



Exchange Rate Volatility and Macroeconomic Variables in South Africa

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ABSTRACT

The significance of the exchange rate in determining a country's macroeconomic performance is indisputable. This study investigated the impact of exchange rate volatility on macroeconomic variables in South Africa using time series data from 1979 to 2019. Only six macroeconomic variables have been included in this study: GDP, FDI, growth rate, INFR, INT, and trade openness. These variables were chosen as dependent variables, with real exchange rate volatility as the independent variable. The GARCH model was used to generate real exchange rate volatility, and the Ordinary Least Square regression technique was employed to analyze the relationship between dependent and independent variables in this study. The impact of exchange rate volatility on macroeconomic variables in South Africa was substantiated by this study's findings. It is also concluded that exchange rate volatility has a positive impact on growth, inflation, and interest rates (INT) while having a negative impact on FDI, GDP, and trade openness (OPENN). The results suggest that to increase trade and foreign direct investment, South African authorities should consider the existence and level of exchange rate volatility as well as the expected effects of the exchange rate on each macroeconomic variable.

Keywords: Exchange Rate Volatility, Inflation Rate, FDI, Least Square Method, South Africa

JEL Classifications: C32, F31, F41

1. INTRODUCTION

Economists are usually curious about how the South African rand and other world currencies are performing, particularly, how the former is performing or trading against the US dollar and other international currencies. When individuals without an economics background watch television, or read books about economic difficulties, it appears that many of them are completely puzzled about what is happening. They become perplexed when the rand is stated to have depreciated or appreciated or is weak or strong. As cited in Nor et al. (2020), Nor (2015) stated that currencies' behavior is important for the people of each country as its exchange rate volatility has a direct effect on the prices of basic commodities. The impact of exchange rate volatility on macroeconomic variables has become a subject of increasing debate in both developing and advanced countries (Mahjoub, 2014).

Exchange rate management is a topical issue among academics and policymakers. This mainly started when the gold standard collapsed in the 1930s and the subsequent emergence of the Bretton wood system of adjustment peg from the 1940s. This was through the espousal of flexible exchange rates given by the developing nations in 1970 as well as those countries carrying out structural reforms in the 1980s, in the wake of the currency crises in developing economies in the 1990s. The flexibility resulted in fluctuations in the exchange rate making it a major focus in the debate due to its impact on business outcome as nations' business partners would prefer a stable exchange rate to a volatile one. It has been recognized in previous studies that maintaining a relatively stable exchange rate is essential in boosting economic growth (Azeez et al., 2012). It is generally believed that the exchange rate management is crucial in economic development, globally and particularly in South Africa because non-management has

contributed not only to economic instability but also political instability. This is supported by Kilicarslan (2018) who pointed out that in both developed and emerging economies, exchange rate stability is essential in achieving macroeconomic policy objectives. Governments have adopted different exchange rate management policies, especially for developing economies, to create a realistic and stable exchange rate.

The exchange rate is an important macroeconomic variable used as a parameter for determining international competitiveness, hence, it is regarded as an indicator. To this end, the lower the value of this indicator in any country, the higher the competitiveness of the currency of such a country will be. It becomes imperative at this junction, to distinguish between the real and nominal exchange rates. The nominal exchange rate (NER) is a monetary concept, which measures the relative price of the amounts of moneyness or currencies, for example, the rand in relation to the U.S dollar. While real exchange rate (RER) is regarded as the real concept that measures the relative price of two tradeable goods (exports and imports) in relation to non-tradable goods (goods and services produced and consumed locally). The relationship between two goods can be seen from the fact that a change in NER causes short-run changes in RER (Danmola, 2013).

Backman (2006) pointed out that the exchange rate is a critical macro variable that affects the entire economy and has sparked several debates among policymakers, academics, and other economic actors, as it is a significant macro issue that affects the entire economy. The erratic fluctuations in exchange rates also referred to as 'exchange rate volatility' could be described as periods of domestic currency appreciation or depreciation. The exchange rate is therefore a relative price as it has influences on the external competitiveness of domestic goods, thus, it has received considerable attention in terms of its influence on macroeconomic variables. Policymakers have often been confronted with the problem of determining an appropriate exchange rate system through which the domestic economy is linked to the global economy, however, the literature is ambiguous about the direction of the impact of real exchange rates on macroeconomic variables (Jongbo, 2014).

This study covers a detailed analysis of some of the macroeconomic variables which accept the impact of real exchange rate volatility in South Africa. To investigate this relationship, a detailed picture of these variables is presented in this study. The general view of researchers about exchange rate is that, if the exchange rate of a country is properly valued, it does not substantially affect the macroeconomic variables and thus the macroeconomic performance of that country. Volatility in the exchange rate of a country can affect the investment in that country adversely. It creates an uncertain environment for investment in that country, thereby, requiring that resources in that country should be reallocated among various sectors of the economy of that country (Mahmood et al., 2011).

Most developed and developing economies of the world have experienced high real exchange rate volatility, which translates into a high degree of uncertainty in the attainment of major

macroeconomics and monetary policy objectives in price stability and economic growth. Volatile real exchange rates are associated with unpredictable movements in the relative prices in the economy. Exchange rate stability is one of the main factors influencing foreign (direct and portfolio) investments, price stability, and stable economic growth (Ajao, 2015). Previous research on the impact of exchange rate volatility on macroeconomic variables have established diverse views on this issue. This is evidenced in the discussions on the empirical literature, in section 2.2. The researcher was unable to locate any South African studies that addressed the problem, although, Danmola (2013) and Mahmood et al. (2011) each conducted investigations in Nigeria and Pakistan, respectively.

There have been various efforts by the South African government to maintain a stable exchange rate, however, the rand has fluctuated against the U.S. dollar throughout 1979-2019. The fluctuation and instability in the rand have been more profound with the inception of the liberalization of the exchange rate. Against this background, this research seeks to examine the impact of the volatility of the exchange rate on macroeconomic variables in South Africa over the period of 42 years (1979-2019). The study is among a few studies in developing countries and Africa that examined the impact of exchange rate volatility on macroeconomic variables. The study, therefore, adds to the limited literature on the subject matter, especially on Africa and South Africa, in particular. There is no agreement on a common impact of exchange rate volatility on macroeconomic variables and there are no empirical studies which have investigated the impact of exchange rate volatility on macroeconomic variables in South Africa, therefore, the current study fills in these gaps. A brief overview of each macroeconomic variable has been provided below so to understand the background of South Africa's development during the study period.

1.1. Exchange Rate in South Africa

The rand became the official currency of South Africa on February 14, 1961 and has since developed into a liquid emerging market currency that is most typically traded against the US dollar. It had a strong value in the ever-changing international economic climate; however, the rand's global footing was lost due to South Africa's Apartheid system. The South African government chose to decouple the rand from the dollar in June 1974 and implemented an independently managed, floating exchange rate mechanism; the rand was trading at 87 cents to the dollar at the time. Tito Mboweni, the then-SARB governor, noted in 2001 that the level at which the rand was pegged to the dollar had changed 6 times between 1974 and 1978. There was a large increase in the value of gold in the 1980s, which boosted the rand's value and the contrary happened when gold's value fell after that. The apartheid government abolished the financial rand exchange rate system in 1983, and major financial institutions refused to offer credit lines for South Africa, forcing the country's foreign exchange market to close temporarily. The rand had never been lower against the dollar than it was in 1985; the rand was trading at R2.23 against the dollar, its lowest since its appearance. Normalcy has returned to South Africa's international ties since the democratic elections in 1994, however, the rand's exchange rate against the US dollar has continued in a long-term downward trend that began in the early

1980s. In post-apartheid, South Africa's, national and international, social, political, and economic developments have had significant impact on the rand/dollar exchange rate, which remained in a downward trend. The rand fell to an average of R3.55 against the dollar in 1994 due to political instability surrounding the country's new leadership. Thabo Mbeki's inauguration as president in 1999 boosted the rand's value to an average of R6.11 per dollar. The rand rose to R13.84 in 2001 after the terrorist attacks on the World Trade Center in New York, although, from 2002, local events such as rising debt, socio-political unrest, and energy issues have kept the rand weak. In 2007, Eskom's power outages caused serious problems in the mining and telecommunications sectors, resulting in massive production cuts and mine closures. The rand's value rose from slightly over R6 to the dollar in 2006, to more than R7 in 2007 and was trading at R8.34 to the dollar in 2012, due to pressure from unrest in South Africa's mining sector as well as continued euro-zone crisis uncertainty (Bronkhorst, 2012). To put it another way, in 2002, the South African rand and the dollar had a 10.52 exchange rate. It depreciated at rates of 7.56, 6.44, and 6.36 from 2003, 2004 and 2005, respectively. Then the rates increased from 2006, 2007, 2008 and 2009, hitting 6.77, 7.05, 8.25, and 8.411, respectively. Then, following a decrease from 7.32 in 2010 to 7.25 in 2011, it rose once again to 8.34 in 2012 (Bronkhorst, 2012). Between 2002 and 2012, the South African rand and the dollar fluctuated at a rate that indicated an average of 7.66.

In nominal terms, the rand fell about 28% against the US dollar between 1998 and 2001. Short-term interest rates increased by approximately 700 basis points. The yield on long-term bonds climbed by less than a hundred basis points and since the end of apartheid, the rand has lost a lot of value. It had lost roughly half of its value by the end of 2003. Most of this depreciation was caused by South Africa's greater inflation rate than its trading counterparts. Between 1994 and the end of 2003, the rand value fell over 15% in real terms, after peaking at 35% at the end of 2001. During this time, the currency had significant volatility, as some crisis patterns emerged in 1998 and 2001, with abrupt depreciations followed by recoveries. Policymakers and companies are both concerned about exchange rate fluctuations. If hedging is expensive or incomplete, it may disrupt trade flows; it may also deter investment decisions associated with such trade flows (Bhundia and Ricci, 2005).

The South African rand, as one of the most-traded emerging market currencies, exhibited excessive volatility in a generally depreciating trend during the period under review (1979-2019). The pace of depreciation was particularly strong from 1996 to 2001, with the rand losing 15.8% of its value vis-à-vis the US dollar, in annual average terms. This rate of depreciation exceeded the average differential between the rates of consumer inflation in South Africa and the United States by almost 12 percentage points, on average per year, over this period. After free-falling in the aftermath of the 9-11 attacks in the United States, the rand not only recovered from this substantial depreciation in the final months of 2001 but remained extremely strong for the next couple of years. A weakening trend resumed early in 2008, with a sharp depreciation ensuing as the global financial and economic crises intensified. The nominal effective exchange rate (that is, the rand against a basket of currencies of its major

trading partners, on a trade-weighted basis) exhibited a largely continuous downtrend during the period under review. The main exceptions were the periods 2003-2006 and 2009-2010, which were characterized by rand strength, with adverse implications for the price competitiveness of South African products in external and domestic markets, therefore, for the sustainability of many industrial enterprises. A substantial worsening of the deficit on the current account of the balance of payments from the start of 2011, among other factors, resulted in a sharp weakening of the external value of the rand in 2011 and 2012. However, accounting for inflation differentials, the real effective exchange rate (REER) was stable as illustrated above, moving generally sideways within a relatively narrow range, from 2003 to 2012 (IDC, 2013).

The rand was one of the worst performers among the major emerging market currencies in 2013, depreciating by almost 24% against the US dollar. Developments, such as the anticipated tapering of quantitative easing in the USA, changing perceptions of risk in emerging markets, major portfolio adjustments globally, weakening economic fundamentals locally (for example, large current account and budget deficits) and continued labour unrest, among other factors, affected foreign investors' sentiments toward domestic assets; this altered capital flows and by implication weakened the rand during 2013 and early in 2014. Almost immediately after the largely unexpected 50 basis points hike in the repo rate by the MPC on 29 January, (2014) which came soon after sizeable rate adjustments were made by Turkey's monetary authorities, the rand tumbled to its weakest level in over 5 years. The currency has since recovered some ground but remains highly vulnerable to local and global development (IDC, 2014).

The rand has been under severe pressure since the start of 2015, being one of the worst-performing emerging-markets' currencies. Having started the year at R11.52 per US dollar, the rand depreciated sharply by 34.3% to R15.49 by the end of 2015. Increased risk aversion towards emerging markets, concerns over the slowdown in China, weak commodity prices and interest rate normalisation in the USA, all impacted on the rand. Domestically, contributing factors to the currency's weakness included poor economic growth, concerns over the balance of payments and fiscal deficits as well as low business confidence. The rand rebounded somewhat in the first quarter of 2016 as commodity markets showed signs of recovery; it was also supported by highly accommodative monetary policy in the Eurozone and Japan along with the postponement of further interest rate hikes by the US Federal Reserve Bank (IDC, 2016).

The rand-US dollar exchange rate strengthened at the end of 2017 after the election of Cyril Ramaphosa as ANC President, although, the rand remained quite volatile. It was trading below R12 to the US dollar at the beginning of 2018; it later weakened by 14.2 % against the US dollar by the end of the second quarter as it traded at R13.74 to the US dollar. This weakening of the rand could be associated with US trade policy and the sell-off of emerging markets' financial assets. In the third quarter of 2018, the rand further weakened to its lowest level against the US dollar in two years at the time of the Turkish meltdown. The rand lost 14.6% against the US dollar and was trading at R15.60. Eventually, it

regained its strength against the US dollar to trade at R14 to the US dollar by the end of the year and continued to strengthen after the results of South Africa's national elections in May 2019 (Amra et al., 2019).

1.2. GDP Growth Rate in South Africa

The Gross Domestic Product (GDP) measures the total value of goods and services generated in a given year and is sometimes referred to as the "economy's size." Economists evaluate economic growth using GDP, while the investor makes investment decisions based on an economy's size and GDP growth. The GDP is logically computed based on what everyone has earned and spent in a year (Arain et al., 2021). Its annual growth rate is the percentage change in the GDP value compared to the same quarter in the previous year for countries with quarterly data frequency (Gona and Sahoo, 2018). South Africa's economic growth was exceptionally high during the 1960s, relative to where it is in the current decade. Between 1960 and 1969, economic growth reached its peak in 1964 where the percent growth rate was recorded, however, the economic growth deteriorated from 5.2% in 1970 to 3.8% in 1979, which is the initial period of the current study. By 1985, economic growth had decreased to -1.2%. There were some recoveries in economic growth between 1986 and 1988, although, a further decline in South Africa's economic growth occurred from 1989 until 1992, after which it averaged 2.8% per annum between 1993 and 2003. Between 2004 and 2008, South Africa's economic growth improved significantly, until a slump occurred in 2009, following the global economic recession. From 2012 to 2016, South Africa's economic growth has remained below 3%, with 2016 experiencing only a 0.37% economic growth (World Bank, 2016).

Achieving and maintaining a reasonably high rate of economic growth has been one of the most pressing objectives of most countries in the world, especially, after the Second World War. Economic growth, despite largely recovering by the beginning of the 1980s, it has dropped to negative levels by the mid-1980s. The performance of South Africa's economic growth remained poor until the beginning of the 1990s, with a record low of -0.3% in 1990 (Amra et al., 2019). The country's economy grew at an average annual rate of 3.3% from 1994 to 2012; in real terms, its GDP climbed by 77% between 1994 and 2012. The global economy grew by 90% during the same period (IDC, 2013). South Africa's economy recorded a substantial deceleration in growth to 1.9% in 2013. This was underpinned by a combination of external factors, such as - weak global demand for its export products, unfavourable commodity prices, and a difficult economic climate on the home front (IDC, 2014). The country's GDP growth dropped to 1.3% in 2015, down from 1.5% in 2014. The mining sector's GDP increased by 3%, but this was mostly due to a low base. Agricultural production fell by 8.4% in 2015 due to the worst drought on record (IDC, 2016). During 2015 and 2016, South Africa's GDP growth rate dropped significantly, with the yearly average growth rate staying below 3% (Malefane and Odhiambo, 2017). The average real GDP growth between 2015 and 2019 was 0.8%, with a negative average GDP per capita (-0.6%). In 2019, real GDP was over R3.2 trillion, up from R2.9 trillion in 2020. The corona epidemic, as well as the efforts to contain the virus 'spread,

also negatively impacted the economy (Amra et al., 2021). In 2019, the real GDP of South Africa increased by 0.2%. Construction, transportation, and mining all declined by 8.2% in 2020, causing real GDP to decrease. On the demand side, all components fell, with investment falling the most (32.4%). To assist firms and households affected by the epidemic, the Reserve Bank of South Africa reduced the repo rate by 300 basis points in 2020, from 6.5% to 3.5% (African Development Bank Group, 2021).

1.3. Trends in Foreign Direct Investment (FDI) Inflows into South Africa

The importance of FDI in the growth of developing countries cannot be overstated. Foreign investors are encouraged to invest in host countries so as to make long-term profits by contributing to the host countries' production sector. Foreign direct investment not only contributes towards capital formation in the host countries but is also a source of transfer of technological and innovative skills from developed to developing countries. Given the essential nature of FDI in the growth of developing countries, many countries offer incentives to foreign investors to encourage them to invest more (Mahmood et al., 2011). It is generally recognised that foreign investment can act as a catalyst for investment and economic development in the host countries, including South Africa. The significance of FDI for engendering growth in the country was particularly stressed in the Growth, Employment and Redistribution Strategy (1996) and has been reiterated in official statements since then. As private investment has been inhibited by South Africa's low saving rates, foreign investment can help address the saving deficiency and promote economic growth (Bhundia and Ricci, 2005).

Foreign direct investment (FDI) has a considerable role in the development of South Africa's economy, although, in recent years, it has remained at relatively low levels, compared with other emerging market countries. There is an improvement in overall macroeconomic conditions and South Africa has advantage in terms of natural resources and market size, despite this, foreign investors have shown limited interest in acquiring, creating, or expanding domestic enterprises. The annual FDI inflows into South Africa averaged <1.5% of GDP during 1994-2002, compared with 2-5% in a group of similar-background countries. South Africa has attracted very little foreign investment over the last quarter of this century, due to the political environment which resulted in the imposition of trade and financial sanctions in the mid-1980s, a subsequent financial crisis, the tightening of capital controls, and the declaration of a moratorium on payments to external creditors which effectively cut South Africa off from the international capital markets. Cumulative FDI inflows in 1980 - 93 amounted to just over \$0.3 billion. After 1993, FDI increased, with two major events dominating this period - the partial sale of government shares in Telkom in 1997 and the takeover of De Beers by Anglo American in 2003. Overall, however, FDI has stayed at relatively low levels averaging about 1.5% of GDP during 1994-2002 (Bhundia and Ricci, 2005).

Inflows and outflows of foreign direct investment (FDI) have been reported worldwide. The Organization for Economic Cooperation and Development (OECD) countries account for the biggest share

of FDI outflows. From April 2000 to February 2013, total FDI inflows totalled US\$ 287,127 million, a decrease of US\$ 33,912 million in a single year (Gona and Sahoo, 2018). South Africa's foreign direct investment (FDI) more than doubled to USD5.3 billion in 2018. In the automotive and renewable energy sectors, significant investments were made, despite this, South Africa was just the seventh-largest recipient of FDI in Africa in 2018. Compared to other countries on the African continent, the potential attractiveness of South Africa is high, however, its performance is relatively too weak for FDI attraction, despite showing progress, owing to investment potential in infrastructure. According to data published in UNCTAD's 2021 World Investment Report, FDI inflows decreased by 39.4% in 2020 to 3.1 billion USD, compared to the high inflow of 5.1 billion USD recorded in 2019. In 2020, FDI stocks declined to 136 billion USD compared to 151 billion USD in 2019. Data from the OECD shows that in the first half of 2021, FDI inflows reached 1.64 billion USD, up from 234 million USD year-on-year. The USA has traditionally been a key investor, however, this trend has been reversed by the pandemic, hence, outward investment was negative in 2020 (by almost 2.0 billion USD) and in H1/2021, as South African multinationals repatriated capital from abroad (UNCTAD, 2021).

1.4. Trade Openness in South Africa

Trade openness is widely believed to provide numerous economic benefits, including greater technology transfer, skill transfer, labour, total factor productivity, as well as economic growth and development. Any economy's openness is a dynamic process that has evolved over time, through creative and technology processes. Any country's imports and exports are added to achieve openness; hence, increased exports can help a country's economic growth (Gona and Sahoo, 2018). Trade openness appears a controversial policy in international economics and finance. The proponents of the policy argue that the policy promotes free trade and removes obstacles that may inhibit free trade. They further believe that the policy if fully implemented, can promote economic growth for African countries. The application of appropriate fiscal and monetary policies, intense financial reforms and decontrol of domestic prices are measures that are expected to raise international competitiveness; this has been the target of the present government in South Africa (Danmola, 2013). The issue of trade openness has received considerable attention over the past decades owing to the role played by the relationship between the degree of trade openness and economic growth. There is no consensus on how trade openness affects different economies, however, various sources in literature point out the fact that there are some positive effects that can be realised in international trade as a country becomes more open to the process of trading (Malefane and Odhiambo, 2017).

The trade policy reforms that were adopted by South Africa initially, during the early 1970s, primarily aimed at moving the economy away from import substitution industrialization and despite the efforts to open the economy through a more liberal trade, South Africa's level of protection in the trade sector was raised again around the mid-1980s. There was a deterioration in external balance during the period from 1970 to 1980, however, there was an increase in South Africa's trade openness during

that period. Between 1970 and 1975, trade openness increased by about 10%, corresponding to the export incentives measures introduced in 1972. In 1989, export incentives were introduced for clothing and textiles, as well as automobile components. In 1994, the process of converting quantitative restrictions to tariffs was completed. The major trade liberalization process that took place in South Africa during the 1990s was partly driven by the World Trade Organisation's commitment. South Africa's exports and imports made quite different contributions to GDP during the period 1960 to 2013. During the 1960s until the early 1970s, a downward trend was experienced in the share of exports to GDP, however, from 1972 onwards, South Africa's share of export in GDP improved (Malefane and Odhiambo, 2017).

There was a downward trend in trade openness during the 1960s, followed by an upward trend during the 1970s. This upward trend coincided with the period after the implementation of export promotion industrialization in South Africa in 1972. South Africa's trade openness, however, declined considerably during the early 1980s and again during the early 1990s, particularly between 1990 and 1992. From 1993 onwards, trade openness showed a steady upward trend, reaching a peak of 72.9% in 2008. Following the decline in the world trade because of the 2008 global recession, South Africa's trade openness dropped sharply to 55.4% in 2009, before rising again in 2010. During the period between 2011 and 2016, South Africa's trade openness remained slightly above 60% (World Bank, 2016).

1.5. Inflationary Pressures in South Africa

The issue of price instability becomes a re-occurrence decimal in the macroeconomic challenges confronting the South African government. The concept is often referred to as 'inflation', and it has been a major issue in policy decisions in most developing countries (Danmola, 2013). Inflation (INF) is measured as an annual percentage change in the consumer price index as a proxy for macroeconomic stability. Inflation is a factor that affects both the exchange rate and the real economy (Morina et al., 2020). During the 1970s and 1980s, inflation in South Africa was quite high; it averaged over 14% from 1980 to the early 1990s. This illustrates that, despite disinflation in its trading partners, South Africa's inflation was extremely high due to a weak monetary policy stance. Inflation has been on the decline since the early 1990s, averaging 7% between 1994 and 2002. Inflationary trends have been mainly driven by two things throughout this period: global inflation and domestic monetary policy. Inflation reached its peak in most countries around the world in the 1970s, owing primarily to oil price shocks (Bhundia and Ricci, 2005). Inflation in South Africa has been on a declining trend since 1993. Tight monetary policies have ensured that exchange rate depreciation has only had minimum impact on inflation. Consumer price inflation averaged 5.7% for the first eight months of 1998, after averaging 8.6% in 1997. Consumer price inflation rose to 9.1% in September, mainly due to the combined impact of the depreciation of the rand and the increase in interest rates on mortgage bonds (Medium Term Budget Policy Statement, 1998). In 2015, consumer inflation averaged 4.6%, a significant decrease from 2014's 6.1%. A sharp lower commodity costs, particularly, crude oil, as well as a successful crop in the 2013/14 season, helped to

keep food price inflation under control for most of the year. Food inflation was pushed higher in the first months of 2016, hitting 8.8% in February, as severe drought conditions in vast portions of the country impacted agricultural output. Fuel inflation rose to 20.7% in February, compared to a 10.5% average fall in 2015. This was due to a significantly lower rand and a rise in oil prices in early 2016. Consumer prices were expected to climb rapidly for the rest of 2016, owing to a variety of factors, including food inflation (IDC, 2016).

Inflation motivators have been well contained in recent years. Rates of increase in consumer inflation have remained below the SA Reserve Bank's upper target level of 6% since 2017. During 2020, headline inflation declined to its lowest level since 2004, coming in at only 2.1% in May. Various factors have combined to drag inflation low. On the external front, weak global demand led to very low oil prices, while highly accommodative monetary policy stances, across the world, has led to a search for yield, in turn supporting the rand exchange rate; these factors limited imported inflation. In the domestic context, lower fuel prices combined with favourable weather conditions resulted in limited food price inflation. Inflation has trended upward since May 2020, measuring 2.9% in February 2021 as crude oil prices recovered on the back of improved economic activity, globally (IDC, 2021).

Consumer inflation fell to 3.7% in October from 4.1% in September, showing a continuation of its downward trend; the rate in October was the lowest since February 2011, when it was also 3.7%. Consumers exhaled a sigh of relief with this news, as prices for many goods and services were increasing at a far slower pace, and some had even decreased. When compared to the same month the previous year, fuel costs fell by 4.9% in October 2019. The price of onshore 95-octane gasoline increased by R1 to R17.08 per litre in October 2018. The price had dropped to R16.21 per litre by October of that year. Food and non-alcoholic beverages were the largest contributors to the yearly increase of 3.7%, with annual inflation of 3.6%. Domestic political unrest and the onset of an international oil crisis made for a difficult economic environment for the next 10 years. Inflation had reached 14.0% by December 1979 and in the 1980s, the rising trend remained. In January 1986, the country's inflation rate reached 20.7% because of sanctions and economic collapse. August 2008 was the most difficult month in the democratic era, with annual inflation reaching a peak of 13.7%. In 2019, the average rate (from January to October) was 4.2%, somewhat lower than the 4.6% reported in 2018 (Stats SA, 2019).

Inflation remains a crucial macroeconomic problem in South Africa, and the country continues to face several challenges with respect to persistent and escalating inflation rates. Inflation has been declining since 1970, however, it has frequently been at the upper end or even above the target range of 3% to 6% since 2000. Following the introduction of inflation targeting in 2000, the average annual rate of inflation in South Africa was approximately 6% between 2000 and 2013 (Madito and Odhiambo, 2018). High and volatile inflation can be damaging not only to businesses and consumers but to the economy. The social and economic consequences of inflation are diverse and difficult to measure accurately. Inflation causes instability and inefficiency in the

economy as it has the potential of slowing down economic growth in the long run (Madito and Odhiambo, 2018).

1.6. The Interest Rate in South Africa

Another significant macroeconomic indicator influenced by the exchange rate in South Africa is the interest rate. Interest rates remain a key tool that monetary authorities utilize to influence market behaviour in their pursuit of price stability. The South African Reserve Bank introduced the policy of inflation targeting in 2002. In line with the long-term declining trend in consumer price inflation, the Monetary Policy Committee prepared to progressively lower the repo rate. The repo rate was at its lowest level in almost 40 years, since July 2012 (IDC, 2013). Consistent with the lower inflation environment, interest rates declined during 1997, however, capital outflows, exchange rate depreciation, and financial uncertainty put a strong upward pressure on money and capital markets in 1998, resulting in unusually high real interest rates. Following the improved stability in the exchange rate, interest rates began to decline in October 1998 and were expected to continue to ease during the remainder of the year and in 1999 (Medium Term Budget Policy Statement, 1998).

The repo rate remained unchanged at a four-decade low of 5% through 2013, despite upside risks to the inflation outlook. The Monetary Policy Committee (MPC) was reluctant to raise interest rates due to the weak economic growth momentum and the absence of demand-pull pressures on the inflation front. The MPC kept interest rates at record low levels throughout 2013. In real terms, the real repo rate was marginally negative throughout the year, reflecting the extent of monetary policy accommodation. The situation could have been reversed if additional rate hikes ensued during the year as was widely anticipated (IDC, 2014). In 2015, the interest rate tightening cycle continued, with the Monetary Policy Committee (MPC) of the South African Reserve Bank raising the repo rate by 50 basis points in 2015 and 75 basis points in 2016 (IDC, 2016).

The rest of this paper is organised as follows: section two focuses on the empirical literature review while section three relates to the methodology employed. Section four dwells extensively on analysis of the findings, while the last section presents the summary, conclusion, and recommendations.

2. LITERATURE REVIEW

The relevant literature associated with this study will be reviewed from the standpoint of a conceptual, theoretical, and empirical frameworks.

2.1. Conceptual Framework

The conceptual framework of this study was based on the variables identified in this study.

2.1.1. Exchange rates

The exchange rate is the price of one country's currency in relation to another; it is the required number of units of a currency that can buy a number of units of another currency (Adeniran et al., 2014). To put it another way, an exchange rate is the value of two

currencies in terms of another currency, thus, it is the price of one currency in terms of another. The rate at which one currency is exchanged for another is known as an “exchange rate” (also known as “FOREX rate,” “FX rate,” or “Foreign Exchange Rate”). It is also the worth of one currency in terms of another. For example, 96 South African rands to United States Dollar (US\$) interbank exchange rate indicates that US\$1 will be exchanged for each Rs. 96 (Kanwal et al., 2014).

2.1.2. Exchange rate volatility

Exchange rate volatility refers to the tendency for foreign currencies to appreciate or depreciate, thus affecting the profitability of foreign exchange trades. Volatility is a measurement of the amount that these rate change and the frequency of such changes. There are many instances of exchange rate volatility, including during business dealings between parties in two different countries and international investments. Volatility in such circumstances is difficult to avoid. Exchange rate volatility explains the fluctuation in the economy’s exchange rate. In South Africa, there has been a persistent fluctuation in the exchange rate and the major factors contributing to this include interest rate, inflation, the balance of payment as well as government intervention (Kechi and Nwadiubu, 2020).

Exchange rate volatility represents the degree to which a variable changes over time. The larger the magnitude of a variable change, or the more quickly it changes over time, the more volatile it is regarded. Volatility is a statistical measure of the dispersion of returns for a given security or market index. It can either be measured by using the standard deviation or variance between returns from that same security or market index; normally, the higher the volatility of a particular asset, the riskier is its security (Nganga, 2015).

2.1.3. Nominal exchange rates versus real exchange rates

The nominal exchange rate is the rate at which currency can be exchanged. If the nominal exchange rate between the dollar and the Rand is 16.5, then for one dollar one may purchase 16.5 rand. Exchange rates are always represented in terms of the amount of foreign currency that can be purchased for one unit of domestic currency, thus, we determine the nominal exchange rate by identifying the amount of foreign currency that can be purchased for one unit of domestic currency. The real exchange rate is a bit more complicated than the nominal exchange rate. While the nominal exchange rate indicates how much foreign currency can be exchanged for a unit of domestic currency, the real exchange rate indicates how much goods and services in the domestic country can be exchanged for the goods and services in a foreign country. The real exchange rate is represented by the following equation: $\text{real exchange rate} = (\text{nominal exchange rate} \times \text{domestic price}) / (\text{foreign price})$ (Ikechi and Nwadiubu, 2020). In comparison to the nominal rate, the real exchange rate is often regarded as a key macroeconomic variable. It demonstrates a country’s international competency as well as price adjustments done owing to inflation within a country for those trading partners (Khin et al., 2017). The Real Effective Exchange Rate (REER) will be used as a proxy for exchange rate volatility in this study.

2.1.4. Gross domestic product (GDP)

Gross Domestic Product is the money value of goods and services produced in an economy during a period irrespective of the nationality of the people who produced the goods and services (Azeez et al., 2012).

2.1.5. Inflation rate (INFR)

Inflation is the percentage change in general price level of goods and services in an economy over a period (Azeez et al., 2012). Inflation refers to an increase in general price level in a country in a particular period. In other words, inflation is generally considered as an inordinate rise in general prices in a country (Kanwal et al., 2014).

2.1.6. Trade openness

Trade openness is a policy variable that measures the level of international transactions undertaken by a nation. This variable is a measure of the total sum of trading with the out-world. It is measured as the ratio of the sum of exports and imports to the value of GDP [(Exports + imports)/GDP (Adjei, 2019).

2.2. Empirical Review

There have been many empirical studies that have been carried out on the subject, despite that, the impact of exchange rate volatility on macroeconomic variables remains unclear. Many theoretical modeling studies on the effect of exchange rate volatility showed a negative relationship between exchange rate volatility and macroeconomic variables.

Using the Correlation Matrix, Ordinary Least Square (OLS), and Granger Causality test, Danmola (2013) examined the impact of exchange rate volatility on macroeconomic indicators in Nigeria from 1980 to 2010. The study’s findings revealed that exchange rate volatility has a positive impact on GDP, FDI, and trade openness, but has a negative impact on the country’s inflation rate. In Pakistan, Mahmood et al. (2011) looked at how exchange rate uncertainty and fluctuations affect macroeconomic variables. Like in the case of Danmola (2013), the impact of exchange rate volatility on macroeconomic variables in Pakistan was confirmed by the findings of this study. Exchange rate volatility was found to have a positive impact on GDP, growth rate, and trade openness while having a negative impact on FDI. Khin et al. (2017) used time-series data from January 2010 to August 2016 to explore the impact of exchange rate volatility on macroeconomic factors in Malaysia. The results of the VECM model revealed a strong and positive short-run link between the exchange rate, the consumer price index (CPI), and the exchange rate’s lag. Furthermore, the exchange rate and the money supply have a large and negative short-run relationship. However, the interest rate is negatively and statistically insignificant related to exchange rate in Malaysia. In Tanzania, Kenya, and Uganda, Yabu and Kimolo (2020) investigated the magnitude of exchange rate volatility and its impact on essential macroeconomic variables such as exports, FDI inflows, interest rate, and inflation. The results indicate a positive impact of the exchange rate volatility on export performance and lending rates in the long run. Also, the response of FDI to exchange rate volatility seems to be negative in the long run, while in the short run, the response from the volatility of real exchange rate

seems insignificant, although the volatility of the exchange rate still appears to have a positive impact on inflation. Gona and Sahoo (2018) examined the impact of exchange rate uncertainty or fluctuations on major macroeconomic variables in India using ARDL and Ordinary Least Square over the period 1975 – 2016. The study focused on the variables - consumption, GDP, FDI, interest rate, GDP growth rate and trade openness. The study found that exchange rate volatility has positive effects on Foreign Direct Investment (FDI), GDP, GDP growth rate, trade openness, interest rate (INT) and negatively impacted on consumption (CON).

Sharifi-Renani and Mirfatah (2012) evaluated the determinants of inward FDI, particularly volatility of exchange rate in Iran by using the Johansen and Juselius' cointegration system approach model, covering the period 1980 Q2-2006 Q3. The findings of this study reveal that gross domestic product, openness, and exchange rate, have a positive relationship with foreign direct investment but, world crude oil prices and volatility of exchange rate have negative relationship with foreign direct investment. Moraghen et al. (2020) used semi-annual data from 1990 to 2015 to examine the structure of FDI inflow in different sectors of the Mauritian economy. The cointegration bound test indicated a long-run systematic link between the variables, justifying the usage of an ARDL model. Exchange rates and exchange rate volatility have little impact on FDI inflow in the short run, however, the ARDL results revealed that real depreciation of the Mauritian Rupee versus the US dollar has consistently increased FDI influx into numerous industries over the last decades. Latief and Lefen (2018) analyzed the effect of exchange rate volatility on international trade and foreign direct investment (FDI) in seven developing countries along "One Belt and One Road" using Generalized Autoregressive Conditional Heteroscedasticity (GARCH) (1,1) and Threshold - Generalized Autoregressive Conditional Heteroscedasticity (TGARCH) (1,1) models and panel data for the period 1995 -2016. The results of this study revealed that exchange rate volatility affects both international trade and FDI significantly but negatively in OBOR-related countries, which correlates with the economic theory arguing that exchange rate volatility may hurt international trade and FDI.

Polodoo et al. (2011) investigated the impact of exchange rate volatility on the macroeconomic performance of 15 Small Island Developing States (SIDS) using longitudinal data and the Generalised Method covering the period 1999 – 2010. The OLS with robust standard errors results indicated that, exchange rate volatility negatively impacts on current account balance but positively affects the growth rate of the economies studied; in a dynamic setting, however, exchange rate volatility does not influence the macroeconomic variables. Using Generalized Method Moments (GMM), Musyoki et al. (2012) evaluated the influence of real exchange rate volatility on economic growth in Kenya from January 1993 to December 2009; the RER Volatility Index revealed a negative impact on Kenya's economic growth. Onyango (2014) used the OLS estimation method with secondary time series data from 1980 to 2012 to study the effect of exchange rate volatility on economic growth in Kenya. According to the results, exchange rate volatility has a positive impact on GDP growth but has no meaningful impact on GDP growth rate. The

results differed with Musyoki et al. (2012) who found a negative relationship between exchange rate volatility and economic growth in Kenya. Sanginabadi and Heidari (2012) investigated the effects of exchange rate volatilities on economic growth of Iran over a flexible exchange rate regime period (1988: Q1 - 2007: Q4) using generalized autoregressive conditional heteroscedasticity (GARCH) family models to generate time-varying conditional variance of exchange rate; this was a standard measure of exchange rate volatility, and the autoregressive distributed lag (ARDL) bounds test approach to level relationship as proposed by Pesaran et al. (2001). The results showed a significant relationship between Iranian growth volume and real exchange rate volatility. The long run results of the ARDL model showed that the effect of exchange rate volatility on economic growth is negative.

Using the ARCH and GARCH methodologies and monthly time series data for the period 1983-2010, Adjei (2019) investigated the impact of exchange rate volatility on economic growth in Ghana. Exchange rate volatility and trade openness, GDP per capita, physical capital stock, and human capital stock were among the five variables investigated. The results revealed that exchange rate volatility had a considerable negative impact on economic growth both in the short and long-term during the study's time frame. The coefficient of trade openness was found to be negative and significant in the long run. The long run coefficient for trade openness was -3.5876 implying that a 1% increase in international trade would decrease Ghana's economic growth by 3.5876% in the long run. Using Ordinary Least Square and secondary data derived from the Central Bank of Nigeria Statistical Bulletin, Adeniran et al. (2014) studied the impact of exchange rate on economic growth in Nigeria from 1986 to 2013. The results revealed that the exchange rate has a positive impact but is not significant, confirming prior research that developing nations are better off when it comes to using flexible exchange rate regimes. The results also showed that interest and inflation rates have a negative impact on economic growth, but that the effects are not significant. Morina et al. (2020) examined the effect of real effective exchange rate volatility on economic growth in the Central and Eastern European countries using annual data for the period 2002-2018. The empirical findings revealed that the volatility of the exchange rate has a significant negative effect on real economic growth.

Azeez et al. (2012) examined the effect of exchange rate volatility on macroeconomic performance in Nigeria from 1986 to 2010. The ADF test reveals that all variables are stationary. The OLS results show that OREV and EXR are positively related while BOP is negatively related to GDP. Further findings revealed that oil revenue and balance of payment exert negative effects while exchange rate volatility contributes positively to GDP in the long run. Maina (2018) investigated the effect of exchange rate volatility on inflation rates in Kenya using Generalized Autoregressive Conditional Heteroskedastic (GARCH) approach for the period between 2005 and 2015. The empirical results showed that there was volatility clustering and that exchange rates had an impact on inflation rates. Mulwa (2013) investigated the effect of exchange rate volatility on inflation rates in Kenya using Auto Regressive Integrated Moving Average (ARIMA) secondary data collected from the Central Bank for the period 2003 - 2013. The test

indicated that there was a moderate relationship between foreign exchange rates volatility and inflation rates. On carrying out an Analysis of Variance tests (ANOVA) and at 95% confidence level, it was found that there was an insignificant relationship between exchange rates volatility and inflation rates. Using a t-statistic table, the relationship could be seen to be strong, negative but not significant. The model used by the study showed there was an insignificant relationship between foreign exchange and inflation rates. Rahman et al. (2020) examined the impact of exchange rate volatility on trade in Bangladesh using time-series, monthly-basis data from 2013 M01 to 2019 M06. Major findings of the study were as follows: the GARCH models estimated that the exchange rate volatility creates a negative impact on trade, but the EGARCH model estimated there was no leverage effect in the studied country. Kanwal et al. (2014) found a positive and a very strong impact of exchange rate volatility on interest rate.

3. DATA AND METHODOLOGY

Investigated whether exchange rate volatility has any impact on macroeconomic variables, thus, on macroeconomic performance of South Africa; in other words, to what extent and in what direction exchange rate volatility has an impact on macroeconomic performance of South Africa. This was based on the assumption that exchange rate volatility has some bearings on macroeconomic variables, thus, on macroeconomic performance. The macroeconomic variables selected for the study were - volatility of real exchange rate (VREXR), growth rate (GRATE), foreign direct investment (FDI), GDP and trade openness (OPENN). This study made use of annual observations and data was collected from various secondary sources. Its data span from 1979 to 2019 and provided a series of 40 observations. All the variables used in this study are of quantitative nature. Inflow of foreign direct investment (FDI), GDP, growth rate (GRATE) and trade openness (OPENN) were taken as dependent variables and exchange rate volatility (VREXR) was taken as an independent variable. There are a number of factors which have bearing on macroeconomic variables of South Africa, but only the impact of exchange rate volatility on the selected macroeconomic variables was analyzed in this study. The study period (i.e., 1979-2019) was chosen due the availability of the data of the selected variables.

Several factors that have an impact on macroeconomic indicators in South Africa have been identified in the literature. We, however, only investigated the influence of exchange rate volatility on the macroeconomic indicators we had chosen. The current study adopted and modified the models used by Danmola (2013), Mahmood et al. (2011) and Gona and Sahoo (2018) in Nigeria, Pakistan, and India, respectively. The following econometric models were developed using simple regression equations:

$$FDI = \beta_1 + \beta_2 VREXR \quad (1)$$

$$GDP = \beta_1 + \beta_2 VREXR \quad (2)$$

$$GRATE = \beta_1 + \beta_2 VREXR \quad (3)$$

$$INFR = \beta_1 + \beta_2 VREXR \quad (4)$$

$$INT = \beta_1 + \beta_2 VREXR \quad (5)$$

$$OPENN = \beta_1 + \beta_2 VREXR \quad (6)$$

The above notations represent as follows:

FDI = Inflows of foreign Direct Investment in South Africa

GDP = Gross Domestic product in South Africa

GRATE = GDP growth rate in South Africa

INFR = Inflation rate in South Africa

INT= Interest rate (lending rate) in South Africa

OPENN = Trade openness of South Africa, represented by ratio of exports to imports

VREXR = Volatility of real exchange rate of South Africa

The expected signs were that the exchange rate volatility will positively influence both the GDP and openness. Volatility in the exchange rate were expected to increase GDP because both the exporters and importers will try to take advantage of this, hence, the demand for goods will rise. Exchange rate volatility will also impact positively on trade openness, because of the tendency to encourage exports and make it more competitive in the international market and at the same time reduce the volume of imports. It is also expected that exchange rate volatility will negatively influence FDI, and an unstable exchange rate will discourage the inflow of FDI into that country.

For the process, we will first analyze the relationship between exchange rate volatility and other macroeconomic variables through descriptive statistics, correlation matrix and then, we move to conduct unit root tests using both Augmented Dickey Fuller (ADF) and Phillip Perron (PP), next we run the regression using Ordinary Least Square (OLS) and finally, conduct a Granger causality test to test the short run dynamics. The data were obtained from the publications on the World Development Indicators (WDI) database and the period of research covered 1979-2019.

4. RESULTS AND ANALYSIS OF THE ESTIMATES

The results and a summary of all the variables considered in this study are summarized in Table 1. The mean value of the real exchange rate is 111.63, while the value of the standard deviation is 29.11 showing more variability. The value of the skewness shows the real exchange rate skewed to the right. Table 1 also shows that the maximum FDI and GDP values are 5.983000 and 430.1670, respectively, with minimum values of -0.841000 and 180.0440, respectively. During the study period, the mean values of these variables were 0.889610 and 289.2586, respectively. Similarly, over the study period, real exchange rate volatility showed maximum value of 181.3540 and a minimum value of 70.42800 with the mean value of 111.6302.

Table 2 presents a pair of correlation matrix. The correlation matrix above depicts the relationship between exchange rate volatility and the other macroeconomic factors being studied. The Table above demonstrates a positive association between exchange rate volatility and GDP growth rate, inflation rate, and

Table 1: Descriptive statistics

	FDI	GDP	GRATE	INFR	INT	OPENN	VREXR
Mean	0.889610	289.2586	2.263927	8.881390	14.44463	53.11324	111.6302
Median	0.542000	256.2390	2.485000	7.354000	14.33300	52.31200	104.5970
Maximum	5.983000	430.1670	6.621000	18.65500	22.33300	72.86500	181.3540
Minimum	-0.841000	180.0440	-2.137000	-0.692000	8.500000	37.48700	70.42800
SD	1.252874	84.60870	2.243298	4.648371	4.316381	8.200143	29.11330
Skewness	1.913290	0.460015	-0.193881	0.274045	0.285229	-0.031151	0.702084
Kurtosis	8.005363	1.650130	2.227937	2.091062	1.761414	2.474225	2.756534
Jarque-Bera	67.81466	4.558866	1.275169	1.924558	3.176677	0.478882	3.469567
Probability	0.000000	0.102342	0.528568	0.382021	0.204265	0.787068	0.176438
Sum	36.47400	11859.60	92.82100	364.1370	592.2300	2177.643	4576.837
Sum Sq. Dev.	62.78770	286345.3	201.2954	864.2942	745.2459	2689.694	33903.36
Observations	41	41	41	41	41	41	41

Source: E- views Statistical package version 12

Table 2: Correlation matrix

	VREXR	FDI	GDP	GRATE	INFR	INT	OPENN
VREXR	1.000000						
FDI	-0.498806	1.000000					
GDP	-0.829850	0.443610	1.000000				
GRATE	0.025766	0.117512	-0.014685	1.000000			
INFR	0.651705	-0.456261	-0.726339	-0.297101	1.000000		
INT	0.455939	-0.224811	-0.683039	-0.262108	0.506598	1.000000	
OPENN	-0.515937	0.391112	0.678877	0.326526	-0.367228	-0.694400	1.000000

Source: E- views Statistical package version 12

interest rate, whereas there is a negative relationship between foreign direct investment, GDP, and trade openness.

The results of the unit root test for checking the stochastic features of the data are assessed based on the series of each variable through Augmented Dickey - Fuller and Phillips - Perron tests with intercept and intercept and trend, respectively, in Tables 3a, b and 4a, b. The ADF unit root test shows that foreign direct investment (FDI), GDP growth rate (GRATE), and interest rate (INT) are stationary at the level, as is the case in the PP unit root test, except for inflation rate (INT), which is non-stationary, and the remaining variables are non-stationary at the level. The stationary test is further reinforced with Phillips – Perron Unit root test to ascertain the level of significance and the order of integration of the above variables. The PP unit root test shows that FDI and GRATE were stationary at level with 5% level of significance in the model with intercept and intercept and trend. The stationarity of the all-time series variables is evaluated again at the first difference in both ADF and PP, thus, variables that were previously found to be non-stationary at the level became stationary at the first difference. To use cointegration, Mahmood et al. (2011) and Azeez et al. (2021) recommend that all non-stationary variables have the same amount of integrating factor. Cointegration analysis cannot be employed since the non-stationary variables in our data have a varying pattern of integrating level. The numerous regression equations must now be estimated. The findings of this estimation are presented in Tables 5-10.

A relationship between exchange rate volatility and FDI is depicted in the above regression Table 5. There is a negative and statistically significant relationship between exchange rate volatility and foreign direct investment. International investors' reactions to exchange rate fluctuations were found to be remarkable, according

Table 3a: Augmented Dickey – Fuller test with intercept

Variables	Level	1 st difference	Conclusion
VREXR	-1.308	-5.478*	I (1)
FDI	-4.721*	-	I (0)
GDP	0.605	-3.738*	I (1)
GRATE	-4.121*	-	I (0)
INFR	-1.600	-5.448*	I (1)
INT	-1.535	-5.649*	I (1)
OPENN	-2.157	-6.288*	I (1)

*Significant at 5 %

Table 3b: Augmented Dickey – Fuller test with trend and intercept

Variables	Level	1 st difference	Conclusion
VREXR	-3.740	-5.439	I (1)
FDI	-5.592*	-	I (0)
GDP	-2.176	-3.686	I (1)
GRATE	-4.044*	-	I (0)
INFR	-2.884	-5.363	I (1)
INT	-4.922*	-	I (0)
OPENN	-2.746	-6.313	I (1)

*Significant at 5 %

Table 4a: Phillips Perron test with intercept

Variables	Level	1 st difference	Conclusion
VREXR	-1.110	-6.905*	I (1)
FDI	-4.688*	-	I (0)
GDP	0.782	-3.760*	I (1)
GRATE	-4.006*	-	I (0)
INFR	-1.287	-9.386*	I (1)
INT	-1.964	-5.111*	I (1)
OPENN	-2.091	-6.397*	I (1)

*Significant at 5 %

to the research. This is in line with the findings of Mahmood et al. (2011), Jabu and Kimola (2020), and Latief and Lefen (2018), which revealed a negative impact of exchange rate volatility on

Table 4b: Phillips Perron test with trend and intercept

Variables	Level	1 st difference	Conclusion
VREXR	-3.034	-8.285*	I (1)
FDI	-5.625*	-	I (0)
GDP	-1.432	-3.967*	I (1)
GRATE	-3.946*	-	I (0)
INFR	-2.929	-9.227*	I (1)
INT	-3.385	-5.362*	I (1)
OPENN	-2.447	-6.812*	I (1)

ADF: Augmented Dickey-Fuller, PP: Phillips-Perron, with intercept and intercept and trend. *The null hypothesis can be rejected at 5%

Table 5: Estimation of regression equation-1

Dependent Variable: FDI				
Method: Least Squares				
Sample: 1979, 2019				
Included observations: 41				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.966305	0.623205	4.759758	0.0000
VREXR	-0.019387	0.005406	-3.586045	0.0009
R-squared	0.247971	Mean dependent var		0.802122
Adjusted	0.228688	S.D. dependent var		1.133494
R-squared				
S.E. of regression	0.995484	Akaike info criterion		2.876375
Sum squared resid	38.64855	Schwarz criterion		2.959964
Log likelihood	-56.96569	Hannan-Quinn criter.		2.906814
F-statistic	12.85972	Durbin-Watson stat		1.870817
Prob (F-statistic)	0.000923			

Table 6: Estimation of Regression equation – 2

Dependent Variable: GDP				
Method: Least Squares				
Sample: 1979 2019				
Included observations: 41				
Variable	Coefficient	Std. Error	t-statistic	Prob.
C	463.4930	24.90241	18.61238	0.0000
VREXR	-1.999939	0.216024	-9.257937	0.0000
R-squared	0.687273	Mean dependent var		240.2371
Adjusted	0.679254	S.D. dependent var		70.23673
R-squared				
S.E. of regression	39.77816	Akaike info criterion		10.25206
Sum squared resid	61709.78	Schwarz criterion		10.33565
Log likelihood	-208.1673	Hannan-Quinn criter.		10.28250
F-statistic	85.70940	Durbin-Watson stat		0.318804
Prob (F-statistic)	0.000000			

foreign direct investment, whereas Danmola (2013) and Gona and Sahoo (2018) found a positive relationship between exchange rate volatility and foreign direct investment.

The Table 6 shows the relationship between exchange rate volatility and GDP. The relationship between these variables is negative and significant. The results differed with Gona and Sahoo (2018) who found a positive relationship between exchange rate volatility and GDP.

The relationship between exchange rate volatility and GDP growth rate is depicted in the Table 7. The relationship is positive but not statistically significant, which is consistent with the findings of Onyango (2014), Adeniran et al. (2014) and Gona and Sahoo

Table 7: Estimation of Regression equation - 3

Dependent Variable: GRATE				
Method: Least Squares				
Sample: 1979 2019				
Included observations: 41				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.101286	1.415790	1.484179	0.1458
VREXR	0.001552	0.012282	0.126330	0.9001
R-squared	0.000409	Mean dependent var		2.274488
Adjusted	-0.025221	S.D. dependent var		2.233537
R-squared				
S.E. of regression	2.261529	Akaike info criterion		4.517510
Sum squared resid	199.4660	Schwarz criterion		4.601098
Log likelihood	-90.60895	Hannan-Quinn criter.		4.547948
F-statistic	0.015959	Durbin-Watson stat		1.229767
Prob (F-statistic)	0.900120			

Table 8: Estimation of regression equation 4

Dependent Variable: INFR				
Method: Least Squares				
Sample: 1979 2019				
Included observations: 41				
Variable	Coefficient	Std. Error	t-statistic	Prob.
C	-2.733997	2.235266	-1.223119	0.2286
VREXR	0.104051	0.019391	5.366078	0.0000
R-squared	0.424735	Mean dependent var		8.881390
Adjusted	0.409984	S.D. dependent var		4.648371
R-squared				
S.E. of regression	3.570530	Akaike info criterion		5.430855
Sum squared resid	497.1986	Schwarz criterion		5.514444
Log likelihood	-109.3325	Hannan-Quinn criter.		5.461294
F-statistic	28.79479	Durbin-Watson stat		0.755466
Prob (F-statistic)	0.000004			

Table 9: Estimation of regression equation - 5

Dependent variable: INT				
Method: Least squares				
Sample: 1979 2019				
Included observations: 41				
Variable	Coefficient	Std. Error	t-statistic	Prob.
C	6.898650	2.435598	2.832426	0.0073
VREXR	0.067597	0.021128	3.199359	0.0027
R-squared	0.207895	Mean dependent var		14.44463
Adjusted	0.187585	S.D. dependent var		4.316381
R-squared				
S.E. of regression	3.890531	Akaike info criterion		5.602519
Sum squared resid	590.3130	Schwarz criterion		5.686108
Log likelihood	-112.8516	Hannan-Quinn criter.		5.632957
F-statistic	10.23590	Durbin-Watson stat		0.550068
Prob (F-statistic)	0.002736			

(2018). Musyoki et al. (2012), Sangibadi and Heidari (2012), Adjei (2019) and Morina et al. (2020) on the other hand, discovered a negative relationship between exchange rate volatility and GDP growth rate.

The Table 8 shows the relationship between exchange rate volatility and inflation rate. Inflationary rate shows a positive relationship with exchange rate volatility, hence does not influence the general prices; this means that inflation does not become imperative in

Table 10: Estimation of regression equation - 6

Dependent variable: Openn				
Method: Least squares				
Sample: 1979 2019				
Included observations: 41				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	58.04257	4.396891	13.20082	0.0000
VREXR	-0.074802	0.038142	-1.961125	0.0570
R-squared	0.089764	Mean dependent var	49.69234	
Adjusted	0.066424	S.D. dependent var	7.268993	
R-squared				
S.E. of regression	7.023427	Akaike info criterion	6.783930	
Sum squared resid	1923.813	Schwarz criterion	6.867519	
Log likelihood	-137.0706	Hannan-Quinn criter.	6.814369	
F-statistic	3.846010	Durbin-Watson stat	0.330191	
Prob (F-statistic)	0.057033			

relation to exchange rate volatility. The findings of this study agree with those of Jabu and Kimola (2020), in contrast to Mulwa's (2013) findings, where the former revealed that exchange rate volatility had a negative but insignificant impact on inflation.

The relationship between exchange rate volatility and interest rate is depicted in the Table above, which show that the two variables have a positive correlation. This finding is consistent with Gona and Sahoo (2018), who discovered that exchange rate volatility has a favourable impact on the intertest rate.

The Table 10 shows the relationship between the exchange rate volatility and trade openness. The relationship between these variables is negative and statistically significant. This is in line with the findings of Tahir et al. (2018), who discovered that the exchange rate had a negative and significant impact on trade openness.

The Granger causality test results for the provided variables are shown in Table 11. The results show that there are six bidirectional causal relationships and six unidirectional causal relationships (one variable causes the other but the reverse is not possible), as well as twenty-four instances where there are no causal relationships between the variables, based on the probability values reported in the Table 11.

5. CONCLUSION AND POLICY IMPLICATIONS

In this study, the impact of exchange rate volatility on macroeconomic variables was investigated using regression techniques. The GARCH model was used to calculate the volatility of exchange rates. The findings showed that exchange rate volatility has a positive impact on the growth rate (GRATE), inflation rate (INFR), and interest rate (INT). Exchange rate volatility, however, has a negative impact on foreign direct investment (FDI), GDP, and trade openness (OPENN).

The findings suggest that policymakers in South Africa should consider both the existence and the degree of exchange rate volatility, as well as the likely impact of the exchange rate on

Table 11: Pairwise causality tests

Pairwise Granger causality tests			
Sample: 1979 2019			
Lags: 2			
Null hypothesis	Obs	F-Statistic	Prob.
GDP does not Granger cause FDI	39	4.36959	0.0205
FDI does not Granger cause GDP		0.43238	0.6525
GRATE does not Granger cause FDI	39	1.86059	0.1711
FDI does not Granger cause GRATE		0.30866	0.7365
INFR does not Granger cause FDI	39	5.61745	0.0078
FDI does not Granger cause INFR		4.10649	0.0253
INT does not Granger cause FDI	39	1.35608	0.2713
FDI does not Granger cause INT		2.95796	0.0654
OPENN does not Granger cause FDI	39	1.72082	0.1941
FDI does not Granger cause OPENN		1.35299	0.2720
VREXR does not Granger cause FDI	39	1.65893	0.2054
FDI does not Granger cause VREXR		1.47297	0.2435
GRATE does not Granger cause GDP	39	0.47158	0.6280
GDP does not Granger cause GRATE		0.35216	0.7057
INFR does not Granger cause GDP	39	9.20055	0.0006
GDP does not Granger cause INFR		3.35075	0.0470
INT does not Granger cause GDP	39	11.3092	0.0002
GDP does not Granger cause INT		10.8606	0.0002
OPENN does not Granger cause GDP	39	4.93748	0.0131
GDP does not Granger cause OPENN		7.36863	0.0022
VREXR does not Granger cause GDP	39	3.52297	0.0407
GDP does not Granger cause VREXR		3.27610	0.0500
INFR does not Granger cause GRATE	39	4.23693	0.0228
GRATE does not Granger cause INFR		3.11771	0.0571
INT does not Granger cause GRATE	39	12.0748	0.0001
GRATE does not Granger cause INT		2.06316	0.1427
OPENN does not Granger cause GRATE	39	1.38482	0.2641
GRATE does not Granger cause OPENN		2.69606	0.0819
VREXR does not Granger cause GRATE	39	2.38447	0.1074
GRATE does not Granger cause VREXR		2.23779	0.1222
INT does not Granger cause INFR	39	0.59246	0.5586
INFR does not Granger cause INT		2.59502	0.0894
OPENN does not Granger cause INFR	39	2.81918	0.0737
INFR does not Granger cause OPENN		6.51211	0.0040
VREXR does not Granger cause INFR	39	9.15432	0.0007
INFR does not Granger cause VREXR		5.63000	0.0077
OPENN does not Granger cause INT	39	2.32090	0.1135
INT does not Granger cause OPENN		6.54598	0.0039
VREXR does not Granger cause INT	39	10.0551	0.0004
INT does not Granger cause VREXR		0.29384	0.7473
VREXR does not Granger CAUSE OPENN	39	0.79443	0.4600
OPENN does not Granger cause VREXR		1.71949	0.1944

each macroeconomic variable, when implementing trade policies, to attract higher volumes of trade and foreign direct investment. This research is not conclusive, rather, it paves the road for future research. In this research, we used annual data; if possible, the process could incorporate quarterly and monthly data in future studies to get better and more comprehensive results. In addition, research on this topic can be improved, in the future, by using different macroeconomic variables from those employed in the current study.

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