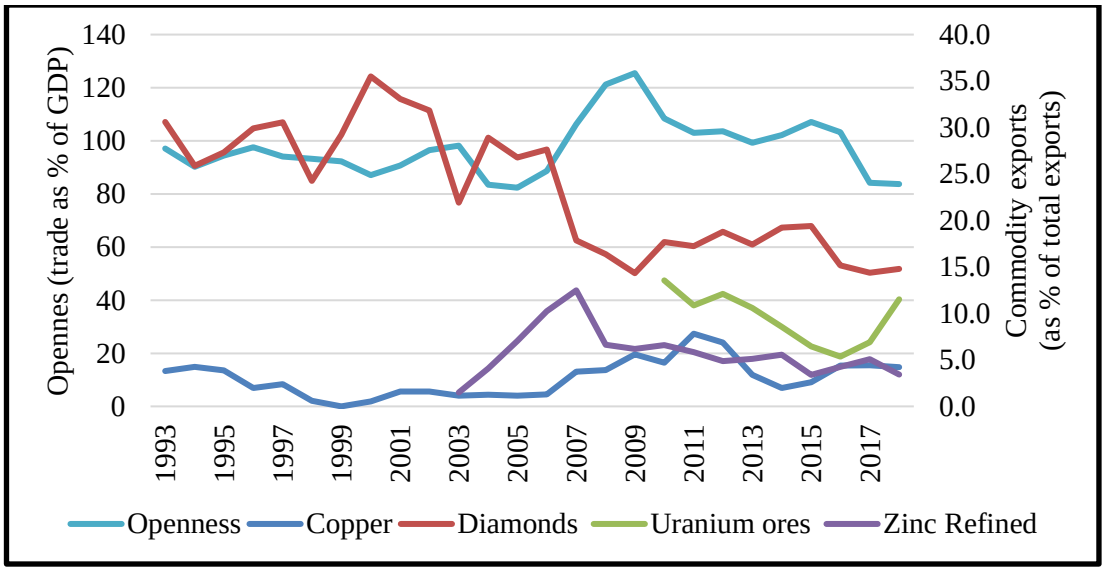
	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average
Exports of ores and minerals (N$ Million current prices)										
Copper	1,860	3,208	3,192	1,721	1,064	1,507	3,000	3,001	3,131	2,409
Diamonds	6,971	7,073	8,708	8,798	10,325	11,195	10,357	9,744	11,014	9,354
Uranium ores	5,348	4,461	5,610	5,348	4,588	3,728	3,653	4,667	8,579	5,109
Metal ores	1,685	1,432	1,531	1,639	2,339	4,010	6,092	5,561	5,402	3,299
Others	12,319	11,534	14,318	14,146	14,913	14,923	14,010	14,411	19,593	14,463
Total mining export	19,061	19,264	22,074	20,913	22,184	23,013	26,772	27,162	31,482	23,547
Total export of goods & services	**39,447**	**41,023**	**46,391**	**50,572**	**53,721**	**57,645**	**68,207**	**67,748**	**74,418**	**55,463**
As % of total exports of goods & services										
Copper	4.7	7.8	6.9	3.4	2.0	2.6	4.4	4.4	4.2	4.5
Diamonds	17.7	17.2	18.8	17.4	19.2	19.4	15.2	14.4	14.8	17.1
Uranium ores	13.6	10.9	12.1	10.6	8.5	6.5	5.4	6.9	11.5	9.5
Metal ores	4.3	3.5	3.3	3.2	4.4	7.0	8.9	8.2	7.3	5.6
Others	31.2	28.1	30.9	28.0	27.8	25.9	20.5	21.3	26.3	26.7
Total mining export	**48.3**	**47.0**	**47.6**	**41.4**	**41.3**	**39.9**	**39.3**	**40.1**	**42.3**	**43.0**

Source: Chamber of Mines (CoM) Annual Reviews (2017-2019)

Literature has established varying primary commodity export thresholds as a percentage of total exports being indicative of a resource-rich country. To this end, Auty (1993) and IMF (2012) postulated a primary commodity export threshold value of at least 40.0% and 20.0%, respectively. Similarly, Namibia is classified among other resource-intensive countries (for which non-renewable natural resources represent

25.0% or more of total exports) within sub-Saharan Africa, according to the IMF (2022). Consequently, Namibia can thus be regarded as a resource-rich country according to either of the established thresholds. However, this commodity dependence exposes the Namibian economy too, among others, to global commodity price dynamics. This view is supported by scholars Acemoglu and Zilibotti (1997), Lederman and Porto (2016) and McIntyre et al. (2018) who proclaimed that the main side effect of commodity dependence is the exposure to sector-specific shocks that trickle down across the economy, increasing their macroeconomic vulnerability and impairing long-term growth.

Figure 3.11: Openness (trade % of GDP) and commodity exports (% of total exports)



Source: NSA trade data and Chamber of Mines various Annual Reviews

Some of the Namibian mining sector's stylized facts include being recognised among the top producers of different minerals and among the earliest countries where minerals were discovered. Accordingly, diamonds were first discovered in Namibia in 1908. In terms of volume and value, Namibia is recognised as the 4th among the leading diamond-producing countries within southern Africa, following Botswana, South

Africa and Angola, respectively (McKechnie, 2019). Similarly, uranium mining in Namibia dates back to the pre-1980 period, given that the first commercial uranium mine began operating as early as 1976. Yet, Namibia has significant uranium mines capable of providing 10% of world mining output (World Nuclear Association, undated). In support of this fact, Table 3.5 shows production figures for the 10 largest producers globally from which Namibia ranks as the 4th largest producer of uranium after Kazakhstan, Canada and Australia, in that order, according to World Nuclear Association uranium production figures 2011-2020 (World Nuclear Association, undated). Evidently, for the period 2011 – 2020, Namibia was the largest uranium producer in SSA, with an average production of 7.6% of the global total. Its production figures have increasingly been rising significantly above peers such as Niger.

Table 3.5: Uranium Production Figures (Tonnes Uranium Oxide – U3O8) (2011-2020) for the Top 10 largest producers

Country	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Avg**
Kazakhstan	19,451	21,317	22,451	23,127	23,607	24,689	23,321	21,705	22,808	19,477	2,195
% of Total	36.4	36.4	37.8	41.3	39.1	39.1	38.5	40.1	41.7	40.8	39.1
Canada	9,145	8,999	9,331	9,134	13,325	14,039	13,116	7,001	6,938	3,885	9,491
% of Total	17.1	15.4	15.7	16.3	22.1	22.2	21.7	12.9	12.7	8.1	16.4
Australia	5,983	6,991	6,350	5,001	5,654	6,315	5,882	6,517	6,613	6,203	6,151
% of Total	11.2	12.0	10.7	8.9	9.4	10.0	9.7	12.0	12.1	13.0	10.9
Namibia	**3,258**	**4,495**	**4,323**	**3,255**	**2,993**	**3,654**	**4,224**	**5,525**	**5,476**	**5,413**	**4,262**
% of Total	**6.1**	**7.7**	**7.3**	**5.8**	**5.0**	**5.8**	**7.0**	**10.2**	**10.0**	**11.3**	**7.6**
Uzbekistan	2,500	2,400	2,400	2,400	2,385	3,325	3,400	3,450	3,500	3,500	2,926
% of Total	4.7	4.1	4.0	4.3	4.0	5.3	5.6	6.4	6.4	7.3	5.2
Niger	4,351	4,667	4,518	4,057	4,116	3,479	3,449	2,911	2,983	2,991	3,752
% of Total	8.1	8.0	7.6	7.2	6.8	5.5	5.7	5.4	5.4	6.3	6.6
Russia	2,993	2,872	3,135	2,990	3,055	3,004	2,917	2,904	2,911	2,846	2,963
% of Total	5.6	4.9	5.3	5.3	5.1	4.8	4.8	5.4	5.3	6.0	5.2
China	885	1,500	1,500	1,500	1,616	1,616	1,692	1,885	1,885	1,885	1,596
% of Total	1.7	2.6	2.5	2.7	2.7	2.6	2.8	3.5	3.4	3.9	2.8
Ukraine	890	960	922	926	1,200	808	707	790	800	400	840
% of Total	1.7	1.6	1.6	1.7	2.0	1.3	1.2	1.5	1.5	0.8	1.5

USA	1,537	1,596	1,792	1,919	1,256	1,125	940	582	58	6	1,081
% of Total	2.9	2.7	3.0	3.4	2.1	1.8	1.6	1.1	0.1	0.0	1.9
Total world	**53,493**	**58,493**	**59,331**	**56,041**	**60,304**	**63,207**	**60,514**	**54,154**	**54,742**	**47,731**	**56,801**

Source: https://world-nuclear.org/information-library/facts-and-figures/uranium-production-figures.aspx

Note: Avg – Average

Namibia is also among the key copper-producing countries, although not quite as significant a producer as it is of uranium. According to Copper Development Association Inc. (2021), Namibia's production figures are significantly lower in comparison with others; it is the 4th largest in Africa after Zambia, Congo and South Africa, respectively. Table 3.6 presents production figures for selected copper-producing countries.

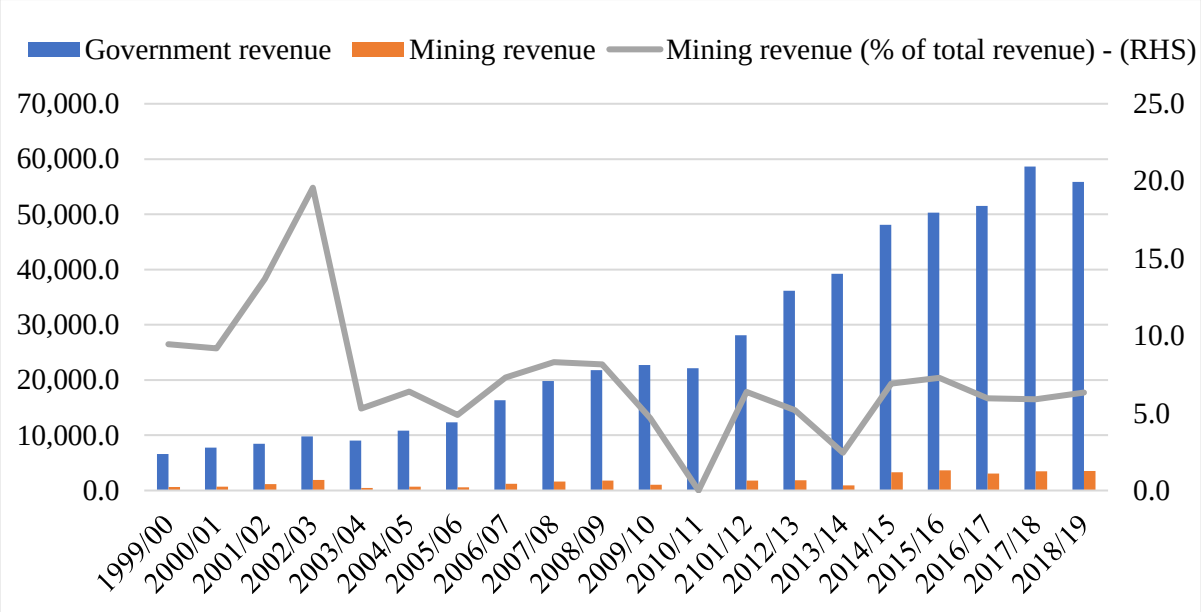
Table 3.6: Copper Production Figures (Tonnes) for selected countries

Country	**2000-05**	**2006-11**	**2012-16**	**2017**	**2018**	**2019**
Chile	5,431	5,937	6,236	6,067	6,428	6,380
Peru	920	1,335	1,788	2,696	2,686	2,707
China	861	1,208	1,894	1,881	1,754	1,795
Congo	64	299	928	1,169	1,370	1,415
Namibia	**15**	**5**	**10**	**17**	**7**	**17**
South Africa	116	114	83	72	53	58
Zambia	384	655	802	875	941	879
Total Africa	**578**	**1074**	**1823**	**2,134**	**2,371**	**2,369**
Total World	**15,422**	**17,347**	**20,494**	**22,309**	**22,736**	**22,655**

Source: Copper Development Association Inc. (2021)

Data from the Chamber of Mines annual reviews divulge that the mining sector has consistently contributed significantly to government revenue, as evidenced by the path of mining revenue (% of total revenue) trendline (Figure 3.12). During the period from 1999/00 to 2018/19, mining revenue (as % of government revenue) averaged 7.2%.

Figure 3.12: Government and mining revenues (N$ Millions)



Source: Chamber of Mines Various Annual Reviews and Ministry of Finance Budget Documents

The mining sector has, over the years, created a significant number of permanent jobs, which has ultimately helped lower the country's unemployment rate, a feat that augurs well with the government's national objective of employment creation. From 1990 to 2018, the number of people in permanent employment averaged 8,172. However, there are other direct employment created by the sector. Table 3.7 depicts permanent employment in the mining sector since independence in 1990.

Table 3.7: Employment (number of people in permanent employment) in the mining sector

	1990-94	1995-99	2000-04	2005-09	2010-14	2015	2016	2017	2018
Permanent employment	11,383	7,686	6,577	7,338	7,277	8,259	9,143	9,390	8,880

Source: Chamber of Mines Various Annual Reviews

Namibia's economy, just like her peers in sub-Saharan Africa, is a mineral-rich country characterised by a narrow manufacturing base and a dominant mining sector. Being a small, open and commodity-based economy, Namibia is susceptible to global economic outturns (booms and recessions) owing to volatile commodity prices. Thus, the dependency on the mining sector has been a topic of concern to policy makers given the fact that, in most instances, the minerals are exported in their raw form without any value addition. Yet, as outlined in NPC (2021), only a few minerals have value addition i.e., Gold (gold bars), Diamonds (diamond polishing and processing), Copper (copper smelting – copper cathodes) and Zinc [Zinc processing leading to Special High Grade (SHG) 99.995% pure zinc].

This slow structural transformation is notwithstanding the fact that the country's long-term aspirations, as articulated in Vision 2030 (Republic of Namibia, 2004), are to become *"*A prosperous and industrialised Namibia, developed by her human resources, enjoying peace, harmony and political stability*."* At the core of the vision is industrialisation, which would ultimately lead to the country's structural transformation. Consequently, various policies have been adopted to achieve the required transformation. These include the National Development Plans (NDPs);

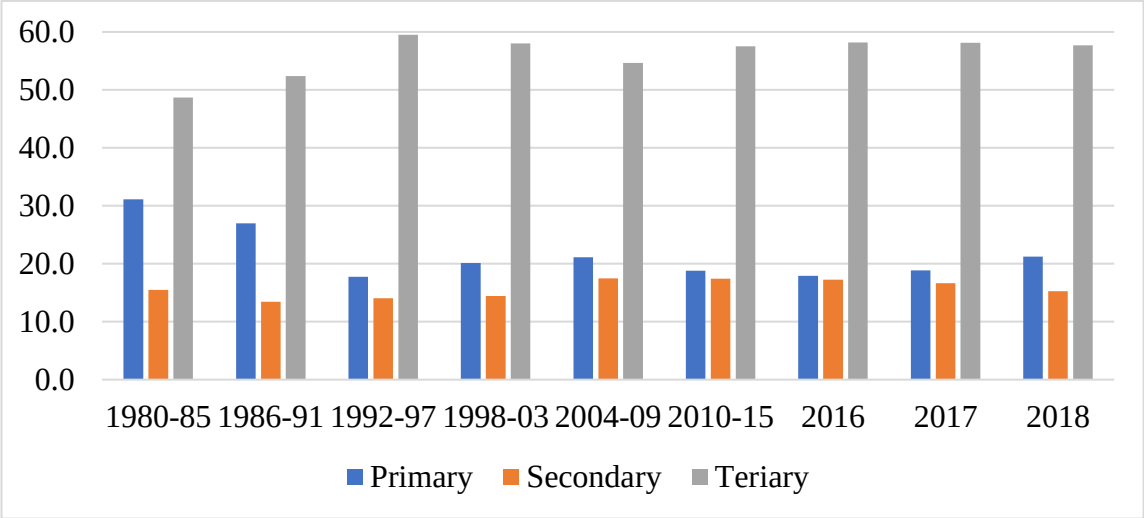
Industrialization Policy (IP); Growth at Home (Namibia's industrialisation strategy), among others. These policies and strategies advocated for increased manufacturing (value addition), of which primary industries (extractive sectors, agriculture and mining) were to play a significant role in the transformation trajectory.

The Joint Value Addition Committee (JVAC), led by the Ministry of Industrialization and Trade and chaired by the Ministry of Mines and Energy, was established in 2013, and through this committee, an in-depth analysis of the beneficiation possibilities for Namibia's key mineral commodities and opportunities for value addition was done (Mines and Energy, 2013). Moreover, an export levy is one of the policy interventions introduced by the government to incentivise value addition in Namibia. However, as Hausmann et al. (2022) establish, Namibia's economy is comparatively less complex and attractive opportunities to diversify tend to be more distant when assessed within the lenses of economic complexity (a measure of knowhow agglomeration vis-à-vis its peers). Yet, the researchers identified 97 products with potential for diversification which were grouped into five diversification schemes: (i) Chemicals & Basic materials, (ii) Food industry, (iii) Machinery and electronics, (iv) Metals, mining, & adjacent industries, and (v) Transportation & logistics.

According to Namibia Statistics Agency's national income accounts data (2019a), manufacturing (whose contribution to GDP from 1980 to 2018 has remained stagnant whilst averaging below 20.0%) falls into the secondary industries. This is notwithstanding the fact that the afore-mentioned noble policies aimed at ensuring the achievement of industrialisation. Clearly, the structural transformation has not

matched expectations. The primary and secondary industries' contributions to GDP have since 2010 averaged less than 20.0%, although primary has been higher than secondary, on average. To this end, the disaggregation between the three industries (primary, secondary, and tertiary) of the economy as a contribution to GDP has remained virtually the same from the 1980s to 2018, as Figure 3.13 attests.

Figure 3.13: Primary, secondary, and tertiary industry (% contribution to GDP)

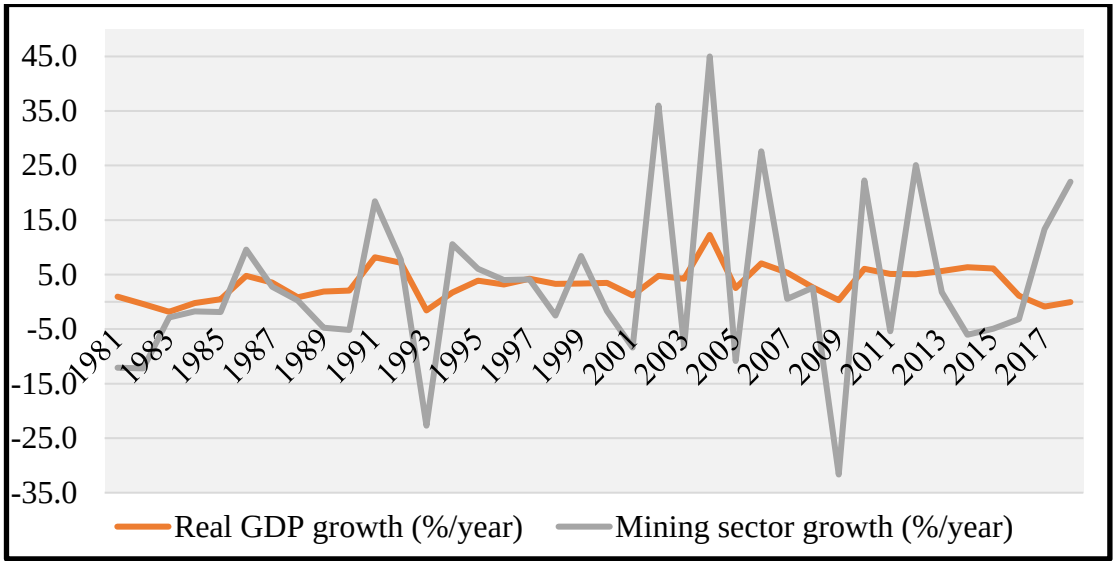


Source: NSA Time series data (2020)

3.5.3 Namibia's Business Cycles

As a result of the commodity boom experienced during the period from 2001 to 2007, the mining sector recorded an average growth of 11.7% which was more than double the average real GDP growth of 5.4%. Over the years, Namibia's mining sector growth has been characterised by volatility, as can evidently be seen in Figure 3.14.

Figure 3.14: Real GDP and mining sector growth rates (%), 1981 – 2018



Source: NSA (2019a)

3.6 Summary

This chapter elucidates Namibia's fiscal and monetary policies, external sector, commodity prices and business cycle developments. Some salient features evidently reflected include the following: Namibia is a member of the Common Monetary Area (CMA) through whose membership it has ceded monetary and exchange rate policies. Namibia is also a member of the Southern African Customs Union (SACU), from which it derives approximately a third of its revenue. Since attaining independence in 1990, the country has experienced key structural reforms and policy changes resulting in increased integration with the global and regional markets. Moreover, planning was adopted as a tool to uplift the living standards of the masses of the people. Subsequently, the Transitional National Development Plan (TNDP) was formulated covering the period 1990/91 to 1993/94, after which the first NDP (1195/96 to 1999/00) and second NDP (2001/02 to 2005/06) followed.

The country's long-term blueprint, Vision 2030, was launched in 2004. The overall objectives have largely been on addressing the country's four socio-economic challenges: increased and sustainable economic growth, employment creation and reductions of poverty and inequality. On the fiscal developments front, Namibia has been experiencing huge fiscal deficits, which posed a serious challenge of satisfying its inter-temporal budget constraint with conventional revenue and borrowing. Owing to improved economic growth prospects and a boom in commodity prices, the government introduced and implemented a fiscal consolidation programme in 2005/06 to strengthen fiscal fundamentals. This resulted in three consecutive budget surpluses achieved through a combination of revenue enhancement and expenditure restraint during 2006/07, 2007/08 and 2008/09. Other developments reveal that from 1981 to 2020, economic growth averaged a modest 2.8%. Inflation and interest rates averaged 9.1 and 15.2% between 1980 and 2018, respectively. Namibia is an open economy, evidenced by its high openness average of 98.8% over the same period.

Mining sector developments reveal that between 2009 and 2018, the mining sector GDP increased multi-fold from N$8.1 billion to N$27 billion. Yet, mining remain an important foreign exchange earner evidenced by the fact that mineral exports averaged 43.0% of total exports of goods and services from 2010 to 2018. In view of this, Namibia has been classified among resource-intensive countries (for whom non-renewable natural resources represent at least 25% of total exports). In terms of mineral production, Namibia ranks fourth and first globally and in sub-Saharan Africa in terms of uranium during the period 2011 to 2020. Also, on copper production, the country is ranked fourth in Africa for the period 2000 to 2019. Notwithstanding this, however, mining sector growth performance has been characterised by volatility.

Chapter Four: The Dynamic Effects of Fiscal Policy Shocks on Macroeconomic Variables

4.1 Introduction

This Chapter presents briefly what entails fiscal policy shocks and the associated effects on macroeconomic variables. Moreover, identification schemes, support for adopting Vector Autoregressions (VARs) and Structural Vector Autoregressions (SVARs) in modelling these shocks, materials and methods applied in the analysis, results, and discussion as well as chapter's summary are discussed.

4.2 Synopsis of Fiscal Policy Shocks

Until recently, especially after the world financial crisis of 2008/09, studies on the effects of fiscal policy shocks on macroeconomic variables have somewhat gained traction, given the renewed interest in respect of stabilising the economy through the effective use of fiscal policy as a macroeconomic tool, among others. To this end, Eschenhof-Kammer (2013) stated that the question of how intensely fiscal policy affects an economy is more relevant than ever. Conducting empirical studies on fiscal policy shocks makes it worthwhile to start by providing a comprehensive meaning to fiscal policy. According to Tanzi (2006), the term fiscal comes from the Latin word *'fiscalis'*, which in turn comes from fiscus, i.e., a basket used for collecting money. In Italian, the word "*il fisco"* refers to the agency that collects taxes. Thus "fiscal policy" means policy related to taxes. Dornbusch, Fischer and Swartz (2014), on the other hand, defined fiscal policy as the policy of the government with regard to the level of government purchases, the level of transfers, and the tax structure. However, the meaning of the fiscal policy, just like other policies, has evolved over time. To this end, Johnson (2018) proclaimed that fiscal policy was conceived very differently in

the period before 1936, and it was only in the 1930s that the meaning of *"fiscal policy"* even began to approach the modern narrow definition – macroeconomic stabilization through the manipulation of taxation and government spending. Fiscal policy has thus been described in the simplest sense as the use of government revenue and expenditure to influence the economy and maintain macroeconomic stability in view of the achievement of sustainable economic development.

Generally, it takes time for fiscal policy changes in response to shocks. Blanchard and Perrotti (2002) posited that fiscal policy is subject to two types of lags: (i) decision lags, which in other words, suggest that it takes some time for policy to be changed in response to shocks; (ii) implementation lags, which indicate that it takes some time for policy changes to be implemented. Overall, the main object of fiscal policy is centred around stimulating the macroeconomy to achieve socio-economic development. In view of this, Ocran (2010) postulated that the intent of the fiscal policy is essentially to stimulate economic and social development by pursuing a policy stance that ensures a sense of balance between taxation, expenditure and borrowing that is consistent with sustainable growth.

Fiscal policy shocks are in the simplest terms defined as surprises (unanticipated) changes in fiscal policy and are viewed as existing in a two-dimensional space: government revenue and spending shocks (Mountford & Uhlig, 2009). Damane et al. (2016), on the other hand, posited another view by defining fiscal shocks as positive shifts in government expenditure and government revenue, respectively, which is done in order to examine and conclude the different effects of each shock on identified macro variables together with their mutual influence. In contrast, Favero (2002)

offered an econometric definition where fiscal shocks can be considered as the residuals of estimated fiscal rules.

Notwithstanding the plethora of empirical studies on the effects of fiscal policy shocks on macroeconomic variables, however, a consensus has not been reached. In support of this, Caldara and Kamps (2008) claimed that varying conclusions have been drawn for different countries and econometric approaches in respect of the effects of fiscal policy shocks (government spending shocks and tax shocks) on economic activity. Franta (2012), on the other hand, theorized that the effects of fiscal policy shocks are still a subject of lively debate, as neither theoretical nor empirical studies have so far reached a consensus on either the qualitative or quantitative properties of such effects. Recently, Mencingera *et al.* (2017) argued that since the financial and economic crisis, there have been ambiguities on the effects of fiscal policy and its transmission mechanisms have been reflected by the adoption of varying economic policies in view of counteracting faltering economies across countries.

This ideological dispute has centred around two strands of literature: firstly, scholars (Fatas & Mihov, 2001a; Kuttner & Posen, 2002; Gali *et al.*, 2007; Giordano *et al.*, 2008; and Romer & Romer, 2010) supporting the Keynesian theory for which fiscal policy shocks have clear positive effects on output, consumption and/or employment. The second strand of scholars, i.e. Ramey and Shapiro, 1998; Edelberg *et al.*, 1999; Blanchard & Perotti, 2002; van Aarle *et al.*, 2003; Burnside *et al.*, 2004; Mountfold & Uhlig, 2005; Perotti, 2004, 2007; Caldara & Camps, 2008; Alfonso & Sousa, 2009; Taylor, 2009; Cogan *et al.*, 2010; Barro & Redlick, 2011; Ramey, 2011) supports neo-

classical view by revealing that expansionary fiscal policy may produce adverse effects on some macroeconomic variables.

Furthermore, some researchers (Auerbach & Gorodnichenko, 2012, 2013; Krugman, 2015; Romer, 2012; Henning *et al.*, 2002; Perrotti, 1999; amongst others) support the Keynesian view, which advocates for an active countercyclical fiscal policy. Meanwhile, new classical economists (Alesina & Ardana, 2010; Hebous, 2011; Monacelli & Perotti, 2008; Ravin *et al*., 2007; among others) have advocated for austerity measures aimed at reducing soaring government deficits. Perotti (2002) contended that contrary to what the policy discussion seems to take for granted, there is clearly no consensus even on the basic effects of government spending on output and its components. Favero and Giavazzi (2007), on the other hand, postulated that a shift in taxes or in government spending (a "fiscal shock") at some point in time puts a constraint on the path of taxes and spending in the future since the government inter-temporal budget constraint will eventually have to be met. Yet, there have been different strands on the effects of fiscal policy shocks established by literature thus far.

A plethora of literature on fiscal policy shocks in developed economies exists; however, there appears to be a dearth of literature in view of developing countries in sub-Saharan Africa in general and Namibia in particular. To the best of the researcher's knowledge, there is no empirical study conducted for the Namibian economy examining the dynamic effects of fiscal policy shocks on output, inflation, and interest rate. Against this backdrop, the novelty of this study on fiscal policy shocks is two-fold: *firstly*, to fill the current literature gap and contribute to modelling literature on the effects of fiscal policy shocks on macroeconomic variables in Namibia and, by

extension to, sub-Saharan Africa. *Secondly*, the study is also conducted with a view to providing tools for evidence-based policymaking, especially in the case of formulating future NDPs and associated annual macroeconomic targets, as well as informing the formulation of fiscal and overall macroeconomic policies.

4.2.1 Support for modelling Fiscal Policy Shocks using VAR and SVAR models

There is strong empirical support, in the literature, for studies on fiscal shocks using VAR and SVAR models. SVAR models were first introduced by Sims in 1980 as an alternative to traditional large-scale macro econometric models when the theoretical and empirical support for these models became increasingly doubtful. However, Sims (1980) argued that truly exogenous variables are hard to come by as many of those exogenous variables in large macroeconomic models are treated as exogenous by default rather than as a result of there being a good reason to believe them to be strictly exogenous. Moreover, he posits that one of the major problems in the traditional approach to identification relates to the difficulty of finding truly exogenous variables that can be used as instruments in the field of monetary economics, where practically every variable is to some extent endogenously determined owing to well established financial markets and rational expectations. Against this backdrop, it is difficult to justify on a priori grounds that a given variable has no influence on another variable. In view of these difficulties, SVAR models treat all variables as endogenous.

Stock and Watson (2007), on the other hand, advanced that the main difference between SVARs and VARs is that structural modelling requires very specific assumptions of what is exogenous or not. In view of areas of applicability, Blanchard

and Perotti (2002) postulated that the SVAR approach seems to be more suitable in fiscal policy analysis to the extent that there exist some genuine exogenous fiscal shocks (not due to output stabilization) and decision and implementation lags in fiscal policy imply that there is little discretionary response (within a quarter) to unexpected movements in activity. It was in this context that some researchers began studying the impulse response to fiscal policy, but this was done mostly for industrialised countries.

This study specifically employed the SVAR, a methodology whose practical relevance in view of three-fold observations: (theoretical underpinnings, identification assumptions and statistical methodology) has been challenged in Cooley and Dwyer (1998); Chari, Kehoe and McGratten (2008), among others. However, despite being challenged on these grounds, the SVARs continue to prove being indispensable macro-econometric tools for examining fiscal policy shocks, among other approaches or models.

In support of the application of SVARs, Breitung (1998) asserted that they are useful in taking a theory-guided look at the data. Moreover, as Bogoev et al. (2012) argued, the main advantage of the VAR methodology lies in its simplicity and its well-suited tools (impulse response functions and variance decomposition) for tracing the dynamic interactions between a set of endogenous variables. Recently, Mazzi et al. (2016) observed that "a perceived advantage of SVAR models, relative to unobservable components (UC) type models, is that SVAR models can be viewed as one-sided filters; in this sense, they overcome the end-point problem associated with UC model that can be seen to involve the application of a two-sided filter." Overall, SVAR econometric methodology has been applied overwhelmingly in view of addressing the

economy's response to fiscal policy shocks. These empirical studies include Blanchard and Perotti (2002), Mountford and Uhlig (2009), Romer and Romer (2010), Mertens and Ravn (2011), among others.

4.3 Materials and Methods

This section specifically outlines the data and the methodology [Unit Root, co-integration, Structural Vector Autoregressions (SVAR), Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD) tests] applied in this research. Most economic variables that are used for policy analysis and forecasting are characterized by high persistence and possibly nonstationary behaviour. It is common practice in applied work to subject these series to pre-tests for unit roots and co-integration prior to the Vector Autoregressive (VAR) analysis to determine the appropriate transformations that render the data stationary.

4.3.1 Model Specification and Econometric Approach

It is standard practice in econometric modelling that the choice of variables to be included in the model is not made arbitrarily. In view of this, Ouliaris et al. (2018) posited that there are two ways of choosing variables to be included in the VAR or SVAR model, that is, by institutional knowledge (intuition over what variables are needed to adequately model the system) and from theoretical models. After carefully examining literature (Ravn, Schmitt-Grohe & Uribe, 2007; Afonso & Sousa, 2011; Lozano & Rodríguez, 2011) on the fiscal policy effects and interrogating the institutional knowledge and theoretical models, this study adopted Real government spending (G), Real output as reflected by Real GDP (Y), inflation (P), Real tax revenue (T) and interest rate (R) as the variables to be included. These variables exceed the minimal set of macroeconomic variables (taxes, spending and GDP, all in real per

capita terms) required for the study on the dynamic effects of fiscal changes as advanced by Perotti (2002). Data on all variables were transformed to their log form (except for interest rate), after which the analyses were carried out using EViews 11.

The baseline VAR model utilises government spending and tax revenue to identify the fiscal spending shocks, although other researchers (Blanchard and Perotti, 2002; Ocran, 2011; Oseni and Onaoya, 2012, amongst others) in literature have adopted alternative measures of the fiscal spending variables, i.e., government budget balance (or in some instances deficit). This study sought to analyse the effects of government expenditure and tax revenue shocks on macroeconomic activity by applying a SVAR model to Namibian data. To assess the dynamic effects of fiscal policy shocks, the SVAR estimation technique was applied following Ahumada (2009), Lozano and Rodríguez (2011) and Boiciuc (2015). Two approaches were applied: Recursive Method (Cholestsky decomposition) SVAR and VAR (which served as a robustness check).

Considering that high-frequency data (quarterly or monthly) are not available for the Namibian economy over the sample period, a limited number of endogenous macroeconomic variables were included in view of preserving the loss of degrees of freedom. To this end, the model was made up of five-endogenous macroeconomic variables [government expenditure (g), output (y), inflation (p), tax revenue (r), and interest rate (i) observed at time t.]. This set of variables is similar to those adopted in Krusec (2003), de Castro (2003), Surjaningsih *et al.* (2012), Hayo and Uhl (2014) and Boiciuc (2015) but wider than the three-variable VAR in Blanchard and Perotti (2002). The SVAR model in its primary form is expressed as:

$$A_j X_t = A_1 X_{t-1} + A_2 X_{t-2} + \cdots + A_p X_{t-q} + \mathrm{B}\varepsilon_t \quad (4.1)$$

Where $X_t = [g_t, y_t, p_t, r_t, i_t]'$ is a (5x1) vector of endogenous macroeconomic variables; A, B, and A_i are (5x5) coefficient matrices, with $j = 1, 2, \ldots, q$ and $\varepsilon_t = [\varepsilon_t^g, \varepsilon_t^y, \varepsilon_t^p, \varepsilon_t^r, \varepsilon_t^i]'$is a (5x1) vector of structural shocks. The elements of ε_t are shocks to the different variables in the system i.e., ε_t^g and ε_t^r denotes fiscal shocks. When relation 4.1 is unpacked, it becomes a system of five equations as follows:

$$g_t = \sum_{j=1}^{q} \delta_{1,j} g_{t-1} + \sum_{j=1}^{q} \gamma_{1,j} y_{t-1} + \sum_{j=1}^{q} \theta_{1,j} p_{t-1} + \sum_{j=1}^{q} \varphi_{1,j} r_{t-1} + \sum_{j=1}^{q} \omega_{1,j} i_{t-1} + B\varepsilon_{1,t} \quad (4.2)$$

$$y_t = \sum_{j=1}^{q} \delta_{2,j} g_{t-1} + \sum_{j=1}^{q} \gamma_{2,j} y_{t-1} + \sum_{j=1}^{q} \theta_{2,j} p_{t-1} + \sum_{j=1}^{q} \varphi_{2,j} r_{t-1} + \sum_{j=1}^{q} \omega_{2,j} i_{t-1} + B\varepsilon_{2,t} \quad (4.3)$$

$$p_t = \sum_{j=1}^{q} \delta_{3,j} g_{t-1} + \sum_{j=1}^{q} \gamma_{3,j} y_{t-1} + \sum_{j=1}^{q} \theta_{3,j} p_{t-1} + \sum_{j=1}^{q} \varphi_{3,j} r_{t-1} + \sum_{j=1}^{q} \omega_{3,j} i_{t-1} + B\varepsilon_{3,t} \quad (4.4)$$

$$r_t = \sum_{j=1}^{q} \delta_{4,j} g_{t-1} + \sum_{j=1}^{q} \gamma_{4,j} y_{t-1} + \sum_{j=1}^{q} \theta_{4,j} p_{t-1} + \sum_{j=1}^{q} \varphi_{4,j} r_{t-1} + \sum_{j=1}^{q} \omega_{4,j} i_{t-1} + B\varepsilon_{4,t} \quad (4.5)$$

$$i_t = \sum_{j=1}^{q} \delta_{5,j} g_{t-1} + \sum_{j=1}^{q} \gamma_{5,j} y_{t-1} + \sum_{j=1}^{q} \theta_{5,j} p_{t-1} + \sum_{j=1}^{q} \varphi_{5,j} r_{t-1} + \sum_{j=1}^{q} \omega_{5,j} i_{t-1} + B\varepsilon_{5,t} \quad (4.6)$$

Where $\delta_k, \gamma_k, \theta_k, \varphi_k$ and $\omega_k$are the time-varying coefficients with $k = 1,2, \dots ,5$ while all variables and coefficients are as explained earlier. Accordingly, the assumption is that the elements of vector ε_t are orthogonal, which in other words, implies that they are uncorrelated with unit-variance and zero expected value. This also implies that structural shocks are uncorrelated and identically normally distributed. Consequently, the covariance matrix of structural shocks, $E(\varepsilon_t \varepsilon_t') = \Lambda$, is an identity matrix. To estimate the SVAR model, equation (4.1) has to be transformed, that is, multiplied by an inverse matrix A^{-1}, in order to determine the reduced form. Moreover, as Caldara and Kamps (2008) posit that since the reduced-form disturbances will, in general, be correlated, it is thus necessary to make a transformation of the reduced-form model to a structural model. Therefore, to estimate the SVAR model, the reduced form is determined by multiplying equation 4.1 by an inverse matrix A^{-1}. The structural models in equations 4.1 up to 4.6 must be identified by imposing restrictions on elements in the matrix. From these, reduced-form SVAR in equation 4.1 becomes:

$$X_t = \Gamma_1 X_{t-1} + \Gamma_2 X_{t-2} + \cdots + \Gamma_p X_{t-q} + e_t \quad (4.7)$$

Where $\Gamma_i = A^{-1} A_i$ are reduced-form coefficient matrices with $i = 1, 2, \dots, q$ and $e_t = A^{-1} B\varepsilon_t$ is the vector of reduced-form innovations or vector of shocks in reduced-form which are uncorrelated and normally distributed, however, contemporaneously correlated with each other.

4.3.2 Data, Description and Source

This study employs annual time series data from 1980 to 2018, which gives a sample size of 39 observations with coverage of Namibia's pre- (prior to 1990) and post-independence (1990-2018) periods. The study's sample period reflects much change in respect of some notable international, regional and domestic events, which had a bearing on Namibia's macroeconomic and fiscal stability. These include the following: depressed commodity prices since the 1980s; the Establishment of the Southern African Development Coordination Conference (SADCC) in 1980, which led to the creation of the Southern African Development Community (SADC) in 1992; Namibia's independence in 1990; the Asian Financial Crisis of 1997; the Organisation of the Petroleum Exporting Countries (OPEC) oil price shocks in 1999 and 2002; the Global Financial Crisis of 2008-09; the European outbreak of the sovereign debt of 2010; among others.

The time series includes government expenditure (G_t) and tax revenue (R_t) as fiscal policy variables, whereas the output (Y_t), interest rate (I_t), and inflation (P_t) are the variables of interest. Interest rate and inflation are included to ensure that the system captures all relevant information as well as being mindful of the fact that in the absence of the former, fiscal policy shocks might pick up the effects of interest rate shocks if there is some systematic contemporaneous relationship between monetary and fiscal policies as advanced by Krusec (2003). All variables except interest rate (I_t), and inflation (P_t) were expressed in real terms after being deflated by the GDP deflator. Moreover, all variables except interest rate were log-transformed to reduce the scale of the variables, which is desirable when analysing time series properties of variables with large values. The descriptions of the variables are presented in Table 4.1.

Table 4.1: Description and sources of variables

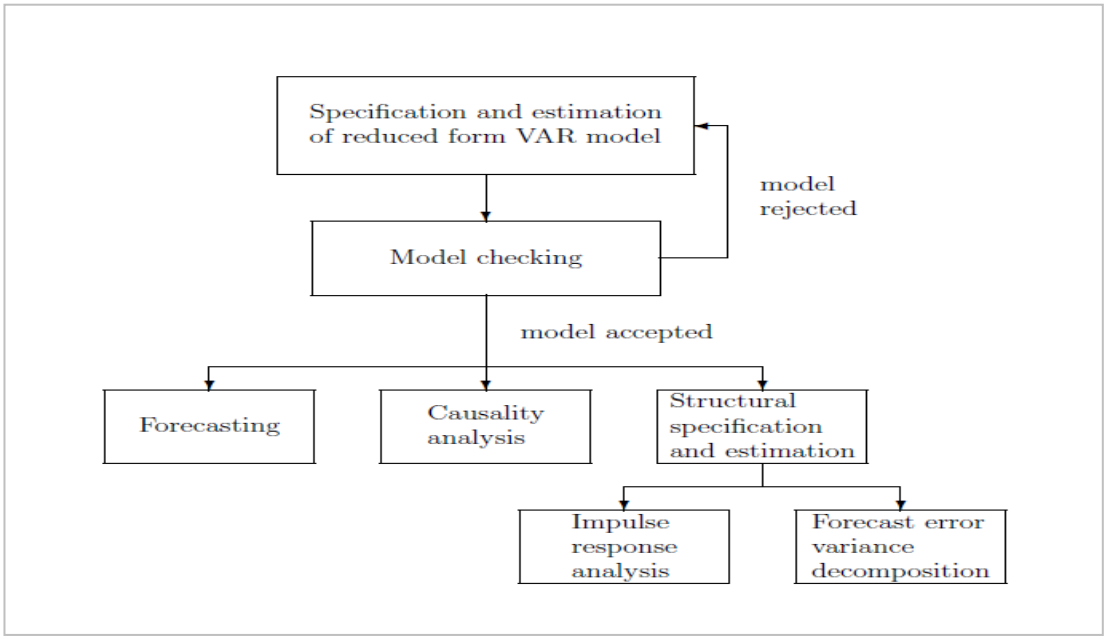
Variable	Descriptor	Definition	Source
G_t	Real General Government Expenditure or Real Government (public) spending	Government's spending on goods and services. Summation of government investment and consumption expenditures.	Ministry of Finance
Y_t	Real Output expressed as Real GDP	GDP, at constant 2010 prices measures the total value of all final goods & services produced per year.	Namibia Statistics Agency
P_t	GDP Deflator (Inflation rate)	A sustained increase in the general price level in a year as computed using the GDP deflator.	Namibia Statistics Agency
R_t	Real Tax Revenue	Government's total tax revenue from all tax categories. Tax revenue includes interest collected on tax arrears and penalties collected on non-payment or late payment of taxes.	Ministry of Finance
I_t	Interest rate	The lending rate refers to the weighted average lending rate (the rate charged by other Depository Corporations to borrowers). This is the rate at which commercial banks lend money to their clients. Namibia was part of South Africa prior to becoming independent in 1990; hence 1980-1989 is South African data, while 1991-2018 is Namibia data. Independence's (1990) data was estimated using the two data points (1989 and 1991).	Quantec (South African data) & Bank of Namibia (Namibian data)

4.3.3 VAR Analysis

Lütkepohl (2007) theorised that a typical VAR analysis proceeds by specifying and estimating a model and then checking its adequacy from which, if a model defect is detected at a later stage, model revisions are made until such time a satisfactory model has been found. Then the model may be used for other analyses i.e., forecasting, causality or structural analysis, from which impulse response analysis and forecast

error variance decomposition can be computed. These main steps in VAR analysis are presented in Figure 4.1.

Figure 4.1: VAR analysis [adopted from Lütkepohl (2006)



4.3.4 Tests for Unit Root (Stationarity)

Sims (1980) and Doan (2000), amongst others, strongly advocated against differencing especially when conducting VAR analysis, even if the time series is non-stationary owing to the risk of losing valuable information about the co-movements of the series. Moreover, Lutkepohl (2006) contended that it is the overall stationarity of the model, as opposed to the stationarity of the individual variables, that is necessary to ensure the robustness of the findings and hence VAR-in-levels are said to be well-behaved in that the cumulative effects of shocks are both finite and measurable. The approach of adopting VAR-in levels for SVAR analysis has become common practice in similar studies (Perotti, 2002; de Castro, 2006; Heppke-Falk, Tenhofen & Wolf, 2006; and Ravinik & Zilic, 2010), among others.

According to Ashley and Verbrugge (2009), advocates of VAR modelling in levels advances two issues in rendering their support: (i) they are cognisant of the fact that the diagonal element lag structures in the VAR-in-levels model are free to mimic a first difference in the data generating process for each series in the model and (ii) they recognise that VAR models in levels generally have higher R-squared values than do VAR models in differences. Against the foregoing and the study's cognisance of the fact that results of SVAR estimates do not truly depend on the stationarity properties of the variables, thus, the analysis will be conducted in their level forms motivated by this study's primary interest, which lies in the dynamics rather than parameter estimation.

4.3.5 Lag Selection Criteria

The second step of the estimation procedure is the selection of the optimum lag length for the VAR model for which different selection criteria suggests specific lags. The importance of lag length selection is ascribed to avoiding econometric challenges i.e., choosing very few lags which leads to misspecification or choosing too many lags which yield an unnecessary loss of degrees of freedom and over parameterisation. Lag length selection is based on different criteria i.e., the sequential modified Likelihood Ratio (LR) test, Final Prediction Error (FPE), Akaike Information Criterion (AIC) (Akaike, 1973), Schwarz Information Criterion (SC) (Schwarz, 1978) and Hannan-Quinn Information Criterion (HQ) (Hannan & Quinn, 1979).

Liew (2004) established that Akaike's Information Criterion (AIC) and Final Prediction Error (FPE) are superior to the other criterion under study especially in the case of small sample (60 observations and below), in the manners that they minimize

the chance of under estimation while maximizing the chance of recovering the true lag length. In small samples, the AIC lag order distribution tends to be more balanced about the true lag order than the SIC lag order estimates (Nickelsburg, 1985; Lütkepohl, 1985; 1991). Moreover, as observed by Killian (2001), impulse response confidence intervals based on the AIC lag order estimate tended to be by far the most accurate intervals. Following these grounds, the number of lags suggested by AIC criterion was considered optimal and thus adopted for further analysis.

4.3.6 Model Robustness Checks

Against the backdrop that the reduced-form VAR represented in equation 4.1 underlies the structural VAR, Lütkepol (2011) maintained that it is important to check the adequacy of the reduced-form VAR in the data generation process. In consideration of this, VAR residual tests (serial correlation, normality, and heteroscedasticity), as well as VAR structural stability, were performed.

4.3.7 SVAR Identification

Sims (1986) specifically advanced that identification is simply the interpretation of historically observed variation in data in a way that allows the variation to be used to predict the consequences of an action not yet undertaken. However, Fragetta and Melina (2011) cautioned that, in general, empirical studies aiming at studying the effects of fiscal policy shocks confront great difficulties in identifying such shocks, as they have to disentangle the role of automatic stabilisers responding to business cycles from the effects of discretionary fiscal policies. Moreover, Zubairy (2010) asserted that the identification of fiscal shocks is, in general, complicated due to difficulties in isolating exogenous movements in fiscal variables, which are not simply an automatic response to the economy and also due to lags in implementation. Identification in view

of fiscal policy shocks relies on the Blanchard and Perotti (2002) original methodology, which greatly endowed econometricians with an ideal toolkit and, as such, remains the seminal paper for fiscal policy SVAR techniques.

For the identification approach, Heppke-Falk et al. (2006) asserted that the frequency of the time series used is crucial so as to exclude the possibility of discretionary fiscal policy actions within one time period hence the use of quarterly data. However, high-frequency data (i.e., quarterly) is not available for the chosen variables and sample in view of the Namibian economy hence the use of annual time series data. After the reduced-form VAR model passes the residual diagnostic and structural stability, the SVAR can now be specified and estimated. To identify and estimate the SVAR model, the AB-method is applied following Amisano and Giannini (1997) and Lütkepohl (2006). The relationship between structural shocks, on the one hand, and reduced-form shocks, on the other, is given by:

$$Ae_t = B\varepsilon_t \tag{4.8}$$

Equations (4) and (5) below elucidate the usefulness of the AB-method:

$$\Sigma = E(e_t e_t') = E\left(A^{-1}B\varepsilon_t\varepsilon_t'B'A^{-1'}\right) = A^{-1}BE(\varepsilon_t\varepsilon_t')B'A^{-1'} \tag{4.9}$$

$$= A^{-1}B\Lambda B'A^{-1'} = A^{-1}BI_nB'A^{-1'} = A^{-1}BB'A^{-1'}$$

Equation 4.8 which results from $e_t = A^{-1}B\varepsilon_t$, draws attention to the relationship between structural shocks ε_t and reduced-form innovations e_t. However, as Hayo and Uhl (2014) observed, the problem is that observed innovations in macroeconomic variables e_t cannot be separated into exogenous policy innovations ε_t and endogenous co-movements. Notwithstanding this identification problem, the literature presents

two conventional solutions in a VAR framework. These involve making assumptions about the form of matrices A and B, either by assuming a Cholesky ordering of variables (Fatás & Mihov, 2001b) or by following the structural VAR approach in Blanchard and Perotti (2002). Relation 4.9 concisely describes the identification procedure in an efficient way. Fundamentally, the elements of e_t, the vector of reduced-form innovations will be correlated. Consequently, its covariance matrix Σ, will be a non-diagonal symmetric matrix containing $\frac{n(n+1)}{2}$independent parameters in which case n denotes the model's total number of endogenous variables. Herein matrix Σ is the variance/covariance matrix of the vector of reduced-form innovations, e_t. The main diagonal elements (σ_i^2) are the variances whereas the rest are covariances (σ_{ij}). Matrix Σ can be presented according to the following:

$$\Sigma = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \dots & \sigma_{1n} \\ \sigma_{21} & \sigma_2^2 & \dots & \sigma_{2n} \\ . & . & . & . \\ \sigma_{n1} & \sigma_{n2} & \dots & \sigma_n^2 \end{bmatrix}$$

Where each covariance term is specified by $\sigma_{ij} = \frac{1}{T}\sum_{t=1}^{T} e_{it}e_{jt}$. Matrix Σ above is symmetric as $\sigma_{21} = \sigma_{12}$; $\sigma_{31} = \sigma_{13}$; $\sigma_{41} = \sigma_{14}$ etc. To achieve identification of the structural shocks in the AB-model, the number of restrictions on the off-diagonal elements of matrix A is *n(n-1)/2* since the estimated variance-covariance matrix of reduced-form residuals has *n(n+1)/2* unique elements. This is the maximum number of identifiable parameters in matrices A and B on which the identifying restrictions are imposed. Generally, the number of restrictions required to ensure exact identification is: $2n^2 - \frac{n(n+1)}{2}$ on A and B matrices. To estimate the covariance matrix, Σ for this study requires exactly *5(6)/2=15* parameters or free-information elements, while the off-diagonal elements of matrix A are *5(4)/2=10*. As Favero (2001) advanced, once

the shocks have been identified, the dynamic properties of the system can be described by analysing the response of all variables in the system to such shocks.

Cholesky decomposition identification scheme of the variance-covariance matrix of VAR residuals is applied to identify the structural shocks (government expenditure shock ε_G and tax revenue shock ε_R). According to Favero (2001), the Cholesky decomposition is obviously a just-identified scheme where the identification of structural shocks depends on the ordering of variables and corresponds to a recursive structure with the most endogenous variable ordered last. Identifying equation 4.8 requires the imposition of restrictions against the backdrop that some structural shocks have no contemporaneous effects on some endogenous variables. Congruent to Cholesky decomposition, the matrix A is identified as a lower triangular matrix while the matrix B as n-dimensional identity matrix.

Cholesky decomposition or factorization can be used to obtain structural innovations from reduced-form innovations with the assumption that matrix A is a unit matrix, whereas matrix B is a lower triangular one where all elements above the main diagonal are zero (Lütkepohl, 2005). However, careful ordering of the variables is of paramount importance and is usually informed by both theory and empirical works. In view of this, the variables: government expenditure, real output, inflation, tax revenue and interest rates represent the ordering adopted which is consistent with past empirical studies on fiscal policy shocks. This ordering is based on the following assumptions:

- Government expenditure/spending is placed first and is not contemporaneously affected by any of the shocks in the system. This, in other words, indicates that the policy variable (government spending) does not respond within the period to the other endogenous variables.

- Second is real output which is contemporaneously affected only by the government expenditure shock.
- Inflation is placed third and reacts contemporaneously to government expenditure and real output shocks while it is not contemporaneously affected by the government revenue and interest rate shocks.
- Tax revenue is placed fourth and is contemporaneously influenced by all shocks of the system except interest rate shock; and
- Last is the interest rate, which is contemporaneously influenced by shocks from all variables (the most endogenous variable) in the system.

It is worthwhile to note that these assumptions define relationships between reduced shocks only in the first period, while later, every shock can be affected by any other shock. In line with Cholesky decomposition, equation 4.8 becomes:

$$Ae_t = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ -a_{yg} & 1 & 0 & 0 & 0 \\ -a_{pg} & -a_{py} & 1 & 0 & 0 \\ -a_{rg} & -a_{ry} & -a_{rp} & 1 & 0 \\ -a_{ig} & -a_{iy} & -a_{ip} & -a_{ir} & 1 \end{bmatrix} \begin{bmatrix} e_{gt} \\ e_{yt} \\ e_{pt} \\ e_{rt} \\ e_{it} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{gt} \\ \varepsilon_{yt} \\ \varepsilon_{pt} \\ \varepsilon_{rt} \\ \varepsilon_{it} \end{bmatrix}$$

$$= B\varepsilon_t \qquad (4.10)$$

The next step after the estimation of the VAR is to get Impulse Response Functions (IRFs) and Forecast Error Vector Decomposition (FEVD). The Impulse Response Analysis approach or IRFs, which was first introduced by Sims (1980), are descriptive tools specifically representing the reaction of each variable to a shock in each equation of the system. Moreover, Lutkepohl (2005) postulated that IRFs help to know the response of one variable to an impulse in another variable in a system that involves a number of other variables as well. IRFs or dynamic multipliers precisely measure the effects of a shock to an endogenous variable on itself or on another endogenous

variable. Overall, IRFs provide the response of the variable to the underlying shocks. However, as Sims (1980) observed, in order to be able to see the distinct pattern of movement the system may display, the shocks must obviously be orthogonal. In view of this study, IRFs are used to reflect the response of real output, inflation and interest rates to innovations in the fiscal policy variables (public spending and tax revenue).

Similarly, the Forecast Error Variance Decomposition (FEVD) technique was also first introduced by Sims (1980) as a primary tool outlining complementary information for a better understanding of the relationships between the VAR model variables. According to Enders (2004), FEVD tells us the proportion of the movements in a sequence due to its "own" shocks versus shocks to the "other variable". It is the aim of the FEVD to measure the traction of the forecast error variance of an endogenous variable that can be attributed to orthogonalized shocks to itself or to another endogenous variable. Namibian data for the sample period is subjected to this identification scheme, and the results are presented in the next section.

4.4 Results and Discussion

4.4.1 Descriptive Statistics

The study variable's descriptive statistics are presented in Table 4.2, from which it is evident that interest rate (I) and inflation (LNP) have the highest and lowest mean values, respectively. The standard deviation measures the degree of variability hence the larger it is, the more volatile a said variable is. In view of this, interest rate (I) and real GDP (LNY) have the highest and lowest standard deviations of 4.5% and 0.4%, respectively. This suggests that interest rate and real output are the most volatile and the least volatile variables, correspondingly. The probabilities of the Jarque-Bera (JB)

statistic for all variables are greater than 0.05 thus suggesting that the null hypothesis of normality could not be rejected. Therefore, this implies that all variables are normally distributed.

Table 4.2: Descriptive statistics

	I	LNG	LNP	LNR	LNY
Mean	14.57115	9.787112	3.676786	9.546554	10.90908
Median	14.00000	9.755694	3.824475	9.532576	10.83827
Maximum	22.33333	10.72071	5.173352	10.47242	11.60725
Minimum	8.289167	8.796514	1.752767	8.651050	10.37969
Std. Dev.	4.514141	0.509461	1.016260	0.568041	0.421122
Skewness	0.224948	0.317530	-0.356380	0.132915	0.306708
Kurtosis	1.645645	2.167524	1.985830	1.788313	1.721074
Jarque-Bera	3.309610	1.781517	2.496922	2.500634	3.269389
Probability	0.191129	0.410344	0.286946	0.286414	0.195012
Sum	568.2750	381.6974	143.3947	372.3156	425.4541
Sum Sq. Dev.	774.3438	9.862905	39.24582	12.26149	6.739064
Observations	39	39	39	39	39

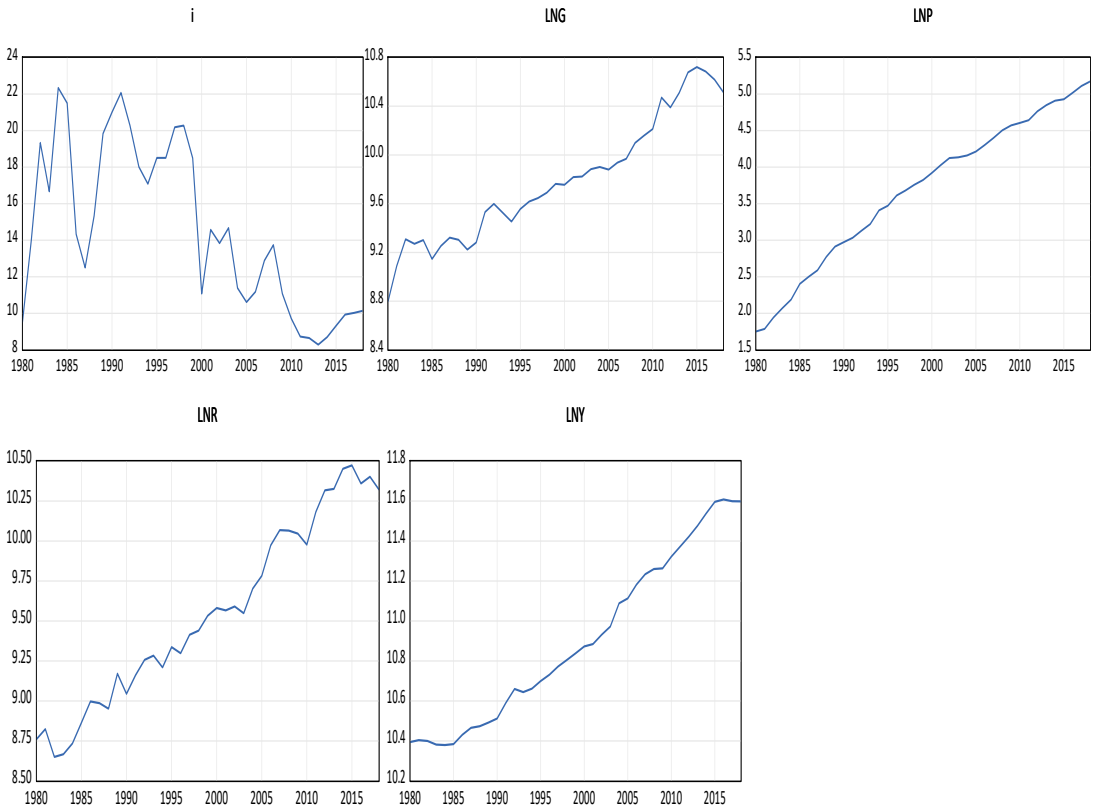
Source: Author's own calculations using EViews 11

4.4.2 Graphical Analysis of Variables used in the estimation

Figures 4.2 and 4.3 present the plots of variables adopted in the VAR analysis in their levels and first difference forms, respectively. Following Figure 4.2, it is evident that

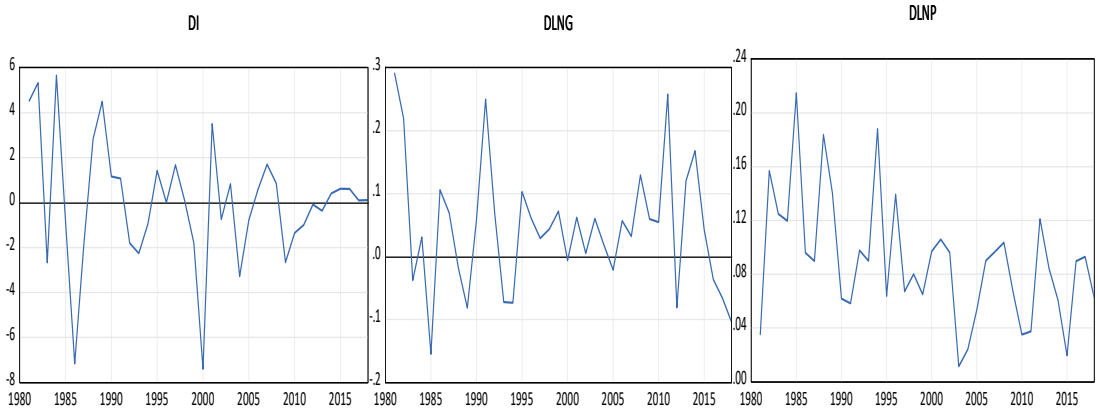
all variables portray either rising (LNG, LNP, LNR and LNY) or falling (interest rate I) trend thereby giving credence to the fact that they may not be stationary in their levels. Figure 4.2, on the other hand, confirms that all variables are stationary at first difference.

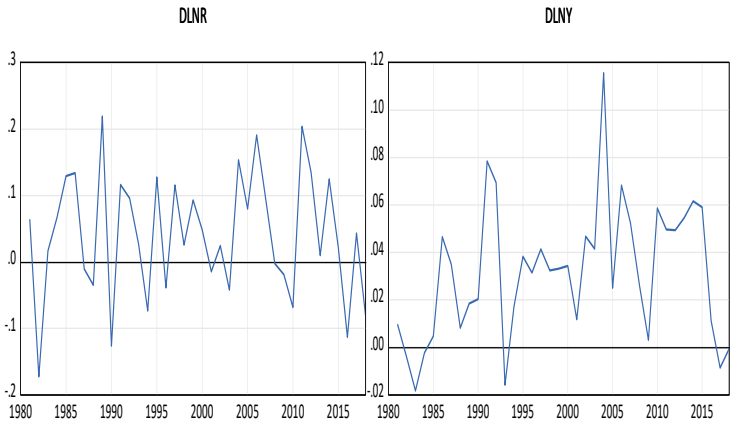
Figure 4.2: Graphical analysis of variables – levels form



Source: Author's own calculations using EViews 11

Figure 4.3: Graphical analysis of variables – first difference form





Source: Author's own calculations using EViews 11

4.4.3 Unit Root Tests (Stationarity) Results

All variables were subjected to stationarity tests to ascertain the order of integration. To this end, the Augmented Dickey Fuller (ADF) and the Phillips-Perron (PP) tests pioneered by Dickey and Fuller (1979) and Phillips and Perron (1988), respectively, were performed. The results of the unit root tests are presented on Table 4.3 from which it is evident that all variables are integrated of the first order [I(1)]. Nevertheless, the VAR-in-levels was adopted in the analysis following the justification provided in section 4.3.4 Tests for Unit Root (Stationarity).

Table 4.3: Unit root tests: ADF and PP in levels and first difference

Variable	Model specification	Phillips-Peron (PP)			Augmented Dickey Fuller (ADF)		
		Level	First difference	Order of integration	Level	First difference	Order of integration
I	Intercept	-2.115163	-8.941348**	I(1)	-1.989308	-5.823397**	I(1)
	Intercept and Trend	-4.264611**	-10.28764**		-4.132495**	-5.763293**	
LNG	Intercept	-1.379946	-7.062192**	I(1)	-1.381666	-5.647106**	I(1)
	Intercept and Trend	-2.845203	-6.820821**		-2.845203	-5.558008**	
LNP	Intercept	-6.534155**	-5.004140**	I(1)	-3.673044**	-4.956057**	I(1)
	Intercept and Trend	-1.330106	-7.218894**		-1.367602	-4.397740**	
LNR	Intercept	-0.389117	-7.413102**	I(1)	-0.536689	-6.920728**	I(1)
	Intercept and Trend	-3.566146**	-7.271960**		-3.527466	-6.815849**	
LNY	Intercept	1.109133	-4.107439**	I(1)	1.296681	-4.209790**	I(1)
	Intercept and Trend	-3.196605	-4.102956**		-3.055005	-4.293217**	

Source: Author's own computation using values from EViews 11.
*Note: ** Implies rejection of the null hypothesis at 5% significance level for the sample period: 1980 – 2018.*

The decision criteria are as follows:

PP Test
H_0: Series has a unit root
H_1: Series has no unit root (series is stationary)

Decision criteria: Reject H_0 if PP test statistic < critical value

ADF Test
H_0: Series has a unit root
H_1: Series has no unit root (series is stationary)

Decision criteria: Reject H_0 if ADF test statistic < critical value

4.4.4 Lag Selection Criteria

As presented in Table 4.4, three criteria (FPE, AIC and HQ) select 4 lags; hence this becomes optimal, which is then adopted in the analysis. The lag of 4 is tested for model stability, and the results are presented under Section 4.4.5. Furthermore, according to AIC standards, out of these criteria, the model with the lowest value of AIC is the best henceforth in support of the suggested 4 lags. In related literature, Höppner (2001); Blanchard and Perotti (2002); Perotti (2004); Assadzadeh et al. (2013) and Hayo and Uhl (2014) have adopted the lag length of 4, thereby rendering support for using these number of lags as suggested by most of the information criteria.

Notwithstanding the preceding, however, Mountfold and Uhlig (2005), on the other hand, declared that different lag orders have no effect on the whole results. This view is also validated by Saba, Saqib and Igbal (2015), who adopted lag orders of 1 and 4 while employing four identification approaches (Recursive, Blanchard and Perotti, Sign Restriction and Event Study), but then the outcomes of impulse responses and variances are not affected.

Table 4.4: Lag Selection Criteria

Lag	**LogL**	**LR: sequential modified LR test statistic**	**FPE: Final Prediction Error**	**AIC: Akaike information criterion**	**SC: Schwarz Information Criterion**	**HQ: Hannan-Quinn information criterion**
0	-6.374539	NA	1.32e-06	0.649974	0.872166	0.726674
1	170.8982	**293.7662***	2.23e-10	-8.051324	**-6.718168***	-7.591119
2	198.3390	37.63318	2.13e-10	-8.190802	-5.746683	-7.347092
3	232.9354	37.56174	1.59e-10	-8.739164	-5.184083	-7.511950

4	270.3552	29.93590	**1.38e-10***	**-9.448871***	-4.782827	**-7.838153***

* Indicates lag order selected by the criterion

Source: Author's own calculations using EViews 11

4.4.5 SVAR Results

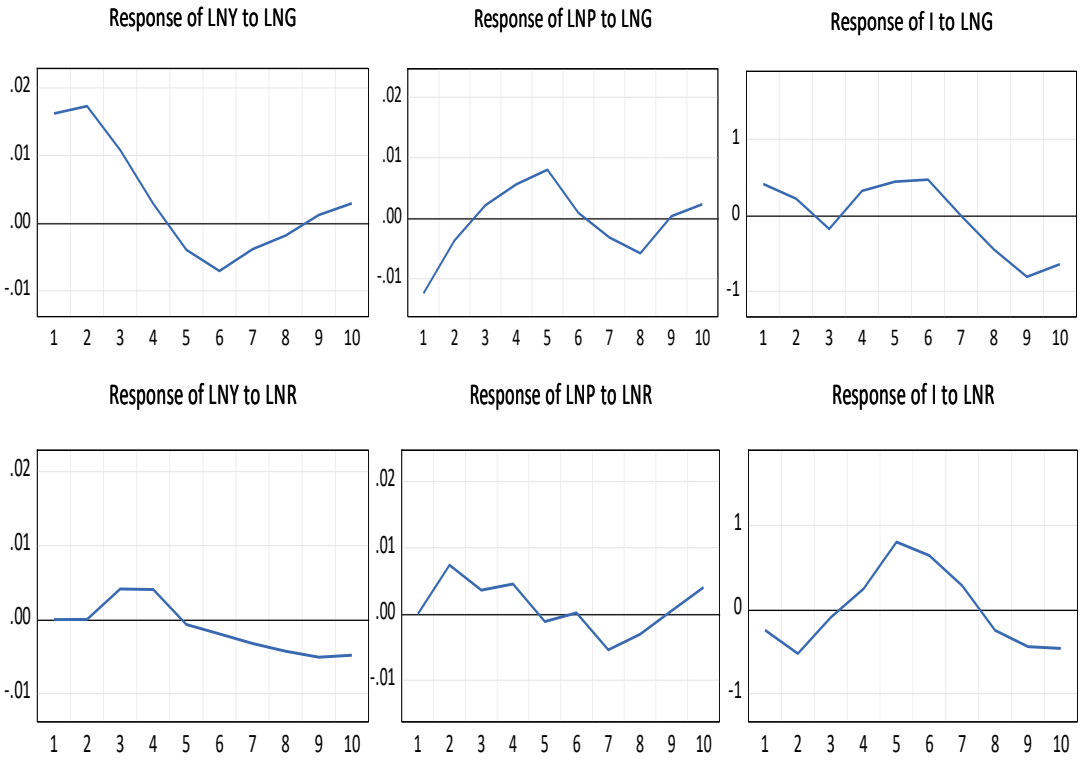
The SVAR approach was applied to estimate the dynamic effects of fiscal policy shocks on macroeconomic variables for the Namibian economy. Accordingly, the results of the Impulse response functions (IRFs) and Forecast Error Variance Decomposition (FEVD) from the SVAR model are presented below:

- **Impulse Response Functions (IRFs):** The IRFs are presented in Figure 4.4, from which the effect of public spending shock to endogenous variables reveals that real output is positive at impact up to the fourth horizon (four years), after which it moves towards negative territory (shown by movement from the 4^{th} to the 8^{th} year) and returns to equilibrium path and beyond thereafter. Against the backdrop that all variables except interest rate were log-transformed, the results can be translated into elasticities by dividing the responses through the estimated standard deviation of the shocks. Results for interest rate variables are interpreted directly as they appear in the figures.

  Specifically, a positive 1.0% public spending shock increases output at impact by 0.016%. All in all, an inference can thus be made that public spending shock yields a positive impact on real output. This is consistent with the Keynesian theory's proposition that positive government spending shocks have expansionary effects on output. This finding is also in alignment with Blanchard and Perotti (2002); Burriel et al., (2010); Tenhofen, Wolff, & Heppke-Falk (2010), amongst others. Similarly, the interest rate also remains positive at impact, whereas inflation, though negative at impact, is generally increasing. Specifically, a 1.0% public

spending shock decreases inflation by 0.012% while increasing interest rates by 0.4% at impact. This finding is somewhat in support of the Mundell-Fleming view. Overall, the results of the effect of public spending shock on output, interest rate and inflation are consistent with economic theory.

Figure 4.4: Impulse Response Functions from public spending and tax revenue shocks according to the Cholesky (recursive) procedure



Source: Author's own calculations using EViews 11

The impact of tax revenue shock on endogenous variables indicates that at impact, there was non-response (neutrality) of real output to tax revenue shock, but from the second horizon, real output was positive up to the fourth year before contracting. Tax revenue shock has a long-lasting negative effect on real output. Precisely, a positive 1.0% tax revenue shock increases output three horizons after impact by 0.004%. This finding, which reflects minimal influence, is not surprising given that other scholars (Blanchard & Perotti, 2002; Jooste & Naraidoo, 2013; Chileshe, 2015; Nkhalamo &

Sheefeni, 2017) established that tax revenue shock leads to a negative effect on output. However, although tax revenue shock has a positive impact on real output, unlike the public spending shock, the intensity is low. The analysis further reflects that a positive 1.0% tax revenue shock increases inflation by 0.007% two years after impact while decreasing interest rates by 0.2% at impact. Also, a positive tax revenue shock increases inflation up to four years while interest rates remain negative for up to three years. Overall, the results from the impulse response functions reveal that public spending and tax revenue do not produce similar results even if implemented by the same volume in different directions. Moreover, the findings indicate that public spending significantly influences output in the long run.

- **Forecast Error Variance Decomposition (FEVD):** Table 4.5 presents the FEVD of the variables of interest (output, inflation and interest rates) for the Namibian economy. From this, it is evident that in the short run (during the first horizon), output exhibits strong endogeneity (endogenous influence) on itself, followed by public spending. In this vein, output contributes about 66.4% of variations in itself, while public spending contributes about 33.6%. However, inflation, tax revenue and interest rate exhibit strong homogeneity (weak influence) on output. Moreover, it is apparent that from the first to the fourth period, between 66 and 51% of movements in output are ascribed to itself. Thereafter, especially during the fifth horizon, shocks in public spending, inflation, tax revenue and interest rates account for 34, 6, 2 and 12%, respectively, of variations in output. At the tenth horizon, public spending, inflation, tax revenue and interest rate account for about 27, 12, 4 and 20%, correspondingly, towards variations in output.

Table 4.5: Forecast Error Variance Decomposition (FEVD from the SVAR)

Period	LNG	LNY	LNP	LNR	I
Variance Decomposition of LNY:					
Year 1	33.57482	66.42518	0.000000	0.000000	0.000000
Year 2	42.67759	56.63885	0.322934	3.57E-05	0.360592
Year 3	40.03031	52.88233	3.106328	1.015421	2.965615
Year 4	37.77171	51.15245	3.604729	1.849449	5.621670
Year 5	33.74175	46.65883	5.601226	1.636267	12.36193
Year 6	30.05015	42.53920	8.093436	1.507785	17.80943
Year 7	28.99111	41.40280	7.960196	1.819924	19.82597
Year 8	28.62613	40.72466	8.635350	2.461366	19.55249
Year 9	27.24233	39.25769	10.55061	3.243686	19.70570
Year 10	26.62102	38.07721	11.74126	3.919453	19.64105
Variance Decomposition of LNP:					
Year 1	18.79375	7.610527	73.59572	0.000000	0.000000
Year 2	11.38783	21.98651	57.31720	3.687398	5.621066
Year 3	10.45580	23.05045	57.04230	4.079091	5.372364
Year 4	11.38551	22.99484	55.63339	4.893094	5.093170
Year 5	12.36042	19.08953	54.96855	4.108563	9.472934
Year 6	10.05776	18.17768	53.50873	3.334304	14.92152
Year 7	9.249310	16.64051	55.37725	3.926877	14.80606
Year 8	9.999362	17.55382	54.07725	4.088806	14.28077
Year 9	9.339526	20.83666	50.64905	3.825570	15.34919
Year 10	9.154622	22.07411	49.60512	4.148584	15.01756

Variance Decomposition of I:					
Year 1	2.376986	24.50735	22.86051	0.833130	49.42202
Year 2	2.137610	26.41419	23.26207	3.268131	44.91801
Year 3	2.400542	26.43372	23.19418	3.289185	44.68237
Year 4	3.161207	28.62019	21.98075	3.605835	42.63202
Year 5	4.341563	27.77909	20.60945	8.248284	39.02161
Year 6	5.717561	26.93181	19.47278	10.79747	37.08037
Year 7	5.653786	26.72268	19.68485	11.26521	36.67348
Year 8	6.928077	26.10475	19.64145	11.38618	35.93955
Year 9	10.85550	24.87068	18.54706	11.98293	33.74383
Year 10	12.99076	24.07721	17.88672	12.79128	32.25403
Cholesky Ordering: LNG LNY LNP LNR I					

Source: Author's own calculation using EViews 11

- Generally, in the long run, interest rate, inflation and tax revenue, respectively, show a strong exogenous influence on output, evident in the increasing influence from period 1 going into the future. The output and public spending exhibit strong exogeneity reflected by the decreasing influence going into the future. Overall, from the FEVD result, an inference can be made that among the fiscal variables, public spending has strong explanatory power on output both in the short run and long run as it clearly exerts more influence than tax revenue on the output, which is found to be insignificant for the entirety of the ten horizons.

- The FEVD of inflation reveals that in the short run (during the first horizon), it displays strong endogeneity (endogenous influence) on itself. Public spending and output are the other variables exhibiting strong endogeneity on inflation, albeit

marginal. In view of this, inflation contributes about 74.0% of variations while public spending and output influence about 19.0 and 8.0%, respectively. However, tax revenue and interest rate exhibit strong homogeneity (weak influence) on inflation. From the first to the fifth horizon, shocks to public spending, output and interest rates contribute significantly (12, 19 and 9%, in that order) to movements in inflation, whereas tax revenue is insignificant at 4%. The tenth horizon reflects that output, interest rate and public spending influence 22, 15 and 9%, separately, to variations in inflation while inflation maintains a contribution of 50%. Largely, in the long run, inflation and government spending exhibit strong exogeneity (weak endogenous), as can be seen from the decreasing influence as you go into the future. In contrast, output and interest rates exhibit strong endogeneity on inflation, as suggested by the increasing influence going into the future. Overall, an inference can be made that of the two fiscal policy variables; public spending was found to exert greater influence on inflation than tax revenue both in the short and long run.

- The FEVD of interest rate largely reflects that all variables exhibit strong endogeneity in the short run. This is not surprising as it is in line with the assumption made that interest rate is affected by all shocks. Unlike output and inflation, whose contributions to own self exceeded 50% in the first horizon, the own contribution is just 49% thereby implying that it is affected by shocks to all variables in line with the assumption made. From the first to the fifth horizon, contributions of 28, 21 and 8% were made by output, inflation and tax revenue, respectively, to variations in interest rates, whereas public spending was insignificant at 4%. The tenth horizon reveals that output, inflation, public spending and tax revenue at 24, 18, 13 and 13%, separately, had the highest

contributions to interest rates. Generally, both fiscal policy variables, public spending and tax revenue, seem to impact interest rates equally especially in the long-run.

4.4.6 Robustness Checks

This section presents model robustness checks in view of confirming the suitability and applicability of the econometric approach adopted and the underlying results. These are narrated as follows:

- **Test of model stability:** Results of model stability reflect that the first stability condition in VAR(4) (4-lagged VAR) estimation, which shows that no root lies outside the circle (Table 4.6), is satisfied; hence the defined VAR(4) model is stable. Specifying the graph option produced a graph of the eigenvalues with the real components on the x-axis and the complex components on the y-axis. Overall, the estimated VAR(4) model is said to be stationary as it met the stability criteria in which all values have inverse root characteristics of AR polynomial smaller than one and are all in the unit circle, as Figure 4.5 reveals. There are five variables and four lags, and thus the estimated VAR(4) model has twenty eigenvalues.

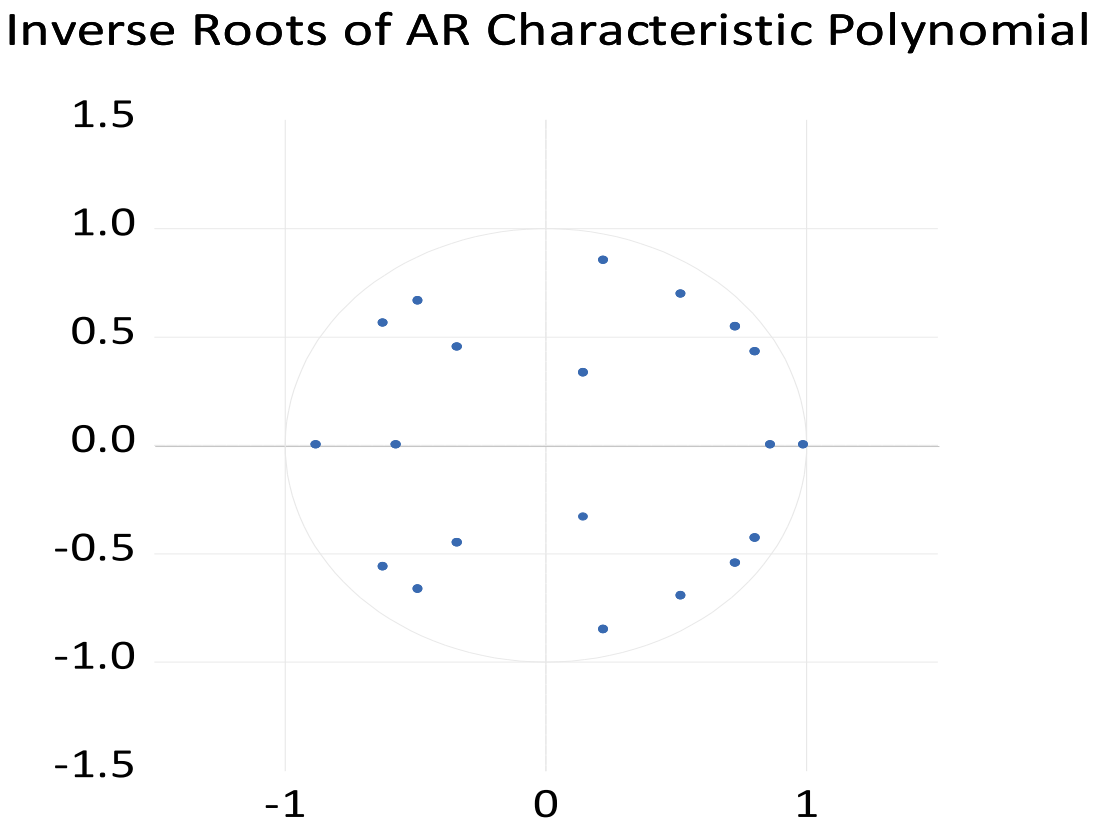
Table 4.6: VAR stability condition check (Eigenvalue stability condition)

Roots of Characteristic Polynomial
Endogenous variables: LNG LNY LNP LNR I
Exogenous variables: C
Lag specification: 1 4

Root	Modulus
0.991635	0.991635
0.805531 + 0.429683i	0.912967
0.805531 - 0.429683i	0.912967
0.729496 + 0.545391i	0.910832
0.729496 - 0.545391i	0.910832
0.223668 + 0.852232i	0.881094
0.223668 - 0.852232i	0.881094
-0.879170	0.879170
0.521338 - 0.695764i	0.869414
0.521338 + 0.695764i	0.869414
0.865015	0.865015
-0.621881 - 0.561667i	0.837978
-0.621881 + 0.561667i	0.837978
-0.487983 - 0.665393i	0.825151
-0.487983 + 0.665393i	0.825151
-0.571828	0.571828
-0.337676 + 0.450783i	0.563232
-0.337676 - 0.450783i	0.563232
0.146489 + 0.333472i	0.364229
0.146489 - 0.333472i	0.364229

No root lies outside the unit circle.
VAR satisfies the stability condition.
Source: Author's computations using EViews 11

Figure 4.5: Model stability



Source: Author's computations

- **Results of the SVAR (with different ordering) and Unrestricted VAR:** Robustness was also supported by the fact that although the ordering of the variables in the SVAR was altered from [LNG, LNY, LNP, LNR, I] to [I, LNG, LNP, LNR, LNY], the resulting IRFs remained similar. However, due to space constraints, the IRFs are not discussed but are presented in the appendix (*Appendix Figure 1*). Besides, an unrestricted VAR was added to the robustness checks to serve as confirmatory of the findings. The variables are ordered in line with the degree of their evidence for exogeneity to align with the Cholesky ordering according to the adopted SVAR specification. However, due to space constraints, the IRFs are not discussed but are presented in the appendix (*Appendix Figure 2*).

- **Residual Tests:** Meanwhile robustness and validity of the model were also evidenced by residual tests performed (i.e., serial correlation and normality). To this end, to test for serial correlation for the null hypothesis of no serial correlation at lag h, the VAR Residual Correlation LM tests were applied, which support the hypothesis of no serial correlation (Table 4.7).

Table 4.7: LM auto-correlation test

Lags	LM statistic	P-value
1	19.82788	0.7637
2	31.14860	0.1941
3	15.34006	0.9358
4	45.14970	0.0693

Note: Null hypothesis: there is no serial correlation at lag order h.

Source: Author's own calculations using EViews 11

In testing for normality, VAR Residual Normality Tests – Orthogonalization: Cholesky (Lutkepohl) was adopted with a null hypothesis of residuals are multivariate normal. Results are shown in Table 4.8, from which the null hypothesis of multivariate normal is not rejected since the p-value > 0.05; hence residuals are normally distributed.

Table 4.8: Residuals Multivariate Normality Test

	Test statistic	Degrees of freedom	P-value
Skewness	6.244688	5	0.2831
Kurtosis	1.728115	5	0.8853
Jacque-Berra	7.972803	10	0.6315

Note: Null hypothesis: residuals are multivariate normal.

Source: Author's own calculations using EViews 11

4.5 Summary

This chapter presents the introduction and background to fiscal policy shocks, materials and empirical results of the study's first objective. Fiscal policy shocks are surprises (unanticipated) change in fiscal policy and are viewed as existing in a two-dimensional space (government revenue and spending shocks). Fiscal policy shocks have been estimated through four identification schemes: recursive approach, sign-restrictions, event study (dummy variable approach) and Structural Vector Autoregression (SVAR). This study implements SVAR in estimating the effects of fiscal policy shocks. The time series includes government spending and tax revenue as fiscal policy variables, while output, interest rate and inflation are the variables of interest.

The descriptive statistics were presented while the VAR-in levels were justifiably undertaken in the analysis. The lag selection, SVAR results (IRFs and FEVD), and robustness checks (model stability and residual test) were also performed. The optimal lag of 4 was selected based on AIC criterion. This was also found to be stable as no root lied outside the unit circle.

Results from the impulse response analysis reveal that public spending shock has Keynesian effects, considering that it yields a positive impact on real output. Additionally, the public spending shock yields a long-lasting positive impact on real output while tax revenue has a negative effect in the long run. The public spending and tax revenue shocks do not produce similar results even if implemented by the same volume in different directions. Although tax revenue shock has a positive impact on real output in the short-run, its intensity is lower compared to the public spending shock. Following the public spending shock, the interest rate also remains positive at impact, whereas inflation, though negative at impact, is generally increasing. This finding is somewhat in support of the Mundell-Fleming view. The analysis further reflects that a positive tax revenue shock increases inflation up to four years while interest rates remain negative for up to three years.

Results from the variance decompositions reflect that public spending has strong explanatory power on real output both in the short run and long run as it clearly exerts more influence than tax revenue, which is found to be insignificant for the entirety of the ten horizons. Similarly, public spending was found to exert greater influence on inflation than tax revenue both in the short and long-run. Both fiscal policy variables, public spending and tax revenue, seem to impact interest rates equally especially in the long-run.

Chapter Five: The effects of external shocks on domestic macroeconomic variables

5.1 Introduction

This Chapter provides the background on the effects of several external shocks to Namibia's macroeconomy, regional (sub-Saharan African) and Namibia's susceptibility to external shocks, materials and methods adopted in the analysis, results and discussion as well as the summary of the chapter.

5.2 Background on external shocks

What are the effects of external shocks on Namibia's macroeconomy? The answer to this question yields the novelty of this paper, which is specifically to examine the effects of external shocks (global output, US monetary policy, oil prices and exchange rate) on Namibia's output, interest rate and inflation for the period 1980 – 2018 through a VAR analysis. External shocks are unanticipated changes in the external environment that directly or indirectly affects the economic well-being of a country (Chaiyindeepum, 1992). Moreover, an external shock is deemed by international institutions such as the International Monetary Fund (IMF) to denote an exogenous or unanticipated variation from an expected and/or normal trend (Varangis et. al., 2004).

The effect of external shocks on macroeconomic variables and their associated propagation channels on any economy is one of the cornerstones in macroeconomics. Thus, an important task of open-economy macroeconomics is to enumerate how much of the macroeconomic variation in small open economies originates abroad (Maćkowiak, 2005). Yet, literature in the past decades and at present has not yielded consensus on the effects of external shocks, despite the wide swings in key

macroeconomic variables. Also, empirical studies on the impact of external shocks have, however, produced mixed results (Mishra & Montiel, 2012). Within the open-economy macroeconomics literature, the generally accepted definition of a small open economy is that it takes exogenously external variables. In other words, China is considered to be a large open economy as opposed to a small open economy. The main difference between these two types of economies is that: the variables of the rest of the world are exogenous in a small open economy, while this is not the case in a large open economy (Zhao et al., 2016).

5.3 Namibia's vulnerability to external shocks

Namibia, like its mineral resource-rich peers in sub-Saharan Africa (SSA), has always been and remains susceptible to external shocks (i.e., global output, world commodity prices, world interest rates, oil prices and exchange rate etc.) owing to a great reliance on mineral commodity exports for revenues, narrow manufacturing base (which makes the country a net importer of goods and services) and large agricultural sector. Tjirongo (1995) articulated that between 1980 and 1992, the major external shocks that the Namibian economy was subject to were due to, amongst others, changes in the demand for minerals and in mineral prices.

At the regional level, SSA economies have, over time, become increasingly integrated with the global economy through trade, cross-border, financial and capital markets links, among others. Furthermore, Matos, Monteiro and Soma (2011) documented that Southern African Development Community (SADC) economies (including Namibia) are generally interlinked internationally due to trade, financial and/or cultural bonds. In other words, they are mainly synchronised with the economies of the European

Union and, more recently, with the Chinese economy. However, as Price and Elu (2014) pointed out, the more (less) integrated sub-Saharan capital markets are with that of world capital markets, the more (less) vulnerable sub-Saharan African economies are to global macroeconomic shocks that affect capital inflows.

Andonova and Petkovska (2011) argued that Macedonia, as a small and open economy, in a world of increased globalization and integration, may have benefited from the trade and international liberalization process, but these may also contribute to the transmission of external shocks. Also, with a de facto fixed exchange regime, it is more probable for Macedonia to be more vulnerable to such shocks than countries that opted for more flexible exchange rate arrangements. Similarly, Namibia is also in a fixed exchange regime through the Common Monetary Area (CMA) arrangement and hence may be susceptible to external shocks arising from increased trade and globalisation with the global economy.

Namibia's vulnerability to shocks also includes developments in the international reserves position and cross-border links. Herein, IMF (2015) specified that Namibia's international reserves have noticeably declined since 2009, making it exposed to exogenous shocks under the exchange rate peg. Though the Namibian financial system remains largely unexposed to the global financial crisis, the economy nevertheless remains susceptible to the crisis through other channels, i.e., less optimistic growth prospects due to lower demand for Namibian commodities; the impact on the real sector; potential balance-of-payments shocks due to a depreciation in the exchange rate; and reduced revenue collection due to slower economic growth (BoN, 2009). Moreover, among sub-Saharan regional groups, SACU countries registered the sharpest decline in GDP between 2008 and 2009; the global financial crisis was

transmitted mainly through trade channels, as well as a reduction in output in mining for Namibia (Chauvin & Geis, 2011).

It is also worthwhile to note that Namibia's financial system has many cross-border links, mainly with South Africa, given that three of the four largest commercial banks in Namibia are subsidiaries of South African banks. These interlinkages expose Namibia to potential channels of contagion and systemic risks, whereas funding flows from South Africa to Namibia's financial institutions are currently limited. Canales-Kriljenko, et al. (2013) contended that the South African GDP is closely correlated to the world GDP, a correlation that has increased over the last few decades. However, such a correlation could, in principle, also re-transmit some of the global shocks to other sub-Saharan African economies (and give rise to outward spillovers) through trade and financial channels.

Namibia shares similar economic characteristics with peers within the SSA region, such as being small, open, commodity-rich and developing with no influence on the global mineral commodity market, and hence take world prices for commodities they own as given. Specifically, as Kose (2002) advanced, the special features that make these economies vulnerable to world price shocks are related to their production and international trade structure. Against this background, for economies such as Namibia, it is crucial to quantify how much shocks arising from external significantly influence its macroeconomy as a way of mitigating such macroeconomic disturbances.

The examination of the effects of macroeconomic shocks on an economy is an area that has been and continues to receive quite considerable attention due to its importance in view of the pursuance of optimal macroeconomic policy. For the

Namibian economy, a few macroeconomic models have been developed i.e., Sunde (2015); Eita (2011), and Tjipe et al. (2004), among others. However, a comprehensive examination of the effects of external shocks has, to the knowledge of the author, not been performed. Moreover, Namibia has been formulating National Development Plans (NDPs), which are essentially the building blocks of its long-term blueprint, Vision 2030, adopted in 2004, whose ultimate objects include: the achievement of sustainable economic growth, creation of jobs, reduction of poverty and income inequality, among others.

Notwithstanding this, however, NDPs have been formulated without econometric quantification of the potential effects which could ensue from external shocks on key macroeconomic variables. Likewise, the MacroABC model (mainly adopted in Namibia) is used only on forecasts of medium-term targets rather than on modelling the effects of external macroeconomic shocks. This is evidently a gap which creates a problem in that national targets are deficient as they are set based on incomplete information. Thus, there appears to be a mismatch between the NDP targets and the effects which could accrue from external shocks. Yet, this mismatch can often lead to wrong policy prescriptions, which could potentially derail the achievement of those noble targets. This is a big challenge for macroeconomic policy formulation in Namibia. Therefore, a dearth of literature on macroeconomic shocks (especially external) in Namibia exists. It is thus this problem and gap that this study seeks to address and contribute to macroeconometric modelling literature on macroeconomic shocks in Namibia and sub-Saharan Africa. This study's relevance lies in the fact that it will provide an important tool for evidence-based decision-making to aid macroeconomic policymaking, planning and forecasting in view of Namibia's future NDPs and, by and large, contribute to the implementation of Vision 2030.

Additionally, the motivation for this study includes the adoption of rarely investigated, yet equally important external variables, in investigating their effects on the Namibian economy.

5.4 Materials and Methods

5.4.1 Model Specification and Econometric Approach

Sims (1980) pioneered the Vector Autoregression (VAR) framework, which has since become a significant econometric tool for the analysis of shocks. In view of this, he presented the VAR system, an alternative to a macroeconomic model which is based on the data itself and facilitates a dynamic continuum of responses as opposed to many economic assumptions. Thus, the VAR econometric technique is indispensable in the examination of the effects of external shocks on an economy. Lutkepohl and Kratzig (2004) documented that VAR processes are suitable model classes for describing the data generation process (DGP) of a small or moderate set of time series variables. Moreover, the VAR model allows for tracking responses of domestic variables to shocks and to address endogeneity issues that may hamper the econometric estimations (David, 2008). The striking feature is that all variables are often treated as being a priori endogenous, and allowance is made for rich dynamics.

This study adopted a VAR technique to estimate the effects of external shocks (modelled through global output growth, US monetary policy and oil prices) on Namibia's macroeconomic variables (output, interest rate and inflation). Senadheera (2016) adopts an almost similar set of variables for the Sri Lankan economy. The growth of the global economy would lead to an increase in demand for Namibian exports. The US monetary policy impacts the global economy, including Namibia,

significantly through variables such as GDP, interest rate, and consumer prices. Similarly, oil prices exert a global influence on both exporters and importers. Henceforth, global output growth, US monetary policy and oil price shocks matter for the Namibian economy. Reduced-form VAR is represented as follows:

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_P Y_{t-p} + \varepsilon_t \quad (5.1)$$

Where Y_t represents an $nx1$ vector of endogenous variables *(foreign block – global output, US monetary policy, oil prices; domestic block – domestic output, interest rate and inflation)* observed at time t; A_0 is a vector of constants; $A_i (i = 1, 2, \dots, p)$ is an nxn matrix of coefficient estimates; ε_t is an *(nx1)* vector of error terms (serially uncorrelated system of innovations); p is the optimal lag length of each variable. The Ordinary Least Squares (OLS) method is used to estimate equation (5.1) which represents the following system of six equations:

$$GOG_t = \beta_{1,0} + \sum_{i=1}^{p} \theta_{1,i} GOG_{i,t-1} + \sum_{i=1}^{p} \lambda_{1,i} USINT_{i,t-1} + \sum_{i=1}^{p} \phi_{1,i} OILP_{i,t-1} + \sum_{i=1}^{p} \varpi_{1,i} NOG_{i,t-1} + \sum_{i=1}^{p} \gamma_{1,i} NINT_{i,t-1} + \sum_{i=1}^{p} \delta_{1,i} NINF_{i,t-1} + \varepsilon_{1,t} \quad (5.2)$$

$$USINT_t = \beta_{2,0} + \sum_{i=1}^{p} \theta_{2,i} GOG_{i,t-1} + \sum_{i=1}^{p} \lambda_{2,i} USINT_{i,t-1} + \sum_{i=1}^{p} \phi_{2,i} OILP_{i,t-1} + \sum_{i=1}^{p} \varpi_{2,i} NOG_{i,t-1} + \sum_{i=1}^{p} \gamma_{2,i} NINT_{i,t-1} + \sum_{i=1}^{p} \delta_{2,i} NINF_{i,t-1} + \varepsilon_{2,t} \quad (5.3)$$

$$OILP_t = \beta_{3,0} + \sum_{i=1}^{p} \theta_{3,i} GOG_{i,t-1} + \sum_{i=1}^{p} \lambda_{3,i} USINT_{i,t-1} + \sum_{i=1}^{p} \phi_{3,i} OILP_{i,t-1} + \sum_{i=1}^{p} \varpi_{3,i} NOG_{i,t-1} + \sum_{i=1}^{p} \gamma_{3,i} NINT_{i,t-1} + \sum_{i=1}^{p} \delta_{3,i} NINF_{i,t-1} + \varepsilon_{3,t} \quad (5.4)$$

$$NOG_t = \beta_{4,0} + \sum_{i=1}^{p} \theta_{4,i} GOG_{i,t-1} + \sum_{i=1}^{p} \lambda_{4,i} USINT_{i,t-1} + \sum_{i=1}^{p} \phi_{4,i} OILP_{i,t-1} + \sum_{i=1}^{p} \varpi_{4,i} NOG_{i,t-1} + \sum_{i=1}^{p} \gamma_{4,i} NINT_{i,t-1} + \sum_{i=1}^{p} \delta_{4,i} NINF_{i,t-1} + \varepsilon_{4,t} \quad (5.5)$$

$$NINT_t = \beta_{5,0} + \sum_{i=1}^{p} \theta_{5,i} GOG_{i,t-1} + \sum_{i=1}^{p} \lambda_{5,i} USINT_{i,t-1} + \sum_{i=1}^{p} \phi_{5,i} OILP_{i,t-1} + \sum_{i=1}^{p} \varpi_{5,i} NOG_{i,t-1} + \sum_{i=1}^{p} \gamma_{5,i} NINT_{i,t-1} + \sum_{i=1}^{p} \delta_{5,i} NINF_{i,t-1} + \varepsilon_{5,t} \quad (5.6)$$

$$NINF_t = \beta_{6,0} + \sum_{i=1}^{p} \theta_{6,i} GOG_{i,t-1} + \sum_{i=1}^{p} \lambda_{6,i} USINT_{i,t-1} + \sum_{i=1}^{p} \phi_{6,i} OILP_{i,t-1} + \sum_{i=1}^{p} \varpi_{6,i} NOG_{i,t-1} + \sum_{i=1}^{p} \gamma_{6,i} NINT_{i,t-1} + \sum_{i=1}^{p} \delta_{6,i} NINF_{i,t-1} + \varepsilon_{6,t} \quad (5.7)$$

Where β_j's are the constants; $\theta_j, \lambda_j, \emptyset_j, \varpi_j, \gamma_j$ and δ_j are the time-varying coefficients with $j = 1,2,\ldots,6$ while all variables and coefficients are as explained earlier. The ordering on the VAR assumes that the external shocks (global output, US monetary policy and oil prices) are not contemporaneously impacted by developments in

Namibia's macroeconomic variables though their effects are transmitted to Namibia. Also, these external shocks contemporaneously affect Namibia's macroeconomic variables and are first transmitted through the output channel.

5.4.2 Data, Description and Source

In view of the non-availability of high-frequency (daily, monthly, or quarterly) data for the variables of interest, this study adopts annual time series data for the period 1980 to 2018. This gives a sample size of 39 observations which importantly covers both Namibia's pre (prior to 1990) and post-independence (1990-2018) periods. The study's sample period is richly endowed with some notable external shocks and events which had a bearing on the country's macroeconomic developments. These include depressed commodity prices since the 1980s; the First Persian Gulf War in 1990, Namibia's membership of the Common Monetary Area in 1992; the Asian Financial Crisis of 1997; OPEC oil price shocks in 1999 and 2002; US recession in 2001; the Global Financial Crisis of 2008-09; the European outbreak of the sovereign debt of 2010; the collapse of commodity prices of 2014; among others.

To examine the effect of external shocks on Namibia's macroeconomic variables, the study adopts a six-variable model reflecting three external variables or foreign blocks (indicating specific types of shocks) and three internal or domestic target variables. The external variables include real global output growth to proxy a demand shock, US monetary policy to proxy short-term global interest rates, and real international oil price to proxy international supply shocks. The three target domestic variables include real output growth, interest rate and inflation. The variable descriptions are reflected in Table 5.1.

Table 5.1: Description and sources of variables

Variable	Descriptor	Definition	Source
GOG	Global output growth as a proxy for demand shock or real global economic activity.	Real global GDP growth is the growth in the total value of final goods and services produced globally during a year.	World Economic Outlook (WEO) Database of IMF
USINT	US monetary policy	US real interest rate (lending interest rate adjusted for inflation as measured by the GDP deflator).	World bank – World Development Indicators (2020).
OILP	Real international price of oil	Crude oil, the average spot price of Brent, Dubai and West Texas Intermediate, equally weighed (USD) per barrel.	World Bank Commodity Price Data (The Pink Sheet**)**
NOG	Domestic (Namibia) output growth Real Output expressed as Real GDP	Real GDP growth, measures the total value of all final goods & services produced per year.	Namibia Statistics Agency
NINT	Domestic (Namibia) real interest rate	Real interest rate (lending interest rate adjusted for inflation as measured by the GDP deflator).	World Bank – World Development Indicators (2020).

NINF	Domestic (Namibia) average inflation rate	Average inflation is computed from the consumer price index (consumer prices). A sustained increase in the general price level in a year.	Namibia Statistics Agency

5.4.3 Unit Root (Stationarity) Test

The first step before estimation involving time series is to establish univariate characteristics of the data to determine whether the variables are stationary or not. This is undertaken since non-stationary or trended data presents a problem in that the standard Ordinary Least Squares (OLS) regression procedures can easily lead to incorrect conclusions. Also, the stationarity of variables (unit root test) was conducted as a standard procedure to examine long-run equilibrium. To this end, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were collectively utilized to establish whether the series are either I(0) or I(1). The PP test, which is non-parametric, was used as an alternate, especially in view of controlling for serial correlation and heteroscedasticity in the errors. The null hypothesis is that the variable under consideration has a unit root (non-stationary) while the alternative is that the variable does not have a unit root (stationary). In view of this, the ADF test was employed as follows:

$$\Delta Y_t = \beta_1 + \beta_2 \Delta Y_{t-1} + Y_{t-1} + \mu \qquad with\ constant \qquad (5.8)$$

$$\Delta Y_t = \beta_1 + \beta_2 t + \beta_3 \Delta Y_{t-1} + Y_{t-1} + \mu \qquad with\ constant\ and\ trend \qquad (5.9)$$

The PP test is based on the statistic:

$$t_\alpha = t_\alpha(\frac{\gamma_0}{f_0})^{\frac{1}{2}} - \frac{T(f_0 - \gamma_0)\left(\delta\epsilon(\alpha)\right)}{2f_0^{\frac{1}{2}}s} \quad (5.10)$$

Where α is the estimate, and t_α the t-ratio of α, $\delta\epsilon(\alpha)$ is a coefficient standard error and s is the standard error of test regression. The Phillips-Perron (1988) test is an alternative to the ADF test which corrects the standard errors for heteroskedasticity, and autocorrelation (HAC) as opposed to compensating for serial correlation in the error terms by adding lagged differences.

5.4.4 Lag Selection Criteria

The optimal lag selection in VAR analysis is important in yielding the best or optimal results. Precisely, Brandt and Williams (2007) proposed setting lags not larger than 5, 8 or 15 for yearly, quarterly, or monthly data, respectively.

5.4.5 Johansen Co-integration Test

In most econometric analyses it is always ideal to test for co-integration among variables. To test for co-integration among variables, Johansen (1988) developed a maximum likelihood estimation procedure that allows one to test for the number of cointegrating relations. In view of this, the Johansen approach was performed through two tests, the trace and maximum eigenvalue (Verbeek, 2017). The trace and max eigenvalue test statistics both assume a linear trend in the data and allow for an intercept and a trend in the cointegrating relationship. According to Verbeek (2017) the Johansen technique is superior to the Engle–Granger approach which suffers from the following drawbacks, among others (i) the results of the tests are sensitive to the left-hand side variable of the regression; and (ii) the residual-based test tends to lack power since it does not exploit all the available information about the dynamic interactions of the variables. Moreover, cointegration is said to exist when variables

are independently nonstationary, although a linear combination of them is found to be stationary such that there is a long-run relationship between those variables (Brooks, 2008).

The Johansen cointegration approach was performed through two tests, the trace and maximum eigenvalue. The trace statistics assumes the null hypothesis that there are less than or equal to r cointegrating vectors (($\boldsymbol{H_0}$: r ≤ 1), whereas the alternative is the opposite ($\boldsymbol{H_1}$: r ≥ 2). The decision rule is that if the test statistic is greater than the critical value (i.e., the probability is less than 5%), then $\boldsymbol{H_0}$ is rejected, which in other words, implies acceptance of $\boldsymbol{H_1}$. The max eigenvalue statistics, on the other hand, tests whether r is equal to or not. Specifically, $\boldsymbol{H_0}$: r = 1 and $\boldsymbol{H_1}$: r = 2. The decision rule is that if the test statistic is greater than the critical value (i.e., the probability is less than 5%), then $\boldsymbol{H_0}$ is rejected. Overall and generally, both the trace and maximum eigenvalue tests seek to assess the null hypothesis that there is no cointegration versus the alternative of there is cointegration relationship among variables.

5.4.6 Vector Autoregression (VAR)

Vector autoregression analysis often involve elucidating effects of shocks as suggested by Impulse Response Functions (IRFs) and the Forecast Error Variance Decomposition (FEVD). To this end, Sims et al., (1990) theorized that an impulse response function traces the effect of one standard deviation shock to one of the innovations on current and future values of the endogenous variables. A shock to the i^{th} variable directly affects the i^{th} variable, and is also transmitted to all the endogenous variables through the dynamic structure of the VAR. The Forecast Error Variance Decomposition (FEVD) procedure was introduced by Sims (1980) as a basic tool that

involves determining to what extent the behaviour of each variable in the VAR system is affected by the different structural innovations at different horizons.

5.4.7 Model Stability and Residual Diagnostic Tests

Model stability is of critical importance in VAR analysis. In view of this, the estimated VAR is said to be stable (stationary) if all roots have modulus less than one and lie inside the unit circle (Levendis, 2018). Residual diagnostic tests performed include multivariate normal distribution and autocorrelation. In testing for multivariate normal distribution, the Jarque-Bera normality test is used to determine whether the regression errors are normally distributed (Brooks, 2019). In this instance, the null hypothesis is that the errors are normally distributed. Regarding autocorrelation, Brooks (2019) postulated that testing for this helps to identify any relationships that may exist between the current values of the regression residuals and any of its lagged values. In view of this, the LM test for autocorrelation assumes the null hypothesis that the residuals are not serially correlated, while the alternative is that the residuals are serially correlated.

5.5 Results and Discussion

5.5.1 Descriptive statistics

Table 5.2 presents descriptive statistics of the time series from which it is evident that oil price and domestic output growth have the highest and lowest unconditional averages of 46.7 and 3.2%, respectively. The standard deviation reflects the level of volatility in the variables by displaying the rate at which each variable deviates from the mean value. To this end, the oil price is the most volatile at 25.3%, while global output is the least volatile at 1.2%. Also, in view of the Jarque-Bera statistics, all

variables have probabilities greater than 5%, thereby leading to the non-rejection of the null hypothesis of normality and thus confirming that they are normally distributed.

Table 5.2: Descriptive statistics

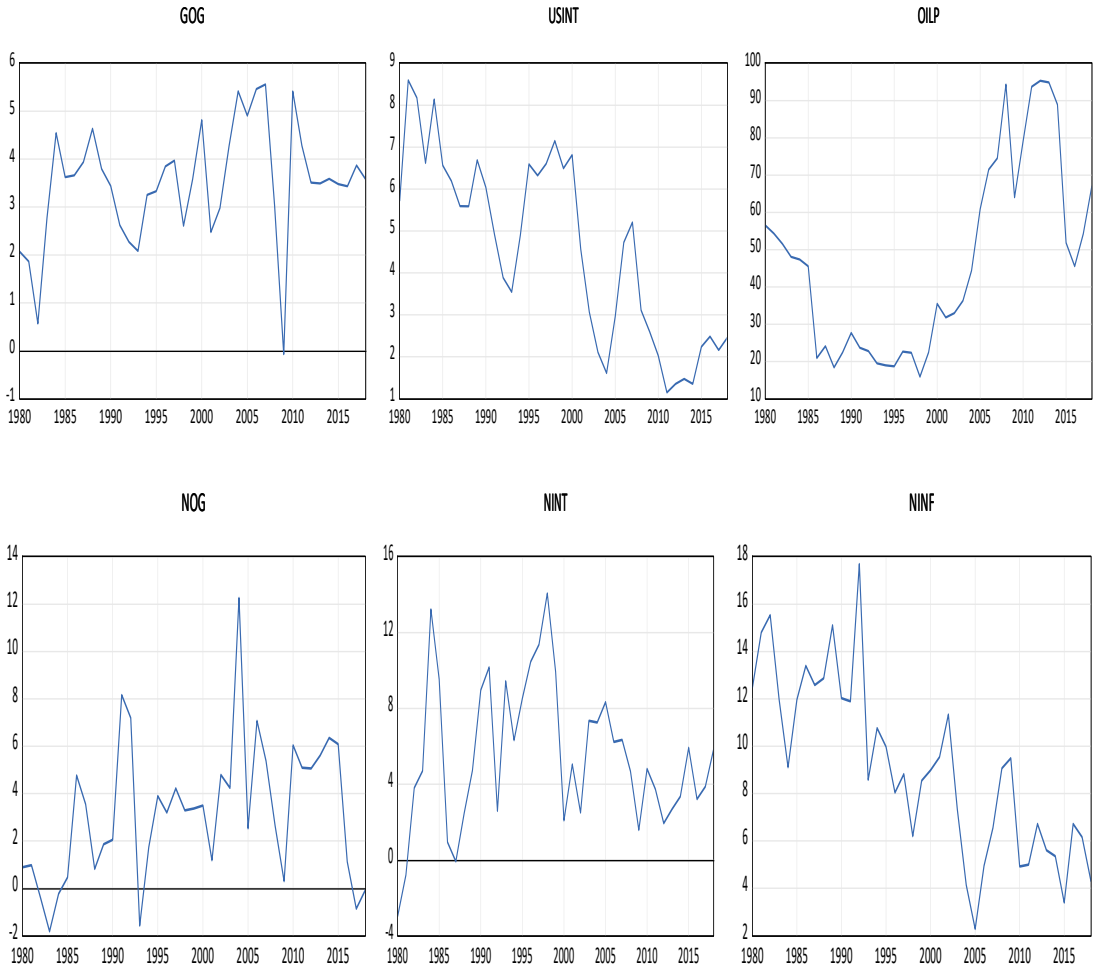
	GOG	USINT	OILP	NOG	NINT	NINF
Mean	3.486333	4.558410	46.68054	3.197503	5.488231	9.082924
Median	3.579000	4.898310	45.52832	3.291585	4.804411	8.992538
Maximum	5.560000	8.594620	95.31152	12.26955	14.07133	17.69437
Minimum	-0.073000	1.148425	15.89910	-1.823450	-2.976299	2.280482
Std. Dev.	1.223748	2.211939	25.26343	2.973867	3.848369	3.721765
Skewness	-0.644989	0.001603	0.598828	0.594575	0.206243	0.264162
Kurtosis	3.916595	1.718954	2.176943	3.556753	2.650045	2.330252
Jarque-Bera	4.069306	2.666771	3.431678	2.801581	0.475497	1.182493
Probability	0.130726	0.263583	0.179813	0.246402	0.788401	0.553637
Sum	135.9670	177.7780	1820.541	124.7026	214.0410	354.2340
Sum Sq. Dev.	56.90724	185.9216	24253.16	336.0677	562.7780	526.3583
Coefficient of variation	0.35101294	0.48524354	0.54119832	0.93005917	0.70120390	0.40975406
Observations	39	39	39	39	39	39

Source: Author's computation using EViews 11

5.5.2 Graphical Analysis (Plots) of Variables

Annual time series data used in the model estimation for the period 1980 – 2018 are displayed in Figure 5.1, from which it can be seen that global output growth (GOG), domestic output growth (NOG) and domestic interest rates (NINT) show fluctuation while all other variables reflect either increasing (OILP) or decreasing (USINT and NINF) trends, meaning that the mean is not constant (varies over time). Figure 5.2 displays the variables in their first difference forms.

Figure 5.1: Graphical Analysis of variables used in the VAR estimation – Levels

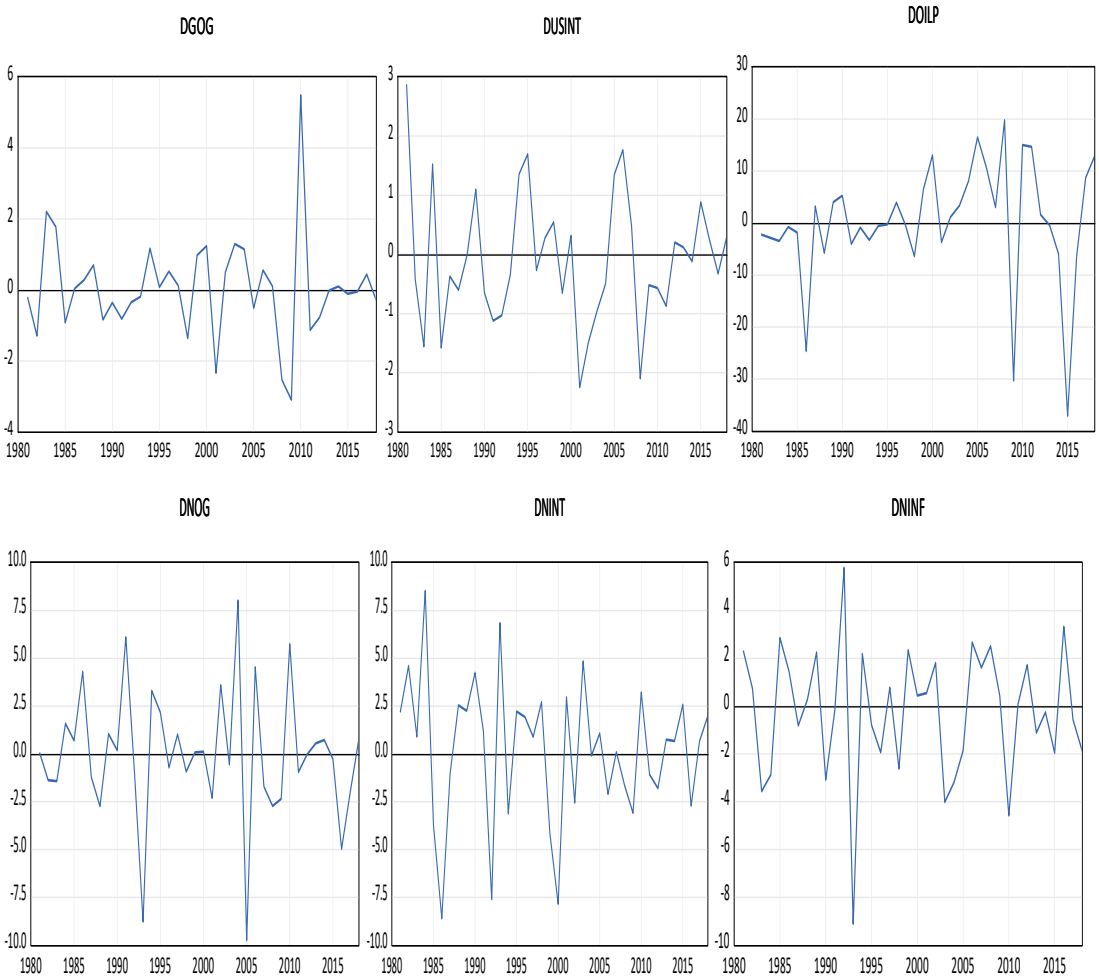


Source: Author's computation using EViews 11

GOG = Global output growth (%); USINT = US real interest rate (%); OILP = Oil prices (US dollars per barrel); NOG = Domestic output growth (%); NINT = Domestic interest rate (%); and NINF = domestic inflation rate (%).

**Note: for target domestic variables, the subscript N stands for Namibia, the reference country.*

Figure 5.2: Graphical Analysis of variables used in the VAR estimation – First Difference



Source: Author's computation using EViews 11

5.5.3 Stationarity Test Results

The study implements two-unit root tests (ADF and PP) in testing for stationarity. Unit root tests confirmed that three variables (OILP, USNT and NINF) are integrated of the first order I(1) while the other three (GOG, NOG and NINT) are stationary in level I(0) as presented in Table 5.3. Since variables are integrated in different orders, this justifies the appropriateness of the VAR.

Notwithstanding this, however, the analysis was conducted in their level forms inspired by this study's primary interest, which lies in the dynamics rather than parameter estimation. This justification is motivated by the wisdom of Sims (1980); Doan (2000); Perotti (2002); de Castro (2006); Lutkepohl (2006); and Ravinik and Zilic (2010); amongst others, who advocated for the appropriateness of a VAR-in-levels.

Table 5.3: Unit root tests: ADF and PP in levels and first difference

Variable	Model specification	Augmented Dickey-Fuller (ADF)			Phillips-Peron (PP)		
		Level	First difference	Order of integration	Level	First difference	Order of integration
GOG	Intercept	-4.440094**		I(0)	-4.269515**		I(0)
	Intercept and Trend	-4.545476**			-4.358646**		
USINT	Intercept	-2.213472	-5.905504**	I(1)	-1.566905	-6.169272**	I(1)
	Intercept and Trend	-3.368450	-5.806670**		-3.100091	-6.086517**	
OILP	Intercept	-1.305760	-5.726811**	I(1)	-1.305760	-5.721841	I(1)
	Intercept and Trend	-2.156965	-5.721312**		-2.156965	-5.716492	
NOG	Intercept	-4.265045**		I(0)	-4.210536**		I(0)
	Intercept and Trend	-4.394955**			-4.228422**		
NINT	Intercept	-3.929013**		I(0)	-3.821236**		I(0)
	Intercept and Trend	-3.928547**			-3.805782**		
NINF	Intercept	-2.312503	-7.987598**	I(1)	-2.169513	-13.53972**	I(1)
	Intercept and Trend	-4.647420	-7.874883**		-4.643198	-13.38247**	

Source: Author's own computation using values from EViews 11.
*Note: ** Implies rejection of the null hypothesis at 5% significance level for the sample period: 1980 – 2018.*

The decision criteria are as follows:

ADF Test
H_0: Series has a unit root
H_1: Series has no unit root (series is stationary)
Decision criteria: Reject H_0 if ADF test statistic < critical value

PP Test
H_0: Series has a unit root
H_1: Series has no unit root (series is stationary)
Decision criteria: Reject H_0 if PP test statistic < critical value

5.5.4 Lag Selection Criteria

Lag selection in view of adopting the optimal number of lags to include is important in VAR analysis. When selecting the number of lags to include in the VAR estimation, Brandt and Williams (2007) suggest setting lag(s) less than 5 for annual data, 8 for quarterly, or 15 for monthly data. To this end, all five lag length selection criteria (LR, FPE, AIC, SIC and HQ) suggest a lag of one (Table 5.4). Thus, subsequent VAR modelling was based on the one-lag structure specification.

Table 5.4: VAR Lag order selection criteria

					Included observations: 36	
Lag	**LogL**	**LR: sequentially modified LR test statistic**	**FPE: Final Prediction Error**	**AIC: Akaike information criterion**	**SC: Schwarz Information Criterion**	**HQ: Hannan-Quinn information criterion**
0	-538.4516	NA	551355.3	30.24731	30.51123	30.33943
1	-454.3531	**135.4921***	**39261.52***	**27.57517***	**29.42261***	**28.21998***
2	-435.3673	24.25958	120302.7	28.52041	31.95136	29.71790
3	-385.6087	46.99428	92981.90	27.75604	32.77051	29.50622

* Indicates lag order selected by the criterion
Source: Author's own computation using values from EViews 11.

5.5.5 Johansen Co-integration Test Results

After subjecting the time series to unit root tests and determining the optimal number of lags, the next step involves checking for the long-run relationship between the variables. To this end, the Johansen co-integration test was implemented, whose results

are shown on Table 5.5. In general, both the trace statistics and maximum eigenvalue tests the null hypothesis that there is no cointegration among the variables against the alternative that there is indeed cointegration among variables. The decision rule is that if the test statistic (trace or maximum eigenvalue) is greater than the critical value (i.e., the probability is less than 5%), then $\boldsymbol{H_0}$ is rejected, which in other words, implies acceptance of $\boldsymbol{H_1}$. The test statistic is less than the critical value and probability is greater than 0.05 hence the null hypothesis of no cointegration cannot be rejected. This suggests that there is no cointegration among variables.

The max eigenvalue statistics, on the other hand, tests whether r is equal to or not. Specifically, $\boldsymbol{H_0}$: r = 1 and $\boldsymbol{H_1}$: r = 2. The decision rule is that if the test statistic is greater than the critical value (i.e., the probability is less than 5%), then $\boldsymbol{H_0}$ is rejected, implying the acceptance of $\boldsymbol{H_0}$. Similar to the case of the trace test, the test statistic is less than the critical value and probability is greater than 0.05, $\boldsymbol{H_0}$ cannot be rejected. Henceforth, there is no cointegration among variables. Overall, both trace and maximum eigenvalue confirm that there is no cointegration among variables in the long run.

Table 5.5: Johansen Maximum Likelihood Cointegration (Trace and Maximum Eigenvalue Tests)

$\boldsymbol{H_0}$	$\boldsymbol{\lambda_{trace}}$	Critical Value (95%)	Prob**	$\boldsymbol{\lambda_{max}}$	Critical Value (95%)	Prob**
r = 0	90.73141	95.75366	0.1054	29.52577	40.07757	0.4554
r = 1	61.20564	69.81889	0.2002	20.12956	33.87687	0.7476
r ≤ 2	41.07609	47.85613	0.1863	17.05303	27.58434	0.5754

r ≤ 3	24.02306	29.79707	0.1995	13.85294	21.13162	0.3772
r ≤ 4	10.17012	15.49471	0.2679	9.454701	14.26460	0.2503
r ≤ 5	0.715415	3.841465	0.3977	0.715415	3.841465	0.3977

r denotes the number of cointegrating equations

Trace test and Max-eigenvalue test indicate no cointegration at the 0.05 level

* Denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

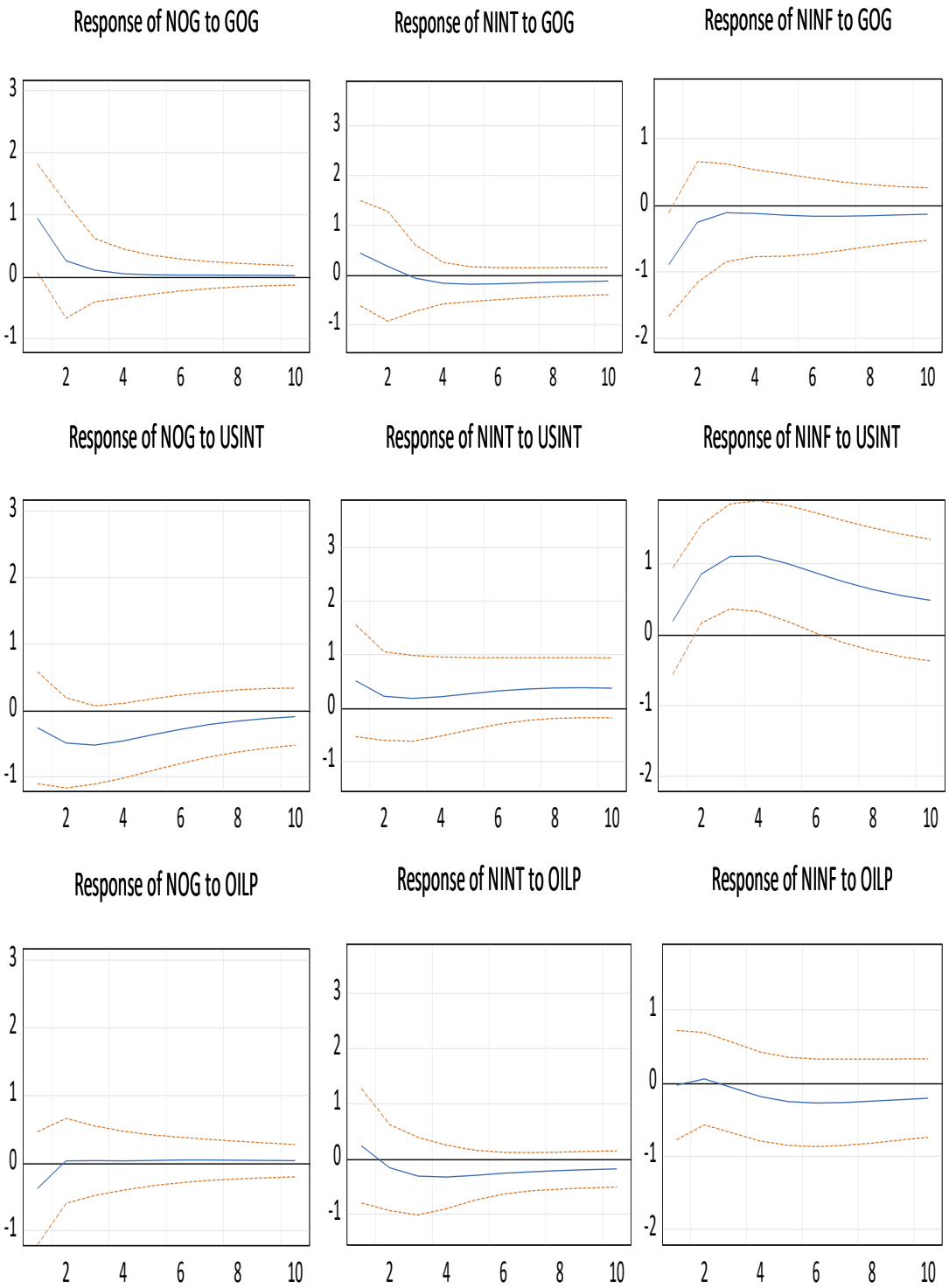
Source: Author's own computation using values from EViews 11.

5.5.6 Vector Autoregression (VAR) Results

Johansen (1995) postulated that relationships among non-stationary time series variables that are cointegrated of rank r can be represented as a multivariate Vector Error Correction Model (VECM). However, the Johansen cointegration test results indicated that there is no cointegration among variables. Considering that there was no cointegration, the VAR was appropriate. Henceforth, a VAR was estimated from which IRFs and FEVD were extracted. The results of the IRFs and FEVD are discussed below:

- **Impulse Response Functions (IRFs):** these reflect the response of one variable to an impulse/shock in another variable in a system that involves a number of further variables as well (Lutkepohl, 2005). This, in other words, implies that a shock to the *i*-th variable not only directly affects the *i*-th variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR. An IRF generally traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. Figure 5.3 portrays the IRFs for the three external shocks.

Figure 5.3: Impulse Response Functions from external shocks according to the Cholesky one S. D. (df adjusted) innovations



Source: Author's computations with EViews 11

The impulse responses to global output shocks are elucidated as follows: a typical global output growth shock raises domestic output growth by 0.9 percentage points at impact, 0.3 percentage points in the second year, effect dies out in the fourth period. This corroborates findings by Krznar and Kunovac (2010); Bermingham and Conefrey (2014); Majuca and Pagaduan (2015), and Bazhenova and Bazhenova (2016) in view of the Croatian; Irish; ASEAN and Ukrainian economies, respectively. The strong effect of foreign demand (world real output growth) shock on Namibia's real GDP growth is ascribed to, among others, the Namibian economy's openness (trade as % of GDP) which averaged 98.8% between 1980 and 2018. The significant openness of the Namibian economy contributes to the direct spillover of foreign GDP shocks on domestic real output growth. The other factors for the robust impact of foreign demand (world real output growth) shock on Namibia's real GDP growth include globalization, through which Namibia has become increasingly integrated with the global economy.

A 1% shock to global GDP output growth yields an increase of 0.4 percentage points in a domestic interest rate at impact before declining by 0.2 percentage points in the fifth year. Also, a positive standard error unit shock to global output corresponds to declines of 0.9 and 0.1 percentage points in domestic consumer inflation at impact, and in the third period, respectively, the impact remains negative thereafter. This validates the findings by Chileshe (2018).

A 1% hike in the US real interest rate (US monetary policy shock mirrored by the tightening of US monetary policy) yields contractions of 0.3 and 0.5 percentage points at impact and the third period, respectively, on domestic real GDP growth. Overall, the impact is negative, a result reinforcing those established by researchers (O'Grady, Rice & Wash, 2017; Oladunni, 2019; Abdel-Latif & Bolhuis, 2022; etc.). Yet, this result corroborates those of Frankel and Roubini (2001) and Reinhart and Reinhart

(2001), who found negative effects of the US interest rate changes on GDP in developing countries. Also, this supports the finding that an increase in the U.S. federal funds rates generates contractions in developing countries, as advanced by Demir (2019). Additionally, Miranda-Agripino and Rey (2019) posited that the US monetary policy shock induces significant fluctuations in financial activity on a global scale. Di Giovanni and Shambaugh (2008) revealed that, generally, high foreign interest rates have a contractionary effect on annual real GDP growth in the domestic economy. However, this effect is centred on countries with fixed exchange rates.

Following a positive US real interest rate hike (US monetary policy innovation), the domestic interest rate reaches 0.5 percentage points at impact, after which the effect remains in a positive trajectory throughout. This is in alignment with Mackowiak (2007) and substantiates findings by Demir (2019), who proffered that an increase in the U.S. interest rate leads to an increase in the other countries' interest rate since the U.S. is a large, open economy that impacts other countries that are integrated into global capital market to some extent. Also, interest rates in countries with floating exchange rate regimes are as dependent on and responsive to Federal Reserve monetary policy shocks as those with fixed currency regimes (Hausman et al., 2001). In response to a positive US real interest rate shock, domestic consumer prices reach 0.2 and 1.1 percentage points at impact and in the third year, correspondingly. All in all, the effect is positive.

The IRFs for oil price shocks reveal the following: a positive oil price shock corresponds to a decline of 0.4 percentage points in domestic output growth at the time of the shock, the impact is short-lived and reaches baseline in the second horizon. This finding validates Lorde et. al., (2009) and Abdel-Latif and Bolhuis (2022), amongst others. For Namibia, a net oil-importing country, real GDP growth is negatively

impacted by surges in oil prices owing to oil being a key commodity in different sectors of the economy. A 1% oil price innovation wields a 0.2% at impact, a decline of 0.3% between years 3 and 6, negative throughout, on the domestic interest rate. This finding is broadly in line with Dias (2013) and Choi, et al. (2018), though the latter established similar results between advanced and developing economies. A 1% oil price innovation wields 0.2 percentage points on domestic consumer prices at impact, declining by 0.3 percentage points between the third and sixth periods, after which the effect remains negative throughout. This outcome aligns with Kavila and Le Roux (2017). The finding that oil price shock is associated with a reduction in real GDP growth and an increase in consumer prices corroborates findings by Parlak, Salinas and Vargas (2021). Following an oil price innovation, domestic output, interest rate, and inflation declines. This finding can be expected from an oil-importing country.

- **Forecast Error Variance Decomposition (FEVD):** Forecast error variance decomposition helps quantify how much of each shock contributes to a given variable, including itself. Table 5.6 presents the FEVD of domestic macroeconomic variables. Generally, external shocks exert persistent and significant effects on variations of domestic macroeconomic variables. Specifically, the results reveal that global output growth (external demand) shock is the main external shock affecting Namibia's output growth while US monetary policy shock is the dominant external shock affecting consumer price inflation. Global output growth shock contributes 10.9% and 10.1% to output fluctuations during the second- and fourth-year horizons, correspondingly.

Table 5.6: FEVD of target domestic variables

Variables	Horizons (years)				
	2	**4**	**6**	**8**	**10**
Variance decomposition of output (GDP)					
Global output	10.9	10.1	9.8	9.7	9.7
US real interest rate	3.6	8.3	10.3	10.9	11.0
Oil prices	1.6	1.5	1.5	1.5	1.5
Total contribution	*16.1*	*19.9*	*21.6*	*22.1*	*22.2*
Variance decomposition of interest rate					
Global output	1.8	1.9	2.4	2.6	2.8
US real interest rate	2.5	3.0	4.2	5.9	7.7
Oil prices	0.7	2.2	3.3	3.9	4.3
Total contribution	*5.0*	*7.1*	*9.9*	*12.4*	*14.8*
Variance decomposition of inflation					
Global output	10.4	7.9	7.0	6.8	6.7
US real interest rate	9.2	28.2	36.6	40.0	41.7
Oil prices	0.0	0.4	1.3	2.1	2.6
Total contribution	*19.6*	*36.5*	*44.9*	*48.9*	*51.0*

Source: Author's computations with EViews 11

US monetary policy shock is important to consumer price inflation and interest rate fluctuations. The contribution of US monetary policy innovation to variations in domestic inflation and interest rates increases significantly with time. Specifically, US monetary policy shock contributes 9.2% and 28.2% to consumer price inflation while contributing 2.5% and 3.0% to interest rate fluctuations within

the second and fourth years, respectively. Even though the contribution of oil prices to domestic interest rate and inflation is marginal in the short span as it contributes approximately less than 2.0% in the first two years, the contribution increases considerably in the longer horizons as it accounts for approximately 4.3% and 2.6% to fluctuations in the interest rate and inflation, correspondingly. The impact on real GDP growth, on the other hand, is stagnant at about 1.5% for all periods.

5.5.7 Model Stability and Residual Diagnostic Tests

VAR analyses involve testing for model stability through the stability condition check for the optimal number of lags adopted in the model. The estimated VAR(1) is stable (stationary) as all roots have a modulus of less than one and lie inside the unit circle, as shown in Table 5.7 and Figure 5.4. In other words, this implies that the results of Impulse Response Functions (IRFs) and Forecast Error Variance Decomposition (FEVD) to be made are validated.

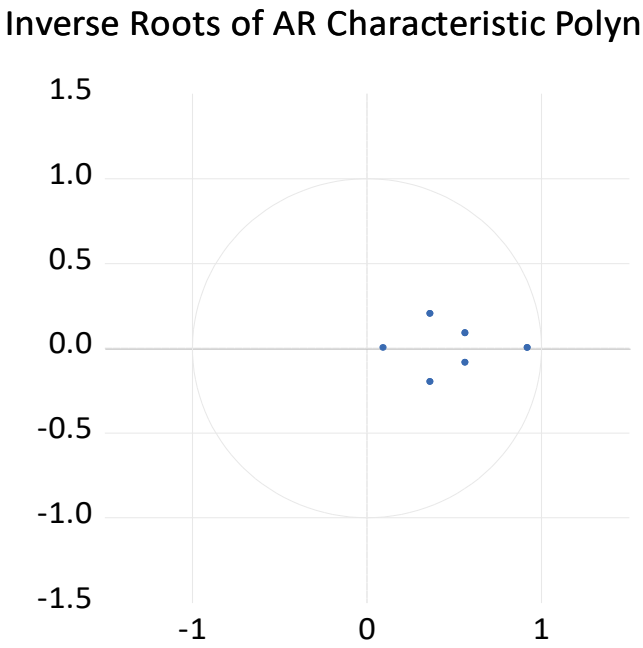
Table 5.7: Roots of Characteristic Polynomial

Root	**Modulus**
0.923182	0.923182
0.566400 - 0.087128i	0.573062
0.566400 + 0.087128i	0.573062
0.365445 - 0.200380i	0.416776
0.365445 + 0.200380i	0.416776
0.095381	0.095381

No root lies outside the unit circle. VAR satisfies the stability condition.

Source: Author's own computation using values from EViews 11.

Figure 5.4: Inverse roots of AR Characteristic Polynomial



Source: Author's own computation using values from EViews 11.

Diagnostic tests are performed after VAR specification to ensure the credible of the results. Accordingly, this study performs residual multivariate normal and LM auto-correlation tests. Results are shown in Table 5.8, from which the null hypothesis of multivariate normal is not rejected since the p-value > 0.05; hence residuals are normally distributed.

Table 5.8: Results of Residuals Multivariate Normality test

	Test statistic	**Degrees of freedom**	**P-value**
Skewness	5.223734	6	0.5155
Kurtosis	12.40632	6	0.0535
Jacque-Berra	17.63006	12	0.1274

Note: Null hypothesis: residuals are multivariate normal.

Source: Author's own calculation using values from EViews 11.

The LM auto-correlation test indicates that residuals are not serially correlated at 5%, as confirmed by the results for LM auto-correlation test results whose p-values exceed 0.05 as presented in Table 5.9.

Table 5.9: Results of LM Auto-correlation test

Lags	LM statistic	P-value
1	51.02558	0.0697
2	24.95292	0.9169
3	31.71976	0.6724

Note: Null hypothesis: there is no serial correlation at lag order h.
Source: Author's own computation using values from EViews 11.

5.6 Summary

This chapter reflects on the analysis undertaken in view of the study's second objective. Following this, it introduces external shocks and domestic macroeconomic variables, modelling of external shocks, materials, and results, as well as a discussion of empirical results. External shocks are unanticipated changes in the external environment that directly or indirectly affects the economic wellbeing of a country. Although unit root tests confirmed a mixed order of integration of the variables [three are integrated at first order (USINT, OILP and NINF) while three (GOG, NOG and NINT) are integrated at level], the study implemented a VAR-in level in the estimation of the effects of external shocks. This was modelled through the employment of a six-variable model comprising of three external variables (real output growth, US monetary policy and international oil price) and three domestic variables (output growth, inflation, and interest rate). Descriptive statistics, as well as results of the stationarity test, lag selection, model stability and residual diagnostic, Johansen

cointegration, and VAR (IRFs and FEVD), are discussed. The number of optimal lags is one selected by all five criteria whose stability is confirmed by the fact that all roots lie within the unit circle. Residual diagnostic tests confirmed that the residuals are normally distributed and are not serially correlated.

Findings from the IRFs reflect that a typical global output growth shock raises domestic output growth up to the fourth period and raises domestic interest rates in the first year while it yields negative responses to inflation throughout. The global interest rate shock has a negative impact on domestic output growth, while exerting a positive influence on domestic interest rate and domestic inflation, albeit the intensity is highest on inflation. The oil price shock, on the other hand, has a negative effect on domestic output growth and negligible from the second period onwards. Following an oil price shock, domestic interest, though positive at impact, remains negative territory throughout the ten-year horizon. Similarly, an oil price shock has a negative impact on domestic inflation.

Results from the variance decomposition reveal that global output shock is the dominant external disturbance affecting Namibia's output growth especially in the short-run, while US monetary policy innovation is found to be significantly impacting Namibia's inflation and interest rate dynamics, although, the impact is more pronounced on inflation in the long-run. The contribution of oil price shock to domestic output growth is rather insignificant. Yet, the contribution of oil price shock to Namibia's interest rate and inflation, though low in the first two years, the contribution surges gradually in the long-run.

Chapter Six: The effects of commodity prices on Namibia's business cycles

6.1 Introduction

This Chapter provides the background on the commodity price – business cycle relationship specifically outlining the importance of understanding interactions between commodity prices and the business cycle of commodity exporters which is important for all countries with a stake in international trade. Then Namibia's commodity price and business cycle developments are briefly discussed with greater emphasis on the role played by Namibia's mining sector in economic development especially in terms of contribution to GDP. Additionally, the sector is a significant export and exchange earner through which the country is exposed to external shocks in the form of mineral commodity prices, which are inherently determined by international markets.

The materials and methods adopted in the analysis which included description of variables adopted, model specification and estimation approach and justification for the implemented econometric model. Moreover, tests such as unit root, BDS nonlinearity, cointegration (bounds) were discussed followed by the estimation of NARDL Long-Run and Short-Run/Error Correction (ECM) Models as well as model stability and residual diagnostics. This was followed by the results and discussion where the underlying findings emanating from the estimation techniques were presented. Finally, the summary of the chapter was briefly outlined.

6.2 Background on commodity price – business cycle nexus

Commodity prices, especially in mineral-rich countries, play a significant role in the business cycles of those economies. This is especially so given that the effects of commodity price shock on business cycles drive the growth path of mineral-rich

economies. Namibia, just like its peers in sub-Saharan Africa, is a mineral-rich country which derives a significant share of its revenue from mineral exports, i.e., diamonds, uranium, gold, copper etc., to finance its national budget and development priorities. However, the Namibian economy is poorly diversified, relying heavily on extractive mining for export earnings and fiscal revenue, and is thus exposed to large and unpredictable fluctuations in commodity prices (AfDB & OECD, 2007).

Commodity prices–business cycle nexus is important to economic agents, macroeconomists, policymakers and scholars, among others, especially for decision-making and planning purposes. Thus, understanding the commodity prices–business cycle nexus for a commodity-rich country such as Namibia is a highly relevant aspect of overall macroeconomic policy. Also, understanding interactions between commodity prices and the business cycle of commodity exporters is important for all countries with a stake in international trade. The impact of commodity prices on business cycles (reflected by business cycle indicators i.e., GDP etc.) for different economies has been established in the literature. Yet, the debate about the direction of the effects of commodity prices on business cycles remains lively. Hamilton (1983), in his seminal work, documented that there is a significant negative relationship between commodity prices (specifically oil price increases) and economic activity. The researcher specifically postulates that oil shocks were a contributing factor in at least some of the U.S. recessions prior to 1972. This strand of literature has been supported by scholars (Burbidge & Harrison, 1984; Gisser & Goodwin, 1986; Bjørnland, 2000; Hamilton, 2009, 2011; Kilian & Vigfusson, 2014; among others) in view of different countries.

On the impact of commodity price shocks, Kose (2002) found that world price shocks account for a significant fraction of business cycle variability in developing countries. Houssa, Mohimont and Otrok (2015) established that commodity shocks are an important driver in business cycles in both Ghana and South Africa. Jégourel (2018) contended that cyclicality is one of the key properties of commodity prices, no matter their type and commodity cycles vary in their duration and amplitude and are often asymmetrical. The author additionally postulates that commodity prices are both a cause and a consequence of business cycles, depending on the country, and require dedicated measures to ensure that public investment in exporting countries can be sustained. Recently, Mohtadi and Castells-Quintana (2021) asserted that for every country, the extent of a commodity shock depends on the array of commodities exported and on the share of each commodity in the country's total exports.

Academic discourse still rages on whether the impact of commodity prices on business cycles is either linear or nonlinear. Camacho and Perez-Quiros (2014), in view of seven South American economies[3], proffered evidence on the nonlinear responses of output growth to commodity prices and that their effects on output growth are contingent on the state of the economy, the size of the shock and the sign of the shock. Fossati (2014) documented evidence of a positive and linear relationship between real GDP growth and the growth rate of commodity prices for selected Latin American countries. Liu and Serletis (2022), on the other hand, argued that there is a common belief postulating a close link between commodity prices and economic growth, yet it is not clear whether there exists nonlinear and tail dependence in that relation.

[3] Argentina, Brazil, Colombia, Chile, Mexico, Peru and Venezuela.

Literature has established the commodity prices-business cycle nexus to be more of a short-run phenomenon than a long-run. Herein, Bjornland (2004), in view of Norway, suggested that an oil price shock stimulates the economy temporarily; however, it has no significant long-run impact. Issa et al. (2008) asserted that the long-run economic growth of commodity-rich countries does not correlate with commodity prices, but short-run economic growth does. Similarly, as Alberola et al. (2017) argued, generally booms in commodity prices tend to raise real GDP in the short-term by increasing the value and production of a key production factor in the economy (natural resources) and lifting the demand for ancillary goods and services.

Notwithstanding the numerous works on the commodity price-business cycles nexus, changes in macroeconomic policies have had a significant bearing on the effects of commodity price shocks in some economies. To this end, De Gregorio and Labbé (2011) postulated that the Chilean economy has become increasingly resilient to copper price shocks (the impact of copper prices on the business cycle has been declining) in the last twenty-five years, especially during the last decade owing to macroeconomic policies (a flexible exchange rate, a rule-based fiscal policy, and a flexible inflation targeting regime).

There are a plethora of research works on the effects of commodity price shocks (Blanchard & Galí, 2010; Gubler & Hertweck, 2011; Inoue & Okimoto, 2017; Garcia & Escobar, 2018; Roch, 2019) and monetary policy shocks (Kim, 2001; Kilian & Lewis 2011; Adelakun & Yousfi, 2020; Le & Finch, 2021) on macroeconomic variables. However, research on commodity prices – business cycles nexus is scant, especially in sub-Saharan Africa, including Namibia. This is notwithstanding the fact

that economies within sub-Saharan Africa are richly endowed with mineral commodities which have a significant bearing on these economies' business cycles. Therefore, this study seeks to address two aspects: first, fill this literature gap and contribute to the commodity price – business cycle discourse for Namibia in particular and sub-Saharan Africa in general; and second, inform macroeconomic policy by recommending policy prescriptions for adoption going forward.

6.3 Namibia's commodity price and business cycle developments

A few macroeconomic models have been developed for the Namibian macroeconomy. These include Tjipe et al. (2004); Eita (2011); and Sunde (2015), among others. However, a comprehensive examination of the effects of macroeconomic shocks with specific emphasis on the estimation of the effects of commodity prices on the country's business cycles has not been performed. The novelty of this study is by bridging the current literature gap and the adoption of a new econometric approach to estimate the effects of commodity prices on Namibia's business cycles.

The Namibian economy can be disaggregated into three industries: primary, secondary and tertiary (services). The mining sector, one of the primary industries, is the largest contributor to the country's GDP, with an average contribution of 13.1% from 1980 to 2020, while the diamond mining subsector single-handedly averaged 7.0% (or 53.5% of total mining contribution) over the same period (Namibia Statistics Agency, 2021). Moreover, the mining sector remains an important foreign exchange earner given that between 2010 and 2018, minerals as a percentage of total exports of goods and services averaged 43.0% (Chamber of Mines of Namibia, 2018; 2019). However, the importance of the mining sector in terms of exports and foreign exchange earnings

clearly indicates that the country is exposed to external shocks in the form of mineral commodity prices, which are inherently determined by international markets. Yet, during the same period, the mining sector registered a decline of 0.2% in average real growth, with fluctuations evident in the sector's growth pattern (Namibia Statistics Agency, 2017). These fluctuations clearly indicate the heightened impact of commodity prices on Namibia's business cycles as well as external shocks to the overall performance of the mining sector. However, no study has empirically estimated the impact of commodity price shocks on business cycles for the Namibian economy; hence it is an area warranting comprehensive examination. Therefore, one of the key questions for this study is, *"What are the effects of commodity price shocks on Namibia's business cycles?"* The panacea to this question yields what the novelty of this study is essentially, which lies in the fact that it attempts to empirically quantify the importance of the effects of commodity prices on business cycles for Namibia.

To address this objective, the study adopted rarely investigated mineral commodity (copper and uranium) prices to quantify their effects on Namibia's business cycle (proxied by real GDP). Considering that diamond is the most significant contributor to GDP according to annual national accounts time series data as published by the Namibia Statistics Agency (NSA), it would ideally have been best to use its price. However, diamond prices are unavailable; hence copper and uranium were chosen to capture commodity price shocks owing to their availability in addition to them being among the largest GDP contributors within the mining sector. This estimation was conducted through a new econometric technique, the nonlinear Autoregressive Distributed Lag (NARDL), as advanced by Greenwood-Nimmo (2013) and Shin et al. (2014).

6.4 Materials and Methods

6.4.1 Data, Description and Sources

This study adopts annual time series data spanning the period 1980 to 2018, given the unavailability of high-frequency (daily, monthly, or quarterly) data for the variables of interest. This gives a sample size of 39 observations which prominently covers both Namibia's pre (prior to 1990) and post-independence (1990-2018) periods. The study's sample period has rich endowments of several events impacting the commodity price-business cycle nexus. These include the Iran–Iraq of 1980-1981; the U.S. recession of 1990-1991; the Asian Financial Crisis of 1998-2000; commodities boom in the 2000s (or the commodities super cycle experienced from 2000 to 2014); the Global financial crisis of 2008-2009; among others.

To examine the effect of commodity prices on Namibia's business cycles, the study adopts a five-variable model reflecting two international commodity prices (copper and uranium prices expressed in real US$ per metric tonne and real US$ per pound, respectively), one business cycle variable (real GDP reflected in US$) and two control variables [investment and exports shares of GDP, expressed as a percentage (%)]. In the analysis, asymmetric copper and uranium price changes are used. To this end, positive copper price changes (CP^{+}) and positive uranium price effects (UP^{+}) are distinguished from negative copper price changes (CP^{-}) and negative uranium price changes (UP^{-}), correspondingly.

On the choice of business cycle indicator, Teräsvirta and Anderson (1992) cautioned that it is convenient to select one that shows as much cyclical variation as possible whenever the non-linearity of business cycles is studied. In reinforcing this, Botha (2004); Aigheyisi (2018); and Yan and Huang (2020) adopted the real GDP growth

(year-over-year), fluctuations or volatility as the representative or proxy variable for the business cycle. Moreover, since output in the industrial sector corresponds roughly to output in the traded goods sector and is closely related to business cycle shocks for the countries analysed, this variable is a reasonable proxy for measuring the aggregate business cycle (Agenor et al., 2000). Based on these studies, real GDP is chosen as the business cycle indicator in this study.

This study is cognisant of other studies which assumed other variables as proxies of the business cycle. The proxies include (i) the output gap calculated using the Hodrick-Prescott (HP) filter adjusting the smoothing parameter k to allow for shorter cycles (k = 1 as opposed to 10 or 100 as is customary for yearly data) and dropping endpoints (Rand & Tarp, 2002; Dabla-Norris, Minoiu & Zanna, 2015); (ii) the Bry–Boschan (BBQ) algorithm proposed by Harding and Pagan (2002) specifically to identify cyclical turning points in quarterly series (Calderón & Fuentes, 2014; Claessens, Kose & Terrones, 2009; amongst others).

All in all, scholars such as Deaton (1999); Dehn (2000); Collier and Goderis (2012); Gruss (2014); amongst others, have established the impact of commodity price shocks on business cycles or business cycle indicators i.e., GDP. Notwithstanding the fact that most studies on business cycles are based on quarterly data, this study's depiction of business cycles with quarterly time series is strictly constrained by data unavailability hence the adoption of low-frequency annual time series. The study includes international commodity prices (copper and uranium) and business cycle variable (economic growth) as well as two control variables [investment and exports of goods and services (% of GDP)], as presented in Table 6.1.

Table 6.1: Description and sources of variables

Variable	Descriptor	Definition	Source
LNGDP	Log of real GDP	Real GDP in US$ GDP (constant 2015). This is a measure of real economic activity, which is reflected as a business cycle indicator.	World Bank's World Development Indicators (WDI) time series data 2020.
LNCP	Log of real copper prices	Real copper prices (in US$ per metric tonne) reflected by Copper (LME), grade A, minimum 99.9935%. purity, cathodes and wire bar shapes, settlement price.	World Bank's Commodity Price Data (the Pink Sheet).
LNUP	Log of real uranium prices	Real uranium prices reflected by Uranium, u3o8 restricted price, Nuexco exchange spot (US$ per pound). Nominal uranium prices are converted to real	International Monetary Fund (IMF) World Economic Outlook (WEO) 2021.

		(deflated using the US GDP deflator).	
LNINV	Log of investment / GDP ratio	Investment / GDP ratio proxied by Gross Fixed Capital Formation (GFCF)/GDP.	Namibia Statistics Agency national accounts time series data.
LNMXP	Log of exports (% of GDP)	Exports of goods and services (% of GDP). Exports of goods and services represent the value of all goods and other market services provided to the rest of the world.	World Bank – World Development Indicators (2020).

6.4.2 Model specification and Estimation Approach

Greenwood-Nimmo (2013) and Shin et al. (2014) advanced the well-known Autoregressive Distributed Lag (ARDL) model of Pesaran and Shin (1999) and Pesaran, Shin and Smith (2001) to the Nonlinear ARDL cointegration approach (NARDL) which has nonlinearity properties to detect asymmetries in both short-run and long-run among the variables. Also, the NARDL technique is superior to standard cointegration (i.e., Engle-Granger and Johansen) as it permits for modelling simultaneously asymmetric nonlinearity and cointegration among underlying variables in a single equation context. Botha (2004) advanced that non-linear models learn over

time and adjust to the new level of peaks and troughs and can therefore predict turning points more accurately. Camacho and Perez-Quiros (2014) asserted that examining the effects of commodity price shocks on output growth, which is crucial in the design of counter-cyclical stabilization policies in the Latin American region, is essentially nonlinear and multivariate. The scholar also contends that a long-term relationship between output and commodity prices is not detected for selected Latin American countries.

Notwithstanding the numerous works on business cycles, Kamber *et al.* (2016) advised that no model can include all the factors that might be relevant for understanding the business cycle. To test the model adequacy, the study adopted the Cumulative Sum of Recursive Residuals (CUSUM) and the Cumulative Sum of Squared Recursive Residuals (CUSUM of square) tests for which if the plots CUSUM and CUSUM of squares statistics lie within the 5% significance level, then the estimates are stable. Following the empirical literature review, the economic models in respect of copper and uranium prices are written as follows:

$$GDP_t = f(CP_t, INV_t, MXP_t) \tag{6.1}$$

$$GDP_t = f(UP_t, INV_t, MXP_t) \tag{6.2}$$

Where GDP_t is Gross Domestic Product (reflected as the business cycle variable); CP_t is the copper price; UP_t is the uranium price; INV_t is investment share of GDP (%) whereas MXP_t is the exports (% of GDP). Next, equations 6.1 and 6.2 are log-transformed into natural logs reflecting the two commodity prices of interest as follows:

$$LNGDP_t = \beta_0 + \beta_1 LNCP_t + \beta_2 LNINV_t + \beta_3 LNMXP_t + e_t \tag{6.3}$$

$$LNGDP_t = \alpha_0 + \alpha_1 LNUP_t + \alpha_2 LNINV_t + \alpha_3 LNMXP_t + \pi_t \tag{6.4}$$

Where e_t and π_t represents residuals that are assumed to be white noise while β_0, β_1, β_2, β_3 and α_0, α_1, α_2, α_3 are the vectors of long-run coefficients; all other variables are as previously defined. According to economic theory, when commodity prices (for copper and uranium in this case) rise, it increases exports earnings and value for those minerals in commodity exporters (Collier & Goderis, 2012; Cavalcanti, Mohaddes & Raissi, 2012). This will improve the country's net export position, thereby ultimately impacting output positively. Therefore, the effect of an increase in commodity prices on output is expected to be positive. Also, upsurges in investment and exports, by virtue of them being among the components of aggregate demand, positively impacts GDP according to the Keynesian theory, among others. This is suggestive of the fact that there is an expected positive relationship between investment and exports shares of GDP and real output.

Following Shin, Yu and Green-wood-Nimmo (2014), this study adopted the nonlinear ARDL technique to estimate the effects of commodity prices on Namibia's business cycles. Accordingly, the variables (commodity prices) can be decomposed into negative and positive partial sums. To this end, the asymmetric impact of commodity prices (copper and uranium prices) is accounted for by including their positive changes ($LNCP_t^+$and $LNUP_t^+$) and negative changes ($LNCP_t^-$ and $LNUP_t^-$). These reflect the partial sums of positive and negative commodity prices. Specifically, the partial sums for copper prices are as follows:

$$\Delta CP_t^+ = \sum_{i=1}^{t} \Delta CP_i^+ = \sum_{i=1}^{t} \max\left(\Delta\, CP_i, 0\right)$$

and

$$\Delta CP_t^- = \sum_{i=1}^{t} \Delta CP_i^- = \sum_{i=1}^{t} \min\left(\Delta\, CP_i, 0\right)$$

Similarly, the partial sums for uranium prices are:

$$\Delta UP_t^+ = \sum_{i=1}^{t} \Delta UP_i^+ = \sum_{i=1}^{t} \max\left(\Delta\, UP_i, 0\right)$$

and

$$\Delta UP_t^- = \sum_{i=1}^{t} \Delta UP_i^- = \sum_{i=1}^{t} \min\left(\Delta\, UP_i, 0\right)$$

Given the linear specifications of equations (6.3) and (6.4), it is not possible to capture the asymmetric impact of copper and uranium price changes. Thus, there is a need to account for asymmetries in the relationship between copper price and GDP on the one hand, and uranium price and GDP, on the other. Subsequently, equation (6.3) can be specified in nonlinear form as follows:

$$\begin{aligned}\Delta LNGDP_t = {} & \gamma_0 + \beta_1 LNGDP_{t-1} + \gamma_1^+ LNCP_{t-1}^+ + \gamma_2^- LNCP_{t-1}^- + \beta_4 LNINV_{t-1} \\ & + \beta_5 LNMXP_{t-1} + \sum_{i=1}^{p} \varphi_1\, \Delta LNGDP_{t-i} + \sum_{i=0}^{q} \varepsilon_1^+ \Delta LNCP_{\mathrm{t-i}}^+ \quad (6.5) \\ & + \sum_{i=0}^{q} \varepsilon_2^- \Delta LNCP_{t-i}^- + \sum_{i=0}^{q} \varphi_4\, \Delta LNINV_{t-i} + \sum_{i=0}^{q} \varphi_5\, \Delta \mathrm{LNMXP}_{t-i} + e_t\end{aligned}$$

Where Δ is the first difference operator; LN is the natural logarithm of the variables; γ_0 is the drift; e_t is white noise error; p and q are lag orders, $\gamma_i's$ are the short-run asymmetry coefficients while ε_i, the long-run asymmetry coefficients (effect of positive and negative copper price changes on GDP) are calculated as $\beta_2 = \frac{\gamma_1^+}{\beta_1}$ and $\beta_3 = \frac{\gamma_2^-}{\beta_1}$; β_1 and φ_1 are the lagged effects. Also, $\sum_{i=0}^{q} \varepsilon_1^+$ captures the short-run impact of copper price increase on real GDP while $\sum_{i=0}^{r} \varepsilon_2^-$ captures the short-run impact of a

copper price decrease on real GDP. Similarly, equation (6.4) can be specified in nonlinear form as follows:

$$\Delta LNGDP_t = \theta_0 + \alpha_1 LNGDP_{t-1} + \delta_1^+ LNUP_{t-1}^+ + \delta_2^- LNUP_{t-1}^- + \alpha_4 LNINV_{t-1} + \alpha_5 LNMXP_{t-1} + \sum_{i=1}^{p} \vartheta_1 \Delta LNGDP_{t-i} + \sum_{i=0}^{q} \epsilon_1^+ \Delta LNUP_{t-i}^+ + \sum_{i=0}^{q} \epsilon_2^- \Delta LNUP_{t-i}^- + \sum_{i=0}^{q} \vartheta_4 \Delta \mathrm{LNINV}_{t-i} + \sum_{i=0}^{q} \vartheta_5 \Delta \mathrm{LNMXP}_{t-i} + \pi_t \quad (6.6)$$

Where Δ is the first difference operator; LN is the natural logarithm of the variables; θ_0 is the drift; π_t is white noise error; p and q are lag orders; $\delta_i's$ are the short-run asymmetry coefficients while ϵ_i, the long-run asymmetry coefficients (effect of positive and negative copper price changes on GDP) are calculated as $\alpha_2 = \frac{\delta_1^+}{\alpha_1}$ and $\alpha_3 = \frac{\delta_2^-}{\alpha_1}$; α_1 and ϑ_1 are the lagged effects. Furthermore, $\sum_{i=0}^{q} \epsilon_1^+$ captures the short-run impact of uranium price increase on real GDP while $\sum_{i=0}^{r} \epsilon_2^-$ captures the short-run impact of a copper price decrease on real GDP. The dynamic NARDL models computed in equations (6.3) and (6.4) were used to perform the bound-testing procedure proposed by Pesaran et. al. (2001) to establish whether variables are cointegrated (i.e., exhibits a long-run relationship). Also, the standard Wald test was applied to uncover the existence of asymmetric relationship among variables in the long-run, and in the short-run.

6.4.3 Steps in implementing the ARDL/NARDL Bound co-integration Test/Technique

To account for the fact that business cycles (i.e., real GDP) respond asymmetrically to commodity price shocks (copper and uranium prices), the study adopted the NARDL approach based on asymmetric cointegration. In view of this, the long-run relationship

among variables for both linear and non-linear models was determined through the ARDL/NARDL bounds test approach to cointegration (Pesaran, Shin and Smith, 2001). The ARDL/NARDL approach to co-integration involves estimating the conditional error correction version of the ARDL/NARDL model for real GDP and its relationship with various determinants in the two commodity price models. To this end, the ARDL/NARDL bounds test approach to cointegration (Pesaran, Shin and Smith, 2001) can be implemented briefly through three steps.

Step One: involves the determination of the existence of the long-run relationship of the variables. Herein, equations (6.5) and (6.6) can be estimated through the Ordinary Least Squares (OLS) method. This is in order to test for the existence of a long-run relationship among the variables by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables in each model. For the copper price model represented by equation (6.5), the null hypothesis of no co-integration or presence of symmetric cointegration ($\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$) versus the alternative hypothesis of there is asymmetric cointegration or the effect is asymmetrical ($\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$) should be tested.

Similarly, from equation (6.6), the null hypothesis in respect of uranium prices is that the effect is symmetrical ($\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$) or there is no asymmetric cointegration. Put differently, this also implies no asymmetry (equality). In contrast, the alternative hypothesis is that the effect is asymmetrical ($\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq 0$) or there is asymmetric cointegration. In view of these, two asymptotic critical values bounds provide a test for cointegration when the independent variables are I(d) (where $0 \leq d \leq 1$): a lower and upper values assuming that the regressors are I(0) and purely I(1), correspondingly. If the F-statistic is above (below) the upper critical value, then

the null hypothesis of no long-run relationship can be rejected (not rejected) irrespective of the orders of integration for the time series.

Step Two: revolves around choosing the appropriate lag length for the ARDL model. Specifically, once co-integration is confirmed in step one, the conditional long-run ARDL models for both copper and uranium prices are then estimated. Pesaran and Shin (1998) posited that if there exists a stable long-run relationship then the conventional asymptotic theory can be applied for statistical inference on any of the coefficients. It is in step two where the selection of the order of the distributed lag on the dependent variable and the regressors using information criterion is undertaken. The appropriate lag selection can be chosen through the Akaike Information Criterion (AIC) or the Shwarz Bayesian Criterion (SBC). Based on Monte Carlo evidence, Pesaran and Smith (1998) established that SBC is preferable to AIC, as it is a parsimonious model that selects the smallest possible lag length, whereas the AIC selects the maximum relevant lag length. Herein, the AIC was adopted as a lag selection criterion in this study.

Step three: encompasses the estimation of the long run estimates of the selected ARDL model. Precisely, once long-run equilibrium is confirmed among the variables, then the long-run asymmetric impact of commodity prices on real GDP can be estimated. Similarly, the short-run/Error correction models for the two commodity price models can be estimated. These represent the short-run asymmetric impact of commodity prices on the business cycle indicator (real GDP). For the short-run/ECM, it is critical that the coefficient of the lagged Error Correction Term (ECT_{t-1}) carries a negative sign and is statistically significant at the 1%, 5% or 10% significance level.

This confirms adjustment to equilibrium after a commodity price shock. In the third and final step, the Error Correction Model (ECM) associated with the long-run estimates is estimated to obtain the short-run dynamic parameters. For the copper price model represented in equation (6.5), this is specified as follows:

$$\Delta LNGDP_t = \gamma_0 + \sum_{i=1}^{p} \varphi_i \, \Delta LNGDP_{t-i} + \sum_{i=0}^{q} \varepsilon_i^{+} \Delta LNCP_{\mathrm{t-i}}^{+} + \sum_{i=0}^{q} \varepsilon_i^{-} \Delta LNCP_{t-i}^{-} + \sum_{i=1}^{q} \omega_i \, \Delta LNINV_{t-i} + \sum_{i=1}^{q} \tau_i \, \Delta \mathrm{LNMXP}_{t-i} + \pi ecm_{t-1} + e_t \qquad (6.7)$$

Where $\varphi,\ \varepsilon, \omega, and\, \tau,$ are the short-run dynamic coefficients of the model's convergence to equilibrium and π is the speed of adjustment. All other variables are as defined earlier. Similarly, the error correction model associated with the long-run estimates for the uranium price model in equation (6.6), can be represented as follows:

$$\Delta LNGDP_t = \gamma_0 + \sum_{i=1}^{p} \rho_i \, \Delta LNGDP_{t-i} + \sum_{i=0}^{q} \vartheta_i^{+} \Delta LNUP_{\mathrm{t-i}}^{+} + \sum_{i=0}^{q} \vartheta_i^{-} \Delta LNUP_{t-i}^{-} + \sum_{i=1}^{q} \infty_i \, \Delta LNINV_{t-i} + \sum_{i=1}^{q} \partial_i \, \Delta \mathrm{LNMXP}_{t-i} + \omega ecm_{t-1} + e_t \qquad (6.8)$$

Where $\rho, \vartheta, \infty, and\, \partial$ are the short-run dynamic coefficients of the model's convergence to equilibrium and π is the speed of adjustment. All other variables are as described earlier.

6.4.4 Justification for the Adoption of the NARDL Approach

This study adopted the NARDL estimation technique to estimate the commodity price-business cycle nexus for Namibia based on its usefulness in this field as well as characteristics of this study. Regarding the adoption of nonlinear approach, Enders (2015) cautioned that utilising symmetric methods to estimate causal links that can

have possible asymmetry could lead to inappropriate decisions. Moreover, Katrakilidis and Trachanas (2012) and Lahiani, Hammoudeh, and Gupta (2016) advanced that the main advantages of the NARDL model over other competing cointegration models are four-fold: firstly, it allows one to discriminate between linear cointegration, nonlinear cointegration and absence of cointegration. Secondly, it performs better in testing for cointegration relationships in small samples.

Thirdly, it accounts for long- and short-run asymmetries in the dynamics of two cointegrated economic variables. Lastly, it can be applied to regressors that have different integration orders, combination of I(0) or I(1), thus allowing for statistical inferences on long-run estimates, which is not possible within the standard linear ECM framework. Yet, it can be used to test for both linear and nonlinear cointegration. However, the linear ARDL cointegration technique is not valid in the presence of I(2) variables. Recently, the NARDL approach has been found to be appealing and has as such been used extensively to model, amongst others, asymmetry in commodity pricing (Atil, Lahiani, & Nguyen, 2014; Bildirici & Turkmen, 2015; Kumar, 2017). The above synopsis provides justifiable grounds for the adoption of the NARDL to examine the commodity price-business cycle nexus for Namibia.

6.4.5 Tests for Unit Root

In testing for stationarity properties (order of integration) of the time series, the Augmented-Dickey Fuller (ADF) and the Phillips-Perron (PP) Tests as proposed by Dickey and Fuller (1979) and Phillips and Perron (1988), respectively, were applied. In view of this, two versions of the tests were performed; the first allows for an intercept whereas the second allows for an intercept and a deterministic trend. A stationary series can be defined as one with a constant mean, constant variance and

constant autocovariance for each given lag. The use of non-stationary data can lead to spurious regressions (Brooks, 2008).

Stationarity properties of variables are critical to be checked before applying the ARDL model to ensure that no series is stationary at I(2); otherwise, the outcomes will be incorrect (Ofori-Abebrese et al., 2017; Wong & Shamsudin, 2017; and Khan et al., 2019). Pesaran et al., (2001) proffered that the ARDL method can be applied in cases where the time series is stationary at levels [I(0)] or stationary at first differences or fractionally integrated [I(1)]. Moreover, within the ARDL framework, the series should not be I(2), since this integration order invalidates the F-statistics and all critical values established by Pesaran. Cointegration of the variables is also often empirically established. Herein, Brooks (2008), in view of cointegration, proffered that in most cases, if two variables that are I(1) are linearly combined, then the combination will also be I(1).

6.4.6 BDS Nonlinearity Test

The objective of this study is to estimate the effects of commodity prices on Namibia's business cycles through the nonlinear ARDL approach. Accordingly, this involves determining the asymmetric relationship between the variables hence the need to investigate nonlinearity among the variables. In view of this, the BDS test developed by Brock, Dechert and Scheinkman (1987) and Broock et al. (1996) was adopted to examine the variables' nonlinearity properties. Researchers Barnett et al. (1997), among others, established that the BDS test has power against a wide range of linear and nonlinear alternatives. Kantz and Schreiber (1997) recommended that before doing any non-lineal analysis on a data set, it is good practice to check if there is no

linearity. The BDS test was designed to test for the null hypothesis of independent and identical distribution (iid) for the purpose of detecting nonlinearity and non-random chaotic dynamics. To this end, the null hypothesis is that data in a time series is independently and identically distributed (iid).

6.4.7 Model Stability

To ensure that the models for both copper and uranium prices are stable, the study performed the Cumulative Sum of Recursive Residuals (CUSUM) and the Cumulative Sum of Squared Recursive Residuals (CUSUM of squares) tests for which if they lie within the 5% band then they are said to be stable.

6.4.8 Residual Diagnostic Tests

To validate NARDL model results, some residual tests such as Breusch-Pagan-Godfrey (BPG) for heteroscedasticity, Jarque-Bera (JB) for normality (Jarque & Bera, 1980) and Breusch-Godfrey (BG) Serial Correlation LM were performed. These were to ascertain the absence of heteroscedasticity and serial correlation while confirming whether residuals were normally distributed or not. Furthermore, the models were also subjected Ramsey's Regression Specification Error Test (RESET) for specification error as advanced by Ramsey (1969). Herein, the null hypothesis is that the model is correctly specified which can in other words be represented as H_0: $\gamma = 0$. The decision rule is that the null hypothesis is rejected if the p-value of the F-statistic exceeds 0.01; 0.05 or 0.10 at 1%; 5% or 10%, significance levels, respectively.

6.5 Results and Discussion

6.5.1 Descriptive statistics

All variables were expressed in natural logs to control for outliers, attain harmony in the units of measurement and avoid spurious estimates. Table 6.2 presents descriptive statistics of the time series of the variables used in the study. Descriptive statistics are a pre-requisite in econometric analysis. The annual time series from 1980 to 2018 represents 39 observations. Results reveal that the real GDP and inflation had the highest and lowest mean values, respectively. All variables, except log of investment (LNINV), have positive skewness. This suggests that the positively skewed variables were high during the initial years but are progressively declining over the years.

The skewness for log of investment (LNINV) is negative thus indicating an increasing trend during the latter years. Moreover, all variables have probabilities greater than 5% as revealed by the Jarque-Bera statistics. Therefore, this indicates that all variables are normally distributed. The standard deviation reflects the level of volatility in the variables by displaying the rate at which each variable deviates from the mean value. In view of this, the log of uranium price (LNUP) is the most volatile at 0.6%, while log of exports (LNMXP) is the least volatile at 0.1%.

Table 6.2: Descriptive statistics

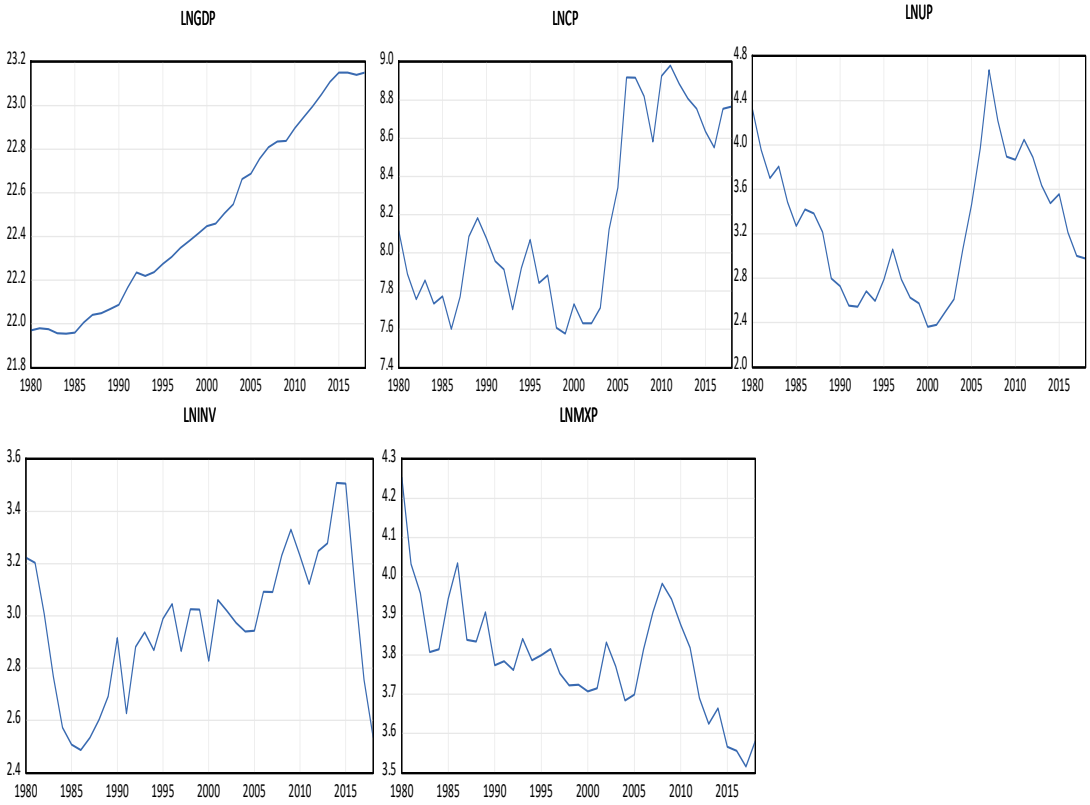
	LNGDP	LNCP	LNUP	LNINV	LNMXP
Mean	22.48122	8.173996	3.258492	2.963533	3.798452
Median	22.41313	8.068920	3.215365	2.989103	3.799722
Maximum	23.15173	8.981383	4.675634	3.509051	4.254025
Minimum	21.95455	7.576430	2.361909	2.486160	3.515145
Std. Dev.	0.416610	0.479541	0.610503	0.266067	0.146279
Skewness	0.282930	0.445252	0.330620	-0.056986	0.566491
Kurtosis	1.686257	1.639478	2.111234	2.458237	4.079620
Jarque-Bera	3.324942	4.296529	1.994109	0.498058	3.979992
Probability	0.189670	0.116686	0.368965	0.779557	0.136696
Sum	876.7677	318.7859	127.0812	115.5778	148.1396
Sum Sq. Dev.	6.595421	8.738452	14.16313	2.690087	0.813110
Observations	39	39	39	39	39

Source: Author's own computation using values from EViews 11.

6.5.2 Graphical analysis

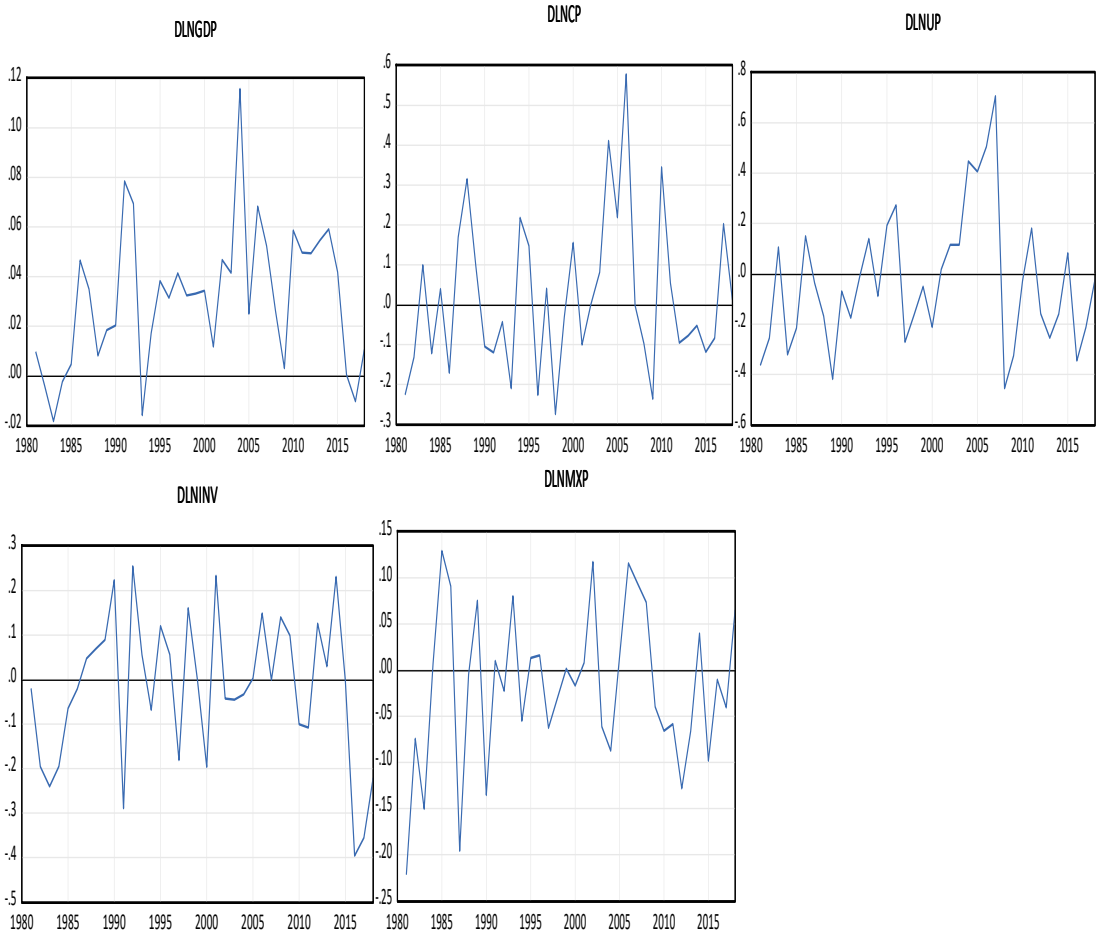
The log-transformed annual time series data used in the model estimation for the period 1980 – 2018 are displayed in Figures 6.1 and 6.2, reflecting their level and first difference forms, respectively. To this end, it is evident that the plots of all variables shown in Figure 6.1, with the exception of exports reflect increasing trends, meaning that the mean is not constant (varies) over time.

Figure 6.1: Graphical analysis of variables used in the NARDL estimation – Levels



Source: Author's own calculations from EViews 11

Figure 6.2: Graphical analysis of variables used in the NARDL estimation – First Difference



Source: Author's own calculations from EViews 11

6.5.3 Unit Root Analysis

The unit root tests (ADF and PP) all confirmed the preliminary finding of the plot of variables that one variable (LNMXP) is stationary at level I(0) whereas four variables (LNGDP, LNCP, LNUP and LNINV) are integrated of the first order I(1) as presented in Table 6.3. The fact that the examined variables have a different order of integration [(I(0) and I(1)] while none is integrated of the second order I(2) justifies the appropriateness of applying the ARDL model for the analysis (Pesaran, Shin and Smith, 2001).

Table 6.3: Unit root tests: ADF and PP in levels and first difference

Variable	Model specification	Augmented Dickey-Fuller (ADF)		Order of integration	Phillips-Peron (PP)		Order of integration
		Level	First difference		Level	First difference	
LNGDP	Intercept	1.163122	-4.298512**	I(1)	1.163122	-4.208468**	I(1)
	Intercept and Trend	-3.048183	-4.372643**		-3.091208	-4.224651**	
LNCP	Intercept	-0.913248	-5.281628**	I(1)	-1.036335	-5.246766**	I(1)
	Intercept and Trend	-2.243143	-5.213096**		-2.243143	-5.163415**	
LNUP	Intercept	-2.049590	-4.276038**	I(1)	-2.151281	-4.288385**	I(1)
	Intercept and Trend	-2.131240	-4.209574**		-2.224255	-4.226284**	
LNINV	Intercept	-1.735036	-4.980726**	I(1)	-2.021904	-4.981987**	I(1)
	Intercept and Trend	-1.938428	-4.913236**		-2.295604	-4.910336**	
LNMXP	Intercept	-3.261477**		I(0)	-3.270519**		I(0)
	Intercept and Trend	-3.544264**			-3.613294**		

Source: Author's own computation using values from EViews 11.
*Note: ** Implies rejection of the null hypothesis at a 5% significance level for the sample period: 1980 – 2018.*

The decision criteria are as follows:

ADF Test
H_0: Series has a unit root
H_1: Series has no unit root (series is stationary)
Decision criteria: Reject H_0 if ADF test statistic < critical value

PP Test
H_0: Series has a unit root
H_1: Series has no unit root (series is stationary)
Decision criteria: Reject H_0 if PP test statistic < critical value

6.5.4 BDS Nonlinearity Test

To estimate the effects of commodity prices on Namibia's business cycles through the nonlinear ARDL approach this study performed the BDS nonlinearity test to examine the variables' nonlinearity properties. Table 6.4 shows results of the BDS test for linearity from reveals that the null hypothesis of linearity is rejected for all variables, thereby confirming nonlinearity.

Table 6.4: Results of the BDS test for nonlinearity

Variable	Dimension	BDS statistic
LNGDP	2	0.183831
	3	0.300871
	4	0.375257
	5	0.423638
	6	0.455442
LNCP	2	0.119557
	3	0.202479
	4	0.276723
	5	0.317083
	6	0.331908
LNUP	2	0.142043
	3	0.225834
	4	0.273846
	5	0.304730

	6	0.323654
LNINV	2	0.079187
	3	0.133410
	4	0.183072
	5	0.180473
	6	0.176895
LNMXP	2	0.113327
	3	0.160447
	4	0.172903
	5	0.167854
	6	0.185607

**Probability for all dimensions is zero.*

Source: Author's computations from EViews 11

6.5.5 Cointegration Test Results

The NARDL approach based on asymmetric cointegration is adopted to confirm that business cycles (i.e., real GDP) respond asymmetrically to commodity price shocks (copper and uranium prices). The study applied Wald F-test statistics to determine whether there is asymmetric cointegration between commodity prices and real output in Namibia. The decision rule is such that if the F-statistic is greater than their respective Pesaran upper bound critical values at the 5% level of significance, then there is cointegration. This, in other words, implies that there is a long-run relationship among the variables. Yet, there would be no cointegration should the F-statistic fall below the lower bound and undetermined should it have fallen in between the lower and upper bounds. The results of the cointegration test for both the linear (ARDL) and nonlinear (NARDL) models are presented in Table 6.5 which reveal that the F-

statistics are greater than the Pesaran upper bound critical values at the 5% level of significance for both linear and nonlinear models of copper and uranium prices. This confirms that there is long run cointegration relationship among variables for both copper and uranium price models.

Table 6.5: Bounds Test for Linear / Non-Linear Cointegration

Model 1 – Copper prices				
Model specification	**F-statistic**	**Lower bound I(0) critical value**	**Upper bound I(1) critical value**	**Conclusion**
Linear	4.854213	2.79	3.67	Cointegration
Nonlinear	3.562881	2.56	3.49	Cointegration
Model 2 – Uranium prices				
Linear	5.335273	2.79	3.67	Cointegration
Nonlinear	6.556687	2.56	3.49	Cointegration

Note: decisions made at 5% significance level. The optimal lag order was based on AIC.

Source: Author's calculations from EViews 11

6.5.6 NARDL Lon-run and Short-run/ECM Estimation

Since there is evidence of nonlinear cointegration, the next step is to estimate the NARDL long-run parameters for commodity prices (copper and uranium prices). Table 6.6 presents the results from which it is evident that the non-linear specification for model 1 (copper prices) has lags 4, 3, 3, 0 and 3 selected based on the Akaike Information Criterion (AIC). It reveals that the decomposed positive effects of copper prices are significant at 1% significance level while the decomposed negative effects are not significant even at a 10% significance level. The estimated long-run parameters

for positive and negative copper price shocks are 0.315 and -0.088, correspondingly. This clearly illustrates that positive copper price shock exerts the greatest impact on real GDP than the negative shock, whose impact on real GDP is negative. Specifically, the results reveal that a 1% increase in copper price causes real GDP to increase by 0.32%, whereas a negative copper price shock is associated with a decrease in real GDP by 0.09%.

Table 6.6: NARDL long-run parameter estimation (copper and uranium prices)

Model 1 – Copper prices		
Exogenous variables	**Parameters**	**P-values**
LNCP_POS	0.315032	0.0000***
LNCP_NEG	-0.087911	0.1596
LNINV	0.085016	0.2619
LNMXP	-0.311213	0.0702*
C	22.94052	0.0000***
Selected Model: ARDL(4, 3, 3, 0, 3)		
Model 2 – Uranium prices		
Exogenous variables	**Parameters**	**P-values**
LNUP_POS	0.139384	0.0000***
LNUP_NEG	-0.184955	0.0000***
LNINV	0.094579	0.0237**
LNMXP	-0.166965	0.0979*
C	22.21100	0.0000***
Selected Model: ARDL(1, 1, 2, 0, 0)		

*Note: *** 1% significance level, ** 5% significance level, * 10% significance level.*

Dependent Variable: D(LNGDP).

Source: Author's calculations using EViews 11.

Table 6.6 also shows that model 2 (uranium prices) has lags 1, 1, 2, 0, and 0 selected based on the AIC. Unlike the case for copper prices, for which only the positive effects are significant, both the decomposed positive and negative effects of uranium prices are highly significant at a 1% significance level. The estimated long-run parameters for positive and negative uranium price shocks are 0.139 and -0.185, in that order. Like the effects of copper price shocks, this exemplifies that a positive uranium price shock exerts the greatest impact on real GDP (positive effect) than negative shocks whose impact on real GDP is negative. Precisely, the outcomes disclose that a 1% increase in uranium price causes real GDP to increase by 0.14%, whereas a negative uranium price shock is associated with a decrease in real GDP by 0.18%. Overall, the finding that both positive shocks for copper and uranium prices are positive is in line with economic theory and implies that the positive shocks (increase) impact real economic activity positively.

Following the NARDL long-run parameter estimation, the study also estimates short-run models for copper and uranium prices. Table 6.7 shows the short-run results, which reveal that positive shocks (appreciations) are positive and statistically significant at 1% significance level while negative shocks (depreciations) for both commodity prices are not statistically significant even at 10% significance level. Therefore, the short-run estimated results corroborate those of the long run, specifically in view of positive shocks. This finding is in line with economic theory and implies that the positive shocks (increase) impact real economic activity positively. The lagged Error Correction Term or ECT_{t-1} term reflects the speed of adjustment toward long-run equilibrium from any short-run shock in the repressors. Typically, the coefficient of the ECT_{t-1} term is expected to be negative and statistically significant to confirm the

existence of a long-run relationship among variables. Omoshoro-Jones (2021) stated that if the lagged error correction term coefficients are slightly less than one (1) then the convergence to equilibrium is rather slower and as such this is referred to as a gradual monotonic adjustment process. However, if the term exceeds 1 then the speed of adjustment (the convergence) to equilibrium is said to be rapid.

The ECT_{t-1} term was found to be negative and statistically significant at 1% significance level for both commodity price models. Yet, the error correction term is less than 1 for both models, although highest for copper prices, albeit marginally. Precisely, the estimated error correction terms for copper and uranium prices are -0.538 and -0.505, correspondingly. This implies that about 53.8% and 50.5% of the disequilibria in copper and uranium prices, respectively, are corrected within one year. The finding that the error correction term is less than 1 for both models suggests that both models follow a gradual monotonic adjustment process. Also, the finding that the ECT_{t-1} term was found to be negative and statistically significant for both copper and uranium commodity price models is in line with a priori expectation, thus confirming a stable and robust asymmetric long-run relationship between real GDP and the two commodity prices as previously established by the result of the Wald test for cointegration in Table 6.6.

The R-squared for the copper and uranium price models are 0.641 and 0.520, correspondingly. This implies that 64.1% and 52.0% of the variability observed in real GDP for the copper and uranium price models, respectively, is explained by the regression model. Moreover, the Durbin-Watson statistic for both copper and uranium price models is closer to two (2). Precisely, the Durbin-Watson statistic is 2.3 and 1.8

for copper and uranium price models, respectively, thereby confirming the absence of autocorrelation in the two models.

Table 6.7: Short-Run NARDL estimation (copper and uranium prices)

Model 1 – Copper prices		
Exogenous variables	**Parameters**	**P-values**
Δ(LNGDP(-1))	0.405843	0.0184**
Δ(LNGDP(-2))	-0.238808	0.3118
Δ(LNGDP(-3))	-0.350951	0.1003
Δ(LNCP_POS)	0.153033	0.0011***
Δ(LNCP_POS(-1))	-0.114901	0.0232**
Δ(LNCP_POS(-2))	-0.114632	0.0276**
Δ(LNCP_NEG)	0.097056	0.1278
Δ(LNCP_NEG(-1))	0.114396	0.0803*
Δ(LNCP_NEG(-2))	0.127885	0.0360**
Δ(LNMXP)	0.029138	0.5969
Δ(LNMXP(-1))	0.126408	0.0431**
Δ(LNMXP(-2))	0.079206	0.1397
CointEq(-1)*	-0.538362	0.0001***
R-squared	0.641037	
Durbin-Watson stat	2.289480	
Model 2 – Uranium prices		
Exogenous variables	**Parameters**	**P-values**
Δ(LNUP_POS)	0.133330	0.0000***
Δ(LNUP_NEG)	-0.026718	0.2453

Δ(LNUP_NEG(-1))	0.077310	0.0118**
CointEq(-1)*	-0.505071	0.0000***
R-squared	0.520404	
Durbin-Watson stat	1.811052	

*Note: *** 1% significance level, ** 5% significance level, * 10% significance level. Dependent Variable: D(LNGDP).*

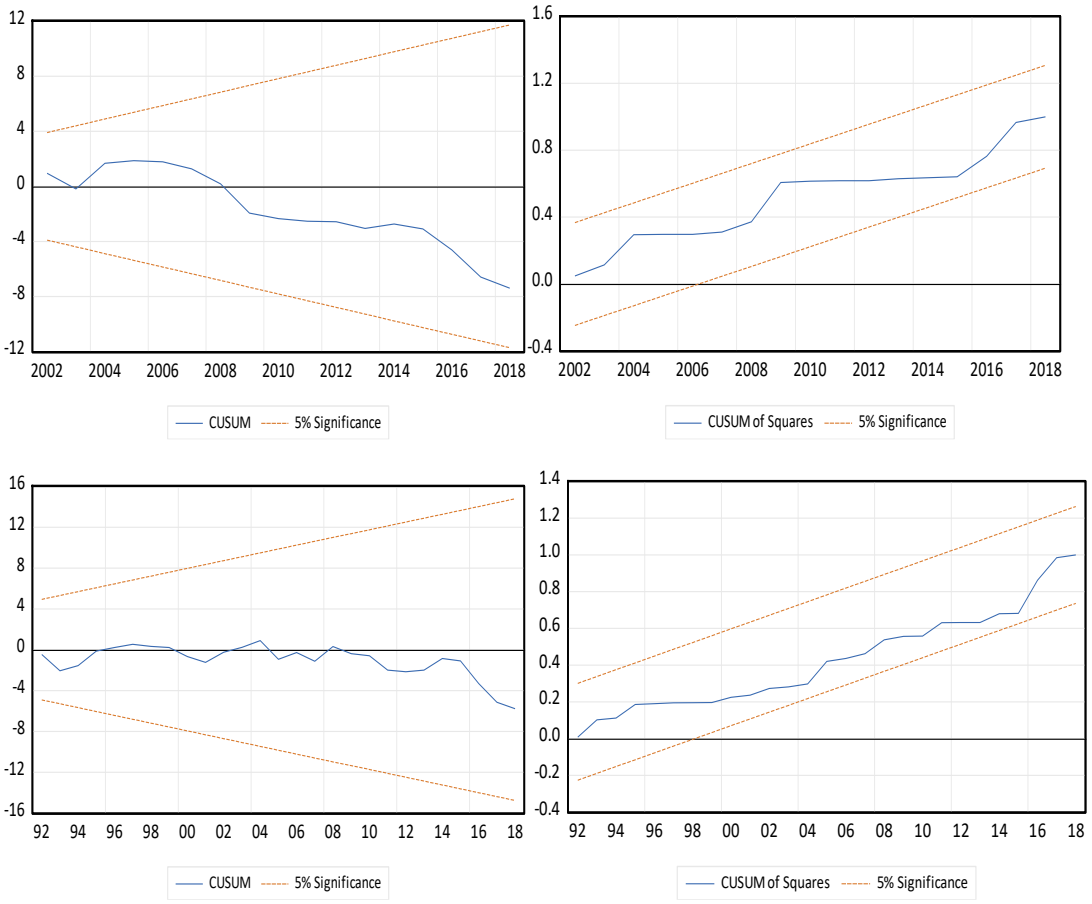
Source: Author's calculations from EViews 11.

Overall, the finding that positive effects of commodity prices have a positive impact on real GDP corroborates those of Fuentes and García (2016) and Vallejo (2017), among others. They are also congruent with Deaton and Miller (1995) and Raddatz (2007), in view of Africa and low-income countries, correspondingly, who found that higher commodity prices significantly raise income in the short run. Whereas the resource literature predicts an ambiguous effect of commodity booms on long-run growth, empirical studies by Deaton and Miller (1995) for Africa and Raddatz (2007) for low-income countries use vector autoregressive (VAR) models and establish that higher commodity prices significantly raise income in the short run.

6.5.7 Model Stability

Model stability was assessed by means of CUSUM and CUSUM of squares tests. The results of CUSUM and CUSUM of squares tests for copper and uranium price models are presented in Figure 6.3. The outcomes clearly reflect that they lie within the 5% band, thereby confirming that the models for both copper and uranium prices are stable.

Figure 6.3: Results of Model Stability (CUSUM and CUSUMSQ) Tests



**Note: Copper prices – the first two horizontal panels;*

Uranium prices – the bottom two panels

Source: Author's own construct using EViews 11.

6.5.8 Asymmetric Cointegration Test Results

In addition to the stability above, the study sought to examine whether the coefficients are symmetrical or asymmetrical in the long-run through the Wald Coefficient diagnostic tests. To test for long-run asymmetry between commodity prices (copper and uranium prices) and business cycle (GDP) in Namibia, the null hypothesis is H_0: No asymmetry (equality) against the alternative H_1: there is asymmetry. Table 6.8 presents the results of the joint asymmetric test whose p-values are less than 0.05 for

both the copper and uranium prices models thereby indicating rejection of the equality null hypothesis at 5% level of significance. This, therefore, confirms that there is a long-run asymmetric relationship among the variables for both copper and uranium price models.

Table 6.8: Joint asymmetric test

Model	**Asymmetric test**	**F-statistics**	**p-value**
Copper prices	$\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$	3.335127	0.0200**
Uranium prices	$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$	5.452661	0.0024***

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

Source: Author's own construct using EViews 11

Table 6.9 presents the results of the Wald coefficient long-run asymmetric test. The null hypothesis is that there is equality between the decomposed positive and negative changes. The decision rule is such that if the p-value of the F-statistic is greater than 0.05 then the null hypothesis is rejected. The results reveal that the p-values for both models are lower than 0.05 hence the null hypotheses of asymmetric changes between the decomposed positive and negative effects for both commodity prices can be rejected. This implies that there is inequality (asymmetry) and the coefficients for positive and negative effects are not the same in the long-run.

Table 6.9: Wald Coefficient (Long-run) asymmetric test

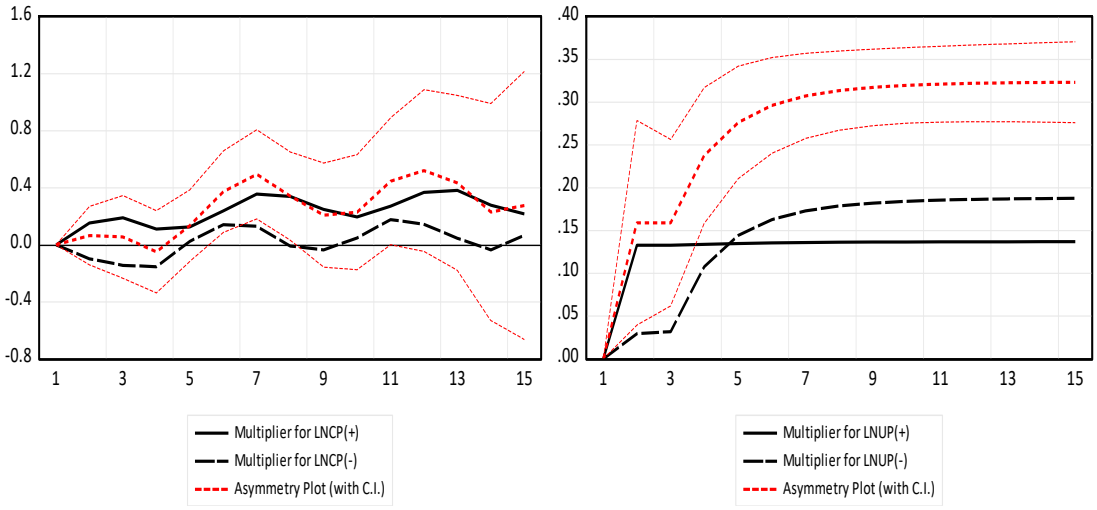
Model	**Asymmetric test**	**F-statistics**	**p-value**
Copper prices	Long run: $-\gamma_1^+/\beta_1 = -\gamma_2^-/\beta_1$	134.3262	0.0000***
Uranium prices	Long run: $-\delta_1^+/\alpha_1 = -\delta_2^-/\alpha_1$	704.0470	0.0000***

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

Source: Author's own construct using EViews 11

Figure 6.4 depicts the effect of the dynamic multiplier of negative and positive changes in commodity prices. In view of copper prices, the figure reveals that during the short-run period, negative shocks are unstable compared to positive shocks. Also, an increase in copper price appears to have a larger impact on GDP during both the short-run and long-run periods. In view of uranium prices, the figure reflects that both positive and negative shocks are more short-lived. Moreover, it shows that in the short-run period, positive changes (appreciations) have a larger impact on GDP than negative changes (depreciations). Overall, appreciations in both copper and uranium prices have positive effects on real GDP reflected by the solid black line that lies above zero.

Figure 6.4: NARDL Dynamic multiplier graphs for copper and uranium prices



Source: Author's own construct using EViews 11.

6.5.9 Residual Diagnostic Tests

Residual diagnostic tests such as Breusch-Pagan-Godfrey (BPG) for heteroscedasticity, Jarque-Bera for normality and Breusch-Godfrey Serial Correlation LM were performed to validate the results of the NARDL models. Table 6.10 reveal

that the optimal model passed all the conventional and stability tests. Specifically, for the copper price model, the probability values of 0.14; 0.74, and 0.22 for the Brush-Pagan-Godfrey (BPG) test for heteroskedasticity, Jacque-Bera (JB) test for normality, and the Breusch-Godfrey (BG) Serial Correlation LM, respectively, are all greater than 5%; thus, implying that the residuals are normally distributed; they are not serially correlated and are homoscedastic. Similarly, for the uranium price model, the probability values of 0.31; 0.63, and 0.85 for the BPG test for heteroscedasticity, JB test normality, and the BG for Serial Correlation LM, respectively, are all greater than 5%; thus, suggesting that the residuals are normally distributed; they are not serially correlated and are homoscedastic.

Table 6.10: Results of the Residual Diagnostic and Stability Tests

Model 1 – Copper prices		
Test	**Test-Statistic***	**Probability**
BPG for heteroscedasticity	1.698044	0.1424
Jarque-Bera (JB) for normality	0.609021	0.7375
Breusch-Godfrey (BG) Serial Correlation LM	1.644007	0.2225
RESET for model specification	0.304283	0.5888
Model 2 – Uranium prices		
Test	**Test-Statistic***	**Probability**
BPG for heteroscedasticity	1.247434	0.3109
Jarque-Bera (JB) for normality	0.918426	0.6318
Breusch-Godfrey (BG) Serial Correlation LM	0.158694	0.8541
RESET for model specification	0.350210	0.5591

**Note: F-statistic – BPG,BG and RESET tests; the JB statistic – JB*

Source: Author's own construct using EViews 11.

The models were also subjected to Ramsey's Regression Specification Error Test (RESET) for specification error as advanced by Ramsey (1969). The null hypothesis is that the model is correctly specified which can in other words be represented as $H_0: \gamma = 0$. The decision rule is that the null hypothesis is rejected if the p-value of the F-statistic falls below 0.01; 0.05 or 0.10 at 1%; 5% or 10%, significance levels, respectively. From Table 6.10, the Ramsey's RESET test p-values are 0.5888 and 0.5591 for copper and uranium price models, respectively. These are greater than 0.05 thereby leading to the non-rejection of the null hypothesis at 5% level of significance thus implying that the long-run NARDL models are free from specification error. Consequently, the two models are said to be correctly specified.

6.6 Summary

This chapter provides an analysis of the study's third objective, which is premised on unravelling the commodity prices – business cycle nexus for Namibia. In accordance with this, it reveals the introduction and background, materials and methods, and discussion of empirical results. Descriptive statistics of the variables were presented together with their graphical plots (both in level and first difference). The unit root tests (ADF and PP) confirmed that one variable (LNMXP) is stationary at level I(0) while four variables (LNGDP, LNCP, LNUP and LNINV) are integrated of the first order I(1). Considering that the stationarity tests confirmed a combination of I(0) and I(1) while no variables are integrated at second order I(2), this justified the appropriateness of the NARDL, which was subsequently adopted in the estimation of the effects of commodity prices on Namibia's business cycles. Additionally, the BDS test was used to test the variables' nonlinearity properties. The null hypothesis of linearity was rejected for all variables, thereby confirming nonlinearity.

Considering that there was evidence of nonlinear cointegration, the NARDL was estimated to determine long-run parameters for commodity prices (copper and uranium prices). The NARDL results reveal that a following a 1% increase in copper prices, real GDP rises by 0.32%, whereas a 1% decrease (negative) copper price shock is associated with a decrease in real GDP of 0.09%. Similarly, a 1% increase in uranium price causes real GDP to increase by 0.14%, while a negative uranium price shock is associated with a decrease in real GDP by 0.18%. All in all, results from the NARDL estimation reveal that positive changes for both copper and uranium prices exert the greatest impact (reflected by positive outcomes) on real GDP than negative changes. For the short-run, the error correction term or Ect (-1) terms for copper and uranium prices were estimated at -0.538 and -0.505, respectively. This implies that about 53.8% and 50.5% of the disequilibria in copper and uranium prices, correspondingly, are corrected within one year. Overall, the study established that commodity prices have a positive asymmetric impact on Namibia's business cycles.

Model stability was assessed by means of CUSUM and CUSUM of squares tests whose outcomes lied within the 5% band (i.e., 95% confidence interval), thereby confirming that the estimated coefficients and constructed NARDL models for both copper and uranium prices were stable. Whereas the results of the JB statistics; the BG serial correlation, the BrushPagan-Godfrey (BFG) and the Ramsey RESET tests provide overwhelming evidence that the re-specified dynamic nonlinear models for both copper and uranium prices are devoid of normal errors, serial correlation, heteroscedasticity and incorrect functional form.

Chapter Seven: Conclusion and Policy Recommendations

7.1 Introduction

This chapter provides a synopsis of the whole dissertation. Initially, chapter one presents a summary of what the study was all about as well as the objectives pursued. Thereafter chapter two discusses the theoretical and empirical literatures in view of all three objectives. Chapter three discusses an overview of Namibia's fiscal and monetary policies; external sector; commodity prices and business cycle developments. Thereafter, a synopsis of background information; materials and methods adopted; results and discussion; and empirical findings from chapters four, five and six is discussed. These findings informed the conclusion and policy recommendations discussed in chapter seven. Thereafter, the study summarizes this study's contribution to the literature on this subject as well as policy recommendations. Lastly, the limitations of the study and areas for further research were discussed.

7.2 Summary

This study sought to examine the effects of macroeconomic shocks on Namibia using annual time series data spanning the period 1980 to 2018. Firstly, the study elucidates an overview of Namibia's fiscal, monetary, external, and commodity prices – business cycle nexus developments prior to econometric testing of the effects of the macroeconomic shocks. Following the overview of Namibia's fiscal, monetary, external, and commodity prices – business cycle nexus developments, the principal objective of the study, which was to examine the effects of Macroeconomic Shocks on the Namibian economy, was empirically tested. Henceforth, in Chapter four, the first specific objective pursued to estimate the dynamic effects of fiscal policy shocks on

real output, inflation, and interest rate, was econometrically tested. To this end, fiscal policy shocks were reflected by government spending and tax revenue. The dynamic effects of fiscal policy shocks for the Namibian economy were estimated according to the recursive Cholesky SVAR identification technique.

Chapter 5 presents the second specific objective, which examines the effects of external shocks (global output, US monetary policy and oil price) on Namibia's macroeconomic variables (economic growth, inflation and interest rate). In view of this, external shocks were reflected by global output growth, US monetary policy, and oil prices, whereas the domestic macroeconomic variables were output growth, interest rate and inflation. The effects of external shocks were examined in a VAR setting using annual time series data for the period 1980 – 2018. The study further conducted forecasting involving impulse response and variance decomposition simulations from the three external shocks to evaluate their effects on domestic macroeconomic variables. The third specific objective, which examined the effects of commodity prices on Namibia's business cycles, was discussed in Chapter 6. Herein, copper and uranium prices were adopted as commodity price shocks, while real GDP was a proxy for Namibia's business cycles. The effects of commodity prices on Namibia's business cycles were examined through a new approach known as the nonlinear ARDL (NARDL).

7.3 Findings

The first objective was on the effect of fiscal policy shocks on real output, interest rate and inflation. To this end, the results proved that the residuals were normally distributed and free from serial correlation. Also, the model was found to be stable as

all roots were inside the unit circle. Outcomes from impulse response functions indicate that a positive 1.0% public spending shock increases output at impact by 0.016%, which implies that public spending shock yields a positive impact on real output. In addition, this study establishes that public spending shock has a negative effect (albeit increasing gradually) on inflation. Explicitly, a 1.0% public spending shock decreases inflation by 0.012% while increasing interest rates by 0.4% at impact. This finding is in support of the Mundell-Fleming view. Overall, the results of the effect of public spending shock on output, interest rate and inflation are consistent with economic theory.

The impact of tax revenue shock on endogenous variables, on the other hand, indicates that at impact, there was non-response (neutrality) of real output to tax revenue shock, but from the second horizon, real output was positive up to the fourth year before contracting. Tax revenue shock has a long-lasting negative effect on real output. In other words, a positive 1.0% tax revenue shock increases output three horizons after impact by 0.004%. However, although tax revenue shock has a positive impact on real output, unlike the public spending shock, the intensity is low. This finding is indicative of the fact that of the two fiscal policy variables, public spending exerts the greatest effect on output than tax revenue.

Moreover, the analysis further reflects that a positive 1.0% tax revenue shock increases inflation by 0.007% two years after impact while decreasing interest rates by 0.2% at impact. Meanwhile, the findings indicate that public spending shock significantly influences output in the long run. Tax revenue shock, although it had a positive impact,

was found to be insignificant for the entirety of the ten horizons. Generally, the results from the IRFs reveal that public spending and tax revenue shocks do not produce similar results even if implemented by the same volume in different directions. Notwithstanding this feat, however, an increase in tax revenue which is a significant part of gross total government revenue for the Namibian economy can serve as a key source for public spending, thereby consequently spurring output growth. Overall, the results of the IRFs reveal that responses of output to fiscal policy shocks reconcile with the Keynesian view, that is, when public spending increases, so does output, but when tax revenue rises, the output is neutral.

Results from the FEVD reveal that in the short run (during the first horizon), output exhibits strong endogeneity (endogenous influence) on itself, followed by public spending, whereas inflation, tax revenue and interest rate display strong exogeneity (weak influence). Among the fiscal variables, public spending has strong explanatory power on output both in the short run and long run as it clearly wields more influence than tax revenue on the output which is found to be insignificant for the entirety of the ten horizons. The variance decomposition of inflation, on the other hand, divulges that in the short run (during the first horizon), it displays strong endogeneity (endogenous influence) on itself (contributing 74.0%) while public spending (19.0%) and output (8.0%) are the other variables exhibiting strong endogeneity on inflation, albeit marginally. Yet, tax revenue and interest rate exhibit strong exogeneity (weak influence) on inflation. In the long run, inflation and government spending exhibit strong exogeneity (weak endogenous) as suggested by the decreasing influence as you go into the future, whereas output and interest rate exhibit strong endogeneity on inflation as reflected by the growing influence going into the future.

Generally, from this finding, an inference can be made that of the two fiscal policy variables, public spending was found to exert greater influence on inflation than tax revenue both in the short and long run. The variance decomposition of interest rate reflects largely that all variables exhibit strong endogeneity in the short run. In contrast to output and inflation, whose contributions to own self exceeded 50% in the short run (first horizon), the own contribution is just 49% and it is affected by shocks to all variables in line with the assumption made. In the long run, both fiscal policy variables, public spending and tax revenue, seem to impact interest rates. Generally, in view of the structural shocks under investigation, public spending shocks have demonstrated dominance in accounting for variations in output, even in the long run.

The second objective was based on quantification of the effects of external shocks on real output, interest rate and inflation. Following this, the study found that external shocks are important sources of macroeconomic fluctuations in Namibia, as evidenced by both impulse response analysis and variance decompositions. Results from the impulse responses reveal that global output shocks raise domestic real GDP growth in the short-run. The strong effect of foreign demand (world real output growth) shock on Namibia's real GDP growth is ascribed to, among others, the Namibian economy's openness (trade as % of GDP), globalisation and increased integration with the rest of the world. A positive global output shock raises Namibia's interest rate while yielding a decrease in inflation. Shocks from the US real interest rate (US monetary policy shock mirrored by the tightening of US monetary policy) yield a negative influence on domestic output largely. Following a positive US real interest rate hike (US monetary policy innovation), the domestic interest rate rises and remains positive.

A positive oil price shock leads to a negative impact on domestic output growth. A positive oil price innovation wields a negative influence on the domestic interest rate and consumer prices largely. All in all, a positive oil price shock yields declines in domestic output, interest rate and inflation, a finding that can be expected from an oil-importing country. Results from variance decomposition reflect that external shocks exert persistent and significant effects on variations of domestic macroeconomic variables, whereby global output growth (external demand) shock is the main external shock affecting Namibia's output growth, while US monetary policy shock is the dominant external shock affecting consumer price inflation. Even though the contribution of oil prices to domestic interest rates and inflation is marginal in the short span, the contribution increases considerably in the longer horizons.

The third objective was concerned with investigating Namibia's commodity price-business cycle nexus. To this end, the findings lie in the fact the asymmetric effects of copper and uranium price shocks on real GDP were tracked. Specifically, the outcomes reveal a long-run cointegration among business cycle (real GDP), commodity (copper and uranium) prices, investment and exports shares of GDP. Results from the NARDL multiplier graph reveal that during the short-run period, negative shocks on copper prices are unstable compared to positive shocks, although these shocks become stable in the long-run. Yet, an increase in copper price appears to have a larger impact on GDP than negative shocks during both the short-run and long-run periods. Results for uranium prices from the multiplier graph suggest that both positive and negative changes, although short-lived, are significant in the short-run period. Also, positive changes have a larger impact on GDP than negative changes in the short-run period. Overall, both copper and uranium prices have unveiled asymmetric impacts on

Namibia's business cycle. To this end, positive changes for both copper and uranium prices have the greatest impact on real GDP than negative changes.

7.4 Policy Implications

There are several policy implications in terms of optimal macroeconomic modelling of the Namibian economy arising from the study's findings, and these are presented as follows:

- In view of fiscal policy shocks, following the finding that public spending shock has a positive effect on output, the study recommends that public spending (especially productive spending) should be prioritised in NDPs to spur sustainable economic growth further, which will consequently make a significant contribution towards the achievement of the country's socio-economic development goals/priorities i.e., poverty reduction, employment creation and increased income equality. Yet, considering that Namibia has been implementing pro-cyclical fiscal policy, the pursuit of counter-cyclical fiscal policy rather is strongly encouraged, whereby an expansionary fiscal policy stance is adopted during slow growth or recessionary periods. Moreover, against the backdrop that shocks to government spending exert the greatest impact on domestic GDP than tax shocks, the study reaffirms the recommended pursuance of counter-cyclical fiscal policy. This is strongly encouraged, thereby smoothening the business cycle whilst simultaneously guaranteeing macroeconomic stability.

- On external shocks, following the finding that global output impacts domestic real GDP growth positively, the study recommends continuous efforts to increase integration with the global economy. To this end, concerted efforts should be made

to drive industrialisation further. This will ensure that the country diversifies its export basket from unprocessed products upon which significant foreign exchange earnings could accrue from such, which would ultimately serve as a key economic growth driver. Additionally, these will serve as a buffer to such shocks, thereby lessening the impacts thereof. Since inflation dynamics appear to be significantly impacted by external shocks, ascribed mostly to imported inflation, the country should address supply-side constraints, that is, vigorously encourage value addition and stimulate the processing of mineral and natural resources. This will gradually transform the import basket from one dominated by foreign products to one domestically produced. In light of the finding that oil price shocks have a negative effect on domestic output growth, the study recommends that policymakers should strive to implement policies aimed at reducing the effects of such shocks. In addition, economic diversification is also recommended so that the negative effects arising from oil shocks may be absorbed by other economic activities.

- Regarding the commodity price – business cycle nexus, positive changes for both copper and uranium prices have the greatest impact (positive effect) on real GDP than negative changes. These underlying results have important policy implications for the mineral resource-rich Namibia. The study recommends that Namibia should encourage the extraction of mineral commodities, especially during periods of commodity booms, to boost economic growth. However, prioritisation of the diversification of its export basket from predominantly raw or mineral resource exports (as is the case currently), is strongly emphasised.

- Overall, over the years, mitigation against all sorts of shocks have revolved, in large part, around pursuance of a mix of fiscal and monetary policies. Going forward, there is an urgent need to complement these interventions through development of comprehensive sustainable growth-enhancing strategy(s) specifically to mitigate uncertain shocks of varying nature.

7.5 Limitations of the Study and Areas for Further Research

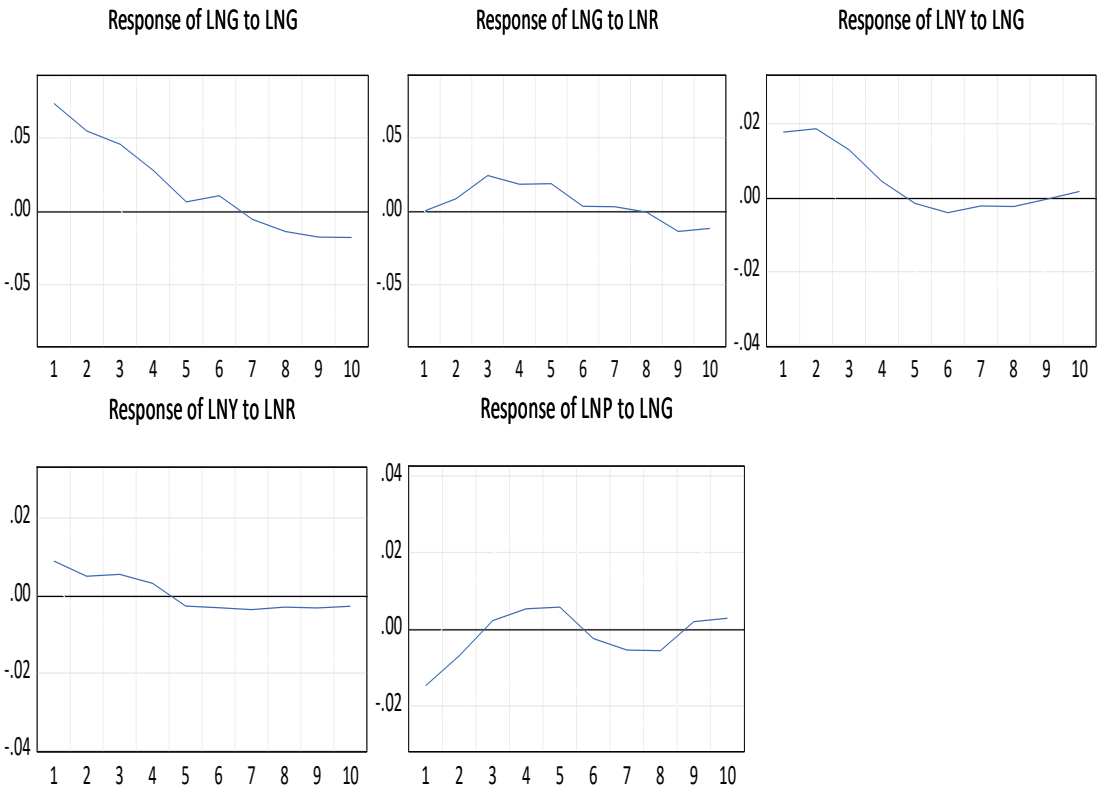
This study was undertaken for the period spanning the period 1980 to 2018 using low-frequency (annual) time series data due to data limitations. In terms of areas for future research on effects of fiscal policy shocks, the adoption of different variables i.e. government revenue, output gap, budget deficit, GDP per capita, etc. and econometric techniques such as Panel Vector Autoregression (PVAR), Factor Augmented Vector Autoregression (FAVAR), Vector Error Correction Model (VECM), Bayesian Vector Autoregression (BVAR) and Autoregressive Distributed Lag Model (ARDL) are encouraged to unearth effects from such shocks. Similarly, for external shocks, the adoption of a different set of variables i.e. exchange rate, Current account (% of GDP), terms of trade, foreign direct investment (FDI), money balances (money supply M2), global food price (food price index), the US federal funds rate etc. and econometric approaches i.e., Global Vector Autoregressive (GVAR), Dynamic Stochastic General Equilibrium (DSGE), Computable General Equilibrium (CGE), amongst others, can be undertaken to ascertain the effects. Also, it will be interesting to examine the effects of external shocks within the realm of the Harberger-Laursen-Metzler (H-L-M) effect, considering the limited application in quantifying this impact.

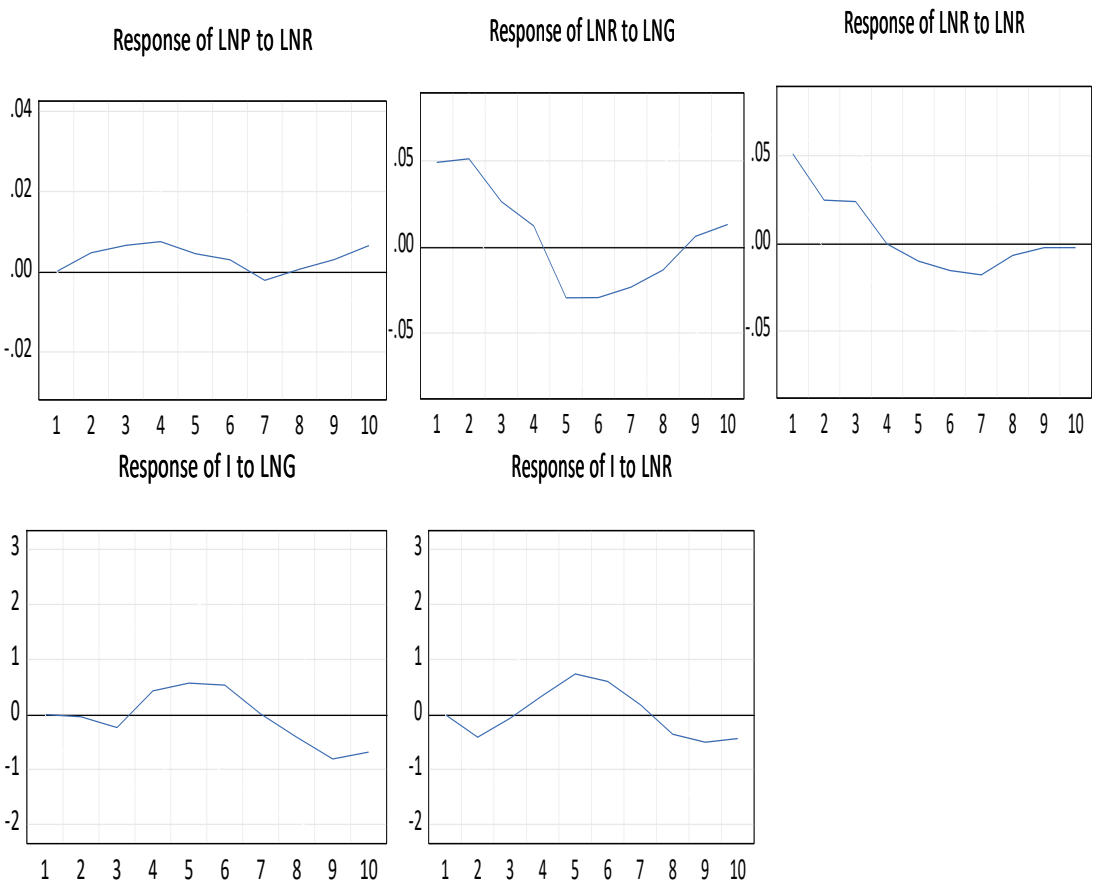
To quantify the effects of commodity prices – business cycle nexus, future research can consider rarely investigated variables i.e., aggregate commodity price indices (fuel; agriculture, and metals and minerals), commodity price volatility, financial development etc. as well as adoption of econometric methods i.e., System of Generalized Method of Moments (SGMM), Factor-Augmented Vector Autoregressive (FAVAR) model, Panel Vector Auto Regression (PVAR), among others.

The Namibian economy, just like its peers in Africa, is characterised by a narrow manufacturing base with its export basket dominated by primary products, thereby revealing a stagnant structural transformation, a feat that does not augur well with the long-term aspirations as articulated in Vision 2030. This is notwithstanding several policies aimed at achieving industrialisation by the year 2030. However, at the continental level, one of the important areas for Africa's transformation agenda is weak institutional and governance capacity. Considering this, Urama et. al. (2021) asserted that weak institutional capacity limits the ability of countries to develop and adopt new technologies, financial systems, markets, and other systems innovations required to build resilient and sustainable systems. Following the stagnant structural transformation of the Namibian economy, further research should be undertaken to either reinforce or disapprove this proposition with a view of subsequently proffering recommendations to transform the dismal status quo.

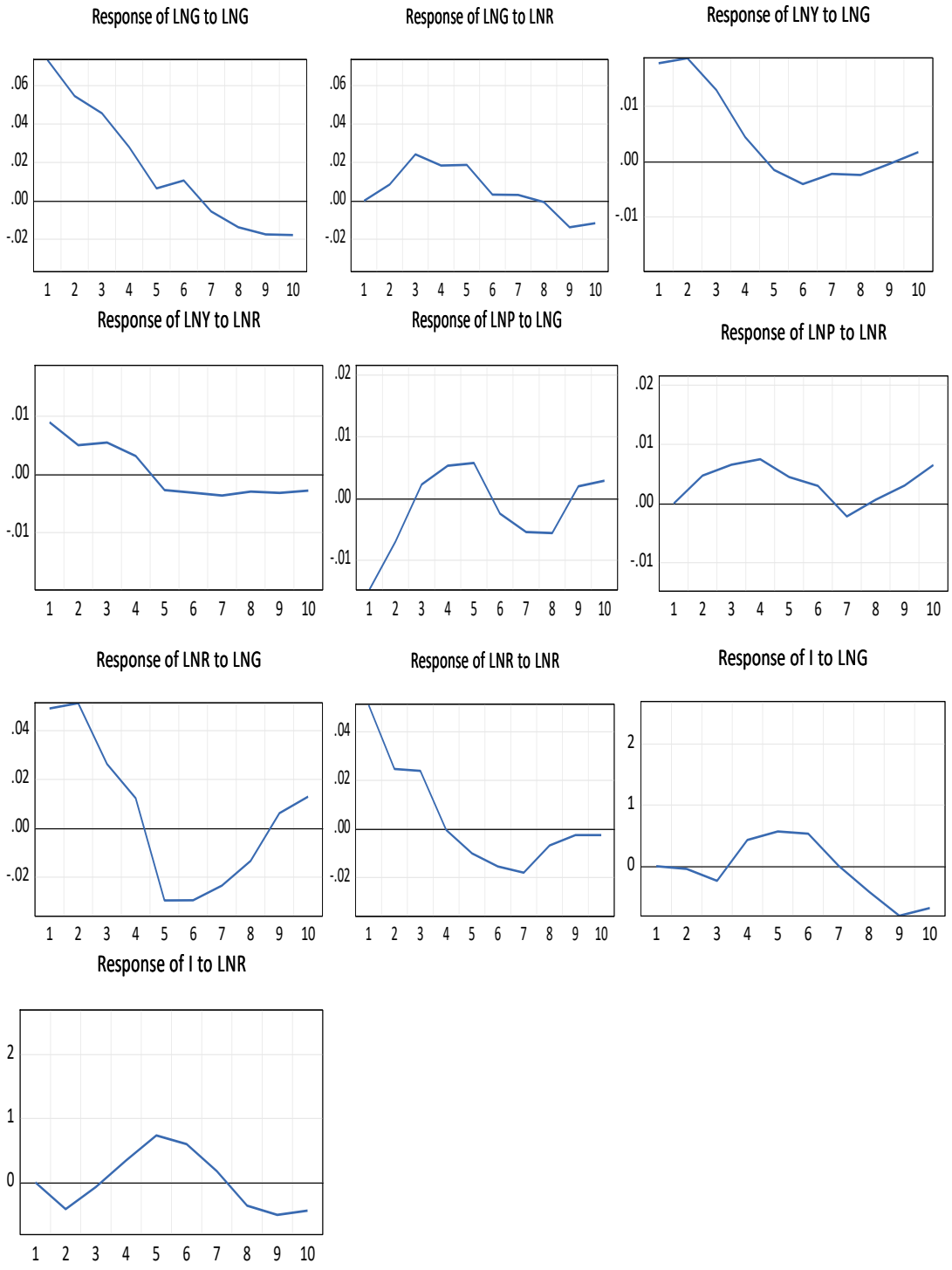
Appendix

Annex Figure 1: **Impulse Response Functions from public spending and tax revenue shocks according to the SVAR procedure with the ordering I, LNG, LNP, LNR, LNY]**




Response of LNP to LNR
Response of LNR to LNG
Response of LNR to LNR
.04
.02
.00
-.02
.05
.00
-.05
.05
.00
-.05
1 2 3 4 5 6 7 8 9 10
Response of I to LNG
Response of I to LNR
3
2
1
0
-1
-2
1 2 3 4 5 6 7 8 9 10

Annex Figure 2: **Impulse Response Functions from public spending and tax revenue shocks according to the VAR approach**



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