MCom

The Effect of Economic Growth Volatility on Income and Wealth Inequality in South Africa

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by

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ABSTRACT

This study uses a vector error correction model with impulse response, variance decomposition, and block Granger causality analysis over the period 1975-2018 to identify the effect of economic growth volatility on income inequality and wealth inequality in South Africa, and to determine whether this effect is more significant for income inequality or wealth inequality. The results show that economic growth volatility leads to long-term increases in both income inequality and wealth inequality with wealth inequality equalising at a higher level than income inequality. In addition, economic growth volatility is found to affect income inequality in the short- and medium-term and wealth inequality in the long-run. Furthermore, economic growth volatility is found to unidirectionally drive income inequality while population growth has a bidirectional causal association with income inequality. None of the factors are found to significantly drive wealth inequality but wealth inequality is found to drive population growth.

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LIST OF ABBREVIATIONS

ADF	augmented Dickey–Fuller test
AIC	Akaike Information Criterion
ASEAN	Association of Southeast Asian Nations
BRICS	Brazil, Russia, India, China and South Africa, as well as Egypt, Ethiopia, Iran, Saudi Arabia and the United Arab Emirates as of 1 January 2024
CPI	consumer price index
HQC	Hannan-Quinn criterion
IMF	International Monetary Fund
G7	Group of 7
G20	Group of 20
GDP	Gross domestic product
GFC	Great financial crisis
JB	Jarque–Bera test
KPSS	Kwiatkowski-Phillips-Schmidt-Shin stationary test
LM	Breusch-Godfrey Lagrange Multiplier test
OECD	The Organisation for Economic Co-operation and Development
PP	Phillips-Perron test
SARB	South African Reserve Bank
SIC	Schwarz information criterion
VAR	vector auto regression
VDA	variance decomposition analysis
VECM	vector error correction model
WIID	World Income Inequality Database

LIST OF DEFINITIONS

2001 Rand Crisis	a currency crisis between September and December 2001 during which the Rand depreciated 26% against the U.S. dollar
2008 Global Financial Crisis	a period of severe liquidity contraction in global financial markets arising out of the bust of the American property market, resulting in global economic instability
Cantillon effect	the uneven change in relative prices caused by a change in money supply
Cubic spline method	a cubic function that smooths out and interpolates data points
Decile	a division of a population into ten equal parts according to the distribution of a particular variable, in this case income and wealth
GDP volatility	the degree of variation or fluctuation in a country's GDP over a specific period of time
Gini coefficient	a statistical dispersion of a variable amongst a population, most often inequality
Government expenditure	all government consumption, investment and transfers
Income inequality	the extent to which income is distributed or concentrated throughout a population
Inflation	the increase in prices of goods and services over a period of time
Inter-race inequality	inequality between different racial groups
Intra-racial inequality	inequality amongst the members of the same racial group
National Income Dynamics Study	the national household panel study of the livelihoods of South Africa individuals and households compiled by the Southern Africa Labour and Development Research Unit
Percentile	a division of a population into one hundred equal parts according to the distribution of a particular variable, in this case income and wealth
Population growth	the annual rate of growth of the population
Wage gap	the average difference in remuneration between two populations of wage earners
Wealth inequality	the extent to which wealth is distributed or concentrated throughout a population

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1 INTRODUCTION

1.1 Background to the Study

Three decades after the end of Apartheid, South Africa continues to suffer from significant inequality, which has led to service delivery protests (Khanyile, 2019; Seleka, 2019; Van Diemen, 2019) and negatively affected race relations (Meiring *et al*., 2018). Estimates of wealth inequality indicate that the richest 10% own 90 – 95% of wealth in the country (Chatterjee, Czajka, and Gethin, 2020; Mbewe and Woolard, 2016; Orthofer, 2016; The Davis Tax Committee, 2018) while roughly 60 – 70% of income accrues to the top 10% of earners (Francis and Webster, 2019a; Leibbrandt *et al*., 2012; Orthofer, 2016).

In common with many other emerging economies, wealth inequality in South Africa is more severe than income inequality (Chatterjee, 2019; Mbewe and Woolard, 2016; Orthofer, 2016). However, South Africa's inequality, both in terms of wealth and income, are extreme even in the current age of extreme global inequality. Another dimension between South Africa and other cases of extreme inequality is the stability of such high rates of inequality. This is due to economic structural issues, embedded into the economic framework through colonialism and Apartheid (Chancel *et al*., 2022).

Throughout the literature, in the South African context both income and wealth inequality remain stubbornly high throughout time. The literature indicates that there is a positive relationship between income inequality and economic growth but there is more evidence that economic growth increases wealth inequality. However, more research is needed to determine the causal relationship between the two.

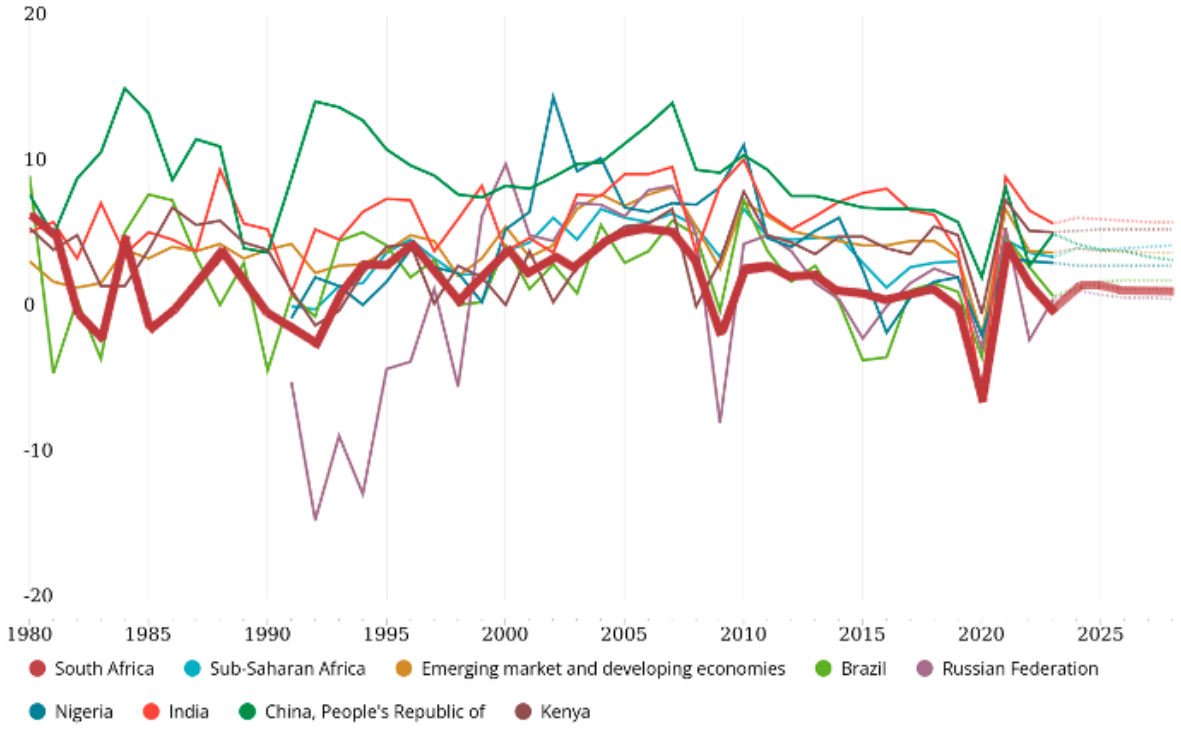
The effects of income and wealth inequality are further reflected, inter alia, in social indicators (Skopek *et al*., 2014; van der Berg, 2011). Income inequality is associated with a litany of social ills including morbidity, obesity, teenage birth rates, mental illness, low life expectancy, infant mortality, racism, poor education attainment, and high crime and incarceration rates (Fajnzylber *et al*., 2002; Wilkinson and Pickett, 2007; Skopek *et al*., 2014; Kollamparambil, 2020).

Concurrently, South Africa suffers from poor economic growth, which is expected to be just 1.3% in 2024 as a result of high levels of inflation, monetary tightening by major central banks, and continued economic-political volatility brought about by the invasion of Ukraine by Russia

and the Israel-Hamas war (World Bank, 2023), compared to 2.4% globally and 3.9% for emerging markets and developing economies (World Bank, 2024).

Figure 1 below shows that South Africa's real economic growth has flatlined at 0.1%, which is far below the average economic growth of Sub-Saharan Africa (3.6%), and emerging and developing economies (3.9%). Similarly, among the BRICS cohort, South Africa's growth rate is low compared to the average of India (5.9%), Brazil (0.9%), and China (5.2%). As is to be expected, average economic growth in Russia (currently severely sanctioned and embroiled in an illegal war) is low (0.7%) but is still higher than South Africa's (IMF, 2023). Moreover, the IMF does not foresee any significant improvement in South Africa's growth rate until at least 2025.

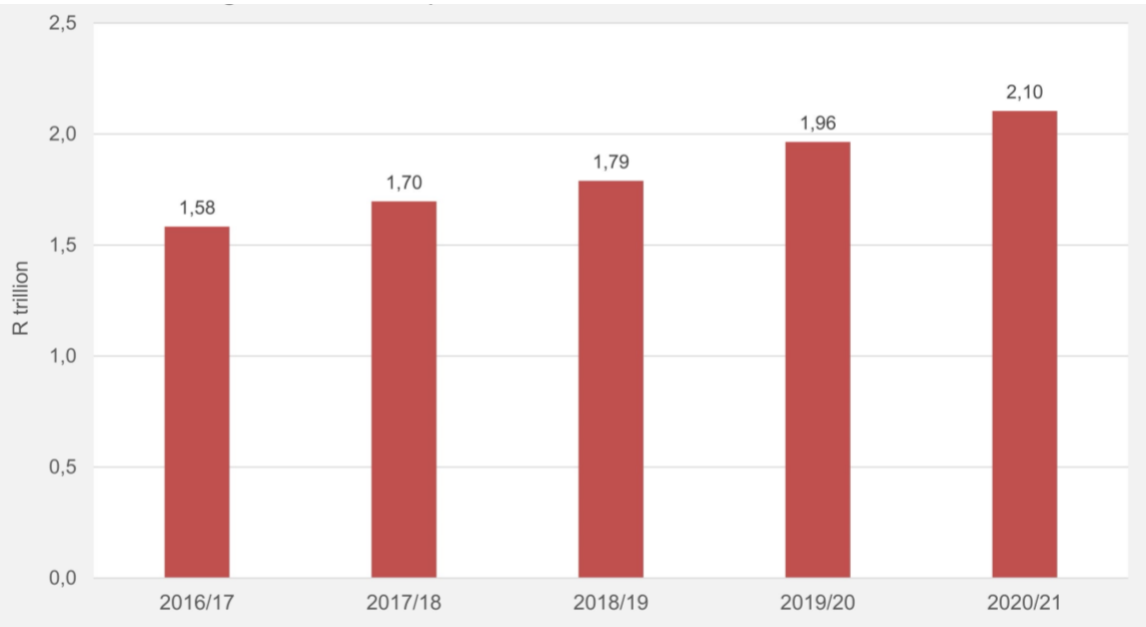
Figure 1 GDP Growth of Selected Countries[1]



As a result of low growth, government spending (summarised in Figure 2) has increased from R1.58 trillion in the 2016/2017 fiscal year to R2.1 trillion in the 2020/2021 year while year-on-year tax revenue dropped by R108 billion from 2019/2020 to 2020/2021(Stats SA, 2022a).

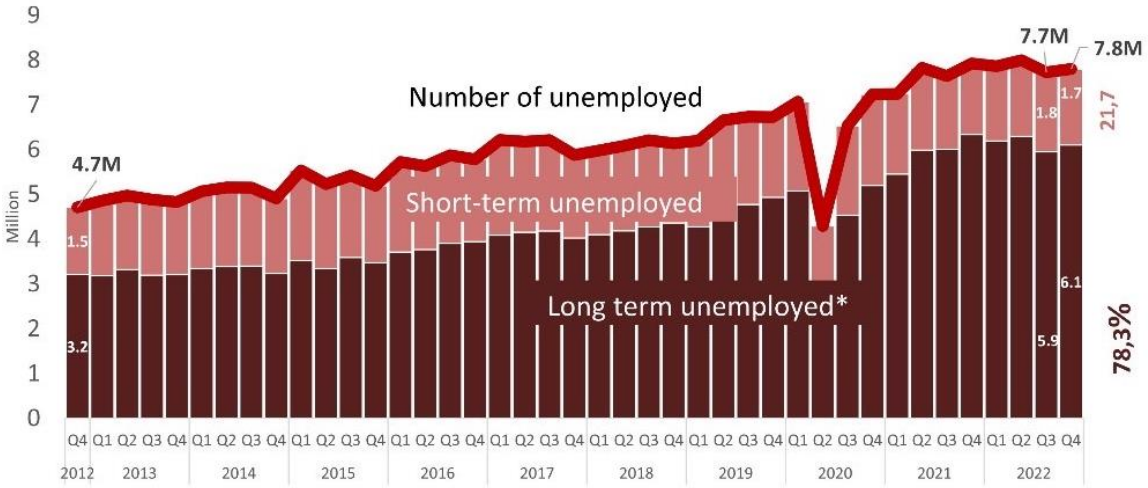
[1] Source - IMF Data Mapper
https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/ZAF/SSA/OEMDC/BRA/RUS/NGA/IND/CHN/KEN

Figure 2 Government expenditure, 2016/2017 - 2020/2021 (Stats SA, 2022b)



In addition, unemployment has increased steadily, as illustrated in Figure 3 below, the unemployment rate increased from 4.7 million in 2012: Q4 to 7.8 million in 2022: Q4. Of these unemployed, 78.3 % are long-term unemployed (unemployed for more than a year) and 21,7% are short-term unemployed (unemployed for less than a year). However, this refers only to the official unemployment rate – persons who are without work, looking for work and available for work. On the basis of the expanded definition, which includes discouraged work seekers or person otherwise not seeking employment, the unemployment rate for 2022: Q4 was 42,6% (Stats SA, 2023b).

Figure 3 Long-term and short-term unemployment rate, Q4 2012 - Q4 2022 (Stats SA, 2023a, 2023b)



Hence, South Africa currently suffers from low growth, escalating government expenditure, high unemployment, and extreme wealth and income inequality.

1.2 Research Problem Definition

While considerable research has been conducted on income inequality in South Africa and there is growing research on wealth inequality, studies devoted to the relationship between income inequality, wealth inequality, and economic growth volatility in South Africa are still uncommon. To date, studies have focussed on calculating the distribution of income (Alvaredo and Atkinson, 2022; Hundenborn *et al*., 2019; Leibbrandt *et al*., 2018a; Wittenberg, 2017a, 2017b, 2018) and wealth (Aron *et al*., 2005; Aron and Muellbauer, 2006; Mbewe and Woolard, 2016; Orthofer, 2016; Chatterjee, 2019a; Chatterjee *et al*., 2020), the causes of income inequality (Bhorat *et al*., 2009; van der Berg, 2011; Hundenborn *et al*., 2018; Leibbrandt *et al*., 2018a) and wealth inequality (Orthofer, 2015; Piketty, 2017), and proposals to mitigate such income inequality (Kapingura, 2017; Leibbrandt *et al*., 2011; Shupp, 2002) and wealth inequality (Chatterjee *et al*., |2021; The Davis Tax Committee, 2018; von Fintel and Orthofer, 2020).

1.3 Purpose and significance of the research

This study seeks to contribute to the body of literature by examining the relationship between income inequality, wealth inequality, and economic growth volatility in South Africa over the period of 1975 - 2018.[2] It is envisaged that the empirical analysis will provide greater understanding of the effect of economic growth volatility on income and wealth inequality over the long-run.

This study is significant in several regards:

i. Few studies on inequality in South Africa have considered the multilateral associations between income inequality, wealth inequality, and economic growth volatility as most only consider either income inequality or wealth inequality alone. This study is unique in that it considers income inequality, wealth inequality, and economic growth volatility concurrently. In so doing it highlights the nuanced and varied impact of economic volatility on different types of inequality.
ii. Despite a growing theoretical body of literature on wealth inequality (Orthofer, 2016; Piketty, 2017; van der Berg, 2011), most empirical studies continue to focus on income

[2] This sample is the longest period for which the data sets overlap.

inequality and exclude wealth inequality. By focussing on wealth, this research contributes by filling in the gaps in the literature on this under studied issue.

iii. By employing impulse response analysis, variance decomposition and VECM block Granger causality testing, this research provides empirical evidence on the subject. In so doing, it adds to the limited empirical studies on the relationship between income and wealth inequality and economic volatility.

iv. In focussing on South Africa, this study provides insight on the unique socio-economic factors of the country. In so doing it provides further understanding of the topic in the South African context which allows for more nuanced policy to be crafted.

v. Employing data between 1975 and 2018, this study provides a longitudinal perspective on the subject. This period is also sufficiently long enough to provide a meaningful, long-term analysis of the issue.

1.4 Research Questions

The main research question that this study seeks to answer is:

What is the effect of economic growth volatility on income inequality and wealth inequality in South Africa?

In addition to this primary research question, the following sub-question will also be explored:

Is the effect of economic growth volatility more significant for income inequality or wealth inequality?

1.5 Structure of the Study

The remainder of this study is divided into six chapters. Chapter 2 presents the stylised facts on inequality in South Africa. Chapter 3 reviews the literature on income inequality, wealth inequality and economic growth volatility. Chapter 4 discusses the data and empirical methodology used in conducting this study. In Chapter 5, the results obtained from the empirical methodology are presented, analysed and discussed. Finally, Chapter 6 concludes the study by presenting the policy implications and makes recommendations for future studies.

2 STYLISED FACTS

2.1 Income Inequality in South Africa

Leibbrandt *et al*., (2012) find that income inequality in South Africa accelerated between 1993 and 2008. In 2008 the richest 10% of the population was estimated to have accrued 58% of national income while the share of the bottom 50% of the population decreased from 8.32% to 7.79% and the top 5% of the population increased their share of national income from 38% to 43%. Similarly, Finn and Leibbrandt (2018) find that income inequality remained high yet stable during the period 2000 to mid-2011 but increased thereafter due to a stagnation of wage growth of the lower levels while wage growth continued among the higher earners. Francis and Webster (2019) attribute this acceleration in income inequality after initial improvements after the end of Apartheid, to a bifurcation between high-skilled and low-skilled workers. Today the World Bank (2022) estimates that South Africa's richest 1% and 10% accounted for 10.77% and 55.07% of wages respectively while the middle 40% account for 15.77% and the bottom 50% accrued just 9.71% of national income.

Considering demographic factors such as race, gender and rurality continue to play a role, the literature consistently finds more pronounced inequality among historically disadvantaged groups (der Berg, 2011; Leibbrandt et al., 2018a; Marais, 2020; Mtapuri and Tinarwo, 2021). However, after the end of Apartheid, intra-race income inequality (income inequality amongst the members of the same racial group) has accelerated and even outpaced inter-race income inequality (income inequality between different racial groups) (Leibbrandt *et al*., 2012; Francis and Webster, 2019; van der Berg and Louw, 2003).

Furthermore, gender inequality is apparent throughout the indicators. Only 50.7% of women are reported to participate in the economy compared to 63.2% of men, and only 32.2% of women are formally employed compared to 42.4% for men. In addition, women's median earnings are 77.8% that of men's (Stats SA, 2022c).

2.2 Wealth Inequality in South Africa

Wealth accumulates over time and compounds intergenerationally thus entrenching and exasperates wealth inequality (Piketty, 2017). This dynamic is particularly important in the South African context because of the unequal income and wealth legacies of Apartheid (van der Berg, 2011). As can be seen from Table 1 below, the wealthiest 10% of South Africans own between 86% and 90% of total national wealth with the wealthiest 1% owning 55-60% while the bottom 90% of South Africans own 10% - 14% of total wealth. Of this bottom 90%,

about half are in debt while the average wealth of the other half amounts to just R52,300 per person. In addition, the wealthiest 1%, 0.1% and 0.01% own around 55%, 30% and 15% of total national wealth respectively. Thus, the richest 0.1% own almost a third of all national wealth and the richest 0.01% own more wealth than the combined wealth of the bottom 90% of the population.

Table 1 also highlights just how small South Africa's middle class is (Orthofer, 2016) and how concentrated wealth is at the top of the population pyramid, much greater than global averages and thus posing a risk to social cohesion, democracy, and sustainable development (Mbewe and Woolard, 2016; The Davis Tax Committee, 2018).

Table 1 Distribution of Personal Wealth in South Africa, as of 2017 (Adapted from Chatterjee et al., 2020)

Population (Individual Adults, 20+ years)	Number of Adults	Wealth Threshold	Average Wealth (2018 Rands)	Wealth Share
Total Population	35 400 000		R326 000	100%
Bottom 90% (P0 – P90)	31 860 000		R94 100	14.4%
Bottom 50% (P0 – P50)	17 700 000		-R16 000	-2.5%
Middle 40% (P50 – P90)	14 160 000	R27 700	R138 000	16.9%
Top 10% (P90 – P100)	3 540 000	R496 000	R2 790 000	85.6%
Top 1% (P99 – P100)	354 000	R3 820 000	R17 830 000	54.7%
Top 0.1% (P99.9 – P100)	35 400	R30 350 000	R96 970 000	29.8%
Top 0.01% (P99.99 – P100)	3 540	R146 890 000	R486 200 000	14.9%

A segmentation of wealth by Chatterjee *et al.* (2020) presented in Figure 3 below shows that wealth inequality is consistent across asset classes[3], noting specifically that 99.8% of bonds and stocks (which constitute 35% of total wealth) are owned by the wealthiest 10%. Unfortunately, they also find that the poorest 50% of the country have a negative net worth, meaning that their debts exceed the value of their assets. Alarmingly, Chatterjee *et al.* note that

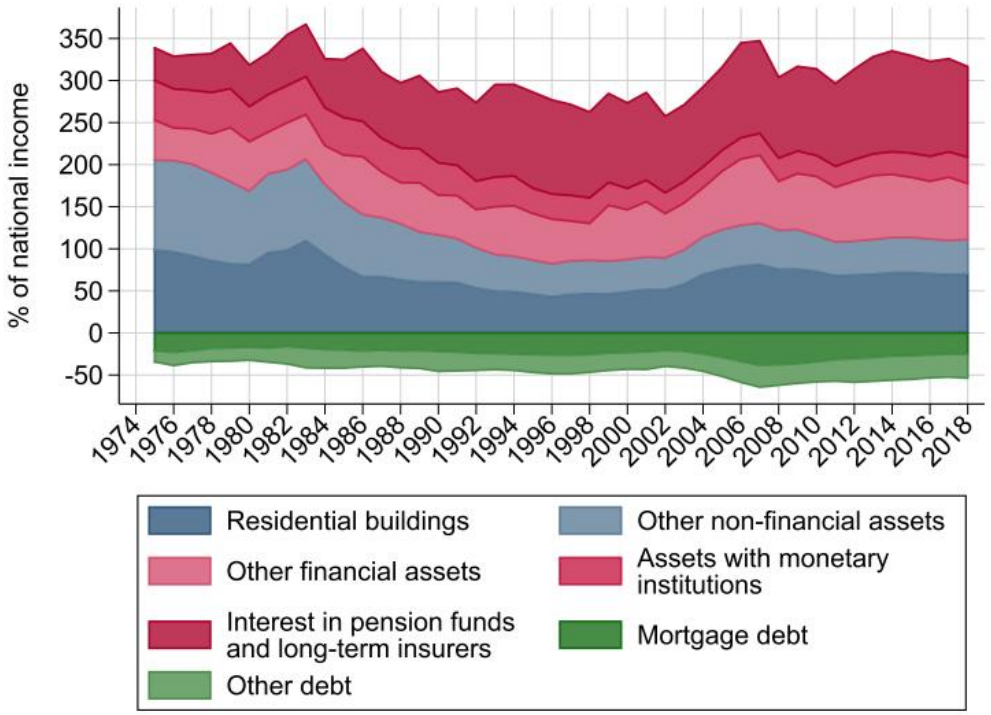
[3] Comprising residential buildings; other non-financial assets; pension fund and long-term insurance assets; monetary assets; and other financial assets; mortgage debt and other debt.

such levels have remained fairly constant and have even slightly increased within the wealthiest groups.

Such disparities are the result of the legacies of colonialism and Apartheid, under which policies and legislation such as the Land Act of 1913; Group Areas Act of 1950 and the Bantu Education Act of 1953 were developed to, directly and indirectly, expropriate and channel land, capital, mineral resources, assets, wealth, and skills into the minority White population. Such racist designs formed an extractive, exploitative economic system underpinned by migrant labour. Although Apartheid was dismantled in the early 1990's, the economic structural elements upon which it was erected remain, thus perpetuating and entrenching inequality (Wilson, 2011).

Orthofer (2016) finds that in South Africa only a quarter of private assets are in the form of housing assets with the remainder in the form of financial assets, of which interest in pension funds and long-term insurers account for the largest category. Compared to other countries, South Africa's inequality levels are even more profuse. In the United States, France, and Germany the wealthiest decile owns 77%, 61% and 59% of total national wealth respectively while the top percentile owns 58%, 21% and 24% of total national wealth respectively. According to Orthofer, the global average of the wealthiest decile and percentile is 87% and 48% respectively. In South Africa however, the wealthiest decile and percentile is 95% and 60% respectively. Unlike many other countries in the global north, South Africa's wealth inequality is not an outcome of an aging population and instead is a racial legacy of Apartheid with Black households owning less than 5% of White households (Mbewe and Woolard, 2016). However, intra-racial inequality is also a significant factor with wealth inequality within the African population far exceeding the wealth inequality of all other racial groups (Orthofer, 2016).

***Figure* 3: *Composition of South African Household Wealth by Asset Class (1975 -2018)* (Chatterjee *et al*., 2020)**



2.3 The Capital-Income Relationship

According to the capital-income hypothesis of Piketty (2017: 97), over the long run, the rate of return will significantly exceed the rate of economic growth which benefits wealth accumulation but widens wealth inequality, producing "*powerful and destabilizing effects on the structure and dynamics of social inequality.*" Studies of South Africa find that wealth inequality is much higher than income inequality, which is to be expected given the distorted wealth accumulation legacies of Apartheid (Cagetti and De Nardi, 2008; Orthofer, 2016; The Davis Tax Committee, 2018; Chatterjee *et al*., 2020). Wealth accumulates from appreciation of the assets and the income derived from the underlying asset (such as rental, dividends, and royalties) whereas income cannot derive the same wealth creating effect because it is eroded by taxation and consumption (Berman *et al*., 2016).

Orthofer (2016) finds that 35% of the population in the top quintile of income earners are also in the highest wealth quintile. In addition, she finds greater income-capital correlation between White South African than Black South Africans, suggesting that even high earning Black South Africans own less capital than their White counterparts. Hence, the already financially well-off White minority have been able to accumulate wealth and income while the Black majority are reliant on income to generate wealth, which naturally widens the wealth gap between the

population groups. Thus, in South Africa, the capital-income relationship entrenches and accelerates inequality.

In summation, despite initial improvements after the end of Apartheid, income inequality has increased due to a widening gap in remuneration between high and low-skilled workers. Estimates vary but it seems that the richest decile earn roughly 55-60% of total national income of which the richest percentile earn roughly 10% of total national income. Meanwhile the bottom 50% of the population earn roughly 10% of total national income.

South Africa also suffers from extreme and entrenched levels of wealth inequality. Wealth inequality is more acute than income inequality owing to the capital-income relationship, the compounding effect of wealth accumulation and intergenerational wealth transmission. Various levels have been estimates but over 90% of wealth is owned by the wealthiest decile with the wealthiest percentile owning roughly 55-60% of wealth. This is true across asset classes. Thus, both income and wealth inequality continue to be particularly acute along racial and gender lines.

3 LITERATURE REVIEW

3.1 Introduction

The literature review below is structured in three parts. The first section reviews the empirical literature that examines income inequality and economic growth (including economic growth volatility). The second section then discusses studies devoted to wealth inequality and economic growth (including economic growth volatility). The third section then explores the studies devoted to inequality and economic growth in South Africa. The chapter then concludes with a summary of the literature.

3.2 Income Inequality and Economic Growth Volatility

3.2.1 Global Panel Studies

Among the first to propose a theoretical model to explain the relationship between inequality and growth is Kuznets (1955), who hypothesises that nations develop along an inverted U-shape whereby income inequality increases with economic development, peaks and then decreases when the nation becomes more developed. Barro (2000) empirically tests the Kuznets hypothesis using a sample of 84 countries over the period 1960 to 1990. Although the results confirm the Kuznets hypothesis, Barro concludes that the theory does not explain the majority of variations in income inequality cross counties and over time. Forbes' (2000) study of 45 countries between 1966 and 1995 similarly finds evidence in support of the Kuznets hypothesis but only in the short-term. Over the medium term however, the results show that an increase in income inequality leads to greater economic growth, but not for poor countries.

Halter *et al.*, (2014) similarly hypothesises that higher income inequality boosts economic growth in the short-run but reduces GDP per capita in the long-run. An empirical test of 106 countries over the period 1965 to 2005 finds supports for this hypothesis but shows that the growth-promoting effects of income inequality arises from economic factors in the short-run, but from political, institutional, socio-political, and educational factors in the long-run. Skopek *et al.* (2014) however highlight, that national differences between income distribution vary considerably as a result of differing demographics (age, race, marital status), education levels, financial literacy levels, psychological factors (such as self-control, saving habits, risk aversion), institutional factors, cultural and historical factors, and macroeconomic factors. Thus, while there is evidence that economic growth volatility leads to greater income inequality, local conditions also drive heterogenous variations among countries.

With regards to the effects of economic growth volatility, Breen and García-Peñalosa (2005) use cross-sectional analysis of 39 developed and developing economies between 1960 and 1990, and find that greater economic growth volatility is associated with higher income inequality. Their results further show that economic growth volatility results in a redistribution of income from the second and third quintile to the fifth quintile, essentially a 'squeezing out' of the middle class. In contrast, the results of Konya and Mouratidis' (2006) analysis of 70 countries between 1960 and 2022 finds that although there is a mutual relationship between inequality and volatility across countries, there is no significant simultaneity within countries, and inequality is influenced by volatility but not the reverse. More recently, Davoodi *et al*., (2021) surveyed the literature on the relationship between macroeconomic stability and inclusive growth, and note that it is the role of domestic macroeconomic policies (fiscal, monetary, macroprudential and exchange rate policies) to promote economic stability and minimise the adverse effects arising from aggregate economic shocks and volatility. However, they also find that the literature shows that poor domestic macroeconomic policies can exacerbate the effects from exogenous economic shocks and volatility.

While very valuable, broad panel studies over long periods risk measurement errors consistency and accuracy owing to the inclusion of countries at vastly different states of development, changes in economic regimes over time and socio-historical events that would influence country data and results. This static assessment could additionally lead to inaccuracies over time as countries develop differently over time.

Thus in summary, while Kuznets' hypothesis that the relationship between economic development and income inequality is an inverted U-shape, global panel data studies suggest that temporal dynamics and multifaceted endogenous factors influence the relationship.

3.2.2 Emerging County Studies

Studies report that income inequality adversely affects emerging and poor countries more than rich, developed countries (Barro, 2000; Forbes, 2000; OECD, 2015). Lechheb *et al*., (2019) examine the relationship between income inequality and econmic growth in 51 middle-income countries over the period of 1970 to 2018. Their results show that a 1% increase in the Gini coefficient decreased GDP per capita on average by 3.8%. Additionally, they find that a 1% increase in GDP reduces the number of persons living below the poverty line by 6.4%.

Ghosh (2020) studies the effect among five ASEAN economies (Malaysia, Indonesia, Singapore, Thailand and the Philippines) over the period of 1980 to 2015 using the linear and

non-linear ARDL bound test methodology. His results show that there is a significant long-run cointegrating relationship between income inequality and economic growth volatility, and that the causal relationship is bidirectional. Ghosh thus concludes that a reduction in economic volatility will lead to a decline in income inequality.

Acheampong *et al.*, (2023) study the BRICS economies (Brazil, Russia, India, China, and South Africa) using a quintile-on-quintile regression model covering the period of 1960 to 2019. The results find significant cointegration between income inequality and economic growth amongst all countries. However, the results also show that income inequality has a strong, negative effect on lower and middle strata of economic growth in Brazil, a positive impact on Russian, Chinese and South African economic growth, and a negative effect on the lower tails of economic growth and a positive effect on the middle and higher tails of economic growth in India. In addition, they find a bidirectional causality for China, unidirectional causality from income inequality to economic growth in Brazil, but no causal relationships for Russia and South Africa.

Especially in the case of developing countries, it is important to bear in mind that the quality and accuracy of data differs between countries going through different stages of development. This in turn affects studies' accuracy. Thus in summary, the emerging country studies suggest that income inequality disproportionately impacts economic growth in emerging countries. In addition, there are indications that income inequality and economic growth volatility share a negative relationship but the causal directionality is difficult to determine as it tends to be based on domestic factors.

3.3 Wealth Inequality and Economic Growth Volatility

3.3.1 Global Panel Data Studies

Chesters (2016) examines the relationship between wealth inequality and economic growth volatility among G20 nations over the period of 2001 to 2013. The results find that during volatile times, rapid economic growth is accompanied by increased wealth inequality whereas periods of negative or low economic growth are associated with decreased wealth inequality. She therefore cautions that economic growth policies without wealth distribution policies raise the risk that wealth generated by higher economic growth will disproportionately benefit the wealthy. Her findings are however, curtailed by the relatively short study period. Long-term assessments will only be able to be made with a longer time horizon.

Building on Chesters (2016), Davoodi *et al*. (2021) surveys 136 studies from 1995 to 2021 that explore the relationship between macroeconomic stability and inclusive growth across countries of various income levels. They identify evidence of a significantly cyclical component to inequality levels that is procyclical to the business cycle. This is driven primarily by differences in households' asset portfolio composition and leverage levels whereby wealthier householders have greater exposure to stocks in their portfolio whereas middle-class households have housing as their major asset. Stock market booms therefore increase the wealthiest households' portfolios value more acutely, thus widening wealth inequality, while housing booms increase the middle-income households' portfolios values, thus reducing wealth inequality (and vice versa during stock and housing busts).

In order to further examine these cyclical effects, Shchepeleva *et al.*, (2022) examines the patterns of wealth inequality before and after the global financial crisis (GFC) in 144 countries covering the period of 2010 to 2018. The results show that there is no significant impact on wealth inequality in the years following the GFC and only weak evidence that the crisis affected wealth inequality. They thus conclude that developed countries, and countries with low initial wealth inequality, experienced increased wealth inequality as a result of the GFC. However, this study focusses on the effects of the GFC but uses data from 2010 and thus only covers an eight year period.

Lee (2023) develops an endogenous growth model with heterogenous households to relate cross-sectional inequality and aggregate economic growth using data from the G7 nations (Canada, France, Germany, Italy, Japan, the U.K. and the U.S.) and Australia for the period 1983 to 2019. He finds that an increase in inequality decreases aggregate consumption demand, which he attributes to increased savings rates amongst the wealthy. This in turn reduces consumption demand, which then discourages firms from investing and leads to an economic slowdown.

Islam and McGillivray (2020) employ a Barro-style unbalanced growth regression model with a data set including 45 countries over the period 2000 to 2023 to study the relationship between governance, wealth inequality and economic growth. They find that wealth inequality is negatively associated with economic growth but improved governance (greater citizenry voice, high levels of accountability, political stability, governmental effectiveness, a good regulatory environment, respect for the rule of law and effective combatting of corruption) can reduce wealth inequality and increases economic growth.

Finally, Chikhale (2023) uses an interactive vector error analysis to examine macroeconomic volatility in the United States over the period from 1989 to 2020. She finds that after a shock, consumption fell by 0.25% more during times of higher wealth inequality than at lower levels of inequality. She illustrates that under such conditions, heightened uncertainty leads to changes in labour demand and a decline in consumption and output growth. Unfortunately, as with all studies on wealth, accuracy of data is impaired by sophisticated illicit and offshoring of wealth.

Thus in summary, the global panel data studies suggest that there is a positive relationship between wealth inequality and economic growth volatility, shaped in part by asset class composition and savings rates, and mitigated by policy interventions such as good governance.

3.3.2 Emerging Country Studies

Studies that explore the relationship between economic growth and wealth inequality in emerging countries are still relatively rare, mainly as a result of data limitations (Bagchi and Svejnar, 2015; von Fintel and Orthofer, 2020). Nevertheless, Caselli (2012) examines how wealth inequality impacts the effect that trade has on economic growth in 44 developing countries over the period of 1960 to 2000. Using a standard regression model, he finds that in countries with low levels of financial development, wealth inequality grows slowly after trade liberalisation, mainly as a result of the limited access to credit.

Bagchi and Svejnar (2015) use a fixed effects model with lagged values to examine the effect of wealth inequality, income inequality and poverty on economic growth. Using the Forbes list of billionaires as a proxy for wealth over the period of 1987 to 2007, they find that wealth inequality has a negative effect on economic growth, and that wealth acquired through political connections has a more adverse effect on growth than politically unconnected wealth. The study is however, prejudiced by relying on the Forbes list as a proxy for wealth, which only considers publicly available data and thus misses private and unreported wealth. In addition, 'rich lists' focus on the upper wealth and income segment of the population, which skews the results.

Chancel *et al*. (2022) compile data on BRICS countries covering the period of 1995 to 2021. Measuring the distribution of net household wealth (the sum of financial and non-financial assets less debts), benchmarked using purchasing power parity estimates, they find that although wealth inequality has increased over the past three decades, it has done so at different rates among the BRICS countries. Wealth accumulation among the wealthiest 1% in Russia

doubled within a decade whereas in China and India, wealth has accrued substantially over time but more gradually. In Brazil and South Africa, the level of wealth inequality has remained high and constant, which can be ascribed to the unequal and hierarchal economic and social systems imbedded by colonialism and Apartheid.

Finally, Das (2022) studies 19 developing South and South-Eastern Asian countries over the period of 1990 to 2000 using a dynamic panel data model. He finds that financial openness has no significant effect whereas trade openness significantly and negatively affects wealth inequality, which supports the Stopler-Samuelson theorem (1941) that trade openness increases inequality in developed nations and decreases inequality in developing nations.

Thus in summary, the emerging country studies suggest that the relationship between economic growth and wealth inequality in emerging countries tends to be more nuances and dynamic than in developed countries, and is particularly susceptible to changes in trade openness and governance.

3.4 Studies Devoted to South Africa

Today, three decades after the end of Apartheid, South Africa remains a land of deep poverty and extreme inequality. Akanbi (2016) finds in his study of all nine South African provinces for the period 1995 to 2012, that there is long-run causality between growth, poverty and inequality and that despite decreased poverty levels, income inequality remains high across all provinces. On a provincial level, Akanbi finds the highest rates of income inequality in Limpopo and the North West and the lowest in Gauteng and the Western Cape. Furthermore, the causality tests reveal that there is a long-run, bidirectional relationship between income inequality and growth but a unidirectional relationship between growth and wealth inequality (proxied by land inequality). Akanbi thus concludes that growth does not equalise income distribution but rather, that income distribution equalises as economic growth accelerates.

Looking specifically at Mpumalanga, Niyimbanira (2017) uses a fixed effect pool regression model to examine income inequality amongst 18 local municipalities for the period 1996 to 2014. She finds a positive relationship between economic growth and income inequality but a negative relationship between growth and poverty. This research is insightful but limited as it focusses on a largely rural province, and thus the results may differ when considering more urbanised provinces.

von Fintel and Orthofer (2020) use re-centred influenced function regression with data from the 2010-2011 and 2014-2015 National Income Dynamics Study and South African Revenue Services (SARS) tax records from the 2011 and 2014 tax years to investigate the relationship between financial inclusion and income and wealth inequality. The results show that access to banking and credit decreases income inequality, but not wealth inequality, and that greater access to financial services only increases wealth accumulation for the middle class. They posit that the reason for this is because the wealthier segments of society already have access to advanced financial instruments while the poorer segments are instead hamstrung by abusive lenders.

Thus in summary, studies devoted to South Africa find in general that there is a negative relationship between income inequality and economic growth volatility while wealth inequality tends to be neutral.

3.5 Conclusion

In this chapter, the literature on income and wealth inequality was reviewed and examined, constructing such examination according to (i) global research on income inequality; (ii) research on income inequality specific to developing countries; (iii) global research on wealth inequality; (iv) research on wealth inequality amongst developing nations; and (v) research dealing specifically with income inequality and wealth inequality in the case of South Africa.

Global panel studies on income inequality generally conclude that economic growth volatility leads to greater income inequality. However, there is heterogeneity among country-specific studies, suggesting that the growth-income inequality relationship is context specific.

The review of the literature devoted to income inequality suggests that although Kuznets' hypothesis that the relationship between economic development and income inequality is an inverted U-shape, global panel data studies indicate that temporal dynamics and multifaceted endogenous factors influence the relationship. Emerging country studies further find that income inequality disproportionately impacts economic growth, and that although income inequality and economic growth volatility share a negative relationship, the causal directionality is difficult to determine because it tends to be based on domestic factors. The literature indicates a disproportionate impact of income equality in emerging nations, highlighting the difficulties such nations face in achieving inclusive, sustainable economic growth. Studies on middle-income countries, such as those from ASEAN the BRICS nations,

indicate a more nuanced relationship between income inequality and economic growth volatility. The causal relationship between income inequality and economic growth volatility is found to vary between unidirectional and bidirectional relationships, which suggests that country-specific context should be considered when tailoring policies.

With regards to wealth inequality, global panel data studies suggest that there is a positive relationship between wealth inequality and economic growth volatility, which is shaped in part by asset class composition and savings rates and mitigated by policy interventions such as good governance. Emerging country studies suggest however that the relationship between economic growth and wealth inequality in emerging countries tends to be more nuances and dynamic than in developed countries and is particularly susceptible to changes in trade openness and governance. In the case of studies devoted to South Africa, the literature finds that in general, there is a negative relationship between income inequality and economic growth volatility but the relationship between wealth inequality and economic growth inequality tends to be neutral.

Research on wealth inequality remains hampered by incomplete and underdeveloped data sets but based on the research conducted thus far, there is emerging consensus that the degree of wealth inequality is more severe than income inequality. Panel data studies suggest that there is an inverse relationship between wealth inequality and growth volatility, but this may again be affected by country-specific factors. In the case of South Africa, studies indicate that increased economic growth reduces income inequality (although the causal directionality remains unsettled) but widens wealth inequality.

Overall, the literature highlights the complex dynamics between wealth inequality, economic growth and macroeconomic stability and indicates the need for policy to be drafted with consideration to asset composition, cyclical macroeconomic trends, good governance, trade policies, societal factors and historical contexts.

4 RESEARCH METHODOLOGY

4.1 Introduction

This chapter describes the data and empirical methodology used to conduct the analysis. The chapter commences with a description of the research approach and strategy before detailing the research design and data collection. Thereafter the data and methodological limitations and assumptions are identified and discussed.

4.2 Research Approach

The common approaches for conducting research are deductive versus inductive, and qualitative versus quantitative (or mixed methods). Inductive reasoning involves the observations of specifics and then derives generalisations from such observations while deductive reasoning assesses specifics against generalisations (Hyde, 2000). Qualitative methods seek to identify underlying concepts and relationships while quantitative research seeks to make generalisations of a population. Hence, qualitative studies focus on the specific while quantitative studies focus on the general (*ibid*). More specifically, qualitative research seeks to answer "why" and "how" questions while quantitative research focusses on answering questions such as "what", "how much" and "why" (Kuper *et al*., 2008). Epistemologically, quantitative research proceeds under an objectivist framework where facts are neutral and truths and reality are absolute while qualitative research is constructive through which differing paradigms are synthesised, different experiences are incorporated, and reality is constructed (*ibid*). Hence, this study uses a deductive, quantitative research approach that involves collecting, quantifying, manipulating, and generalising secondary data, and then investigating and explaining the relationship between variables (Macdonald and Headlam, 2008).

4.3 Research Strategy

This study employs a Johansen and Juselius (1990) vector error correction model (VECM) with impulse responses, variance decompositions, and Granger causality analysis to investigate the relationship between income inequality, wealth inequality, and economic growth volatility in South Africa over the period of 1975 - 2018. The empirical strategy makes use of the following steps:

i. Test for stationarity;
ii. Identify the optimal lag length;

iii. Tests for co-integration amongst the non-stationary variables using the Johansen framework with trace and maximum eigenvalue test statistics;
iv. Produce an initial VECM;
v. Test for stability and specification;
vi. Conduct impulse response analysis;
vii. Conduct variance decomposition analysis; and
viii. Conduct Granger causality tests.

4.4 Data Analysis Methods

4.4.1 Test for stationarity

Stationarity of the data is tested in order to avoid spurious regression (Engle and Granger, 1987; Okunade and Karakus, 2001). This is commonly accomplished using the augmented Dickey–Fuller test (ADF) (1979; 1981) and the Phillips-Perron (PP) (1988) unit roots tests. In cases where the ADF and PP test results are contradictory, the KPSS stationarity test is utilised (Kwiatkowski *et al.*, 1992).

ADF Test

The ADF test is one of the most commonly used unit root tests and is considered reliable for time series involving a large number of observations (Fedorová and Arltová, 2016). The ADF test is used to determine if data series contains unit roots with the null hypothesis being that the data series is non-stationary ($\alpha j = 0$) and the alternate hypothesis being that the data series is stationary ($\alpha j < 1$). The ADF test equation is:

$$\Delta yt = \mu + \beta t + \alpha jyt - 1 - \sum p\, j = 1\, C\Delta yt - ji + \mathcal{E}t \qquad (1)$$

where αj is 0 (null hypothesis), y is the time series, t is the trend, and Δ is the first difference.

PP Test

The PP test is the most often used alternative to the ADF test. It is a non-parametric test and thus the lagged parameters in the test regression do not need to be specified (Fedorová and Arltová, 2016). Under the PP test, the null hypothesis $\pi = 0$ and the alternate is $\pi < 1$. The PP test equation is:

$$\Delta Yt = \beta + \pi Yt - 1 + \mu t \quad (2)$$

KPSS Test

Unlike the ADF and the PP tests, which have null hypotheses that the time series is non-stationary, the KPSS is premised on the null hypothesis that the time series is stationary. The KPSS equation is thus:

$$Yt = \lambda T = (r_t + \alpha) + et \quad (3)$$

where $r_t = r_{t-1} + Ut$ is a random walk, $r_0 = \alpha$ is the intercept, and all other variables are defined as previously done.

4.4.2 Optimal Lag Length Selection

The optimal lag length is identified through the use of the Akaike Information Criterion (AIC) (Akaike, 1974); the Schwarz information criterion (SIC) (Schwarz, 1978) and the Hannan-Quinn criterion (HQC) (Hannan and Quinn, 1979) which make use of the following equations respectively:

$$AIC = -2l/T + 2k/T \quad (4)$$

$$SIC = -2L/T + klogT/T \quad (5)$$

$$HQC = -2L/T + 2\log(logT)/T \quad (6)$$

where *T* is the sample size, *k* is the number of parameters, and *l* is the log likelihood.

4.4.3 Test for co-integration between non-stationary variables

In this study, cointegration among the non-stationary time series is assessed using the Johansen (1988) cointegration procedure, which uses trace and max-eigenvalue test statistics. The Johansen cointegration procedure tests cointegration amongst multiple time series. In addition to generating good estimates and test statistics in the Gaussian instance, the procedure yields

estimates and tests of the underlying data generating process. The procedure produces better results than regression estimates because it considers the error structure of the underlying process.

Under the max-eigenvalue statistic test the null hypothesis is that there are *r* cointegrating vectors using the equation:

$$\lambda_{max}(r, r+1) = -Tln(1-\hat{\lambda}_{r+1}) \quad (7)$$

while under the trace statistic, the null hypothesis is that the rank of the matrix (Π) is less than or equal to the number of cointegrating vectors based on the following equation:

$$\lambda_{\text{trace}}(\text{r}) = -\text{T}\sum_{\text{i}=\text{r}+1}^{\text{n}} \ln(1-\hat{\lambda}_{\text{i}}) \quad (8)$$

4.4.4 Model Specification

This study makes use of a VECM, which is better suited for data involving short- and long-run dynamics and takes account of exogenous shocks (Keating, 1992). The basic form of the VECM can be specified as follows (Brooks, 2012, 2019):

$$\Delta yt = \Pi y_{t-1} + \Gamma_1 \Delta y_{t-1} + \cdots + \Gamma_{p-1} \Delta y_{t-p+1} + u_t \quad (9)$$

where $\Pi = -(I_k - A_1 - \cdots - A_p)$ and $T_{p-1}\Delta y_{t-p+1} + \cdots + u_t$ and where Γ_{yt-1} is the long-run relationship and Γ is the short-run adjustments.

4.4.5 Stability and Specification Tests

In order to ensure that the resultant VECM is stable and correctly specified, the analysis then makes use of the Breusch-Godfrey Lagrange Multiplier test for serial correlation (Breusch and Pagan, 1979), the Jarque-Bera test for normality of the residuals (Jarque and Bera, 1980), and the White VEC Residual test for heteroskedasticity (White, 1980).

<u>Breusch-Godfrey Lagrange Multiplier (LM) Test</u>

The Breusch-Godfrey LM test tests residuals for serial correlation. The null hypothesis of the test is that there is no serial correlation, rejecting the null for any p-value less than 0.05. The Breusch-Godfrey LM test is expressed as:

$$LM = nR^2 \tag{10}$$

where n is the number of observations (or degrees of freedom in general) and R^2 is the coefficient of determination.

Jarque–Bera (JB) Test

The JB test tests the normality of the distribution of the data over the time series so that the null hypothesis is that the data follows the normal distribution as it can identify the difference in the distribution of the study's time series to that of a normal distribution. The JB test equation is:

$$JB = \frac{n-k+1}{6}(S^2 + \frac{1}{4}(c-3)^2) \tag{11}$$

where n is the number of observations (or degrees of freedom in general), S is the sample skewness, and C is the sample kurtosis (the "tailedness" of the distribution).

White VEC Residual Heteroskedasticity Test (the White test)

The White test measures the homogeneity of the model's residuals by regressing independent variables from the original models, the squared residuals from the original regression model and their cross-products. Thereafter the R^2 is calculated, which is used in turn to determine chi-squared value. If the chi-squared value is greater than critical chi-squared value then the null hypothesis of homoscedasticity is rejected.

4.4.6 Impulse response and variance decomposition analysis

Having determined that the VECM is correctly specified and stable, the analysis then proceeds to conduct impulse response analysis and variance decompositions. Impulse response functions test the effects of a shock on the variables while variance decompositions assess the effects of each variable on every other variable.

4.4.7 Granger Causality tests

VECM block Granger causality tests (Granger, 1969) are used to test the causal response of one variable as a result of changes in another variable (Stock and Watson, 2001). The Granger Causality test is expressed as follows:

$$X_t = \alpha_x + \sum_{i=1}^{k} \beta_{x,i} X_{t-i} + \sum_{i=1}^{k} Y_{x,i} Y_{t-i} + \varepsilon_{x,t} \quad (12)$$

where α_x is the intercept term, $\varepsilon_{x,t}$ is the stochastic error terms, k is the lag length; $\beta_{x,i}$ is the parameter of the past value of *X* (indicating how much past value of *X* explains its current value and $Y_{x,i}$ is the parameter of the past value of *Y* (indicating how much past value of *Y* explains its current value.

However, if the time series are I(1) and cointegrated, then the following causality test is applied:

$$\Delta X_t = \alpha_x + \sum_{i=1}^{k} \beta_{x,i} \Delta X_{t-i} = \sum_{i=1}^{k} Y_{x,i} \Delta Y_{t-1} + \varphi_x ECT_{x,t-i} + \varepsilon_{x,t} \quad (13)$$

and φ_x is the parameter of the error correction mechanism that realigns the *Xt* back to its long-run equilibrium relationship.

4.5 Data

This study uses three factors of interest and three control factors in a multivariate VECM framework covering the period of 1975 - 2018.[4]

4.5.1 Factors of Interest

This study uses 3 factors of interest: economic growth volatility (*GDP_Std*), income inequality (*CS_II*), and wealth inequality (*CS_WI*). Economic growth volatility is captured by the standard deviation of the 10-year rolling real GDP. The data was sourced form the World Bank's

[4] This end date is limited by the availability of WIID income inequality data.

Development Indicators Database. Income inequality is derived from the World Income Inequality Database (WIID), which is produced by the UNU-WIDER. Wealth inequality is proxied by net private wealth derived from household balance sheets released by the South African Reserve Bank (SARB). Both the income and wealth inequality series were interpolated using the cubic spline method to compensate for gaps in these data series.

4.5.2 Control Factors

In addition to the three factors of interest, the empirical analysis also includes the three control factors of inflation (*CPI*), government consumption expenditure (*Gov_CE*), and population growth (*Pop_G*). These factors have been selected based on the relevant studies of Mankiw (2010c, 2010a, 2010b), Orthofer (2016), Furceri *et al*., (2018); Leibbrandt *et al*., (2018a); Leibbrandt *et al.*, (2018b); von Fintel and Orthofer (2020), and Alvaredo and Atkinson (2022). Inflation is measured as the annual percentage change in consumer prices of a basket of consumer goods. General government final consumption expenditure includes all government purchases of goods and services, national defence, and security, excluding government military expenditures. Lastly, population growth is measured as the annual population growth rate of all residents regardless of legal status or citizenship. The control factor data was obtained from the World Bank's Development Indicators Database.

4.6 Limitations

The two primary limitations of this study are:

- The inequality data (Gini and household balance sheet) suffers from many gaps. To overcome this problem, the missing data was interpolated using the cubic spline method.
- The sample period has limited the ability to use a pre-liberalisation and post-apartheid sub-sample to assess and compare the relationships between the factors of interest over these two regimes.

4.7 Assumptions

- In common with cubic spline interpolation, it is assumed that the inequality data is non-linear.
- Owing to the difficulties in securing accurate wealth inequality data for South Africa, it is assumed that the SARB's household balance sheet data is a realistic proxy. Such data is compiled in accordance with the methodology developed by Aron et al., (2005)

to estimate South African household balance sheets. Such methodology combines international best practices, benchmarking, ratio allocating, wealth-to-income extrapolation and survey data.

5 RESEARCH FINDINGS, ANALYSIS AND DISCUSSION

5.1 Introduction

This chapter discusses the results and findings of the analyses. The chapter commences with a graphical description of the data, and then proceeds to review the results of the stationarity tests, cointegration tests, and optimal lag length selection. Thereafter, the results of the diagnostic tests are briefly discussed before moving on to the results of the impulse response analyses, variance decompositions analysis, and block-Granger causality tests.

5.2 Graphic and Descriptive Analysis

A graphical and descriptive analysis of the three factors of interest - economic growth volatility, income inequality and wealth inequality – and the control factors – inflation, government consumption, and population growth – are presented below. As can be seen from the interpolated Gini coefficient of South Africa in Graph 1 (a), inequality in South Africa over the last few decades has been cyclical, ranging from a low of 64 in 1988 to a peak of 75 in 2005 with an average of 69 over the sample period.

Comparing income inequality in Graph 1(a) with GDP volatility in Graph 1(c) suggests that there is a positive correlation between the two, which accords with the literature (Steil *et al.*, 2014; Rubin and Segal, 2015; The World Bank, 2018). A possible reason for this correlation is because high income earners derive a large portion of their income from cyclical wealth and performance bonuses than from salaries and wages (Rubin and Segal, 2015).

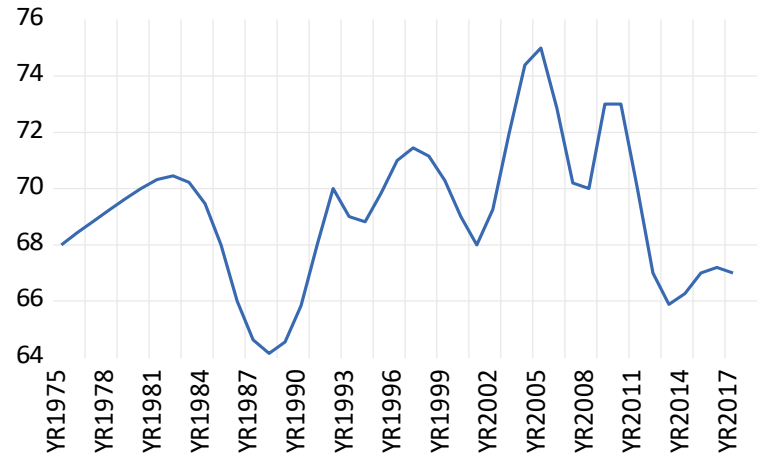
Interpolated wealth inequality, proxied by household balance sheet data, presented in Graph 1(b) shows a dramatic exponential increase over the study period, particularly since around 2002. This may have been influenced, at least in part, by the small bank crisis of 2002/3 which, according to Havemann (2021), resulted in consolidation of the banking sector, reduced competitiveness in the mortgage market, and a concentration of home loans. Considering that housing constitutes the majority of wealth of the bottom 90% (Chatterjee *et al.*, 2020), such concentration and reduced competition would both make it harder for this segment to accumulate wealth and increase their liabilities thus reducing wealth. In addition, there is a significant increase in wealth inequality after the 2008 financial crisis, which accords with the literature (Fligstein and Rucks-Ahidiana, 2015; Pfeffer *et al.*, 2013).

The 10-year rolling standard deviation of GDP presented in Graph 1(c) shows that South Africa has experienced significant GDP volatility from the country's liberalisation in 1994, possibly

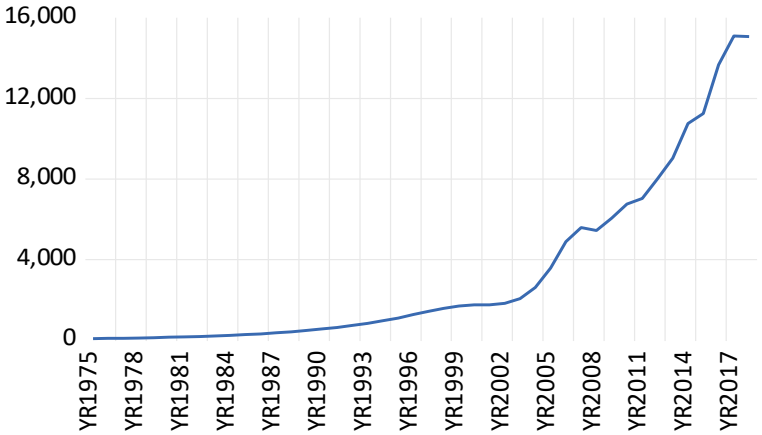
as a result of being more integrated in the global economy after sanctions were lifted in 1993, peaking just after the global financial crisis.

Graph 1 Factors of Interest

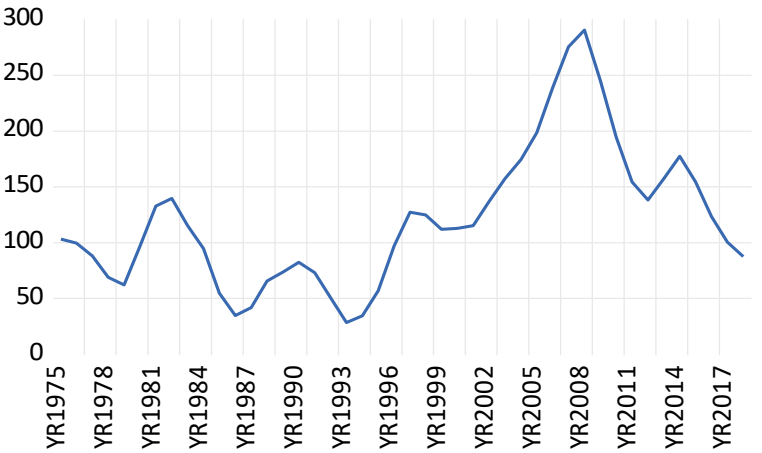
Graph 1(a) Income Inequality



Graph 1(b) Wealth Inequality



Graph 1(c) GDP Volatility

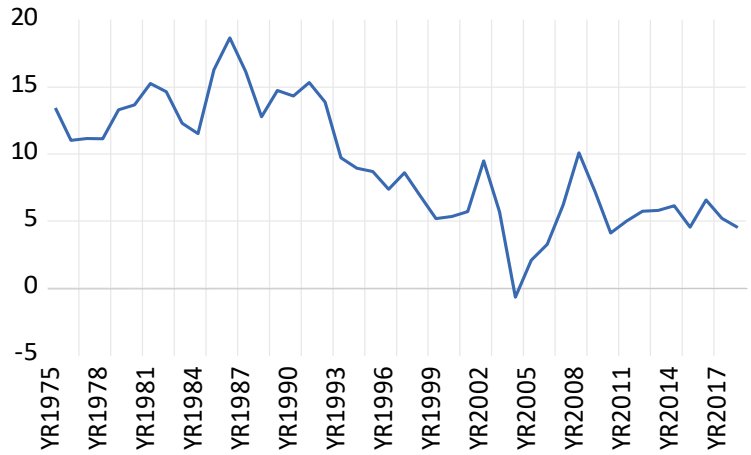


With regards to the control factors, the graphical presentation of inflation in Graph 2(a) below shows that inflation has steadily declined from approximately 13.4% in 1975 to 4.5% in 2018 with one period of deflation in the wake of the 2001 Rand crisis. According to Nowak and Ricci (2006), South Africa's inflation has mainly been driven by world inflation and domestic monetary policy. During the 1970's most countries were experiencing high inflation owing to the oil crisis arising out of the 1973 Yom Kippur war. The subsequent reduction in South African inflation reflects the sustained decrease in global inflation following the crisis, particular amongst South Africa's trading partners. Yet the continued high inflation during the 1980s and early 1990s are attributed to weak domestic monetary policy. The elimination of sanctions and the gradual liberalisation of the economy after Apartheid, together with more disciplined monetary policy, led to a continued downward trend in inflation. The inflationary spikes in 2001 and 2008 may relate to the 2001 Rand Crisis and the 2008 Global Financial Crisis.

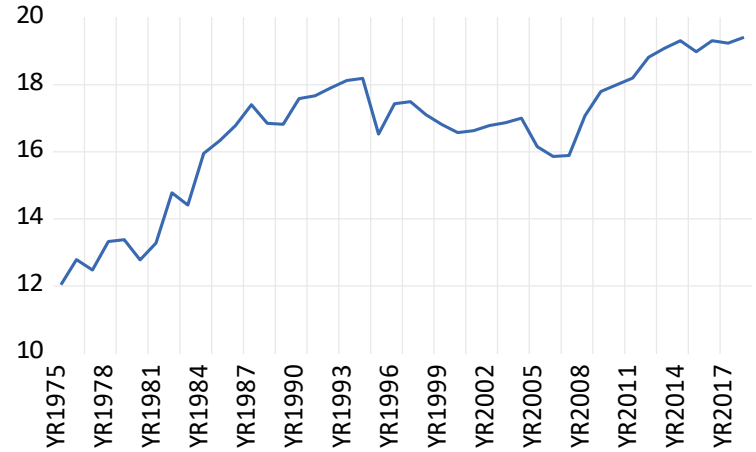
In contrast, government consumption expenditure in Graph 2(b) increased from around 12% of GDP in 1975 to 18% in 1994 before falling back slightly from 1994 to 2008, but then rapidly increased from 16% in 2008 to over 19.5% in 2018. Among the reasons cited for this increase are the considerable growth in public sector headcount and average pay (Sachs *et al*., 2023) and the expansion of social grants, which have quadrupled since 1994 (Steyn, 2023). In addition, Graph 2(c) shows that over the study period, South Africa's population growth rate decreased from 2.7% in 1975 to 1.2% in 2018 with an average of 1.9% and thus the expansion in government expenditure is not simply a factor of population growth. More likely is that this decrease in growth rate is due to how economic factors affect family planning. Morgan *et al*., (2012) find that fertility rates decrease in economic downturns while Alam and Pörtner (2018) find that there is an increase in the use of contraception and delays in pregnancies upon an income shock, particularly in poorer household.

Graph 2 Control Factors

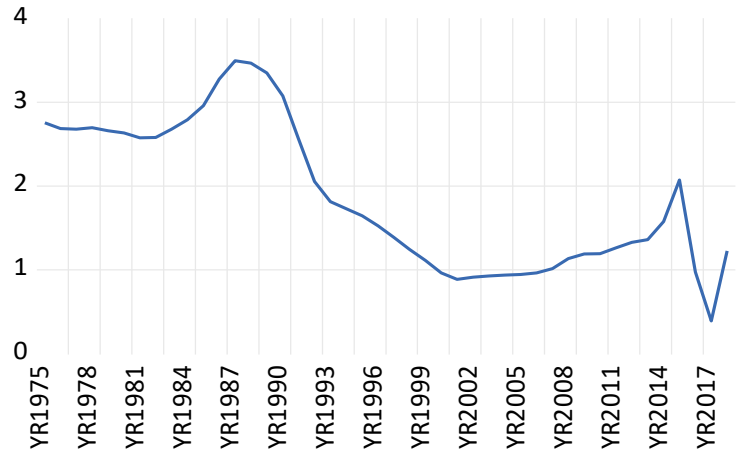
Graph 2(a) Inflation



Graph 2(b) Government Consumption



Graph 2(c) Population Growth



5.3 Tests for Stationarity

To assess the stationary of the time series data, this study used the Augmented Dickey - Fuller (ADF) and the Phillips – Perron (PP) unit root tests. The results presented in Table 2 show that all factors are first-difference stationary.

Table 2 Unit Root Test Results - ADF and PP Tests

Series	ADF		PP	
	I(0)	I(1)	I(0)	I(1)
CS_II	-1.495	-6.925 ***	-2.001	-2.970 **
CS_WI	5.422	-3.485 ***	5.467	-3.466 ***
GDP_Std	-1.843	-4.291 ***	-1.838	-3.967 ***
CPI	-1.682	-6.498 ***	-1.613	-9.731 ***
Gov_CE	-1.909	-7.081 ***	-1.916	-7.079 ***
Pop_G	-1.334	-2.918 **	-1.250	-4.434 ***

Note: The ADF unit root tests include a maximum of five lags chosen on the basis of the Akaike Information Criterion (AIC). ***, ** and * represent significance at the 1%, 5%, and 10% level respectively.

5.4 Cointegration Tests

Having established that the series in this study are nonstationary, the Johansen cointegration test (Johansen, 1988) was performed to determine whether there are any cointegrating relationships between the variables. Cointegration implies a long-term relationship between different variables. The results of the cointegration tests presented below in Table 3 show that the null hypothesis that there are no cointegrating relationships is rejected in respect to at least two cointegrating equations. Hence, these indicate that a VECM rather than a VAR is appropriate (Lütkepohl, 2005).

Table 3 Cointegration Test Results - Trace Test and Max Eigenvalue Test

Trace Test					Max eigenvalue test				
CS_II Model:									
No. of CE(s)	λ	Trace	5% CV	Prob.	No. of CE(s)	Max-λ	Trace	5% CV	Prob.
None *	0.747	114.805	69.819	0.000	None *	0.747	56.404	33.877	0.000
At most 1 *	0.500	58.401	47.856	0.004	At most 1 *	0.500	28.438	27.584	0.039
At most 2 *	0.314	29.963	29.797	0.048	At most 2	0.314	15.449	21.132	0.259
At most 3	0.256	14.514	15.495	0.070	At most 3	0.256	12.130	14.265	0.106
At most 4	0.056	2.384	3.841	0.123	At most 4	0.056	2.384	3.841	0.123
CS_WI Model:									
None *	0.682	103.564	69.819	0.000	None *	0.682	48.125	33.877	0.001
At most 1 *	0.560	55.439	47.856	0.008	At most 1 *	0.560	34.470	27.584	0.006
At most 2	0.269	20.969	29.797	0.360	At most 2	0.269	13.169	21.132	0.437
At most 3	0.158	7.800	15.495	0.487	At most 3	0.158	7.222	14.265	0.463
At most 4	0.014	0.578	3.841	0.447	At most 4	0.014	0.578	3.841	0.447

CE, cointegrating equations; CV, critical value.*denotes rejection of the hypothesis at the 0.05 level based on MacKinnon, Haug and Michelis (1999) p-values.

5.5 Lag Length Selection

Before proceeding to conduct the impulse response, variance decomposition, and Granger causality analysis, it is necessary to determine the optimal lag length for the VECMs. To determine the optimal lag length of the time series, different information criteria were selected and employed with lag orders ranging from 1 to 4 for the two models of income inequality (*CS_II*) and wealth inequality (*CS_WI*). The results summarised in Table 4 indicate that the VECMs will use 2 lags selected on the basis of the Schwartz information criteria (SC).

Table 4 Optimal Lag Length Selection

CS_II Model						
Endogenous variables: CS_II GDP_STD CPI GOV_CE POP_G						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-491.940	NA	80398.520	25.484	25.697	25.561
1	-339.282	258.343	116.802	18.938	20.217	19.397
2	-275.414	91.708*	17.005*	16.944	19.290*	17.786*
3	-250.152	29.797	20.047	16.931	20.343	18.155
4	-215.298	32.173	17.661	16.425*	20.904	18.032
CS_WI Model						
Endogenous variables: CS_WI GDP_STD CPI GOV_CE POP_G						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-801.235	NA	2.210E+11	40.312	40.523	40.388
1	-575.666	383.468	9.873E+06	30.283	31.550	30.741
2	-527.548	69.771	3.304E+06	29.127	31.450*	29.967
3	-491.183	43.638	2.205E+06	28.559	31.937	29.780
4	-448.145	40.886*	1264292.000*	27.657*	32.091	29.260*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

5.6 Diagnostic Tests

Having determined that the data is cointegrated, the model's residuals need to be tested for autocorrelation, normality and heteroskedasticity. The Breusch-Godfrey Lagrange Multiplier (LM) test was used to test for autocorrelation in the residuals of the model. Normality was determined by assessing the model's skewness and Kurtosis and its fit was assess with the

Jarque-Bera test. The results of the autocorrelation, normality and heteroskedasticity tests are presented below in Table 5 and indicate that the model is stable and correctly specified.[5]

Table 5 VECM Diagnostic Summary

VECM Model				
	CS_II		CS_WI	
Lags	Statistic	Prob.	Statistic	Prob.
Residual serial correlation (LM-Stats):				
1	26.801	0.37	23.381	0.56
2	25.708	0.42	23.354	0.56
3	20.347	0.73	25.770	0.42
VEC Residual Normality:				
Skewness	7.523	0.18	4.097	0.54
Kurtosis	3.771	0.58	7.040	0.22
Jarque-Bera	11.294	0.34	11.137	0.35
VEC Residual Heteroskedasticity:				
Chi-sq	381.902	0.606	375.704	0.48

5.7 Impulse Response Results

To assess how shocks in the variables affect the other variables, a Cholesky decomposition impulse response analysis was carried out on the data sets over 100 periods. An impulse of a one standard deviation to GDP volatility was applied to assess the response of income inequality (*CS_II*) and wealth inequality (*CS_WI*). The results of these impulse responses are presented in Graph 3 (a) - (e) and Graph 4 (a) – (e) respectively.

5.7.1 CS_II Impulse Responses of one Standard Deviation shock to GDP_STD

Graph 3(a) depicts the relationship between income inequality (*CS_II*) and GDP_STD shock. The shock precipitates an immediate increase followed by a volatile, continuous increase in CS_II. This increasing level of inequality continues until period 50 whereafter the level starts to level out at 5% greater from the initial shock. Accordingly, a GDP volatility shock leads to a long-term increase in income inequality. A possible reason for this result is because a significant portion of income inequality is derived from salary and wages, and a GDP volatility shock thus feeds into income inequality via the labour market. However, since the wages in the

[5] The income inequality VECM included a 0/1 binary dummy variable to compensate for outliers in 1993 and 2016 while the wealth inequality VECM included a dummy for 2016.

top half of income earners are more resilient due to skilled-based technology and labour unions (Merrino, 2021), there is thus a widening wage differential among the different income structures.

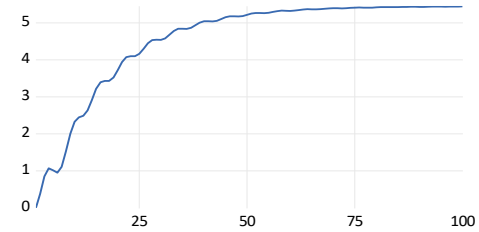
With regards to the control factor responses, Graph 3(b) depicts the response of inflation (CPI) to a GDP volatility shock. The overall trend is negative, resulting in a decrease of -1.6 points at equilibrium. A possible reason for this effect is because monetary policy adapts to the GDP volatility by reducing interest rates to stimulate the economy in the aftermath of the shock (Mankiw, 2010b). The response of population growth (*Pop_G*) to a GDP volatility shock in Graph 3(c) indicates that there is a long-run decrease in population growth of 1.2% at equilibrium, which may be a result of the effect of economic conditions on family planning. (Morgan *et al*., 2012; Alam and Pörtner, 2018).

The response of GDP volatility to its own shock depicted by Graph 3(d) shows that although there is a short-run spike and under-recovery, over the long-run there is increased economic volatility and thus GDP volatility has a reinforcing effect, which accords with the literature (Ramey and Ramey, 1995; Hnatkovska and Loayza, 2003; Aghion *et al*., 2005; Le, 2020). Possible reasons for this effect is that economic volatility is greater in developing countries than their industrialised counterparties by shifting the focus of long-term investment to short-term returns while also increasing exposure to currency and financial instability (Perry, 2009).

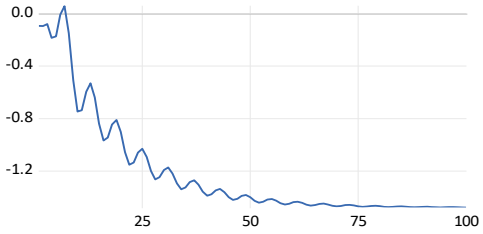
The response of government consumption expenditure (*Gov_CE*) to a GDP volatility shock depicted in Graph 3(e) indicates that although there is a short-run increase of 2% in government consumption, this only lasts about 8 periods before there is a long-run decrease, reaching equilibrium of 10% lower than the starting point. A possible reason for the initial spike in government spending may be due to emergency spending in response to the shock or regular government consumption at elevated price levels while the subsequent drop may be because the shock negatively affects wages and consumption, leading to reduced tax revenue and a corresponding reduction in government spending (Afonso and Jalles, 2012).

Graph 3: CS_II Impulse Responses

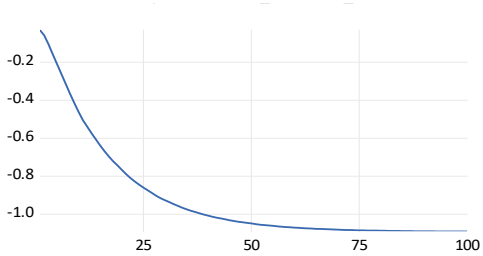
Graph 3(a) Response of CS_II



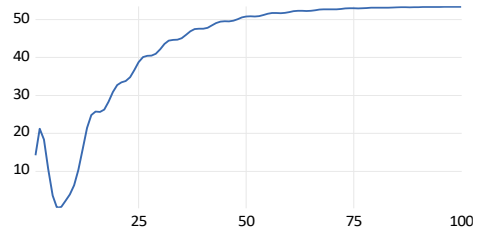
Graph 3(b) Response of CPI



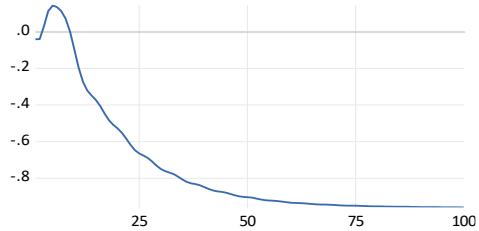
Graph 3(c) Response of Pop_G



Graph 3(d) Response of GDP_STD



Graph 3(e) Response of Gov_CE



5.7.2 CS_WI Impulse Responses of one Standard Deviation shock to GDP_STD

The response of wealth inequality (*CS_WI*) to a GDP volatility shock (*GDP_STD*) is presented in Graph 4(a) and shows that there is a significant short-term surge in wealth inequality of approximately 60% followed by a slowly decreasing period of volatility that only levels off after period 25, stabilising at 22% higher after the shock at equilibrium. This accords with Piketty's (2017) finding that wealth tends to become increasingly concentrated in the long-run and Fligstein and Rucks-Ahidiana (2015) who report that the wealth accumulation of the upper segments of society recover from shocks quicker than the lower segments because the wealthier segments can more easily diversify their investment portfolios.

With regards to the control factors, Graph 4(b) presents the response of inflation (*CPI*) to a GDP volatility shock. In the short-run, there is a sharp drop in CPI from approximately 0.25 to approximately -0.7 but CPI quickly stabilises at around -0.4 over the long-run. The response of inflation in Graph 4(b) is less severe than depicted in Graph 3(b), which could be because income-generated consumption is more affected by inflation than is wealth accumulation.

The response of population growth (*Pop_G*) depicted in Graph 4(c) shows that the long-run decline in population growth to a GDP volatility shock is more significant in the wealth inequality model than in the income inequality model (Graph 3(c)). Hence, this indicates that families are more sensitive to wealth than to income, possibly because family planning is more of a long-term decision and thus more susceptible to long-run wealth accumulation than to short-run income fluctuations.

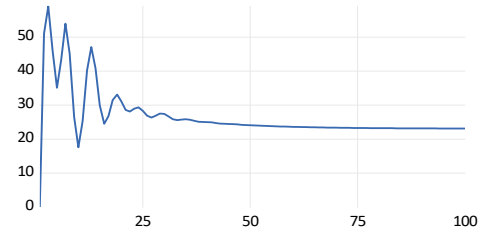
The response of GDP volatility to its own shocks presented in Graph 4(d) shows that although there is a significant short-run increase in GDP volatility, there is long-run stabilisation at an equilibrium of just under 8. This is significantly less than the long-run equilibrium position of GDP volatility in the income inequality model (Graph 3(d)), which suggests that GDP volatility driven by income tends to have worse long-run consequences than the effects of wealth inequality.

The response of government consumption expenditure (*Gov_CE*) in Graph 4(e) shows that there is a short-lived positive response before falling back and stabilising in the long-run at just over -0.02. Compared to the results of the income inequality model in Graph 3(e), Graph 4(e) indicates that government consumption expenditure is affected more negatively to income-related shocks than to wealth-related shocks.

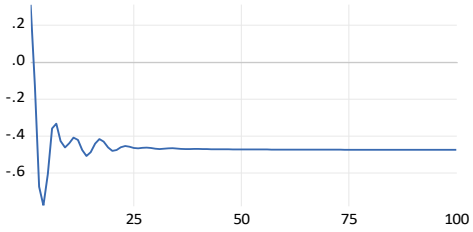
Thus, overall, the impulse responses indicates that income inequality is more affected by GDP volatility than wealth inequality is, which accords with the literature that argues that this is because of the differing time horizons associated with wages, labour markets, intergenerational wealth transfer, and inheritance (Mbewe and Woolard, 2016; Orthofer, 2016; Piketty, 2017; The Davis Tax Committee, 2018; Chatterjee, 2019a).

Graph 4: WI Impulse Responses

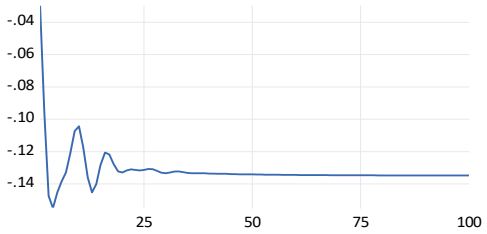
Graph 4(a) Response of CS_W



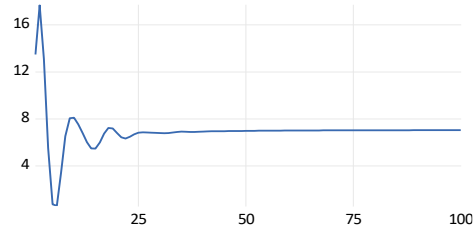
Graph 4(b) Response of CPI



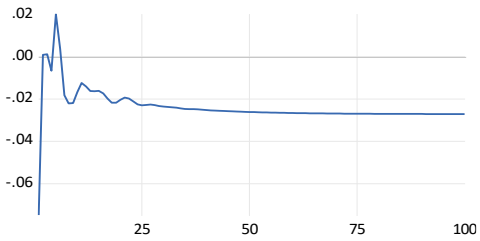
Graph 4(c) Response of Pop_G



Graph 4(d) Response of GDP_Std



Graph 4(e) Response of Gov_C



5.8 Variance Decomposition Analysis

Having examined the effect that a shock has on GDP volatility has on the other factors, the analysis next turns to the variance decomposition analysis (VDA) of income inequality (CS_II) and wealth inequality (CS_WI) over 25 periods. The VDA indicates how much each variable contributes to the forecast error variance of the other variables over time. The results of the VDA in respect of income inequality are presented in Table 6 while the VDA for wealth inequality are presented in Table 7 below.

The results of the income inequality (CS_II) VDA in Table 6 indicate that the contribution of income inequality to the system variance decreases significantly after 1 period from 100% in period 1 to 49.9% by period five, levelling off at around 44% from period 20. In the short-run, the two most significant contributors are GDP volatility and population growth (at 16.2% and 25.6% in period 1 respectively) but over time these factors decline, reaching 15.8% and 21.4% by period 25 respectively. The decline of GDP volatility as a contributory factor may be because increased economic stability is conducive with sustained economic growth, job creation, income growth and more equitable distribution of resources (Ramey and Ramey, 1995). As for the decline in the contribution of population growth, a slowing population growth rate may alleviate market pressures and reduce job competition so that other factors become more impactful (Cervellati and Sunde, 2005). Alternatively, slower population growth may be associated with a demographic transition whereby other factors become more influential in determining distribution (Galor and Zeira, 1993).

In contrast, the contribution of inflation (*CPI*) increases over time, from 4.5% in period 5 to 15.9% by period 25. This may reflect the lagged effected of inflation (Bulir, 1998) as a result of wage inflation and the Cantillon effect[6](Monnin, 2014). Government consumption expenditure (*GOV_CE*) contributes the least to the system variance and decreases over time, from 3.6% in period 5 to just 1.9% by period 25. This may indicate that the composition and focus of government expenditure is inappropriately designed to reduce income inequality (Bastagli e*t al.*, 2015) or that government expenditure is inefficiently being spent (World Bank, 2003).

[6] The Cantillon effect refers to the uneven change in relative prices caused by a change in money supply (Jevons, 1881).

Table 6 Variance Decomposition of Income Inequality

	Variance Decomposition of CS_II:					
Period	S.E.	CS_II	GDP_STD	CPI	GOV_CE	POP_G
1	0.676	100.000	0.000	0.000	0.000	0.000
5	4.319	49.963	16.249	4.531	3.633	25.624
10	11.019	45.386	13.910	11.883	2.685	26.137
15	19.208	45.122	14.848	14.545	2.227	23.258
20	27.429	44.920	15.437	15.521	2.048	22.074
25	35.425	44.880	15.875	15.914	1.947	21.385

Cholesky Ordering: CS_II GDP_STD CPI GOV_CE POP_G

The results of the wealth inequality (CS_WI) VDA in Table 7 shows that unlike income inequality in Table 6, most of the variance is explained by wealth inequality itself. Of the other factors, inflation (*CPI*) is the most significant short-run contributor at 3.9% in period 1 but this then decreases over time to just 0.2% by period 25. In contrast, the contribution of population growth (*Pop_G*) and government consumption expenditure (*Gov_CE*) both increase over the long-run, from 1.8% and 1.6% respectively in period 5 to 3.9% and 3.1% by period 25. The least significant contributor is GDP volatility (*GDP_Std*), which only accounts for 0.4% in period 5, decreasing steadily to just 0.06% by period 25.

Hence, the most significant long-run contributor to the variance of both income and wealth inequality is population growth. This may be because wealth is so concentrated amongst a small percentage of the population that the overall growth of the population does little to affect the distribution of wealth (Piketty, 2017).

Table 7 Variance Decomposition of Wealth Inequality

	Variance Decomposition of CS_II:					
Period	S.E.	CS_WI	GDP_STD	CPI	GOV_CE	POP_G
1	349.895	100.000	0.000	0.000	0.000	0.000
5	1488.654	92.246	0.427	3.920	1.564	1.843
10	2970.033	93.439	0.196	1.232	2.336	2.798
15	4412.952	93.242	0.125	0.577	2.708	3.348
20	5840.030	92.974	0.084	0.335	2.932	3.674
25	7203.088	92.736	0.063	0.236	3.074	3.892

Cholesky Ordering: CS_WI GDP_STD CPI GOV_CE POP_G

5.9 Block Granger Causality Test Results

The block Granger causality tests were used to determine whether there are any unidirectional or bidirectional causal relationships between the factors. The results of the block Granger causality tests are summarised in Table 8 below. With regards to income inequality the results show that GDP volatility unidirectionally drives income inequality while population growth has a bidirectional causal association with the most significant causality running from population growth to income inequality (at the 5% significance level). This may be due to increased competition in the labour market amidst limited job opportunities (Dabla-Norris *et al.*, 2015). Of the control factors, income inequality is shown to be significantly inflationary, which may be a knock-on effect from labour market dynamics, specifically between skilled and unskilled workers. In addition, technological change (Acemoglu, 1998; Autor *et al.*, 2008), education, human capital accumulation (Barro, 1991), occupational shifts, and wage pressures (Card and DiNardo, 2002) lead to income inequality, which would in turn cause inflationary pressure.

In the case of wealth inequality (*CS_WI*), the causality tests find that none of the factors significantly drive wealth inequality, but wealth inequality instead drives population growth. This may be a reflection of the nature of income and wealth. While income is more dynamic and constitutes the bulk of short- and medium-term household cash flows, wealth is the culmination of long-term investment decisions and inheritance. Of the control factors, GDP volatility, inflation, government expenditure tend to be subject to short- to medium-term fluctuations while population growth is a long-term factor. Consequently, it is to be expected that income will have causal associations with the short- to medium-term factors while wealth has a causal association with population growth.

Table 8 VEC Granger Causality/Block Exogeneity Wald Tests

	CS_II	CS_WI
Excluded	Chi-sq	Chi-sq
D(CS):		
D(GDP_STD)	6.382 **	1.293
D(CPI)	1.774	1.369
D(GOV_CE)	1.117	0.882
D(POP_G)	7.175 **	0.911
D(GDP_STD):		
D(CS)	1.325	2.453
D(CPI)	5.538 *	2.822
D(GOV_CE)	3.171	2.147
D(POP_G)	0.086	1.262
D(CPI):		
D(CS)	9.153 ***	3.473
D(GDP_STD)	0.059	0.340
D(GOV_CE)	2.034	1.820
D(POP_G)	2.258	1.065
D(GOV_CE):		
D(CS)	0.487	3.901
D(GDP_STD)	6.076 **	4.661 *
D(CPI)	0.316	0.524
D(POP_G)	1.455	0.935
D(POP_G):		
D(CS)	5.247 *	115.023 ***
D(GDP_STD)	1.386	4.185
D(CPI)	1.677	8.112 **
D(GOV_CE)	2.154	3.398

*, ** and *** represent significance at the 1%, 5%, and 10% level respectively.

6 Conclusion and Recommendations

The discussion below commences with a review of the research questions and a summary of the findings of the analysis. Thereafter, policy recommendations are presented before the chapter ends with some recommendations for future research.

6.1 Conclusion

This study used a VECM model with impulse response, variance decomposition, and block Granger causality analysis over the period 1975-2018 to identify the effect of economic growth volatility on income inequality and on wealth inequality in South Africa, and to determine whether this effect is more significant for income inequality or wealth inequality.

The impulse responses show that a GDP volatility shock leads to a long-term increase in both income inequality and wealth inequality but the post-shock equilibrium level is higher for wealth inequality in the long-run. The variance decompositions further show that the contribution to system variance of income inequality decreases significantly after the first period whereas the contribution of wealth inequality remains high over the long-run. These results thus suggest that GDP volatility affects income inequality in the short- and medium-term but affects wealth inequality in the long-run, which accords with the literature (Mbewe and Woolard, 2016; Orthofer, 2016; Piketty, 2017; Chatterjee, 2019a).

The block Granger causality tests find that GDP volatility unidirectionally drives income inequality while population growth has a bidirectional causal association with income inequality (with the most significant causality running from population growth to income inequality). In the case of wealth inequality, the causality tests find that none of the factors significantly drive wealth inequality, but wealth inequality instead drives population growth. These results accord with the impulse responses and variance decompositions and may reflect the differing time horizons of income and wealth. Income tends to be more dynamic and constitutes the bulk of short- and medium-term household cash flows whereas wealth is the culmination of long-term investment decisions and inheritance. All of the control factors (GDP volatility, inflation, government expenditure) except for population growth tend to be subject to short- to medium-term fluctuations while population growth is a long-term factor. Consequently, it is to be expected that income will have causal associations with the short- to medium-term factors while wealth has a causal association with population growth.

6.2 Policy Implications

The policy implications of the findings of this study are as follows:

1. The results indicate that income inequality and wealth inequality are distinct and affected by different factors. Thus, policymakers should develop and implement interventions specific to each.
2. Given that economic growth volatility worsens income and wealth inequality in both the short and long-term, effective fiscal and monetary policies should be implemented to counter GDP volatility.
3. The wage differential is a core contributor to income inequality and thus education, training, and skills development programs should be developed to narrow the wage gap.
4. Policy makers need to be cognisant of the cyclical nature of income inequality, and thus welfare programs, healthcare access and educational support need to be periodically augmented.
5. Considering the entrenched disposition of wealth inequality in South Africa, targeted interventions such as wealth taxes should be investigated.

6.3 Recommendations for Future Research

Based on the analysis and findings of this study, the following are identified as recommendations for potential future research:

1. This research considered inequality across all segments of South Africa but further research could be conducted to assess inequality between the segments of South Africa's society.
2. The control factors employed in this study focussed on domestic factors but in an increasingly financially globalised world, further research could consider the effects of international capital and trade flows on inequality in South Africa.

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