

## Determinants of Output Growth Volatility in Nigeria

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**ABSTRACT:** The paper analysed the impact of agricultural output, investment, population growth and industry growth on output growth volatility. Many researchers have considered the determinants of output growth volatility but the impact of the above-mentioned variables on output growth volatility is scanty in literature. The data were tested for unit roots using Augmented Dickey-Fuller (ADF). Autoregressive Distributed Model (ARDL) was used in the methodology. The short-run dynamic model shows that the above-mentioned variables must undergo substantial structural changes to exert a significant and stabilising effect on output growth volatility in Nigeria. With F statistics of 15.9 and the upper and lower bound of 4.8 and 2.0 respectively, the bounds test result shows that the variables are co-integrated. The paper recommends an export promotion industrial strategy that is accompanied by an import substitution strategy, the re-introduction of a Marketing Board, alongside the construction of irrigation canals in strategically designated agricultural zones, could play a pivotal role in reversing the trend of business and economic instability, thereby helping to curb the persistent volatility in output growth.

**Keywords:** Growth, Volatility, Autoregressive, Industry, Agriculture.



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## INTRODUCTION

The four major macroeconomic policy objectives are full employment, economic growth exchange rate and interest rate stability. Over the years, an increase in economic growth has been the most important of the above major macroeconomic policy (Chirwa & Odhiambo, 2016; okeowo, 2023). Fatas L. and mihov (2005) opined that macroeconomic policies should be deemphasised in economic growth in favour of strong institutions to instigate growth. Contained budget deficit, low inflation and effective macroeconomic policy instigate economic growth. Acemoglu S. et al. (2003) show that institutional variables included in the regression model have more predictive power than the traditional macroeconomic policies of investment, inflation and exchange rate. The study further suggests that macroeconomic policies do not have a strong impact on economic development. The question is:

what is the role of strong macroeconomic fundamentals in the economic growth process? Economic literature accepted a negative relationship between growth and volatility. A volatile economy will not experience a steady growth rate. Fatas and Mihov present strong evidence to support the above assertion. This gives strong evidence of a high level correlation between volatility and low growth. Bhoola and Kollamparambil (2011) also find evidence of a decline in volatility with less volatile output growth. Using different methodological techniques, Ductor D. (2022), Abubaker (2015) and Acemoglu S. et al. (2003) show evidence of a correlation between volatility and a decline in output growth. No doubt, the adverse effect of output growth volatility has attracted researchers due to its impact on investment and consequently on economic development. Similarly, evidence has also shown that underdeveloped countries like Nigeria, are likely to experience more volatile growth than their developed counterpart. The fact is, given the level of poverty, unemployment, accompanied by the prevalence of infant industries, the business environment is highly vulnerable to economic uncertainty. Baker N. and Davis S.J., (2016) The effectiveness of fiscal and monetary policy, the extent of trade openness, the degree of exchange rate misalignment, which is a greater disturbances than volatility, the level of technology in the economy, the impact of the agricultural sector, financial integration and the country's terms of trade are the major determinants of output growth volatility.

Despite the abundance of literature on the determinants of output growth volatility, research on the impact of agricultural output, investment, population growth and industrial growth are scanty in literature. The main objective of this paper is to analyse the impact of the above-mentioned variables on output growth volatility.

### **Theoretical Literature**

The study is anchored on business cycle theory. Kraay J.} (2007) Business cycle theory refers to the volatile movement of booms and depressions. In the business cycle, there are volatile fluctuations in output, prices, income and employment. Jhingan (2010) recognised eleven major theories of business cycle. They are Hawtrey's monetary theory, Hayek's monetary over-investment theory, Shumpeter's investment theory and the psychological theory. Others include Cobweb, Keynes, Samuelsson, Hicks, Godwin, Friedman and Kaldor's theories. All these theories give their versions of the alternation of periods of prosperity and depression of good trade and bad trade in an economy. Barlak and Jestrzebska (2021) emphasise Shumpeter's theory of creative destruction, insisting that innovations in the structure of an economy are the primary source of economic fluctuation. Jenny (2020) demonstrates Keynesian and classical theories in a study on the determinants of growth volatility in low and middle-income countries. In the study, output and employment volatilities are the results of fluctuations in business investment, government expenditure and household demand. The classical theory is embedded in Hawtary's monetary theory of the business cycle, where volatility is prescribed as a purely monetary phenomenon.

Ramey V.A. (1995) propose a theoretical framework that postulates a negative relationship between macroeconomic volatility and long-run economic growth. Their theory asserts that heightened

volatility undermines output growth through three key mechanisms. First, economic volatility increases uncertainty, which in turn dampens investment. In an unpredictable economic environment, investors and entrepreneurs are less inclined to commit capital due to the difficulty in forecasting future returns. Uncertainty imposes additional risk, thereby discouraging investment activity, particularly among risk-averse agents. Second, the theory emphasizes that capital accumulation—the foundation of sustained economic growth—cannot be maintained in the presence of high levels of risk aversion. Ramey and Ramey argue that volatility contributes to an increase in risk-averse behavior, which inhibits long-term investment and economic planning. Third, the theory posits that under conditions of uncertainty, resource allocation becomes inefficient. Economic agents, facing unpredictability, are less able to optimise the use of resources, leading to sub-optimal economic outcomes. Consequently, reducing macroeconomic volatility is essential for fostering stable and sustained growth.

The endogenous growth models developed by Lucas (1988) and Romer (1990) introduce the possibility that economic volatility can, under certain conditions, stimulate innovation and production. These models suggest that moderate levels of volatility may act as a catalyst for innovation, encouraging firms to develop new products and processes that enhance productivity and long-term growth. However, they also emphasise that excessive volatility undermines innovation and hampers long-term economic planning, ultimately destabilising the growth trajectory. Proponents of the endogenous growth framework explain that innovation itself can be a source of volatility. Economic booms are often characterised by waves of innovation in industrial and commercial sectors. During the upswing, innovators begin investing in novel products, technologies, and strategies, generating substantial profits. These early successes attract imitation, leading to clusters of entrepreneurial activity and the diffusion of innovation across related industries. This cumulative process results in a surge of new products, rising money incomes, and increased economic output. However, the expansion fueled by innovation may lead to over-optimism and excessive market entry (Choudhry F. and Shabi S. (2016). As the market becomes saturated with new products, prices begin to fall and profit margins shrink. Financial institutions, facing heightened credit risk, may demand loan repayments, tightening monetary conditions. The resulting contraction in money supply further depresses prices, prompting firms to scale back production or, in some cases, declare bankruptcy. This chain of events can trigger an economic downturn or depression.

Thus, the endogenous growth models of Lucas and Romer offer a theoretical foundation for understanding the wave-like behavior of business cycles, where periods of rapid innovation and growth are followed by phases of adjustment and contraction. The models underscore the dual role of volatility—as both a driver of innovation and a source of macroeconomic instability when left unchecked.

The investment irreversibility and real options theory advanced by Dixit S.R. and Pindyck (1994) provides a framework for understanding how uncertainty and volatility influence investment behavior. The theory posits that many investment decisions—such as constructing a factory or acquiring

specialized equipment—are at least partially irreversible, meaning that once undertaken, the firm cannot fully recover the sunk costs if conditions change unfavorably.

Real options theory extends the principles of financial options to real-world investment contexts. It argues that firms, when faced with high levels of uncertainty regarding future conditions—such as demand fluctuations, cost changes, price volatility, or policy shifts—may rationally choose to postpone investment. This is particularly true when the investment involves significant sunk costs and cannot be easily reversed. In such cases, waiting provides the firm with valuable information that can improve the quality of future investment decisions. According to this theory, the presence of convex adjustment costs implies that firms prefer a ‘wait-and-see’ approach under uncertainty. That is, the option to delay investment holds value, especially in volatile environments. As a result, uncertainty leads to delayed capital formation, thereby dampening aggregate investment and reducing long-run output growth. In line with the broader economic literature, Dixit and Pindyck's framework reinforces the view that macroeconomic volatility discourages investment by increasing the value of waiting, which ultimately slows economic expansion.

Fogli F. and Perri (2015) examined macroeconomic volatility and the accumulation of assets, especially foreign assets. The standard One-good, two countries' Real Business Cycle Model was used. It was found that there exists a significant positive relationship between macroeconomic volatility and the accumulation of foreign assets. The research found that output volatility follows Keynes's theoretical foundation of precautionary motive. It was discovered that an increase in uncertainty, perpetuated by volatility induces residents to increase savings; with the larger part of this savings being channeled into foreign assets. The paper established that the major determinant of external imbalances in developing nations is a result of high level of output growth volatility.

### Empirical Literature

Ductor D. and Leiva-Leon (2022) observed that the declining volatility experienced in developed countries was also observed in developing countries. However, volatile output movement is larger in developing countries than in developed ones. Specifically, North America, Asia and Oceania were not impacted significantly by the negative spillovers from other regions of the world. Ductor and Leiva-Leon's studies found that Europe and South Africa are influenced by North American output growth volatility. Using the Bayesian Model Averaging (BMA) panel data approach, the study found out that exchange rate volatility increases with policymakers being faced with greater constraints in stabilizing output growth volatility. Abubaker (2015) uses a panel data set for thirty-three countries to study the relationship between trade openness and output growth volatility. The study found a positive relationship between openness and output growth volatility with developed countries having minimal effect from output volatility as a result of trade openness. Abubakar study supports the main issues in the new international economic order regarding trade openness and its attendance effect on developing nations. These issues as put forward by (Anyanwu, 1993) concern trade in primary commodities, manufactured exports of the developing countries, accessibility to appropriate

production technology, the burden of debt of the third world countries and reforms in the international monetary system.

Bartak A. (2021) employ a genetic algorithm to analyse data from 182 countries spanning the period 1951 to 2017. The study associates higher levels of economic volatility with a lower likelihood of transitioning to a more prosperous growth regime. The findings underscore the critical role of macroeconomic stability in facilitating sustained economic growth, highlighting that persistent volatility can hinder a country's ability to achieve and maintain higher growth trajectories. The study also found a negative relationship between volatility and growth. Evidences in their research, indicate that, international trade promotes growth and volatility simultaneously. The study further reveals that human capital is an engine of economic growth and stability. A transmission mechanism was established among financial development, volatility and growth; with financial development directly reducing volatility while output volatility negatively influences growth. Contrary to the findings of Bartak A. (2021), Zagler (2017) identifies a positive and statistically significant correlation between output volatility and economic growth. According to Zagler, volatility and growth exhibit a co-movement, suggesting a potential trade-off whereby economies may experience higher growth accompanied by higher volatility, or conversely, lower growth with reduced volatility. This relationship highlights the complex interplay between economic expansion and stabilisation. Zagler argues that assuming a unidirectional causal link—where volatility universally undermines growth—may not hold across all economies.

Supporting this view, Alimi (2016) presents evidence of a threshold effect in the volatility-growth nexus for developing countries. Specifically, Alimi finds that while volatility below a certain threshold has a negligible impact on growth, exceeding that threshold significantly impairs economic performance. This reinforces the notion that the effect of volatility on growth is non-linear and context-dependent.

Acemoglu S. et al. (2003) post-war period analysis shows that countries that practice distortionary macroeconomic policies such as exchange rate misalignment, high inflation and budget deficit suffer more from output growth volatility and also seem to experience slow growth in their economic activities. The paper established a direct linkage between countries that adopt an 'extractive' institution from their past colonial region and high volatility accompanied by economic crisis. (Jorda M. and Taylor A.) (2017) The paper opined that weak institutions and output growth volatility are not unconnected with poor macroeconomic policies including political institutional frameworks that do not constrain politicians' widespread corruption, political instability and unbridled political elites. On final submission, the paper ascribes weak institutional framework as the main cause of output growth volatility. Blanchard., J and Simon (2001)) observed that the United States has been going through an expansion face for the past twenty years due to the absence of major adverse shocks. This reduction in volatile output was ascribed to a decrease in volatile government expenditure, consumption and investment volatility. Muradov (2018) A strong relationship was also established between output growth volatility and inflation volatility, with the inflation rate playing a vital role in output growth volatility. Jalles G. (2023) established a relationship between macroeconomic volatility and current

account imbalance. Over an estimated period of (1970-2020), it was found that an increase in output growth volatility improves the current account in developed countries but not in developing economies; with exports and real exchange rates playing a significant role.

Weak institution and output growth volatility are positively correlated as observed by (Fata and Mihov, 2005; Acemoglu S. et al., 2003). It is opined that political institutions play a vital role in sharpening policy outcomes regarding macroeconomic uncertainty. Bhoola U. and Kollamparambil U (2011) study the trend and determinants of output growth volatility in South Africa. Using Autoregressive Distributed Lag (ARDL) techniques, it was discovered that inflation targeting monetary policy adopted by the central bank contributed to output and inflation stabilisation. Alizadeh M et al. (2002) analyse range-based estimation of the stochastic volatility model. It was shown theoretically and empirically that range-based volatility is not only efficient but also Gaussian and responsive to microstructure noise. Evidence in the paper also suggests that Gaussian Quasi-Maximum Likelihood estimation techniques produce an efficient stochastic output volatility model. Alizadeh et al also consider the dynamics of daily exchange rate volatility as an important determinant of output growth volatility in their study. The result shows that output volatility strongly supports the Two-factor Model with one of the factors having persistence tendencies and the other demonstrating a mean reversal pattern. Ghosh J. (1997) analyse the relationship between macroeconomic uncertainty and external saving behavior. The outcome of the research depicts a positive and significant relationship between uncertainty in national cash flow and incentives for precautionary savings.

Muradov (2018) analyses the relationship between output growth volatility and inflation uncertainty. In this context, a linkage is established whereby uncertainty tends to exacerbate volatility by influencing investment, production, and consumption decisions (Deniz T. and Yazgan M.E. (2021). While volatility reflects fluctuations in economic variables, uncertainty denotes a lack of predictability or confidence in future outcomes, often driven by unpredictable policy shifts, unexpected internal or external shocks, and geopolitical events. Murodov further investigates the dynamic interaction between output growth volatility and inflation uncertainty in three East Asian economies—China, South Korea, and Japan—using a bivariate VAR-GARCH econometric framework. The findings indicate that output growth volatility exerts a significant adverse effect on inflation uncertainty in China, whereas it has a significant positive impact in the cases of South Korea and Japan. Moreover, the study identifies strong evidence of a bidirectional causal relationship between output growth volatility and inflation uncertainty in China (Mensah E. (2021). In contrast, a unidirectional causal effect—from output volatility to inflation uncertainty—is observed for South Korea and Japan. The results from the impulse response function further reveal that inflationary shocks in both China and South Korea influence output growth volatility.

## **METHOD**

The research uses time series annual data from the period 1987 – 2023. The data is obtained from the Central Bank of Nigeria and it is tested for unit root using Augmented Dickey-Fuller (ADF). The

Autoregressive Distributed Model (ARDL) is used in the methodology. The model is specify as follows:  $DLn(GDP) = a_0 + a_1D(IND) + a_2D(AGR) + a_3D(POP) + a_4D(INV) + a_5IND + a_6AGR + a_7POP + a_8INV + e_t$  where GDP is Gross Domestic Product. It is a key economic indicator that measures the total monetary value of goods and services produced in a country usually on a quarterly or annual basis. AGR is Agricultural Output. It is the total quantity of agricultural products within a specific period, POP is Population. It is the total number of people living in Nigeria, INV is the Rate of Investment and  $e_t$  is error term.

## RESULT AND DISCUSSION

### Unit Root Tests for the Variables

Time series data properties of macroeconomic variables of most economies, especially the developing economies are not very satisfactory (Okeowo J.} (2024). More often than not, the data set are not stationary, hence the need for constant test to determine whether the mean, variance and autocovariance are time invariant (Gujarati, 2005; Okeowo (2023) It implies that using Ordinary Least Square (OLS) will produce a spurious results, hence the need for alternative econometric techniques. GDP and IND are both stationary at level. In line with econometric theory, all the variables are stationary at first difference as shown in Table 1.

**Table 1.** Unit Root Tests- 1987 to 2023 Series

Variables	ADF Test Stat. Level	Conclusion	ADF Test Stat. 1st Diff.	Conclusion
GDP	-3.609152 (-2.945842)	stationary	-8.212828 (-2.948404)	stationary
AGR	-0.063524 (-2.945842)	Non-stationary	-7.161863 (-2.948404)	Stationary
IND	-3.104661 (-2.945842)	stationary	-9.689294 (-2.948404)	Stationary
POP	-0.615989 (-2.991878)	Non-stationary	-3.280915 (-3.012363)	stationary
INV	-1.359085 (-2.945842)	Non-stationary	-5.863920 (-3.012363)	Stationary

### Result extracted from E-views output

The results in Table 2 shows that there is a co-integration among Gross Domestic Product, Agricultural Output, Population and the Rate of Investment. Since the F-statistic value is greater than the critical value. Thus, the time series are co-integrated, implying that a long-run stable relationship exists among the variables used in this study. This means that any short-run deviation in their relationships would return to equilibrium in the long-run (Okeowo M.P. (2023).

**Table 2.** Bounds Test of Co-integration Results

<b>F-Statistic</b>	15.95484
Upper bounds	4.86
Lower bounds	2.01

### Short-Run Dynamic Model

The results indicate that investment exhibits an inverse relationship with output growth. Both the current and one-period lagged coefficients of investment are negative, as presented in Appendix 1. This finding deviates from the ‘a priori’ expectation, which posits a positive association between investment and output growth, suggesting that an increase in government investment should ideally lead to an expansion in national output. Contrary to this theoretical expectation, the empirical results indicate that investment is a significant driver of output growth volatility.

Furthermore, the findings reveal a negative relationship between output growth and industrial output. The coefficients of industrial output for both the current and lagged periods are negative, specifically  $-593,914$  and  $-940,141$ , respectively. This also contradicts the ‘a priori’ expectation of a positive correlation between industrial output and GDP, which serves as a proxy for output growth. These results underscore the critical need to strengthen the industrial sector to achieve sustainable output growth. As demonstrated in the dynamic model, industrial output appears to be a major contributor to the observed volatility in output growth in Nigeria.

With the exception of the one-period lag of agricultural output, which exhibits a positive relationship with output growth, the current agricultural output displays a negative coefficient ( $-9,314,061$ ), indicating a weak and inverse relationship. This suggests that, in the short run, agricultural output does not contribute positively to output growth and may, in fact, exacerbate its volatility. To mitigate this, targeted investment in the agricultural sector—through mechanisms such as revitalized marketing boards, mechanized farming systems, and enhanced irrigation infrastructure (including canal construction in key agricultural zones)—could serve as effective macroeconomic policy tools to reduce output growth volatility. (Blackburn R. (2003)

In terms of population dynamics, the current period coefficient suggests a positive correlation with GDP, indicating that economic output increases with population growth. However, the one-period lag presents an inverse relationship, implying that fluctuations in population levels contribute to output growth volatility. Accordingly, the short-run dynamic model (Appendix 1) underscores that investment, agricultural output, industrial output, and population must undergo substantial structural changes to exert a significant and stabilizing effect on output growth volatility in Nigeria.

**CONCLUSION**

The paper proposed an import substitution and export promotion strategy to reverse the trend often experienced in output growth volatility. The research shows that industrial output needs to change at a very high rate to induce a unit change in output. A concerted effort should be made by the government to replace imported goods with domestic production. Industries that produce exportable goods should be heavily subsidised by the government to reduce over-dependence on foreign-made goods. The paper advocates for the re-introduction of the marketing board. The board can absorb agricultural products during a glut, for further injection of such products during scarcity for price stabilization of such products. Small-scale farmers depend on rainfall which also determines the yield of their product. Inadequate rainfall due to climatic change often leads to agricultural output growth volatility. Mechanised farming and irrigation systems can be encouraged rather than depending on rainfall. Canals should be constructed in designated places which will carry water to farmlands for irrigation. Establishing more research institutes can also be of help. The result of the research should be made available to farmers, marketing boards and farmers' cooperative societies for use. Apart from the rate of interest and expectation, the other major determinants of investment are business and political atmosphere. Political unrest often scares investors with output growth volatility as its attendant effect. To reverse this trend, there should be a peaceful business and political atmosphere for businesses to thrive.

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