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Macroeconomic Uncertainty and Sectoral Output in Nigeria

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Abstract: The paper examined the impact of macroeconomic uncertainty on the ten largest subsectors of the Nigerian economy using quarterly data from Q1 1981 to Q4 2023. The rationale behind selecting the subsectors is that these sectors constitute about 89 percent of the entire productive activities in the economy. To achieve the objectives, the paper created an index for macroeconomic uncertainty using exchange rate uncertainty, interest rate uncertainty, inflation uncertainty, and real gross domestic product (GDP) uncertainty to create this index. Furthermore, the paper explored the impacts of macroeconomic uncertainty and these individual economic uncertainty indexes on sector output. The study employed the novel dynamic autoregressive distributed lag (novel dynamic ARDL) technique to estimate the results and used the canonical cointegrating regression (CCR) and fully modified ordinary least square (FMOLS) techniques as robustness on the main findings. The findings demonstrated that during periods of recession, macroeconomic uncertainty tends to heighten or reach its peak in Nigeria. Furthermore, the paper showed that the sectors react homogenously to macroeconomic uncertainty. In addition, the impulse response results from the novel dynamic ARDL estimation show that macroeconomic uncertainty can predict robust negative movements in sector output for Nigeria. Indeed, these findings are insightful as they show the importance of macroeconomic uncertainties as key drivers of sector output in Nigeria. The paper argues that the policy authorities should improve their efforts to reduce macroeconomic uncertainty and foster a stable real sector/sectoral output to enhance the macroeconomic environment for Nigeria to aim for higher levels of growth.

Keywords: macroeconomic uncertainty; sectoral output; exchange rate uncertainty; interest rate uncertainty; output uncertainty; inflation uncertainty

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1. Introduction

Over the past three decades, studies on economic growth are beginning to include the concept of uncertainty as a major determinant of economic growth (Kormendi and Meguire 1985; Pindyck and Solimano 1993; Ramey and Ramey 1995; Fountas et al. 2006; Kalay et al. 2018; Tran et al. 2019; Ghirelli et al. 2021; Adediran et al. 2023). This is because economic agents are more likely to make mistakes or incur higher transaction costs within environments where macroeconomic uncertainty is rife (Katrakilidis and Tabakis 2004; Moramarco 2023). The impacts of macroeconomic uncertainty on economic growth can be felt directly or indirectly. Directly by affecting productive activities in an economy and indirectly by affecting capital formation, which in turn affects investments and the rate of economic growth (Berger et al. 2017; Ozturk and Sheng 2018; Oyadeyi et al. 2024a).

Even though there have been numerous studies on the effect of macroeconomic uncertainty on economic growth globally (Lucas and Prescott 1971; Bernanke 1983; Leahy and Whited 1996; Brunetti and Weder 1998; Bredin and Fountas 2005; Katrakilidis and Tabakis 2004; Neanidis and Savva 2013; Bäurle and Steiner 2015; Jin et al. 2019; Ghirelli et al. 2021; Oyadeyi 2024a), less work has been carried out on the effect of macroeconomic uncertainty on sector output, especially in a developing country like Nigeria. Most previous studies that have focused on macroeconomic uncertainty and economic growth have

analyzed economic output at the aggregate level or through its main demand components such as consumption and investments (Bayar and Ceylan 2017; Coibion et al. 2021; Irawan and Okimoto 2021; Kong et al. 2022; Lee and Wen 2023). This paper proposes a different approach by focusing on the productive/supply side of the economy and examine the biggest sectors of the economy. The reason why the study focuses on the supply side of the economy is because a focus on the impact of macroeconomic uncertainty on sector-specific output rather than aggregate economic output facilitates a comprehensive understanding of economic resilience, since it emphasizes the unique responses of sectors to macroeconomic uncertainty factors such as interest rate uncertainty, exchange rate uncertainty, inflation uncertainty, and real gross domestic product (GDP) uncertainty. Furthermore, this method assists policymakers in recognizing sector vulnerabilities, such as the susceptibility of the manufacturing sector to exchange rate volatility or the vulnerability of the agriculture sector to interest rates and inflation uncertainties that may be overlooked by aggregate analysis. Moreover, sector-focused analysis facilitates the development of customized policy responses, enabling governments to provide fiscal incentives to labor-intensive sectors or to support export-oriented industries. This, in turn, promotes economic stability in the face of uncertainty.

Nigeria has 46 sectors, and the sum of each sector's activities constitutes the total productive activities in the economy on the supply side. From these sectors, the paper would focus on the connection between macroeconomic uncertainty and the largest subsectors of the economy. These sectors include agriculture, finance and insurance, information and communication technology (ICT), transport, manufacturing, oil and gas, real estate, construction, trade, and the solid mineral sectors. In total, these sectors constitute about 89 percent of productive activities in 2023 and 88 percent of productive activities between 1981 and 2023 (CBN 2023). Analyzing the major sub-sectors of the economy has some advantages. One of which is that it makes it possible to quantify the effects of macroeconomic uncertainty on sector performance, enabling policymakers to assess the results of their decisions in the various sectors (Bäurle and Steiner 2013; Oyadeyi 2023). Another advantage of using the productive side of output is its ability to allow model predictions to be aligned with daily company news and survey results when used for forecasting (Bäurle and Steiner 2015; Adediran et al. 2023; Okunlola et al. 2024; Oyadeyi et al. 2024b).

The reason why the study focused on Nigeria is because Nigeria is the largest economy in sub-Saharan Africa (SSA), with diverse sectors ranging from the agricultural sector to the manufacturing sector, financial sector, and other service sectors. As a result, understanding how macroeconomic uncertainty affects the different sectors of the economy is crucial for businesses, investors, and policymakers to make informed decisions that can grow and stabilize the economy. Furthermore, factors that heighten macroeconomic uncertainty, including inflation surge, exchange rate fluctuations, or economic instability, can affect the performance of the economy. A thorough understanding of these factors can provide insights into how different sectors react to these uncertainties, helping with the formulation of effective policies to mitigate risks and enhance economic resilience. Also, investors need insightful information on the risks as well as returns associated with different sectors in Nigeria. Thus, establishing the effect of macroeconomic uncertainty on Nigeria's sector output can help guide investors in making informed decisions, potentially stimulating investments and economic growth.

In addition, Nigeria's dependence on the oil sector makes its economy subservient to external shocks, particularly fluctuating oil prices. Therefore, establishing the role of macroeconomic uncertainty in the different sectors can help identify which sectors are more resilient and can serve as potential focal points for economic diversification strategies. Consequently, a thorough understanding of establishing the connection between macroeconomic uncertainty and the different sector outputs can assist in identifying the bottlenecks and growth drivers in Nigeria, a crucial criterion for designing growth-enhancing policies for sustainable development. In essence, undertaking a study on macroeconomic uncertainty and sectoral output in Nigeria helps drive effective policy decisions that would help

foster economic stability, attract investments, promote diversification, and enhance the competitiveness of Nigeria in the global economy. This research is not only timely but also helps to navigate the problems resulting from economic uncertainties to leverage opportunities for sustainable development. Finally, the findings of the research can be replicable in similar developing economies with the same economic context, such as Nigeria, thereby enriching the academic discussions and stimulating further research in the area.

As a result, the paper aims to investigate the determinants and patterns of behavior of structural change within the subsectors. In doing this, the paper contributes the following to the empirical literature on macroeconomic uncertainties and sectoral output.

i. First, the paper creates an index for macroeconomic uncertainty and examines the link between macroeconomic uncertainty and sector output in Nigeria. The essence of this is to unravel how these different subsectors respond to macroeconomic uncertainty (either homogenously or heterogeneously) to understand the impacts of policymaking on the economy.

ii. Second, the paper disentangles this connection using two different approaches. The first was by aggregating the four economic uncertainty indexes (real GDP uncertainty, inflation uncertainty, interest rate uncertainty and exchange rate uncertainty) and investigating their connection with sector output, while the second was by examining the effect of each uncertainty index on sector output in Nigeria. This second approach provides robustness to the first approach and helps to understand whether the impacts of these specific uncertainty measures affect the chosen sectors differently compared to the aggregate index.

iii. Third, the paper adopts the four measures of uncertainty because GDP uncertainty affects the ability to forecast future values of output and the future performance of the macroeconomy. Inflation uncertainty on the other hand affects inflation expectations thereby affecting the ability to forecast the level of inflation in an economy. Furthermore, interest rate uncertainty may affect the ability to predict the cost of borrowing, which may then affect investments and productivity in an economy. Lastly, exchange rate uncertainty may lead to exchange rate volatility, which may affect the cost of imports, business planning, and the eventual cost of production of goods and services. Combining these four economic uncertainties will, therefore, affect businesses and economic planning, especially as it relates to the production of goods and services.

iv. Finally, the study focuses on 10 of the 46 sub-sectors of the economy. These sectors constitute roughly 89 percent of the economic activities in the country. Therefore, by focusing on these sectors, the study will provide requisite and timely information in guiding investor decisions across the different sectors, thereby fostering economic investments across these sectors and enhancing sustainable growth.

In essence, the theoretical hypothesis of the study is that macroeconomic uncertainty, encompassing fluctuations in variables, such as exchange rates, inflation, interest rates, and real GDP, has a significant impact on sectoral output in Nigeria, with effects that vary across different economic sectors due to their unique sensitivities and dependencies. The broad objective is to establish the effects of macroeconomic uncertainty on sectoral output in Nigeria. Therefore, the paper will unravel the link between macroeconomic uncertainty and sector output in Nigeria. The rest of the paper is designed as follows. The second section reviews the literature on macroeconomic uncertainty and output, while the third section introduces the data, data measurements, sources, and research methods. The fourth section presents and discusses the results, while the final section concludes the paper with some important policy considerations.

2. Literature Review

The literature review on macroeconomic uncertainty and sectoral output cuts across both panel and country-specific studies, while the focus on the countries cuts across advanced countries, emerging markets, and developing countries. This study will undertake a systemic review of the literature by examining the previous studies on this topic based

on their respective jurisdictions and country-specific categories, be it advanced economies, developing countries, or emerging markets.

To start with, by focusing on advanced countries, Bredin and Fountas (2005) used the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) framework to create an inflation and output uncertainty index and analyze their impacts on economic growth and inflation of G7 countries. Their findings showed that output uncertainty has a direct relationship with output growth, while the results for inflation uncertainty on output and inflation were mixed, meaning that it is not in every case that inflation uncertainty may be detrimental to growth. Still on the topic of G7 countries, Neanidis and Savva (2013) used an exponential GARCH-M (EGARCH-M) model for constructing macroeconomic uncertainty and examined its influence on output and inflation across the G7 countries from 1957 to 2009. The results demonstrated that output uncertainty leads to higher average output growth during low-growth regimes, while inflation uncertainty reduces growth during periods of high-inflation regimes. Also, the findings suggested that nominal uncertainty affects inflation positively while real uncertainty has mixed results across the G7 countries, thereby implying non-linear effects across the observed countries. Furthermore, on the G7 countries, Fountas et al. (2006), using GARCH (1,1) models, found that inflation uncertainty negatively affects the welfare of the people and also provides the incentive for central banks to surprise the public by suddenly raising inflation expectations. The paper also found that the more volatile the business cycle, the more the output growth. Therefore, across G7 countries, the findings showed that uncertainty had significant effects in determining the extent of productive activities within these economies.

Focusing on the global economy, Yono et al. (2020) constructed an uncertainty index using Reuter's news on uncertainty and the volatility index (VIX index) as a supervised signal. The paper conducted a correlation analysis based on the impulse response results and the volatility of the market-based indices. Their findings showed that when macroeconomic uncertainty is high, it tends to correlate with financial market volatility strongly and positively. Also, this outcome was found between macroeconomic uncertainty and the VIX index. Furthermore, on the global economy, Abaidoo and Ellis (2016) used the seemingly unrelated regression to establish how global economies react to macroeconomic uncertainty arising from China and the US. The study showed that global economies were not significantly affected by uncertainties arising from China and the US during the period of investigation. However, the study showed that macroeconomic uncertainty arising from the US has more debilitating effects around the world compared to China, despite the recent rise in Chinese activities globally.

Several studies on macroeconomic uncertainty and output have also been conducted in the euro area. In Europe, Coibion et al. (2021) empirically investigated the effect of macroeconomic uncertainty on household consumption spending in Europe. Their findings suggested that an increase in macroeconomic uncertainty induces households to spend less on luxury items and non-durable goods. Furthermore, the propensity for households to diversify their investments in mutual funds decreases, thereby implying that macroeconomic uncertainty has negative effects on economic activities. Similarly, Bredin and Fountas (2009) employed a bivariate model to uncover the effects of macroeconomic uncertainty on economic activities in the euro area. Macroeconomic uncertainty was measured using real GDP uncertainty and inflation uncertainty in line with their previous study by Bredin and Fountas (2005). The study finds that the output growth rate in these economies was in line with the average output growth during the period of investigation. Furthermore, the study showed that in roughly fifty percent of the observed cases, inflation uncertainty had no significant effects on output performance in these countries, while both inflation and output uncertainty had mixed impacts on inflation during the observed period.

In advanced countries, there are also several studies that have focused on country-specific analysis of the relationship between macroeconomic uncertainty and sector output. Focusing on country-specific research on the US, Shields et al. (2005), in a study on the US economy, examined the response of macroeconomic uncertainty to economic shocks using

the vector autoregressive approach. The paper finds that representing macroeconomic uncertainty using GARCH models may not be correctly specified and a good way to work around this problem will be to incorporate asymmetries and uncertainty spillovers within the GARCH model. The paper also found consistency in the response of uncertainty to economic shocks using the variance decomposition method, while the impulse response results show that macroeconomic shocks affect macroeconomic uncertainty asymmetrically. Furthermore, on the US economy, Choi and Loungani (2015) examined the role of aggregate uncertainty and sector uncertainty shocks in affecting labor and unemployment in the US using a structural Vector autoregressive approach (SVAR). The paper suggested that aggregate uncertainty shocks, measured by the volatility in stock returns, raise the unemployment rate in the short run. Sector uncertainty shocks, on the other hand, measured by cross-industry volatility of stock returns, are very important in explaining the rate of unemployment both in the short and long term. Another study on the US economy by Ugurlu-Yildirim et al. (2021) focused on the effects of interest rate uncertainty on the US stock market firms using the asymmetric ARDL technique to investigate this relationship. The study demonstrated that a long run relationship existed between interest rate uncertainty and stock market performance among listed US firms, while interest rate uncertainty had significant negative effects on the performance of these firms in the short run. In the long run, however, interest rate uncertainty had significant negative effects on firm performance but not asymmetrically.

By focusing on advanced country-specific studies in Europe, Bäurle and Steiner (2013) quantify the impacts of monetary policy, exchange rate, and external demand on the productive sectors of the Swiss economy using a very large dataset. Using a structural dynamic factor model, the paper's findings showed that macroeconomic shocks have heterogeneous impacts across the productive sectors of the Swiss economy. The paper also found foreign GDP to exert a significant influence on Swiss GDP, strongly affecting the manufacturing, hotels, and restaurants sectors. The financial sector reacts significantly, particularly to an exchange rate appreciation, while the exchange rate (after three quarters) and CHF Libor rate (after two years) diminish the GDP negatively. In a similar study, Bäurle and Steiner (2015) found similar outcomes to their earlier work in 2013 in the study of the Swiss economy.

Furthermore, in country-specific studies on European nations, Katrakilidis and Tabakis (2004) examined the influence of macroeconomic uncertainty on sector output in Greece with a specific focus on the agricultural and industrial subsectors of the economy. Their findings showed that output and inflation uncertainties strongly and significantly influence agricultural output, while the exchange rate and industrial output were insignificant. On the other hand, inflation uncertainty and agricultural sector uncertainty influence the behavior of industrial output according to the impulse response results. The variance decomposition results showed that inflation, agricultural output uncertainty, and industrial output uncertainty significantly explain the variations in agricultural output, while in the case of industrial output, none of the observed variables had significant influence in the short run, but they began to exert significant influence in the medium to long term. In another study on European economies, Ghirelli et al. (2021) found macroeconomic uncertainty to significantly influence economic developments for Spain. Furthermore, they demonstrated that economic policy and financial uncertainty affect private consumption negatively, while the influence of uncertainty on capital goods investment, even though initially large, vanishes more quickly in the medium to long run.

In an advanced country study on New Zealand, Tran et al. (2019) developed two separate measures of macroeconomic uncertainty and examined their influence on economic activity in New Zealand. The methods of uncertainty were designed following the works of Jurado et al. (2015) and a freely accessible uncertainty measure using Google trends. The findings showed that macroeconomic uncertainty shocks have a significant influence on the GDP of New Zealand. In Australia, Moore (2016) constructed a monthly uncertainty index for Australia. The paper found that economic uncertainty is higher

during periods of recessions, elections, and a financial crisis such as the one in 2008. The paper also demonstrated that economic uncertainty was found to be countercyclical for Australia, while factors affecting uncertainty in Australia were affected by both domestic and foreign factors, and its rate of rise tends to be faster than the rate at which it falls. Finally, the paper found that uncertainty affects the growth in employment, reduces the growth in investment of machinery and capital goods, and raises household savings.

A few studies on macroeconomic uncertainty and sector output have focused on emerging markets and developing economies (EMDEs). For instance, Aizenman and Marion (1993) examined the connection between macroeconomic uncertainty and private investment in 40 selected emerging economies using the standard deviation of the residuals as a measure of uncertainty. The findings from the paper showed that macroeconomic uncertainty is negatively correlated with private investment in the selected developing countries. Furthermore, Irawan and Okimoto (2021), in their study, focused on the links between macroeconomic uncertainty and over-investments and how these nexuses affect non-renewable and renewable firms on a panel of 584 firms in 32 countries around the globe. The study finds that from these studies, the BRICS nations (Brazil, Russia, India, China and South Africa) over-invested during the period of investigation, while commodity price inflation had stronger effects on investments than commodity price uncertainty. Lastly, the study revealed that global uncertainties do not affect domestic country firm performance as much as the domestic country business cycle. Moreover, Binz (2022) was also of the view that macroeconomic uncertainty affected firm revenues, profits, and operating expenses in a global sample of firms, spanning the period 1997 to 2018.

Some studies on macroeconomic uncertainty and sectoral output have focused on the Indian economy. For instance, Bicchal and Durai (2020) examined the influence of macroeconomic uncertainties in India. Their findings demonstrated that macroeconomic uncertainty shocks significantly influence macroeconomic variables consistently on the three transmission channels. The paper also demonstrated that an international spillover from the US has more influence on domestic uncertainty in India. Similarly, on the Indian economy, Vaswani and Padmaja (2023) examined the effects of macroeconomic uncertainty on stock market performance in India, using the non-linear ARDL methodology. The study confirms non-linearity in the effects of macroeconomic factors on the stock market performance in India during the period under investigation. In Turkey, however, Bayar and Ceylan (2017) focused on the effects of macroeconomic uncertainty on the Borsa Istanbul Non-Metallic Mineral Products sector using quarterly data and employing GARCH methodology on the returns of these firms. In measuring uncertainty, they considered real GDP uncertainty, interest rate uncertainty, and exchange rate uncertainty, and how these measures affected the returns of these firms. The study found that macroeconomic uncertainty, across the different measures, did not affect these firms' products and their performance.

Finally, there have been a few studies on macroeconomic uncertainty and sector output in Nigeria. Among them are Ayeni and Fanibuyan (2022), who studied the effects of macroeconomic uncertainty on the macroeconomy of Nigeria. Their uncertainty measures focused on real GDP and inflation uncertainty and how these affected output and prices in Nigeria. Their study showed that macroeconomic uncertainty had no significant effects on the macroeconomic performance in Nigeria. On the other hand, they showed that oil prices significantly and directly affect performance in the Nigerian economy. Furthermore, in the Nigerian economy, Ubi et al. (2021) explored the role of macroeconomic uncertainty during periods of budget deficit financing in Nigeria and how uncertainty affects inflation and growth using GARCH and ARDL techniques. In measuring macroeconomic uncertainty, they also considered real GDP and inflation uncertainty and their effects on macroeconomic performance in Nigeria. Contrary to Ayeni and Fanibuyan (2022), the study finds that macroeconomic uncertainty negatively affected economic performance in Nigeria during periods of fiscal deficit financing.

In summary, the literature on macroeconomic uncertainty is versed; however, its impact on sector output is yet to be explored, particularly in a developing economic context

such as Nigeria. Therefore, this study will contribute to the literature in this regard, to establish the role of macroeconomic uncertainty on sector output in Nigeria. Furthermore, the study will adopt four different measures of macroeconomic uncertainty to ascertain their individual and combined effects on sector output in Nigeria.

3. Theoretical Framework, Methodology and Data Sources

3.1. Theoretical Framewor—Real Business Cycle Theory

This study rests upon the real business cycle (RBC) theory in line with other studies such as Bloom (2009) and Arellano et al. (2019). The RBC theory is a section of economic theory that explains the role of economic fluctuations on real shocks to economic activities. Shocks here focus on shocks affecting the supply side of the economy (output), rather than demand-side shocks or monetary shocks. The theory's main postulation is that changes in economic output are due to fluctuations in productive activities, technological innovations, and other real factors. The theory relies so much on households and firms making their decisions based on rational expectations about future activities and that supply equals demand across markets at any given time. Furthermore, the theory assumes that wages and prices adjust swiftly to ensure that markets are always in equilibrium. Finally, it assumes that the main reason for economic uncertainty is due to productivity shocks, which can either be positive (through advancements in technology) or negative (through natural causes, regulatory changes, or other reasons).

The link between macroeconomic uncertainty and sectoral output growth in the RBC theory states that technological progress helps raise economic growth through its potential effects on production, investments, and consumption. On the other hand, negative productivity shocks, due to regulatory changes or other natural causes, can weaken potential output, leading to negative swings in economic activities or economic downturns. The mechanism through which macroeconomic uncertainty affects sectoral output under the RBC theory is through intertemporal substitution and capital accumulation. For instance, the intertemporal substitution channel states that when productivity shocks occur, households and firms adjust their labor supply and capital utilization to the extent of productivity shocks. For instance, when shocks are positive within the production process, it leads to increasing labor supply since workers will capitalize on increased wages. On the other hand, the capital accumulation mechanism states that expectations concerning future outputs are determinants of investment in capital goods. Therefore, positive investments are due to positive expectations while a drop in investments is due to negative expectations, thereby slowing down economic growth. Moreover, higher uncertainty levels raise the risk premiums on investments raising capital costs and reducing investments in an economy.

The criticism of the RBC theory argues that the theory's underestimation of the role of monetary factors and demand-side factors in driving the business cycle are reasons for concern. Furthermore, these critics argue that markets are not always perfect and the supply is not always equal to the demand for labor. It is because of these imperfections that other theories such as the New Keynesian economics school of thought introduced market imperfections like sticky prices and wages to explain economic fluctuations. Despite these criticisms, the RBC theory provides valuable contributions on how macroeconomic uncertainties affect economic productivity in an economy.

Indeed, the RBC theory posits that policies directed at economic stability should be targeted at reducing those determinants of real shocks to improve economic productivity. These include policies that foster technological innovation and provide a stable regulatory environment. Moreover, fostering labor supply and demand flexibility can help the economy to quickly adjust to productivity shocks, thereby reducing any negative effects of economic uncertainty. Therefore, a thorough understanding of these dynamics is important for policymakers who aim to enhance a stable macroeconomic environment and sustain sustainable economic growth amidst inherent economic uncertainties.

3.2. Measuring Uncertainty

In creating an index for macroeconomic uncertainty in Nigeria, the paper employs the Autoregressive Conditional Heteroscedasticity (ARCH) (Engle 1982) and Generalized-ARCH (GARCH) (Bollerslev 1986) techniques in line with previous studies such as Adesete et al. (2022), Neanidis and Savva (2013), Bredin and Fountas (2005), and Salisu et al. (2024). To estimate macroeconomic uncertainty, the paper adopts the application of GARCH estimates. The GARCH model, developed by Tim Bollerslev (1986), extends the ARCH model by including lagged values of the variance itself, which helps in capturing long memory in volatility. The GARCH (p, q) model is specified as:

$$y_t = \mu + \in_t \tag{1}$$

with $\in_t = \sigma_t z_t$ and $z_t \sim N(0,1)$. Thus, the conditional variance σ_t^2 is modeled as:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \in_{t-i}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 \tag{2}$$

Consequently, the paper assesses the influence of GARCH's effects on the uncertainty of Nigeria's macroeconomy. This study achieves this by employing the GARCH (1, 1), which consists of a single ARCH and a single GARCH. Therefore, presenting this representation will give the below.

$$\sigma_t^2 = a_0 + \alpha_1 \xi_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \varepsilon_t \tag{3}$$

where σ_t^2 is the conditional variance (or volatility) at time t; α_0 is a constant; $\alpha_1 \xi_{t-1}^2$ is the ARCH term, representing the effect of past squared residuals (volatility shocks); $\beta_1 \sigma_{t-1}^2$ is the GARCH term, representing the impact of past variances; and ε_t is the error term (residual). Therefore, Equation (3) can be re-specified to model the first step in deriving macroeconomic uncertainty/volatility by generating the exchange rate volatility/uncertainty, interest rate volatility/uncertainty, inflation volatility/uncertainty, and real GDP volatility/uncertainty through the GARCH variance series.

$$EXCU_t = a_1 + \alpha_1 \xi_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \varepsilon_{1t} \tag{4}$$

$$INFU_t = a_2 + \alpha_2 \xi_{t-1}^2 + \beta_2 \sigma_{t-1}^2 + \varepsilon_{2t} \tag{5}$$

$$INTU_t = a_3 + \alpha_3 \xi_{t-1}^2 + \beta_3 \sigma_{t-1}^2 + \varepsilon_{3t} \tag{6}$$

$$RGDPU_t = a_4 + \alpha_4 \xi_{t-1}^2 + \beta_4 \sigma_{t-1}^2 + \varepsilon_{4t} \tag{7}$$

where $\alpha_1 \xi_{t-1}^2, \alpha_2 \xi_{t-1}^2, \alpha_3 \xi_{t-1}^2, \alpha_4 \xi_{t-1}^2$ are the ARCH effects and $\beta_1 \sigma_{t-1}^2, \beta_2 \sigma_{t-1}^2, \beta_3 \sigma_{t-1}^2, \beta_4 \sigma_{t-1}^2$ are the GARCH effects of the four macroeconomic variables (exchange rates, inflation rates, interest rates, and real GDP in their respective models). *EXCU* is exchange rate uncertainty, *INFU* is inflation uncertainty, *INTU* is interest rate uncertainty, *RGDPU* is the real GDP uncertainty, and ε_t is the error term (residual). This implies that the conditional variance of the series in Equations (4)–(7) was used to compute the uncertainty index for these four broad macroeconomic variables. By defining the different uncertainty indices, exchange rate uncertainty is the unpredictability of a currency's value in relation to other currencies, frequently resulting from fluctuations in international markets, policy changes, or economic instability. On the other hand, inflation uncertainty is the unpredictability of the rate at which prices for products and services increase, which complicates investment, consumption, and wage decisions due to undetermined future costs. Interest rate uncertainty is the unpredictability of future interest rate levels, which can affect financing costs, savings returns, and investment decisions, and is influenced by economic conditions and monetary policy. Real GDP uncertainty is the situation where economic performance and planning

expectations are influenced by the unpredictability of an economy's output growth or contraction, adjusted for inflation.

Afterwards, the paper creates an overall index of macroeconomic uncertainty. This was created by averaging the four macroeconomic uncertainty series that were generated from Equations (4)–(7). The simple mean was used to average these four uncertainty variables. Therefore, the mean formula in Equation (8) was used to average the conditional volatilities of exchange rate uncertainty, inflation uncertainty, interest rate uncertainty, and real GDP uncertainty at time t using the formula:

$$\mu = \frac{1}{T}\sum_{t=1}^{T} x_t \tag{8}$$

where μ is the mean of the time series, x_t represents the value of the observation at time t, T is the total number of periods (or observations), and $\sum$ denotes the summation over all the observations. That is, the four pillars of the macroeconomic uncertainty index (exchange rate, interest rate, real GDP, and inflation uncertainties) are averaged to form the macroeconomic uncertainty index for Nigeria.

3.3. Model Specification

The paper adopts the endogenous growth model in line with earlier studies such as Barro (1990), Barro and Sala-i-Martin (1992), Oseni (2013). Therefore, the model is specified as follows:

$$\gamma_t = \alpha_0 + K_t + \varepsilon_t \tag{9}$$

where γ_t represent sector output at period t, α_0 is the intercept, K_t are the regressors at period t, and ε_t is the disturbance term in period t.

From Equation (9), the study adopted ten different sub-sectors as our proxy for sector output. These sectors were further discussed in the data section, and they include the agriculture sector, finance and insurance sector, information and communication technology sector, manufacturing sector, oil and gas sector, solid mineral sector, real estate sector, construction sector, transport sector, and trade sector. On the other hand, the regressors include macroeconomic uncertainty, credit to the private sector, and fiscal sustainability.

3.4. Estimation Techniques

The Dynamic Auto-Regressive Distributed Lag (ARDL) Framework

To examine the impact of macroeconomic uncertainty on sector output in Nigeria, the paper adopted the novel dynamic ARDL framework designed by Jordan and Philips (2018), also in a previous study by Oyadeyi (2022). This is because the framework allows the use of variables in different orders of stationarity (I(0), I(1) or a combination of both) in line with the regular ARDL framework. Furthermore, this recently developed framework is capable of simulating and plotting to autonomously determine graphs of (positive and negative) changes in the variables and estimate the relationships for the short/long term. The primary benefit of this framework is its ability to predict, simulate, and instantaneously plot probabilistic change forecasts on the dependent variable in a single explanatory variable, while maintaining the constant values of other regressors. Before employing the dynamic ARDL method, we first need to re-specify Equation (9) to its explicit form.

Equation (9) can, therefore, be re-specified as below:

$$\gamma_t = \alpha_0 + mu_t + cps_t + fs_t + \varepsilon_t \tag{10}$$

Before specifying the dynamic ARDL, we first need to specify the traditional ARDL method. We, therefore, specify a general ARDL framework that we would be using in estimating Equation (10).

$$\gamma_{it} = \beta_{it} + \sum_{f=1}^{l} \iota_{if}\Delta\gamma_{i,t-f} + \sum_{f=0}^{l} \lambda_{if}\Delta mu_{i,t-f} + \sum_{f=0}^{l} \delta_{if}\Delta cps^{k}_{i,t-f} + \sum_{f=0}^{l} \varphi_{if}\Delta fs_{i,t-f} + \omega_{1,if}\gamma_{i,t-1} + \omega_{2,if}mu_{i,t-1} + \omega_{3,if}cps^{k}_{i,t-1} + \omega_{4,if}fs_{i,t-1} + \varepsilon_{it} \quad (11)$$

where Δ connotes the difference operator, $\iota, \lambda, \delta, \varphi$ are the short-run coefficients, $\omega_1 - \omega_4$ are the long-run coefficients of the estimated variables. Once cointegration is established among the variables, the error correction mechanism (ECM) representation of Equation (11) can be written as:

$$\Delta\gamma_{it} = \beta_{it} + \sum_{f=1}^{l} \iota_{if}\Delta\gamma_{i,t-f} + \sum_{f=0}^{l} \lambda_{if}\Delta mu_{i,t-f} + \sum_{f=0}^{l} \delta_{if}\Delta cps^{k}_{i,t-f} + \sum_{f=0}^{l} \varphi_{if}\Delta fs_{i,t-f} + \eta_i ECT(-1)_{i,t-1} + \varepsilon_{it} \quad (12)$$

where η_i represents the adjustment speed at period t. Furthermore, the lag length was determined using Schwarz criterion. In deciding the lag selection criteria, the study will select the SIC as the lag length determination method due to its marginal improvement over the AIC (Pesaran and Shin 1999) in utilizing the minimum latency time feasible and preventing the loss of unnecessary degrees of freedom.

While the above depicts the ARDL methodology, we would then need to specify the dynamic ARDL method. The dynamic ARDL error correction algorithm employs 1000 simulations in this investigation, with the parameter vector following a multivariate normal distribution. The graphs are utilized to investigate the change in the regressors and their impacts on the dependent variable. The dynamic ARDL simulations model is introduced in the following manner:

$$\Delta\gamma_{it} = \alpha_{it} + \psi_1\gamma_{it-1} + \hbar_1\Delta mu_t + \lambda_1 mu_{t-1} + \ell_1\Delta cps_t + k_1 cps_{t-1} + \Im_1\Delta fs_t + \wp_1 fs_{t-1} + \partial ECT_{t-1} + \varepsilon_t \quad (13)$$

3.5. Data and Its Sources

The paper employed quarterly time series data from 1981Q1 to 2023Q4 to achieve its objectives. The period was examined because it was robust enough in checking the impacts of macroeconomic uncertainty on sector output in Nigeria. The rationale for selecting these sectors is that they constitute 89 percent of total economic activity as of Q4 2023, while they constitute an average of 88 percent of the total sector output between 1981 and 2023. The data employed, as well as their sources and measurements, are highlighted in Table 1.

Table 1. Description, Variable Measurements and Sources.

Variable	Description	Type	Sources
Agriculture RGDP	The log of Agricultural sector Real GDP at constant 2010 in LCU.	Dependent	CBN (2023)
Construction RGDP	The log of Construction sector Real GDP at constant 2010 in LCU.	Dependent	CBN (2023)
Finance and Insurance RGDP	The log of Finance and Insurance sector Real GDP at constant 2010 in LCU.	Dependent	CBN (2023)
ICT RGDP	The log of ICT sector Real GDP at constant 2010 in LCU.	Dependent	CBN (2023)
Manufacturing RGDP	The log of Manufacturing sector Real GDP at constant 2010 in LCU.	Dependent	CBN (2023)
Oil and Gas RGDP	The log of Oil and Gas and other Solid Mineral sector Real GDP at constant 2010 in LCU.	Dependent	CBN (2023)
Real Estate RGDP	The log of the Real Estate sector's Real GDP at constant 2010 in LCU.	Dependent	CBN (2023)
Solid Minerals RGDP	The log of the Solid Minerals sector Real GDP at constant 2010 in LCU.	Dependent	CBN (2023)

Table 1. *Cont.*

Variable	Description	Type	Sources
Trade RGDP	The log of Trade sector's Real GDP at constant 2010 in LCU.	Dependent	CBN (2023)
Transport RGDP	The log of Transport sector Real GDP at constant 2010 in LCU.	Dependent	CBN (2023)
Macroeconomic Uncertainty (MU)	Macroeconomic uncertainty—proxied using the conditional variance from a GARCH equation. The average of the conditional variance from RGDPU, INFU, EXCU and INTU were used to derive MU.	Independent	Author's Calculation; CBN (2023)
Real GDP Uncertainty (RGDPU)	Real GDP Uncertainty—proxied using the conditional variance of RGDP from a GARCH equation.	Independent	Author's Calculation; CBN (2023)
Inflation Uncertainty (INFU)	Inflation Uncertainty—proxied using the conditional variance of Inflation from a GARCH equation.	Independent	Author's Calculation; CBN (2023)
Interest Rate Uncertainty (INTU)	Interest rate (measured by the average prime and maximum lending rate) uncertainty. Proxied using the conditional variance of interest rate from a GARCH equation.	Independent	Author's Calculation; CBN (2023)
Exchange Rate Uncertainty (EXCU)	The official exchange rate uncertainty. Proxied using the conditional variance of the exchange rate from a GARCH equation.	Independent	Author's Calculation; CBN (2023)
Fiscal Sustainability (FS)	Fiscal sustainability, measured as the proportion of fiscal deficit to real GDP	Control	CBN (2023)
Private Sector Credit (LCPS)	The log of credit to the private sector	Control	CBN (2023)

4. Results

4.1. Descriptive Statistics, Correlation and Unit Root Analyses

The paper starts the analyses by exploring the descriptive characteristics of the variables. However, due to the large number of variables involved, these results were presented in the appendix section of the paper. The descriptive statistical results (see Table A1 in Appendix A) show that the variables had a good level of consistency and satisfied the conditions to proceed with the main analyses. Furthermore, the results of the correlation analysis were also presented in the Appendix A (see Tables A2 and A3 in the Appendix A). Overall, the correlation analysis shows that the variables selected in each model were not highly correlated. The unit root analyses were presented in Table 2 using the Augmented Dickey and Fuller (1981) and Phillips and Perron (1988) unit root tests, in line with previous studies such as Oyadeyi (2024c, 2024d), Oseni (2013). Due to a mixture of I(0) and I(1), and the presence of cointegration among the models, the paper adopts the dynamic autoregressive distributed lag (ARDL) model propounded by Pesaran et al. (2001). The lag length criteria were chosen using the Schwarz criterion (see Tables A4 and A5 in Appendix A). The SIC was selected as the lag length determination method due to its marginal improvement over the AIC (Pesaran and Shin 1999) in utilizing the minimum latency time feasible and preventing the loss of unnecessary degrees of freedom.

Table 2. Unit Root Tests using Augmented Dickey–Fuller (ADF) and Phillip–Perron (PP) Criterion.

		Levels		First Difference		Status
Variable	**Test**	**T-Stats**	***p* Value**	**T-Stats**	***p* Value**	
Agriculture RGDP	ADF	−0.6562	0.8534	−4.9054	0.0001 ***	I(1)
	PP	−1.3698	0.5961	−23.1633	0.0000 ***	I(1)
Construction RGDP	ADF	−0.6378	0.8577	−4.6363	0.0002 ***	I(1)
	PP	−0.7967	0.8172	−17.9373	0.0000 ***	I(1)
Finance and Insurance RGDP	ADF	−0.6940	0.8442	−5.0805	0.0000 ***	I(1)
	PP	−1.1709	0.6866	−20.6605	0.0000 ***	I(1)
ICT RGDP	ADF	−0.4332	0.8994	−4.7566	0.0001 ***	I(1)
	PP	−0.4559	0.8954	−17.4683	0.0000 ***	I(1)
Manufacturing RGDP	ADF	−0.2609	0.9266	−5.0107	0.0000 ***	I(1)
	PP	−1.9010	0.3313	−30.8328	0.0001 ***	I(1)
Oil and Gas RGDP	ADF	−1.0302	0.7419	−4.8420	0.0001 ***	I(1)
	PP	−1.3838	0.5893	−21.5869	0.0000 ***	I(1)
Real Estate RGDP	ADF	−0.7950	0.8176	−4.8088	0.0001 ***	I(1)
	PP	−0.8716	0.7952	−17.5902	0.0000 ***	I(1)
Solid Minerals RGDP	ADF	−0.4607	0.8944	−4.7448	0.0001 ***	I(1)
	PP	−2.1146	0.2393	−25.7512	0.0000 ***	I(1)
Trade RGDP	ADF	−0.6784	0.8480	−4.8784	0.0001 ***	I(1)
	PP	−1.1208	0.7072	−19.6939	0.0000 ***	I(1)
Transport RGDP	ADF	−0.7063	0.8411	−4.9302	0.0001 ***	I(1)
	PP	−1.3037	0.6275	−22.1874	0.0000 ***	I(1)
Macroeconomic Uncertainty	ADF	−13.3286	0.0000 ***			I(0)
	PP	−13.3286	0.0000 ***			I(0)
Real GDP Uncertainty	ADF	−9.5499	0.0000 ***			I(0)
	PP	−9.5499	0.0000 ***			I(0)
Inflation Uncertainty	ADF	−3.5382	0.0387 ***			I(0)
	PP	−3.61216	0.4266 ***			I(0)
Interest Rate Uncertainty	ADF	−3.7815	0.0038 ***			I(0)
	PP	−5.6649	0.0000 ***			I(0)
Exchange Rate Uncertainty	ADF	−7.1040	0.0000 ***			I(0)
	PP	−7.0048	0.0000 ***			I(0)
Private Sector Credit	ADF	−0.9095	0.7834	−13.3574	0.0000 ***	I(1)
	PP	−0.8789	0.7930	−13.4072	0.0000 ***	I(1)
Fiscal Sustainability	ADF	−2.6558	0.0840 *	−8.3652	0.0000 ***	I(1)
	PP	−2.2810	0.1793	−8.3594	0.0000 ***	I(1)

Source: Author's Computation. '***' and '*' represent the level of significance at 1 percent and 10 percent.

4.2. A Construction of Macroeconomic Uncertainty

Since the objective of the paper is to study the impact of macroeconomic uncertainty on the biggest sectors of the Nigerian economy, the paper starts by generating an uncertainty index using the GARCH methodology. The paper adopts four different measures of uncertainty and creates an overall macroeconomic uncertainty index to fulfill the objectives of the study. Uncertainty was constructed from real GDP, inflation rate, exchange rate, and interest rate. The paper also checked the correlation coefficient among the four economic uncertainty indexes that were created. From Table 3, the correlation coefficient among the four uncertainty measures ranges from low to moderate, and this allows us to use these measures independently and jointly in the formulation of a macroeconomic uncertainty index for Nigeria. The mean of the four uncertainty indexes was used to construct macroeconomic uncertainty as stipulated in Tran et al. (2019) and depicted in Equation (5) above.

In creating the uncertainty index, the paper adopted the average lending rates (the average of prime lending rate and maximum lending rate), inflation rate, real GDP growth, and the official exchange. Figure 1 is the outcome of the construction of a macroeconomic uncertainty index for Nigeria. A higher index score implies a higher level of uncertainty in the Nigerian economy. The index provides evidence to show that uncertainty was high between 1986 and 1992 due to the adoption of the structural adjustment program (SAP) in Nigeria in 1986, while it became higher in the 4th republic post-1999 due to the liberalization policies that were adopted, particularly the exchange rate liberalization. Uncertainty heightened during the global financial crisis between 2008 and 2009, while it heightened again in 2016, the period when the economy was in recession for six consecutive quarters, coinciding with the exchange rate depreciation and falling crude oil prices in 2016, while the COVID-19 pandemic in 2020 also brought some levels of uncertainty to the Nigerian economy and the cash-crunch policies in 2023, coupled with the 2023 general elections, which also brought some instability to the Nigerian economy.

Table 3. Correlation among Economic Uncertainty Measures.

	RGDPU	**INFU**	**INTU**	**EXCU**
RGDP Uncertainty	1.0000			
Inflation Uncertainty	0.1217	1.0000		
Interest Rate Uncertainty	0.0438	0.6083	1.0000	
Exchange Rate Uncertainty	0.4348	−0.2286	−0.3376	1.0000

Notes: All correlations are significantly different from zero at the 1 percent level; all correlations are for the period Q1 1981 to Q4 2023. Sources: Author's computations. Where RGDPU is Real GDP Uncertainty; INFU is Inflation Uncertainty; INTU is Interest Rate Uncertainty; and EXCU is Exchange Rate Uncertainty.

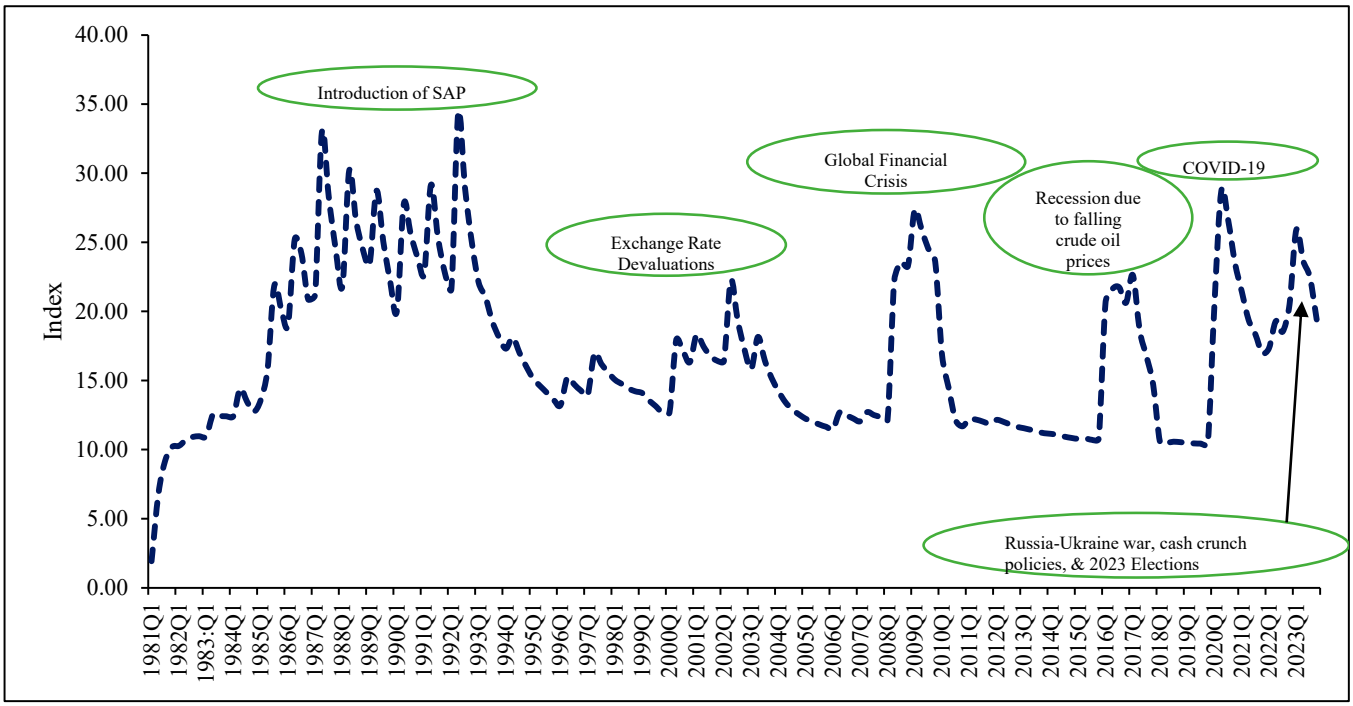

Figure 1. An Evolution of the Macroeconomic Uncertainty Index. Source: Author's Computation. Note that the markers or circles in the chart showed the main causes of macroeconomic uncertainty fluctuations in Nigeria at different points in time.

4.3. The Impact of Macroeconomic Uncertainty on Sector Output

4.3.1. The Impact of Macroeconomic Uncertainty on the Selected Sectors Using the Novel Dynamic ARDL Technique

To examine the impact of macroeconomic uncertainty on the ten biggest sectors of the economy, the paper adopts the dynamic ARDL framework as earlier explained. From Table 4, different models were estimated separately, and each model represents the impact of macroeconomic uncertainty on the selected sectors of the economy, constituting roughly 89 percent of the Nigerian economy. On the short-run impact of macroeconomic uncertainty on the selected sectors, the paper showed that macroeconomic uncertainty significantly impacts the sectors under interest negatively. Furthermore, credit allocated to the agriculture, manufacturing, solid minerals, and trade sectors had significant positive effects on these sectors, while it had no effect on the real estate, ICT, finance and insurance, construction, transport, and oil and gas sectors in the immediate term. On the other hand, fiscal sustainability does not impact any of the sectors in the short term.

Table 4. The Novel Dynamic ARDL Result on the Impact of Macroeconomic Uncertainty on the Sectors.

VARIABLES	Agric	Manufacturing	Solid Minerals	Real Estate	Trade
Lag of Dependent Variable	−0.292 ***	−0.379 ***	−0.302 ***	−0.201 ***	−0.226 ***
	(0.0491)	(0.0580)	(0.0532)	(0.0391)	(0.0437)
D(MU)	−0.1111 ***	−0.0480 ***	−0.0860 ***	−0.0330 ***	−0.1228 ***
	(0.0084)	(0.0053)	(0.0098)	(0.0097)	(0.0086)
MU	−0.2098 ***	−0.0890 ***	−0.0507 ***	−0.0129 ***	−0.0905 ***
	(0.0044)	(0.0080)	(0.0054)	(0.0051)	(0.0045)
D(LCPS)	0.9010 *	0.7320 ***	0.1650 ***	0.0369	0.1100 **
	(0.5010)	(0.0910)	(0.0583)	(0.5760)	(0.0509)
D(FS)	0.0007	−0.0015	0.0002	0.0028	0.0015
	(0.0023)	(0.0041)	(0.0026)	(0.0026)	(0.0023)
LCPS	0.222 ***	0.362 ***	0.181 ***	0.205 ***	0.184 ***
	(0.0401)	(0.0602)	(0.0367)	(0.0439)	(0.0396)
FS	−0.00402 ***	−0.00724 ***	−0.00377 ***	−0.00417 ***	−0.00361 ***
	(0.0009)	(0.0015)	(0.0010)	(0.0010)	(0.0009)
ECT(-1)	−0.0967 ***	−0.0879 ***	−0.0938 ***	−0.0982 ***	−0.0984 ***
	(0.0005)	(0.0043)	(0.0099)	(0.0091)	(0.0046)
Constant	0.8605 ***	−0.462 **	−0.328 **	−0.245 *	0.3210 ***
	(0.1130)	(0.2040)	(0.1360)	(0.1360)	(0.1130)
Observations	172	172	172	172	172
R-squared	0.186	0.266	0.173	0.151	0.171
F(7, 163)	5.32	8.45	4.88	4.14	4.79
Prob > F	0.0000	0.0000	0.0001	0.0003	0.0001
Bound Test F-Stat.	9.026	11.184	8.233	6.776	6.783
VARIABLES	**ICT**	**Finance and Insurance**	**Construction**	**Transport**	**Oil and Gas**
Lag of Dependent Variable	−0.150 ***	−0.310 ***	−0.193 ***	−0.275 ***	−0.297 ***
	(0.0346)	(0.0496)	(0.0391)	(0.0481)	(0.0496)
D(MU)	−0.0307 ***	−0.0510 ***	−0.0605 ***	−0.0180 ***	−0.0322 ***
	(0.0094)	(0.0086)	(0.0090)	(0.0080)	(0.0087)
MU	−0.0800 ***	−0.0140 ***	−0.0207 ***	−0.0260 ***	−0.0400 ***
	(0.0049)	(0.0045)	(0.0048)	(0.0042)	(0.0046)
D(LCPS)	0.0063	0.0118	−0.0387	0.1190	−0.1630
	(0.5570)	(0.5100)	(0.5370)	(0.4780)	(0.5170)
D(FS)	0.0021	0.0020	0.0022	0.0004	0.0022
	(0.0025)	(0.0023)	(0.0024)	(0.0022)	(0.0023)
LCPS	0.201 ***	0.269 ***	0.177 ***	0.185 ***	0.195 ***
	(0.0480)	(0.0465)	(0.0391)	(0.0358)	(0.0373)
FS	−0.00303 ***	−0.00418 ***	−0.00350 ***	−0.00364 ***	−0.00391 ***
	(0.0010)	(0.0009)	(0.0009)	(0.0008)	(0.0009)
ECT(-1)	−0.0978 ***	−0.0978 ***	−0.0879 ***	−0.0897 ***	−0.0875 ***
	(0.0009)	(0.0098)	(0.0099)	(0.0091)	(0.0097)
Constant	−0.344 **	−0.319 **	−0.8510 ***	−0.2911 ***	0.3610 ***
	(0.1430)	(0.1250)	(0.1240)	(0.1080)	(0.1170)
Observations	172	172	172	172	172
R-squared	0.114	0.198	0.149	0.172	0.194
F(7, 163)	2.99	5.76	4.09	4.83	5.59
Prob > F	0.0055	0.0000	0.0004	0.0001	0.0000
Bound Test F-Stat.	4.905	9.894	6.295	8.348	9.086

Source: Author's Computation. Note: Bound test lower and upper critical values at 5 percent are 3.23086 and 4.350, respectively. '***', '**', and '*' are the significance levels at 1 percent, 5 percent, and 10 percent, respectively. MU is Macroeconomic uncertainty, LCPS is the log of credit to the private sectors, FS is fiscal sustainability, Agric Sector is the Agricultural sector real GDP, Finance and Insurance is the finance and insurance sector real GDP, ICT is the ICT sector real GDP, Manufacturing is the manufacturing sector real GDP, Oil and Gas is the oil and gas sector real GDP, Solid Minerals is the solid minerals sector real GDP, Real Estate is the real estate sector real GDP, Construction is the construction sector real GDP, Trade is the trade sector real GDP, and Transport is the transport sector real GDP.

The error correction term (ECT(-1)) showed that the coefficient of the results is negative and statistically significant. This means that the error correction term, which is the speed of adjustment, is statistically significant and shows the correct sign, meaning that short-run errors were corrected in the long term since cointegration exists within the model. This implies that these short-run errors are adjusting towards equilibrium at roughly 10 percent for the agriculture, real estate, trade, finance and insurance, and ICT sectors. On the

other hand, it is adjusting at a pace of 9 percent for the manufacturing, solid minerals, construction, transport, and oil and gas sectors. It is important to note that the adjustment process is slow, but despite this, there is a correction in the long-run since the coefficient of these separate models are negative while also being statistically significant.

The bound test results, proposed by Pesaran et al. (2001), showed that there is a long-term relationship among the variables in each model. Since the F statistics of the bound test exceed the 4.35 upper threshold band in all the models, then the bound test results showed that there exist cointegration relationships among the variables in each of the models. This implies that there is a long-term relationship between the independent and the dependent variables within each model. In the long run, macroeconomic uncertainty significantly affected the sectors negatively for Nigeria. However, credit provided to these individual sectors has a positive and significant effects on the sectors, while fiscal sustainability had negative effects on all the sectors.

4.3.2. The Impact of Disaggregated Economic Uncertainty on the Selected Sectors Using the Novel Dynamic ARDL Technique

Since the results of the impact of macroeconomic uncertainty on the selected sectors has been established, the paper decides to break macroeconomic uncertainty into the individual uncertainty components and check the impact of the individual uncertainty components on the selected sectors of the economy. The short-run results presented in Table 5 show that real GDP uncertainty, exchange rate uncertainty, interest rate uncertainty, and inflation uncertainty all had significant negative effects on the selected sectors. On the other hand, fiscal sustainability does not have any short-term effects on the sectors, while private sector credits affect the agriculture, manufacturing, solid minerals, and trade sectors positively in the short term.

The error correction term showed that the coefficient of the results is negative and statistically significant. This means that the error correction term, which is the speed of adjustment, is statistically significant and shows the correct sign, meaning that short-run errors were corrected in the long term since cointegration exists within the models. This implies that these short-run errors are adjusting towards equilibrium at roughly 10 percent for the agric sector and real estate sectors, while it is adjusting at a 9 percent pace for the remaining eight sectors. It is important to note that the adjustment process is slow, but despite this, there is a correction in the long run since the coefficient of these separate models are negative while also being statistically significant. Since the F statistics of the bound test exceed the 4.35 upper threshold band in all the models, then the bound test results showed that there exist cointegration relationships among the variables in each of the models. This implies that there is a long-term relationship between the independent and the dependent variables within each model.

In the long run, the four macroeconomic uncertainty sub-indicators also significantly affect the ten sectors under investigation. Furthermore, fiscal sustainability significantly affects the sectors negatively, while credit penetration to these sectors had positive effects on the sectors under investigation.

Table 5. The Novel Dynamic ARDL Result on the Impact of Economic Uncertainty on the Selected Sectors.

Panel A	**Agric**	**Manufacturing**	**Solid Minerals**	**Real Estate**	**Trade**
Lag of Dependent Variable	−0.313 ***	−0.391 ***	−0.331 ***	−0.216 ***	−0.245 ***
	(0.0509)	(0.0607)	(0.0554)	(0.0409)	(0.0453)
D(INFU)	−0.0490 ***	0.0150 **	0.0390 ***	0.0220 ***	−0.0800 ***
	(0.0039)	(0.0071)	(0.0045)	(0.0045)	(0.0040)
D(INTU)	−0.0170 ***	−0.0122 **	−0.0170 ***	−0.0500 **	−0.0500 ***
	(0.0033)	(0.0061)	(0.0039)	(0.0039)	(0.0034)
D(EXCU)	−0.1160 ***	−0.0635 **	−0.1140 ***	−0.1610 ***	−0.1360 ***
	(0.0153)	(0.0278)	(0.0177)	(0.0177)	(0.0156)
D(RGDPU)	−0.0470 *	−0.0891 ***	−0.1530 ***	−0.0760 ***	−0.0931 ***
	(0.0251)	(0.0453)	(0.0290)	(0.0290)	(0.0255)
D(LCPS)	0.2920 ***	0.7590 ***	0.1590 ***	0.0784	0.5660 ***
	(0.5060)	(0.0915)	(0.0586)	(0.5840)	(0.0515)
D(FS)	0.0011	−0.0016	0.0003	0.0033	0.0019
	(0.0023)	(0.0042)	(0.0027)	(0.0027)	(0.0024)
INFU	−0.0110 ***	−0.1209 ***	−0.0170 ***	−0.0128 ***	−0.0143 ***
	(0.0021)	(0.0038)	(0.0024)	(0.0024)	(0.0021)
INTU	−0.0190 ***	−0.9476 ***	−0.0238 ***	−0.0111 ***	−0.0122 ***
	(0.0033)	(0.0059)	(0.0038)	(0.0038)	(0.0033)
EXCU	−0.0898 ***	−0.4809 ***	−0.0501 ***	−0.0512 ***	−0.0158 ***
	(0.0071)	(0.0128)	(0.0083)	(0.0081)	(0.0072)
RGDPU	−0.2508 ***	−0.3960 ***	−0.1488 ***	−0.2290 ***	−0.1392 ***
	(0.0206)	(0.0371)	(0.0237)	(0.0238)	(0.0210)
LCPS	0.250 ***	0.405 ***	0.223 ***	0.233 ***	0.220 ***
	(0.0503)	(0.0807)	(0.0499)	(0.0559)	(0.0498)
FS	−0.0426 ***	−0.0714 ***	−0.0406 ***	−0.0450 ***	−0.0395 ***
	(0.0009)	(0.0016)	(0.0010)	(0.0011)	(0.0009)
ECT(-1)	−0.0959 ***	−0.0879 ***	−0.0889 ***	−0.0988 ***	−0.0894 ***
	(0.0005)	(0.0043)	(0.0021)	(0.0089)	(0.0078)
Constant	0.9270 ***	−0.9858 **	−0.8933 ***	−0.9360 ***	0.8004 ***
	(0.2080)	(0.3700)	(0.2380)	(0.2370)	(0.2090)
Observations	172	172	172	172	172
R-squared	0.204	0.289	0.2	0.164	0.189
F(7, 163)	3.1	4.9	3.01	2.37	2.81
Prob > F	0.0004	0.0000	0.0004	0.0063	0.0012
Bound Test F-Stat.	5.586	6.726	5.314	5.138	5.258
Panel B	**ICT**	**Finance and Insurance**	**Construction**	**Transport**	**Oil and Gas**
Lag of Dependent Variable	−0.163 ***	−0.328 ***	−0.209 ***	−0.296 ***	−0.324 ***
	(0.0365)	(0.0516)	(0.0410)	(0.0505)	(0.0516)
D(INFU)	−0.0230 ***	−0.0156 ***	−0.0384 ***	−0.0156 ***	−0.0119 ***
	(0.0044)	(0.0040)	(0.0042)	(0.0038)	(0.0041)
D(INTU)	−0.0789 ***	−0.0445 ***	−0.0338 ***	−0.0541 ***	−0.0267 ***
	(0.0037)	(0.0034)	(0.0036)	(0.0032)	(0.0034)
D(EXCU)	−0.1152 ***	−0.1811 ***	−0.0914 ***	−0.0912 ***	−0.9163 ***
	(0.0171)	(0.0157)	(0.0165)	(0.0147)	(0.0158)
D(RGDPU)	−0.0824 ***	−0.0593 **	−0.1284 ***	−0.9102 ***	−0.0882 ***
	(0.0281)	(0.0257)	(0.0270)	(0.2400)	(0.0259)
D(LCPS)	0.0366	0.0555	0.0038	0.1560	−0.1120
	(0.5660)	(0.5170)	(0.5440)	(0.4850)	(0.5220)
D(FS)	0.0024	0.0026	0.0026	0.0008	0.0028
	(0.0026)	(0.0024)	(0.0025)	(0.0022)	(0.0024)
INFU	−0.0786 ***	−0.0219 ***	−0.0144 ***	−0.0609 ***	−0.0161 ***
	(0.0024)	(0.0022)	(0.0023)	(0.0020)	(0.0022)
INTU	−0.0156 ***	−0.0132 ***	−0.0204 ***	−0.0110 ***	−0.0191 ***
	(0.0037)	(0.0034)	(0.0035)	(0.0031)	(0.0034)
EXCU	−0.0351 ***	−0.0586 ***	−0.0335 ***	−0.0281 ***	−0.0198 ***
	(0.0079)	(0.0072)	(0.0076)	(0.0068)	(0.0073)
RGDPU	−0.1790 ***	−0.1807 ***	−0.1104 ***	−0.1960 ***	−0.2080 ***
	(0.0231)	(0.0212)	(0.0221)	(0.0197)	(0.0214)
LCPS	0.231 ***	0.295 ***	0.216 ***	0.216 ***	0.224 ***
	(0.0601)	(0.0549)	(0.0512)	(0.0461)	(0.0472)
FS	−0.0328 ***	−0.0447 ***	−0.0382 ***	−0.0391 ***	−0.0428 ***
	(0.0010)	(0.0009)	(0.0010)	(0.0009)	(0.0009)
ECT(-1)	−0.0921 ***	−0.0897 ***	−0.0856 ***	−0.0898 ***	−0.0859 ***
	(0.0045)	(0.0064)	(0.0029)	(0.0089)	(0.0099)

Table 5. *Cont.*

Constant	−0.9600 ***	−0.9490 ***	−0.9230 ***	0.9123 ***	0.9940 ***
	(0.2330)	(0.2120)	(0.2200)	(0.1960)	(0.2170)
Observations	172	172	172	172	172
R-squared	0.124	0.213	0.165	0.187	0.215
F(7, 163)	1.71	3.26	2.38	2.77	3.31
Prob > F	0.0036	0.0002	0.0061	0.0014	0.0002
Bound Test F-Stat.	4.984	5.939	5.923	5.077	5.726

Source: Author's Computation. Note: Bound test lower and upper critical values at 5 percent are 3.23086 and 4.350, respectively. '***', '**', and '*' are the significance levels at 1 percent, 5 percent, and 10 percent, respectively. RGDPU is real GDP uncertainty, INFU is inflation uncertainty, INTU is interest rate uncertainty, EXCU is exchange rate uncertainty, LCPS is the log of credit to the private sector, FS is fiscal sustainability, Agric is the Agriculture sector real GDP, Finance and Insurance is the finance and insurance sector real GDP, ICT is the ICT sector real GDP, Manufacturing is the manufacturing sector real GDP, Oil and Gas is the oil and gas sector real GDP, Solid Minerals is the solid minerals sector real GDP, Real Estate is the real estate sector real GDP, Construction is the construction sector real GDP, Trade is the trade sector real GDP, and Transport is the transport sector real GDP.

4.4. Robustness

4.4.1. The Impact of Macroeconomic Uncertainty on the Selected Sectors Using the CCR and FMOLS Techniques

To establish whether the main analysis is valid, we adopted two different regression methods as a robustness to the main analysis. Thus, the study employed the Fully Modified Ordinary Least Square (FMOLS) and Canonical Cointegration Regression (CCR) methods to ascertain the impact of macroeconomic uncertainty on sector output in Nigeria. The results in Table 6 were in line with the dynamic ARDL results depicted in Table 4, and with the same signs. The FMOLS results showed that macroeconomic uncertainty negatively and significantly affected the sectors under investigation. On the other hand, private sector credit had positive effects on the sectors under investigation, while fiscal sustainability had negative effects on these sectors in the long run. Finally, the results of the CCR estimates in Panel B of Table 6 were in line with the FMOLS results in Panel A of Table 6. This implies that the results of these estimates were in line with the main analysis, ensuring their robustness.

Table 6. FMOLS and CCR Results on the Impact of Macroeconomic Uncertainty on the Sectors.

FMOLS						
Panel A		**Agric**	**Manufacturing**	**Solid Minerals**	**Real Estate**	**Trade**
MU	Coefficient	−0.0449 ***	−0.0852 ***	−0.0570 ***	−0.0984 ***	−0.0474 ***
	Std. Error	(0.0017)	(0.0018)	(0.0128)	(0.0177)	(0.0140)
LCPS	Coefficient	0.7426 ***	0.9031 ***	0.5707 ***	1.0008 ***	0.8141 ***
	Std. Error	(0.0527)	(0.0805)	(0.0579)	(0.0798)	(0.0631)
FS	Coefficient	−0.0141 ***	−0.0200 ***	−0.0134 ***	−0.0209 ***	−0.0165 ***
	Std. Error	(0.0016)	(0.0024)	(0.0017)	(0.0024)	(0.0019)
C	Coefficient	0.9626 ***	−0.8682 ***	−0.8832 ***	−1.9732 ***	−0.8889 ***
	Std. Error	(0.2987)	(0.1559)	(0.3278)	(0.4521)	(0.2578)
		ICT	**Finance and Insurance**	**Construction**	**Transport**	**Oil and Gas**
MU	Coefficient	−0.1449 ***	−0.1684 ***	−0.1021 ***	−0.0678 ***	−0.1330 ***
	Std. Error	(0.0203)	(0.0117)	(0.0168)	(0.0115)	(0.0121)
LCPS	Coefficient	1.2879 ***	0.8622 ***	0.8838 ***	0.6621 ***	0.6545 ***
	Std. Error	(0.0914)	(0.0528)	(0.0759)	(0.0519)	(0.0548)
FS	Coefficient	−0.0211 ***	−0.0138 ***	−0.0184 ***	−0.0136 ***	−0.0135 ***
	Std. Error	(0.0027)	(0.0016)	(0.0023)	(0.0020)	(0.0016)
C	Coefficient	−2.2916 ***	−1.0732 ***	−0.9651 ***	−0.4602 ***	0.4031
	Std. Error	(0.5180)	(0.2992)	(0.4299)	(0.2941)	(0.3082)

Table 6. *Cont.*

CCR						
Panel B		**Agric**	**Manufacturing**	**Solid Minerals**	**Real Estate**	**Trade**
MU	Coefficient	−0.0945 ***	−0.0863 ***	−0.0564 ***	−0.0534 ***	0.0635 ***
	Std. Error	(0.0116)	(0.0177)	(0.0127)	(0.0175)	(0.0139)
LCPS	Coefficient	0.7428 ***	0.9043 ***	0.5716 ***	1.0011 ***	0.8140 ***
	Std. Error	(0.0519)	(0.0792)	(0.0569)	(0.0785)	(0.0621)
FS	Coefficient	−0.0140 ***	−0.0199 ***	−0.0133 ***	−0.0208 ***	−0.0165 ***
	Std. Error	(0.0015)	(0.0024)	(0.0017)	(0.0023)	(0.0018)
C	Coefficient	0.8626 ***	−1.8734 ***	−1.8874 ***	−1.2975 ***	−1.0867 ***
	Std. Error	(0.2918)	(0.4447)	(0.3193)	(0.4418)	(0.3497)
		ICT	**Finance and Insurance**	**Construction**	**Transport**	**Oil and Gas**
MU	Coefficient	−0.0715 ***	−0.0677 ***	−0.0529 ***	−0.0687 ***	−0.0715 ***
	Std. Error	(0.0091)	(0.0064)	(0.0067)	(0.0018)	(0.0065)
LCPS	Coefficient	1.2879 ***	0.8622 ***	0.8840 ***	0.6620 ***	0.6541 ***
	Std. Error	(0.0900)	(0.0519)	(0.0747)	(0.0511)	(0.0535)
FS	Coefficient	−0.0210 ***	−0.0137 ***	−0.0183 ***	−0.0135 ***	−0.0135 ***
	Std. Error	(0.0027)	(0.0015)	(0.0022)	(0.0015)	(0.0016)
C	Coefficient	−2.2891 ***	−1.0718 ***	−1.9640 ***	−1.4583 ***	1.4042 ***
	Std. Error	(0.5059)	(0.2923)	(0.4201)	(0.2873)	(0.3013)

Source: Author's Computation. '***' and '**' are the significance levels at 1 percent and 5 percent respectively. MU is Macroeconomic uncertainty, LCPS is the log of credit to the private sectors, FS is fiscal sustainability, Agric Sector is the Agricultural sector real GDP, Finance and Insurance is the finance and insurance sector real GDP, ICT is the ICT sector real GDP, Manufacturing is the manufacturing sector real GDP, Oil and Gas is the oil and gas sector real GDP, Solid Minerals is the solid minerals sector real GDP, Real Estate is the real estate sector real GDP, Construction is the construction sector real GDP, Trade is the trade sector real GDP, and Transport is the transport sector real GDP.

4.4.2. The Impact of Disaggregated Economic Uncertainty on the Selected Sectors Using the FMOLS and CCR Techniques

In line with the main regression using the dynamic ARDL method, the FMOLS and CCRs in Table 7 (a,b) also showed similar outcomes on the impacts of the different macroeconomic uncertainty sub-indexes on sector output in Nigeria. From Panel Table 7 (a), which focuses on the FMOLS results, real GDP uncertainty, inflation uncertainty, exchange rate uncertainty, and interest rate uncertainty significantly and positively affected the ten different sectors under investigation. On the other hand, private sector credits had positive impacts on these sectors, while fiscal sustainability had negative effects on each of the sectors under investigation. Finally, the CCR results in Table 7 (b) were in line with the results of the FMOLS regressions in Table 7 (a). In general, these results on the impact of macroeconomic uncertainty and the disaggregated components on sector output were in line with the main findings using the dynamic ARDL method. In essence, the dynamic ARDL simulations automatically demonstrate the predictions of a change in the regressors and their impacts on the dependent variable, while maintaining the constant values of other explanatory factors.

Table 7. (a) FMOLS Results on the Impact of Economic Uncertainty on the Sectors. (b) CCR Results on the Impact of Economic Uncertainty on the Sectors.

a						
FMOLS						
Variable		**Agric**	**Manufacturing**	**Solid Minerals**	**Real Estate**	**Trade**
INFU	Coefficient	−0.0389 ***	−0.0669 ***	−0.0564 ***	−0.0427 ***	−0.0387 ***
	Std. Error	(0.0050)	(0.0076)	(0.0054)	(0.0076)	(0.0060)
INTU	Coefficient	−0.0394 ***	−0.0779 ***	−0.0381 ***	−0.0396 ***	−0.0231 ***
	Std. Error	(0.0073)	(0.0110)	(0.0078)	(0.0110)	(0.0087)
EXCU	Coefficient	−0.0135 ***	−0.0989 ***	−0.06139 ***	−0.0825 ***	−0.0135 ***
	Std. Error	(0.0017)	(0.0256)	(0.0082)	(0.0257)	(0.0020)

Table 7. *Cont.*

a						
FMOLS						
Variable		**Agric**	**Manufacturing**	**Solid Minerals**	**Real Estate**	**Trade**
RGDPU	Coefficient	−0.0211 ***	−0.0244 ***	−0.0167 ***	−0.0182 ***	−0.0850 ***
	Std. Error	(0.0049)	(0.0073)	(0.0052)	(0.0741)	(0.0058)
LCPS	Coefficient	0.7996 ***	1.0093 ***	0.6543 ***	1.0828 ***	0.88238
	Std. Error	(0.0766)	(0.1154)	(0.0817)	(0.1159)	0.091703
FS	Coefficient	−0.0141 ***	−0.0200 ***	−0.0133 ***	−0.0209 ***	−0.0166 ***
	Std. Error	(0.0015)	(0.0023)	(0.0016)	(0.0023)	(0.0018)
C	Coefficient	2.1926 ***	−2.1617 ***	−1.2140 **	−2.4611 ***	−1.2486 **
	Std. Error	(0.5078)	(0.7643)	(0.5414)	(0.7674)	(0.6072)
		ICT	**Finance and Insurance**	**Construction**	**Transport**	**Oil and Gas**
INFU	Coefficient	−0.0309 ***	−0.0349 ***	−0.01847 **	−0.0896 ***	−0.0359 ***
	Std. Error	(0.0086)	(0.0050)	(0.0071)	(0.0049)	(0.0051)
INTU	Coefficient	−0.0813 ***	−0.0543 ***	−0.0256 ***	−0.0465 ***	−0.0214 ***
	Std. Error	(0.0126)	(0.0073)	(0.0010)	(0.0071)	(0.0074)
EXCU	Coefficient	−0.0522 ***	−0.0752 ***	−0.0105 ***	−0.0567 ***	−0.0722 ***
	Std. Error	(0.0295)	(0.0017)	(0.0024)	(0.0016)	(0.0017)
RGDPU	Coefficient	−0.0312 ***	−0.0161 ***	−0.0228 ***	−0.0843 ***	−0.0364 ***
	Std. Error	(0.0086)	(0.0049)	(0.0069)	(0.0479)	(0.0049)
LCPS	Coefficient	1.3900 ***	0.8916 ***	0.9891 ***	0.7263 ***	0.6949 ***
	Std. Error	(0.1325)	(0.0766)	(0.1094)	(0.0750)	(0.0780)
FS	Coefficient	−0.0210 ***	−0.0138 ***	−0.0184 ***	−0.0135 ***	−0.0135 ***
	Std. Error	(0.0026)	(0.0015)	(0.0022)	(0.0015)	(0.0016)
C	Coefficient	−2.2812 ***	−1.3014 **	−2.9681 ***	−1.5453 ***	2.3663 ***
	Std. Error	(0.8771)	(0.5075)	(0.7241)	0.49645	0.516579
b						
CCR						
Variable		**Agric**	**Manufacturing**	**Solid Minerals**	**Real Estate**	**Trade**
INFU	Coefficient	−0.0456 ***	−0.0759 ***	−0.0501 ***	−0.0528 ***	−0.0465 ***
	Std. Error	(0.0052)	(0.0078)	(0.0055)	(0.0078)	(0.0061)
INTU	Coefficient	−0.0310 ***	−0.0681 ***	−0.0313 ***	−0.0268 ***	−0.0738 ***
	Std. Error	(0.0079)	(0.0120)	(0.0085)	(0.0012)	(0.0096)
EXCU	Coefficient	−0.0559 ***	−0.0135 ***	−0.0197 ***	−0.0824 ***	−0.0769 ***
	Std. Error	(0.0166)	(0.0025)	(0.0017)	(0.0251)	(0.0198)
RGDPU	Coefficient	−0.0219 ***	−0.0247 ***	−0.0463 ***	−0.0471 ***	−0.0322 ***
	Std. Error	(0.0047)	(0.0071)	(0.0050)	(0.0071)	(0.0056)
LCPS	Coefficient	0.8132 ***	1.0280 ***	0.6685 ***	1.1029 ***	0.8984 ***
	Std. Error	(0.0775)	(0.1166)	(0.0826)	(0.1171)	(0.0927)
FS	Coefficient	−0.0139 ***	−0.0197 ***	−0.0132 ***	−0.0206 ***	−0.0200 ***
	Std. Error	(0.0015)	(0.0022)	(0.0016)	(0.0022)	(0.0017)
C	Coefficient	1.4882 ***	−1.7654 ***	−1.9011 ***	−2.0299 ***	2.1003 ***
	Std. Error	(0.3862)	(0.5801)	(0.4116)	(0.5836)	(0.4620)
		ICT	**Finance and Insurance**	**Construction**	**Transport**	**Oil and Gas**
INFU	Coefficient	−0.0400 ***	−0.0420 ***	−0.0280 ***	−0.0620 ***	−0.0425 ***
	Std. Error	(0.0089)	(0.0052)	(0.0073)	(0.0050)	(0.0053)
INTU	Coefficient	−0.0733 ***	−0.0437 ***	−0.0138 ***	−0.0387 ***	−0.0134 ***
	Std. Error	(0.0138)	(0.0079)	(0.0011)	(0.0078)	(0.0081)
EXCU	Coefficient	−0.0130 ***	−0.0492 ***	−0.0183 ***	−0.0112 ***	−0.0227 ***
	Std. Error	(0.0028)	(0.0017)	(0.0024)	(0.0016)	(0.0016)
RGDPU	Coefficient	−0.0613 ***	−0.0375 ***	−0.0309 ***	−0.0282 ***	−0.0564 ***
	Std. Error	(0.0081)	(0.0047)	(0.0670)	(0.0046)	(0.0048)
LCPS	Coefficient	1.4105 ***	0.9053 ***	1.0086 ***	0.7398 ***	0.7079 ***
	Std. Error	(0.1339)	(0.0773)	(0.1103)	(0.0758)	(0.0789)
FS	Coefficient	−0.0207 ***	−0.0136 ***	−0.0181 ***	−0.0133 ***	−0.0133 ***
	Std. Error	(0.0026)	(0.0015)	(0.0021)	(0.0015)	(0.0015)
C	Coefficient	−1.8462 ***	−0.9797 **	−1.7405 ***	−1.2474 ***	1.6537 ***
	Std. Error	(0.6667)	(0.3861)	0.5509	(0.3776)	(0.3927)

Source: Author's Computation. '***' and '**' are the significance levels at 1 percent and 5 percent, respectively. RGDPU is real GDP uncertainty, INFU is inflation uncertainty, INTU is interest rate uncertainty, EXCU is exchange rate uncertainty, LCPS is the log of credit to the private sector, FS is fiscal sustainability, Agric is the Agriculture sector real GDP, Finance and Insurance is the finance and insurance sector real GDP, ICT is the ICT sector real GDP, Manufacturing is the manufacturing sector real GDP, Oil and Gas is the oil and gas sector real GDP, Solid Minerals is the solid minerals sector real GDP, Real Estate is the real estate sector real GDP, Construction is the construction sector real GDP, Trade is the trade sector real GDP, and Transport is the transport sector real GDP.

4.5. Impulse Response Results from the Novel Dynamic ARDL Estimation

Impulse Response Results—Macroeconomic Uncertainty and Sectoral Output

The impulse response plot of macroeconomic uncertainty on sectoral output is displayed in Figure 2. It shows the changes in macroeconomic uncertainty and its effect on the agriculture sector's real GDP in Nigeria. The study examined the effect of a shock from macroeconomic uncertainty from the tenth period. This is because macroeconomic disruptions sometimes do not produce immediate effects; rather, they may require time to manifest. The delayed response of sector output to macroeconomic uncertainty can be captured by researchers by commencing the analysis in period 10. This enables a more thorough comprehension of the long-term impact of these disruptions on the economy. By extending the analysis to 30 periods, it is possible to observe the long-term effects and adjustments in sector output. It is essential for policy implications that researchers can determine whether the effects of macroeconomic uncertainty are temporary or persistent. Furthermore, a lengthier time frame allows for the capture of a variety of response patterns across sectors, thereby increasing the analysis's robustness.

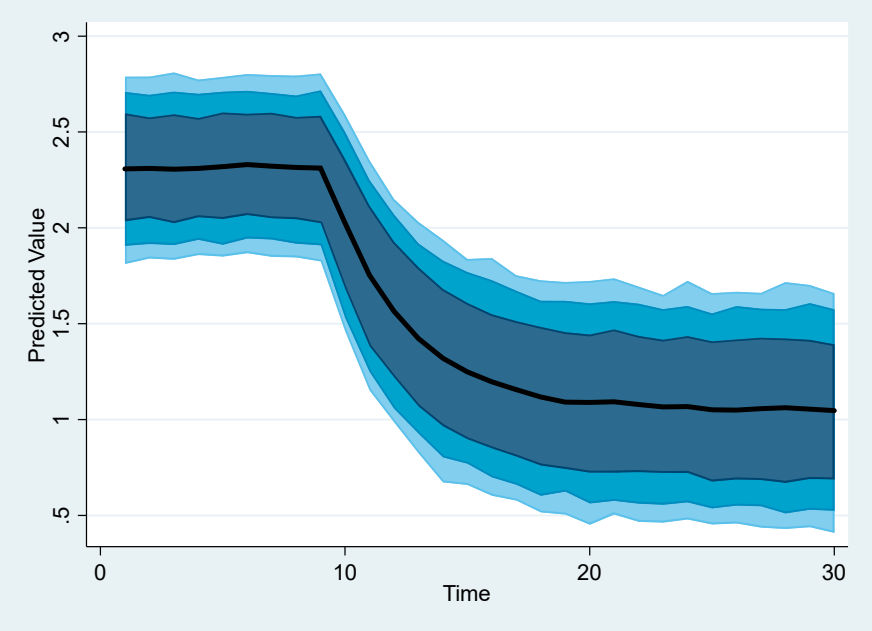

Figure 2. The impulse response plot for macroeconomic uncertainty and agriculture sector real GDP. Source: Author's computation. A predicted value change in macroeconomic uncertainty and its influence on the agriculture sector, where the black line specifies the average prediction value. However, the dark blue to light blue denotes 75%, 90%, and 95% confidence intervals, respectively.

The findings from Figure 2 shows that a percentage shock from macroeconomic uncertainty in periods 1 to 9 will produce a small statistical significance in agriculture GDP and strongly correlates with a change in the agriculture sector by roughly 2.3 percent within the first nine periods. However, this increase will become stronger from the 10th period and over the long term, as agriculture GDP falls steeply between the 10th and 20th periods, before agricultural output falls mildly, between the 21st to 30th periods. This suggests that, in Nigeria, a change in macroeconomic uncertainty changes agricultural output both in the short and long term, with more debilitating long-term consequences.

Figure 3 demonstrates the plot of macroeconomic uncertainty and the manufacturing sector. The findings show that a percentage shock from macroeconomic uncertainty at periods 1 to 9 will produce a small statistical significance in manufacturing GDP by roughly 1.5 percent within the first nine periods. However, this increase will become slightly stronger from the 10th period and over the long term, as manufacturing GDP slightly falls to a long-term average of 1.3 percent from the 10th to 30th periods. This

suggests that, in Nigeria, a standard deviation shock to macroeconomic uncertainty has slightly significant effects on the manufacturing sector. This is because manufacturing typically entails established workflows and long-term production processes. It is frequently challenging for firms to adjust output substantially in response to short-term uncertainties because they frequently have established schedules and capacities. Additionally, numerous manufacturing organizations execute lengthy agreements with their suppliers and clients. These commitments may restrict the capacity to rapidly modify production levels, leading to only minor adjustments in response to macroeconomic disruptions. To mitigate fluctuations in demand, manufacturers frequently maintain substantial inventories. This inventory has the potential to mitigate the immediate reactions to disruptions, enabling businesses to satisfy demand without the necessity of substantially altering production levels. As a result, firms may be slow to adjust production levels in response to macroeconomic uncertainty. This inertia can lead to sustained effects from shocks as businesses wait for clearer signals before making changes.

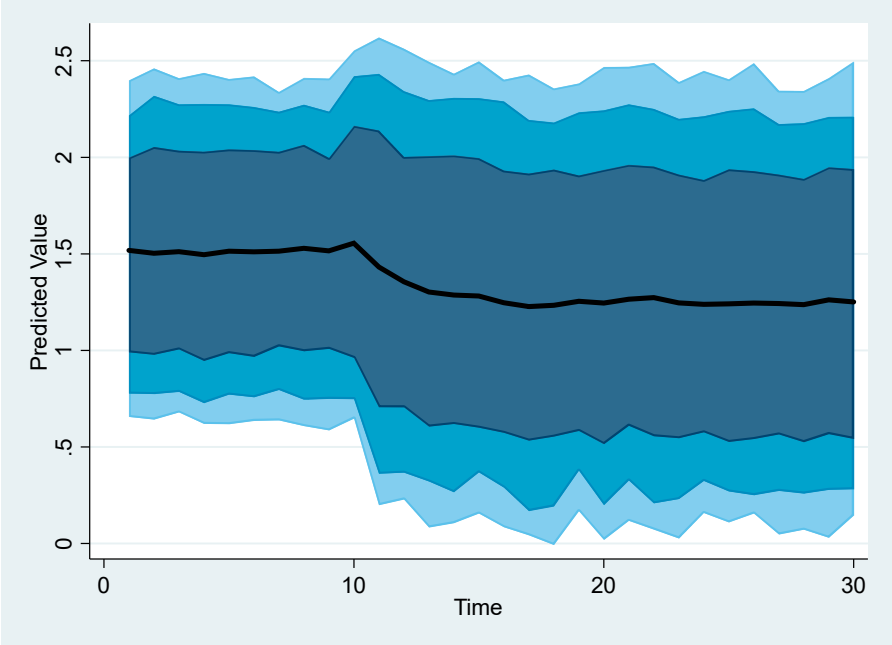

Figure 3. The impulse response plot for macroeconomic uncertainty and manufacturing sector real GDP. A predicted value change in macroeconomic uncertainty and its influence on the manufacturing sector, where the black line specifies the average prediction value. However, the dark blue to light blue denotes 75%, 90% and 95% confidence intervals, respectively.

Figure 4 demonstrates the plot of macroeconomic uncertainty and the solid mineral sector. The findings show that a percentage shock from macroeconomic uncertainty at periods 1 to 9 will produce a small statistical significance in the solid mineral sector GDP and strongly correlates with a change in the solid mineral sector by roughly 0.16 percent within the first nine periods. However, this increase will become stronger from the 10th period and over the long term, as the solid mineral sector GDP falls steeply to negative between the 10th and 30th periods. This suggests that, in Nigeria, a standard deviation shock from macroeconomic uncertainty changes the output produced in the solid mineral sector negatively over the long term.

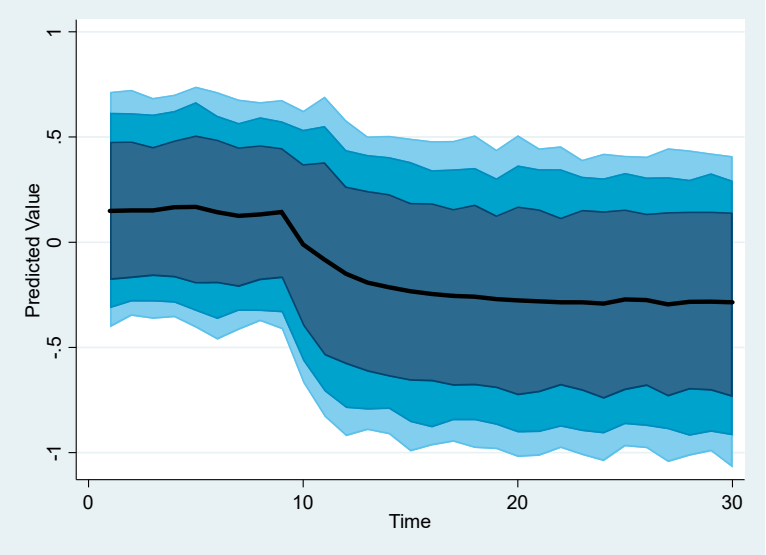

Figure 4. The impulse response plot for macroeconomic uncertainty and solid mineral sector real GDP. A predicted value change in Macroeconomic uncertainty and its influence on the solid mineral sector, where the black line specifies the average prediction value. However, the dark blue to light blue denotes 75%, 90%, and 95% confidence intervals, respectively.

Figure 5 demonstrates the plot of macroeconomic uncertainty and the real estate sector. The findings show that a percentage shock from macroeconomic uncertainty at periods 1 to 9 will produce a small statistical significance in the real estate sector GDP and strongly correlates with a change in the real estate sector by roughly 1.25 percent within the first nine periods. However, this increase will become stronger from the 10th period and over the long term, as the real estate sector GDP falls steeply to negative between the 10th and 30th periods. This suggests that, in Nigeria, a standard deviation shock from macroeconomic uncertainty changes the output produced in the real estate sector negatively over the long term.

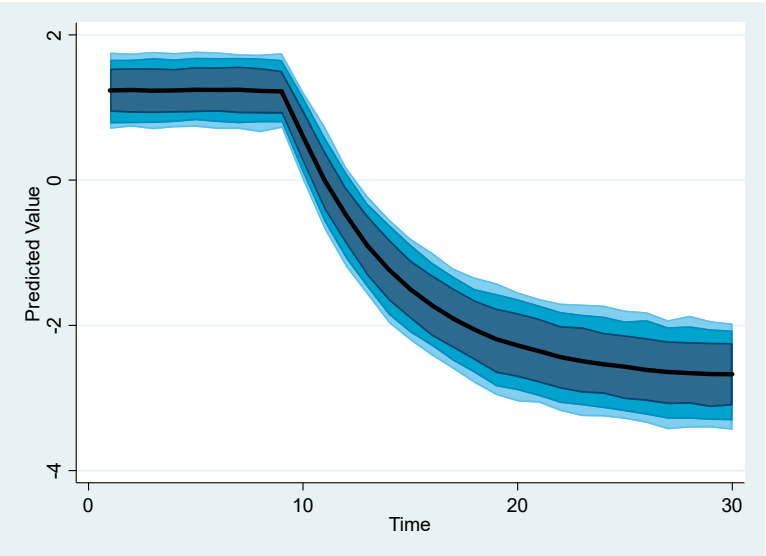

Figure 5. The impulse response plot for macroeconomic uncertainty and real estate sector real GDP. A predicted value change in Macroeconomic uncertainty and its influence on the real estate sector, where the black line specifies the average prediction value. However, the dark blue to light blue denotes 75%, 90%, and 95% confidence intervals, respectively.

Figure 6 demonstrates the plot of macroeconomic uncertainty and the trade sector. The findings show that a percentage shock from macroeconomic uncertainty in periods 1 to 9 will produce a small statistical significance in the trade sector GDP and strongly correlates with a change in the trade sector by roughly 2 percent within the first nine periods. However, this effect will become stronger from the 10th period, falling to negative by the 18th period, as the trade sector GDP falls steeply to negative between the 18th and 30th periods due to macroeconomic uncertainty shocks. This suggests that, in Nigeria, a standard deviation shock from macroeconomic uncertainty changes the output produced in the trade sector negatively over the long term.

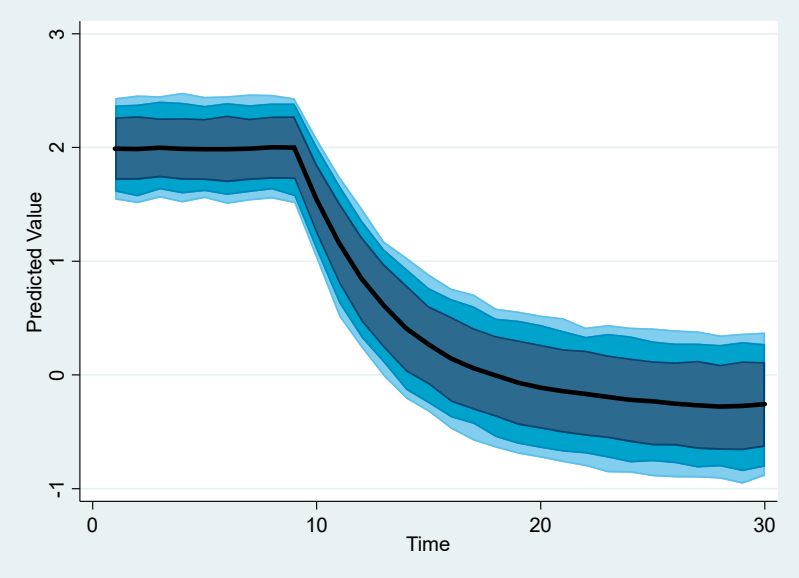

Figure 6. The impulse response plot for macroeconomic uncertainty and trade sector real GDP. A predicted value change in macroeconomic uncertainty and its influence on the trade sector, where the black line specifies the average prediction value. However, the dark blue to light blue denotes 75%, 90% and, 95% confidence intervals, respectively.

Figure 7 demonstrates the plot of macroeconomic uncertainty and the ICT sector. The findings show that a percentage shock from macroeconomic uncertainty in periods 1 to 9 will produce a small statistical significance in the ICT sector GDP and strongly correlates with a change in the ICT sector by roughly 1.1 percent within the first nine periods. However, this effect will become stronger from the 10th period, falling to negative by the 10th period, as the ICT sector GDP falls steeply to negative between the 10th and 30th periods due to macroeconomic uncertainty shocks. This suggests that, in Nigeria, a standard deviation shock from macroeconomic uncertainty changes the output produced in the ICT sector negatively over the long term.

Figure 8 demonstrates the plot of macroeconomic uncertainty and the finance and insurance sectors. The findings show that a percentage shock from macroeconomic uncertainty in periods 1 to 9 will produce a small statistical significance in the finance and insurance sector GDP and strongly correlates with a change in the finance and insurance sector by roughly 1.3 percent within the first nine periods. However, this effect will become stronger from the 10th period, falling to negative by the 12th period, as the finance and insurance sector GDP falls steeply to negative between the 12th and 30th periods due to macroeconomic uncertainty shocks. This suggests that, in Nigeria, a standard deviation shock from macroeconomic uncertainty changes the output produced in the finance and insurance sector negatively over the long term.

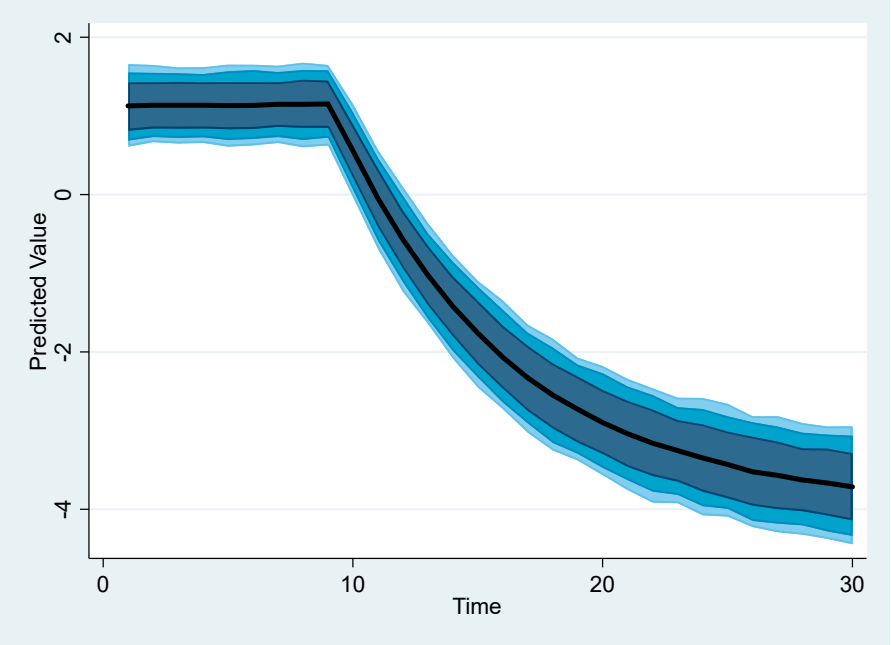

Figure 7. The impulse response plot for macroeconomic uncertainty and ICT sector real GDP. A predicted value change in macroeconomic uncertainty and its influence on the ICT sector, where the black line specifies the average prediction value. However, the dark blue to light blue denotes 75%, 90%, and 95% confidence intervals, respectively.

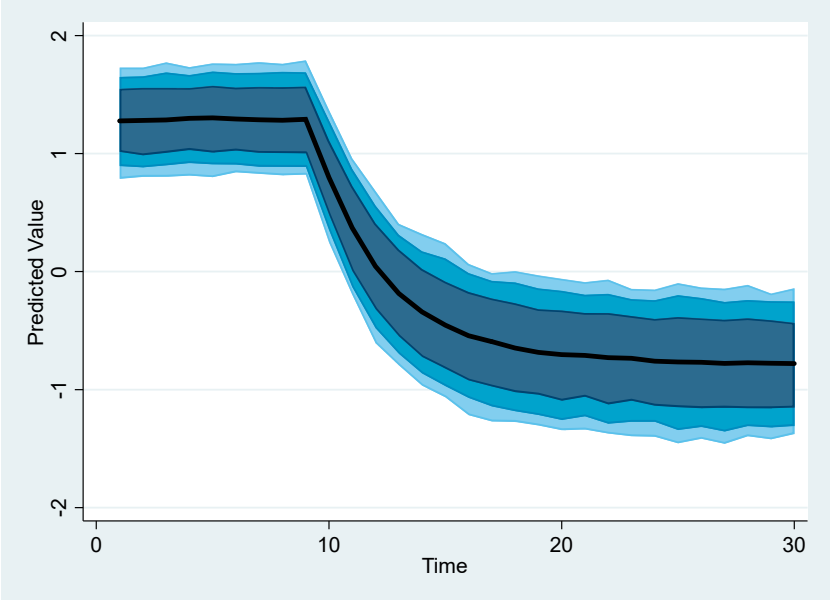

Figure 8. The impulse response plot for macroeconomic uncertainty and finance and insurance sector real GDP. A predicted value change in macroeconomic uncertainty and its influence on the finance and insurance sector, where the black line specifies the average prediction value. However, the dark blue to light blue denotes 75%, 90% and 95% confidence intervals, respectively.

Figure 9 demonstrates the plot of macroeconomic uncertainty and the construction sector. The findings show that a percentage shock from macroeconomic uncertainty in periods 1 to 9 will produce a small statistical significance in the construction sector GDP and strongly correlates with a change in the construction sector by roughly 1.1 percent within the first nine periods. However, this effect will become stronger from the 10th period, falling to negative by the 12th period, as the construction sector GDP falls steeply

to negative between the 12th and 30th periods due to macroeconomic uncertainty shocks. This suggests that, in Nigeria, a standard deviation shock from macroeconomic uncertainty changes the output produced in the construction sector negatively over the long term.

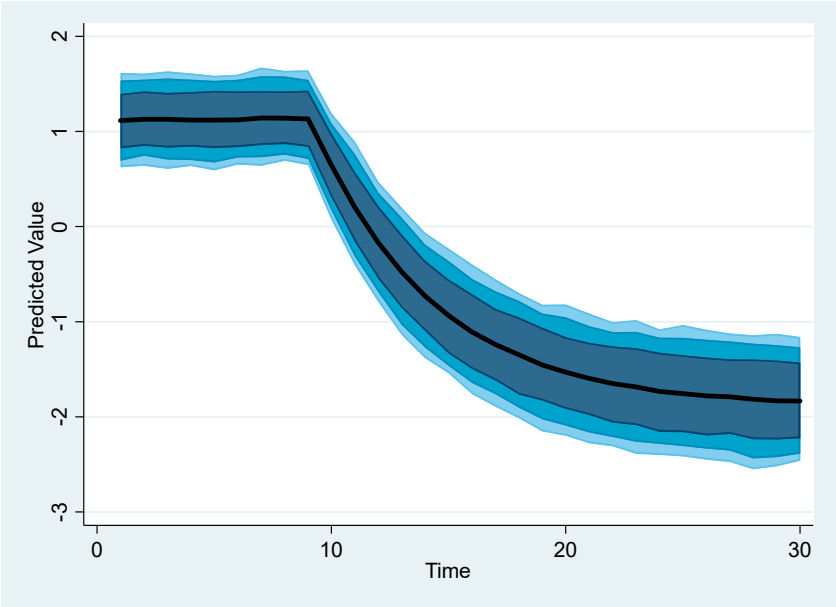

Figure 9. The impulse response plot for macroeconomic uncertainty and construction sector real GDP. A predicted value change in macroeconomic uncertainty and its influence on the construction sector, where the black line specifies the average prediction value. However, the dark blue to light blue denotes 75%, 90%, and 95% confidence intervals, respectively.

Figure 10 demonstrates the plot of macroeconomic uncertainty and the transport sector. The findings show that a percentage shock from macroeconomic uncertainty in periods 1 to 9 will produce a small statistical significance in the transport sector GDP and strongly correlates with a change in the transport sector by roughly 1.1 percent within the first nine periods. However, this effect will become stronger from the 10th period, falling to negative in this period and up to the 30th period due to macroeconomic uncertainty shocks. This suggests that, in Nigeria, a standard deviation shock from macroeconomic uncertainty changes the output produced in the transport sector negatively over the long term.

Figure 11 demonstrates the plot of macroeconomic uncertainty and the oil and gas sector. The findings show that a percentage shock from macroeconomic uncertainty in periods 1 to 9 will produce a small statistical significance in the oil and gas sector GDP and strongly correlates with a change in the oil and gas sector by roughly 2.1 percent within the first nine periods. However, this effect will become stronger from the 10th period and over the long term, as the oil and gas GDP falls steeply between the 10th and 30th periods. This suggests that, in Nigeria, a change in macroeconomic uncertainty reduces the oil and gas output both in the short and long term, with more debilitating long-term consequences.

In summary, shocks arising from macroeconomic uncertainty reduce sector outputs in the agriculture, manufacturing, and oil and gas sectors significantly, albeit the effects of the shock still have a slightly positive effect on these sectors over the long term. However, macroeconomic uncertainty shocks have more debilitating consequences on the other sectors (the solid mineral sector, real estate sector, trade sector, ICT sector, finance and insurance sector, construction sector, and the transport sector) over the long term.

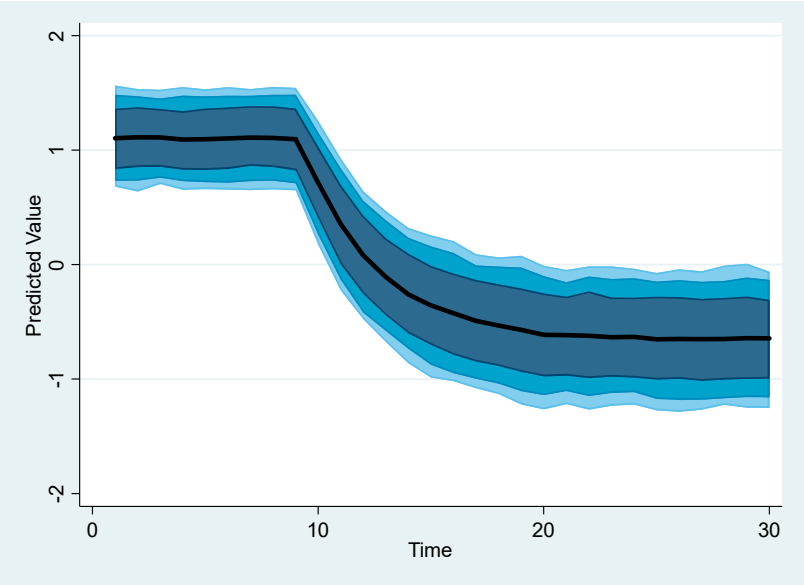

Figure 10. The impulse response plot for macroeconomic uncertainty and transport sector real GDP. A predicted value change in macroeconomic uncertainty and its influence on the transport sector, where the black line specifies the average prediction value. However, the dark blue to light blue denotes 75%, 90%, and 95% confidence intervals, respectively.

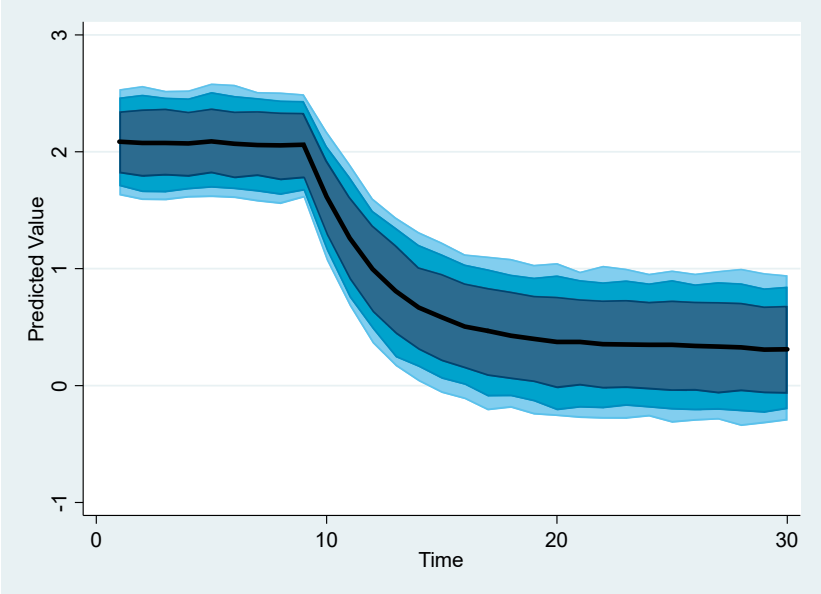

Figure 11. The impulse response plot for macroeconomic uncertainty and oil and gas sector real GDP. A predicted value change in macroeconomic uncertainty and its influence on the oil and gas sector, where the black line specifies the average prediction value. However, the dark blue to light blue denotes 75%, 90%, and 95% confidence intervals, respectively.

5. Discussion of Results

The paper examined the impact of macroeconomic uncertainty on the biggest sectors of the Nigerian economy, constituting roughly 89 percent of economic activities. The constructed macroeconomic uncertainty showed that uncertainty heightened between 1986 and 1993, in 2002, in 2016, in 2020, and in 2023, when the Nigerian economy was affected by several economic activities. The 1986 to 1993 period of higher uncertainty was affected by the introduction of SAP. Also, the 2002 period of uncertainty was due to the liberalization of the economy. During the heightened 2016 uncertainty, Nigeria fell into a recession,

demonstrating that a rise in uncertainty tends to lower economic performance in Nigeria, while the COVID-19 pandemic led to higher uncertainty in 2020, and the recent elections and cash crunch policies by the central bank of Nigeria heightened uncertainty in 2023. This implies that macroeconomic policies tend to have a weaker influence during periods of high uncertainty, which is common during recessions (Caggiano et al. 2017; Castelnuovo and Pellegrino 2018; Tran et al. 2019; Oyadeyi 2024b; Oyadeyi et al. 2024c). Interestingly, our measure of uncertainty peaked in tandem with the periods when Nigeria witnessed recessions in 2016 and 2020, respectively. Therefore, these findings are insightful as they display how macroeconomic uncertainty affects sub-sector output in Nigeria.

The main findings using the dynamic ARDL method revealed that macroeconomic uncertainty affects the different sectors of the economy negatively. In the long run, macroeconomic uncertainty continues to affect these sectors negatively. Furthermore, real GDP uncertainty, inflation uncertainty, exchange rate uncertainty, and interest rate uncertainty affect the selected sectors negatively. To establish the validity of the results of the main analysis, the study conducted an alternative exercise using the FMOLS and CCRs. The findings were in line with the main results, thereby validating the robustness of the results. These findings on the effect of macroeconomic uncertainty on sectoral output were in line with previous studies such as Ugurlu-Yildirim et al. (2021), Tran et al. (2019), Jurado et al. (2015), Moran et al. (2022), and Ludvigson et al. (2020, 2021) while it was in line with a previous study on Nigeria such as Ubi et al. (2021).

For the impulse response results, the study finds that shocks arising from macroeconomic uncertainty reduce sector outputs in the agriculture, manufacturing and oil and gas sectors significantly, albeit the effects of the shock still have a slightly positive effect on these sectors over the long term. This means that macroeconomic shocks weaken output in these sectors, but not to the extent of putting them in long-term recession. However, macroeconomic uncertainty shocks have more debilitating consequences on the other sectors (the solid mineral sector, real estate sector, trade sector, ICT sector, finance and insurance sector, construction sector, and the transport sector) over the long term. This is because shocks arising from macroeconomic uncertainty have negative consequences on these sectors' output and contribution to GDP over the long term. As a result, aggregate economic growth can be impeded by adverse effects on sectoral output. This can contribute to a fall in GDP, which may impede the development of the national economy and create long-term economic obstacles. Furthermore, the economy's overall resilience can be compromised by persistent negative effects from uncertainty, rendering it more vulnerable to future disruptions. This can impede the capacity to adjust to evolving economic conditions and recovery efforts. In essence, the adverse consequences of macroeconomic uncertainty on sectoral output can result in a variety of broader economic challenges, such as slowed growth, employment losses, investment delays, and potential policy interventions. These challenges may have long-term repercussions for the economy. This result corroborates earlier findings suggested by Greig et al. (2018) and Tran et al. (2019).

The implication of the exchange rate uncertainty is that the depreciation of the naira may result in tradable inflation, which could have a negative impact on the activities of the sectors under investigation. This finding is also supported by Kamber et al. (2016) and Tran et al. (2019). Foreign investors may be discouraged by exchange rate uncertainty as a result of the elevated risk of their returns being diminished by currency fluctuations. This has the potential to result in a decrease in foreign direct investment (FDI), which is essential for economic progress and development. In an unstable exchange rate environment, local businesses may also hesitate to invest due to the challenge of predicting costs and returns. This is particularly important in sectors that rely on capital, such as infrastructure and manufacturing. Additionally, sectors that depend on imported products and materials may experience an increase in import costs due to exchange rate uncertainty. This may result in decreased output and elevated production expenses.

The implication of inflation uncertainty is that consumer confidence can be diminished. In the event that individuals are uncertain about future price levels, they may reduce their

expenditures and increase their savings as a precaution. A decrease in consumer expenditure can have a detrimental impact on sectoral growth by reducing aggregate demand. It is also challenging for businesses to plan for the future due to inflation uncertainty. This has the potential to result in productivity declines by impacting production schedules, pricing strategies, and expansion plans. Furthermore, both domestic and foreign investors may experience diminished investment opportunities as a consequence of elevated inflation uncertainty. Investors favor environments that are stable, as they are able to more precisely foresee future costs and returns. Long-term planning is impeded by uncertainty, which results in a decrease in investment levels.

The potential consequence of interest rate uncertainty on sectoral output is that it may result in decreased investment, as businesses may postpone or terminate investment plans as a result of the unpredictable nature of financing costs. This is especially harmful to capital-intensive industries, including manufacturing, infrastructure, and real estate. For example, the real estate and construction sectors are significantly affected by high interest rate uncertainty, as they depend on long-term financing. Reduced investments in new ventures and slowed growth in housing markets may result from uncertainty. Additionally, unpredictable interest rates can have a detrimental impact on the agricultural sector, which frequently relies on seasonal financing to purchase inputs such as seedlings and fertilizers. Farmers' capacity to finance these inputs may be impaired by elevated borrowing costs, which can result in diminished agricultural output. Conversely, the manufacturing and industrial sectors (solid minerals and oil and gas sectors, for example) necessitate substantial capital expenditures for apparatus, equipment, and basic materials. Uncertainty regarding interest rates may result in increased financing expenses, which could potentially result in production reductions and a decrease in profitability.

The implication of real GDP uncertainty is that it can result in a decrease in both domestic and foreign investments. The unpredictability of economic returns may cause investors to be hesitant to commit capital to new initiatives or expand existing ones. This may result in a decrease in capital formation, which is crucial for economic expansion. Moreover, uncertainty can result in businesses delaying or reducing their investment in infrastructure, technology, and other long-term initiatives, thereby reducing the overall capacity for economic expansion. This conservative approach has the potential to impede development and diminish competitiveness. The manufacturing and industrial sectors, which frequently depend on substantial capital investment and long-term planning, may be particularly affected by their effects on these sectors. Lower production levels and job losses may result from decreased investment and consumer demand. Agricultural investments and production decisions can be influenced by uncertainty in the agriculture sector. Farmers may be hesitant to invest in new technologies or expand operations, which could result in a decrease in agricultural output and potential food security concerns. The general service sectors, which encompass trade, ICT, transport, finance, and insurance, are experiencing a decline in consumer expenditure and investment. Business closures and job losses may result from decreased demand. Lastly, the construction and real estate sectors, which are heavily reliant on stable economic conditions and investment, may experience postponements or cancelations of projects, decreased property values, and decreased construction activities as a result of uncertainty.

In general, macroeconomic uncertainty can result in decreased investment, as businesses and investors may postpone or terminate investment plans as a result of the uncertain nature of economic conditions. Sectors that are significantly dependent on capital investment, including manufacturing, infrastructure, and real estate, may experience a decrease in output. For instance, the manufacturing and industrial sectors (solid mineral and oil and gas sectors to be specific from the study) may be particularly susceptible to macroeconomic uncertainty as a result of their dependence on stable economic conditions and long-term investments. Lower production and job losses may result from decreased investment and demand. Additionally, uncertainty can have a detrimental impact on agriculture output, as producers may be hesitant to invest in new technologies or expand their operations.

This may result in decreased agricultural productivity and potential food security concerns. Furthermore, the services sector, which encompasses the finance and insurance, trade, ICT, and transport sectors, may experience a decline in consumer expenditure and investment. Business closures and job losses may result from decreased demand. Lastly, the real estate and construction industries are significantly reliant on investment and economic stability. Macroeconomic uncertainty may result in reduced property values, postponed or canceled projects, and decreased construction activity.

6. Conclusions and Policy Implications

6.1. Conclusions

The paper examined the impact of macroeconomic uncertainty on the largest subsectors of the Nigerian economy using quarterly data from 1981Q1 to 2023Q4. The rationale behind selecting the subsectors is that these sectors constitute about 89 percent of the entire real economic activities in Nigeria. To achieve the objectives, the paper created four different indexes for economic uncertainty using the real GDP growth, interest rate, exchange rate and inflation rate. Afterwards, the paper used the mean to average the different uncertainty components to create a macroeconomic uncertainty index for Nigeria. The specific sectors observed in the paper include agriculture, finance and insurance, ICT, manufacturing, oil and gas, solid minerals, real estate, construction, transport, and trade sectors, respectively. The paper used fiscal sustainability and credit to the private sectors as control variables.

Overall, the paper showed that during periods of recession, macroeconomic uncertainty tends to heighten in Nigeria. Furthermore, the results show that macroeconomic uncertainty and the individual economic uncertainty indexes (real GDP uncertainty, exchange rate uncertainty, inflation uncertainty and interest rate uncertainty) are all important drivers of the business cycle of the economy of Nigeria. This is due to their influence on real economic activity in Nigeria. In addition, the impulse response from the dynamic ARDL estimates shows that macroeconomic uncertainty can predict robust movements in sector output for Nigeria. These findings on the effect of macroeconomic uncertainty on sectoral output were in line with previous studies such as Ugurlu-Yildirim et al. (2021), Tran et al. (2019), Jurado et al. (2015), Moran et al. (2022), and Ludvigson et al. (2020, 2021), and it was in line with a previous study on Nigeria, Ubi et al. (2021).

In essence, a key finding from the paper using the dynamic ARDL method shows that the sectors react homogenously to macroeconomic uncertainty, which highlights the importance of a stable economic environment. This result provides a holistic examination of how macroeconomic uncertainty affects sector output from the perspective of a developing economy like Nigeria. Indeed, these findings are insightful as they show the importance of macroeconomic uncertainties as key drivers of real economic activity in Nigeria. The paper argues that the policy authorities should improve their efforts to stabilize the macroeconomic environment if Nigeria is to aim for higher levels of sustainable growth and reduce the effect of macroeconomic uncertainty on economic productivity in Nigeria. The limitations of the paper stem from the fact that data on the variables could not be gathered from the period of 1960, when the Nigerian economy gained independence, while future studies may look into the effect of macroeconomic uncertainty on sectoral output within the African context.

6.2. Policy Implications

Based on the findings of the study, the following economic and financial implications of the findings from the study are highlighted below:

The implications for Sectoral Policy: The results of this research can be utilized by policymakers to develop sector-specific measures that seek to alleviate the adverse consequences of macroeconomic uncertainty. For instance, to mitigate the negative effects, sectors such as finance and insurance might necessitate stability measures. Conversely,

policies that exploit the positive effects could prove advantageous for sectors like ICT and transportation.

Investment Decisions: The insights can be utilized by businesses and investors to enhance the quality of their investment decisions. Gaining insight into the ways in which sectors react to macroeconomic uncertainty can be beneficial for formulating asset allocation and risk management strategies.

Risk Management: The results of this study can be utilized by financial institutions to enhance and optimize their risk management procedures. Banks and other financial institutions can allocate capital more efficiently and conduct more accurate credit risk assessments by monitoring the effects of various economic uncertainties on sectors.

Macroeconomic Stability: To preserve economic stability as a whole, it is vital to address macroeconomic uncertainty. Uncertainty in critical industries such as finance and insurance can trigger a chain reaction that impacts various facets of the economy, including consumer purchasing, employment, and overall economic expansion.

Policy Formulation: These findings can be employed by governments to develop macroeconomic policies that are more efficacious. For instance, policymakers must take into account the different impacts that policies targeting inflation stabilization or interest rate adjustments may have on different sectors when formulating policy interventions.

International Trade and Foreign Investments: The comprehension of sectoral reactions to macroeconomic uncertainty can likewise exert an impact on the determinations regarding international trade and foreign investment. Nations characterized by greater sectoral stability may be more successful in attracting foreign investment, whereas those beset by high levels of uncertainty may encounter difficulties in this regard.

Overall Economic Growth: Effective management of macroeconomic uncertainty has the potential to significantly contribute to the maintenance of overall economic development. Policymakers can cultivate a more favorable atmosphere for investment, innovation, and entrepreneurship, all of which are pivotal catalysts for sustained economic progress, through a reduction in uncertainty.

In conclusion, the ramifications of these findings on the sectors of interest and aggregate economy highlight the criticality of proficiently handling macroeconomic uncertainty to safeguard long-term development prospects, sectoral performance, and economic stability as a whole.

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Data Availability Statement: The data are available on available request.

Conflicts of Interest: The author declares no conflict of interest.

Appendix A

Table A1. Descriptive Statistics of the Variables.

	Real Estate GDP	Agric GDP	Construction GDP	Finance GDP	ICT GDP	Manufacturing GDP	Oil & Gas GDP	Solid Minerals	Trade GDP
Mean	1.1274	2.2637	1.0254	1.2152	0.9388	1.4191	2.0108	0.0804	1.9060
Median	0.2446	1.6735	0.2431	0.7027	−0.0548	0.7692	1.4521	−0.4109	1.1873
Maximum	3.7214	4.2636	3.4282	3.3710	4.0227	3.8251	3.9344	2.0261	4.0681
Minimum	−0.0874	1.2488	−0.2407	−0.1307	−0.7832	−0.2009	1.1343	−0.9631	0.8631
Std. Dev.	1.4374	1.0267	1.3084	1.1458	1.7523	1.3262	0.9459	0.9547	1.1592
Skewness	0.7509	0.7576	0.7421	0.6406	0.6535	0.6509	0.7946	0.7679	0.7525
Kurtosis	1.6543	1.7674	1.6785	1.7231	1.5859	1.6789	1.8101	1.8756	1.7037
Jarque-B.	29.144	27.343	28.305	23.451	26.573	24.655	28.247	25.963	28.276
Prob.	0.192	0.153	0.176	0.132	0.246	0.295	0.331	0.120	0.189
Sum	193.916	389.362	176.377	209.014	161.469	244.077	345.860	13.831	327.839
SSD	353.293	180.243	292.752	224.500	525.091	300.737	153.007	155.866	229.782

Table A1. *Cont.*

	Real Estate GDP	Agric GDP	Construction GDP	Finance GDP	ICT GDP	Manufacturing GDP	Oil & Gas GDP	Solid Minerals	Trade GDP
Obs.	172.000	172.000	172.000	172.000	172.000	172.000	172.000	172.000	172.000
	MU	**RGDPU**	**INTU**	**INFU**	**EXCU**	**FS**	**LCPS**	**Transport GDP**	
Mean	15.0171	9.4294	5.9940	16.8559	27.7890	19.9054	2.8850	1.0558	
Median	12.8296	9.6986	2.2638	10.8924	29.9736	3.9479	2.9766	0.4871	
Maximum	34.3185	9.7047	51.2571	66.2959	30.5596	107.6277	4.6487	3.0250	
Minimum	1.9248	0.0000	0.0000	0.3817	0.0000	−17.6516	0.8998	0.0286	
Std. Dev.	5.5060	1.2557	8.6366	16.3328	4.7518	31.5795	1.2038	0.9693	
Skewness	1.2671	−6.0300	2.6767	1.1884	−2.8749	1.2121	−0.2093	0.7736	
Kurtosis	4.2187	41.5742	11.4550	3.4372	12.9316	3.2357	1.5694	1.7945	
Jarque-B.	56.666	11,706.150	717.707	41.856	943.824	42.513	15.924	27.573	
Prob.	0.548	0.138	0.220	0.142	0.119	0.130	0.269	0.115	
Sum	2582.933	1621.849	1030.966	2899.212	4779.706	3423.730	496.217	181.590	
SSD.	5184.053	269.645	12,755.030	45,616.260	3861.192	170,532.200	247.801	160.659	
Obs.	172.000	172.000	172.000	172.000	172.000	172.000	172.000	172.000	

Source: Author's Computation.

Table A2. Correlation Matrix on the Analyses of Macroeconomic Uncertainty on the Biggest Sectors.

Agriculture Sector	**Agric GDP**	**MU**	**LCPS**	**FS**
Agric GDP	1			
MU	−0.5285	1		
LCPS	0.8433	−0.5757	1	
FS	−0.4160	0.1094	−0.0245	1
Manufacturing Sector	**Manufacturing**	**MU**	**LCPS**	**FS**
Manufacturing GDP	1			
MU	−0.4873	1		
LCPS	0.7870	−0.5757	1	
FS	−0.4554	0.1094	−0.0245	1
Solid Minerals Sector	**Solid Minerals**	**MU**	**LCPS**	**FS**
Solid Minerals GDP	1			
MU	−0.6006	1		
LCPS	0.7897	−0.5757	1	
FS	−0.4412	0.1094	−0.0245	1
Real Estate Sector	**Real Estate**	**MU**	**LCPS**	**FS**
Real Estate GDP	1			
MU	−0.5394	1		
LCPS	0.8237	−0.5757	1	
FS	−0.4421	0.1094	−0.0245	1
Trade Sector	**Trade**	**MU**	**LCPS**	**FS**
Trade GDP	1			
MU	−0.5450	1		
LCPS	0.8310	−0.5757	1	
FS	−0.4330	0.1094	−0.0245	1
ICT Sector	**ICT**	**MU**	**LCPS**	**FS**
ICT GDP	1			
MU	−0.5622	1		
LCPS	0.8717	−0.5757	1	
FS	−0.3740	0.1094	−0.0245	1
Finance and Insurance Sector	**Finance and Insurance**	**MU**	**LCPS**	**FS**
Finance and Insurance GDP	1			
MU	−0.5358	1		
LCPS	0.8792	−0.5757	1	
FS	−0.3642	0.1094	−0.0245	1

Table A2. *Cont.*

Construction GDP	**Construction**	**MU**	**LCPS**	**FS**
Construction GDP	1			
MU	−0.5665	1		
LCPS	0.8222	−0.5757	1	
FS	−0.4323	0.1094	−0.0245	1
Transport GDP	**Transport**	**MU**	**LCPS**	**FS**
Transport GDP	1			
MU	−0.5629	1		
LCPS	0.8277	−0.5757	1	
FS	−0.4312	0.1094	−0.0245	1
Oil& Gas GDP	**Oil and Gas**	**MU**	**LCPS**	**FS**
Oil and Gas GDP	1			
MU	−0.5307	1		
LCPS	0.8147	−0.5757	1	
FS	−0.4322	0.1094	−0.0245	1

Source: Author's Computation.

Table A3. Correlation Matrix on the Analyses of Disaggregated Macroeconomic Uncertainty on the Biggest Sectors.

	Agric GDP	**INFU**	**INTU**	**EXCU**	**RGDPU**	**LCPS**	**FS**
Agric GDP	1						
INFU	−0.6209	1.0000					
INTU	−0.4152	0.6083	1.0000				
EXCU	0.4496	−0.2286	−0.3376	1.0000			
RGDPU	−0.0397	0.1217	0.0438	0.4348	1.0000		
LCPS	0.8433	−0.7009	−0.4988	0.6296	0.0676	1.0000	
FS	−0.4160	0.0999	0.0293	0.0850	0.0956	−0.0245	1.0000
	Manufacturing	**INFU**	**INTU**	**EXCU**	**RGDPU**	**LCPS**	**FS**
Manufacturing GDP	1						
INFU	−0.5750	1.0000					
INTU	−0.3723	0.6083	1.0000				
EXCU	0.4057	−0.2286	−0.3376	1.0000			
RGDPU	−0.0418	0.1217	0.0438	0.4348	1.0000		
LCPS	0.7870	−0.7009	−0.4988	0.6296	0.0676	1.0000	
FS	−0.4554	0.0999	0.0293	0.0850	0.0956	−0.0245	1.0000
	Solid Minerals	**INFU**	**INTU**	**EXCU**	**RGDPU**	**LCPS**	**FS**
Solid Minerals	1						
INFU	−0.6756	1.0000					
INTU	−0.4317	0.6083	1.0000				
EXCU	0.3447	−0.2286	−0.3376	1.0000			
RGDPU	−0.0831	0.1217	0.0438	0.4348	1.0000		
LCPS	0.7897	−0.7009	−0.4988	0.6296	0.0676	1.0000	
FS	−0.4412	0.0999	0.0293	0.0850	0.0956	−0.0245	1.0000
	Real Estate	**INFU**	**INTU**	**EXCU**	**RGDPU**	**LCPS**	**FS**
Real Estate GDP	1						
INFU	−0.6241	1.0000					
INTU	−0.4190	0.6083	1.0000				
EXCU	0.4233	−0.2286	−0.3376	1.0000			
RGDPU	−0.0627	0.1217	0.0438	0.4348	1.0000		
LCPS	0.8237	−0.7009	−0.4988	0.6296	0.0676	1.0000	
FS	−0.4421	0.0999	0.0293	0.0850	0.0956	−0.0245	1.0000

Table A3. *Cont.*

	Trade	**INFU**	**INTU**	**EXCU**	**RGDPU**	**LCPS**	**FS**
Trade GDP	1						
INFU	−0.6294	1.0000					
INTU	−0.4283	0.6083	1.0000				
EXCU	0.4304	−0.2286	−0.3376	1.0000			
RGDPU	−0.0556	0.1217	0.0438	0.4348	1.0000		
LCPS	0.8310	−0.7009	−0.4988	0.6296	0.0676	1.0000	
FS	−0.4330	0.0999	0.0293	0.0850	0.0956	−0.0245	1.0000
	ICT	**INFU**	**INTU**	**EXCU**	**RGDPU**	**LCPS**	**FS**
ICT GDP	1						
INFU	−0.6563	1.0000					
INTU	−0.4361	0.6083	1.0000				
EXCU	0.4561	−0.2286	−0.3376	1.0000			
RGDPU	−0.0521	0.1217	0.0438	0.4348	1.0000		
LCPS	0.8717	−0.7009	−0.4988	0.6296	0.0676	1.0000	
FS	−0.3740	0.0999	0.0293	0.0850	0.0956	−0.0245	1.0000
	Finance and Insurance	**INFU**	**INTU**	**EXCU**	**RGDPU**	**LCPS**	**FS**
Finance and Insurance GDP	1						
INFU	−0.6380	1.0000					
INTU	−0.4285	0.6083	1.0000				
EXCU	0.4962	−0.2286	−0.3376	1.0000			
RGDPU	−0.0287	0.1217	0.0438	0.4348	1.0000		
LCPS	0.8792	−0.7009	−0.4988	0.6296	0.0676	1.0000	
FS	−0.3642	0.0999	0.0293	0.0850	0.0956	−0.0245	1.0000
	Construction	**INFU**	**INTU**	**EXCU**	**RGDPU**	**LCPS**	**FS**
Construction GDP	1						
INFU	−0.6456	1.0000					
INTU	−0.4320	0.6083	1.0000				
EXCU	0.3982	−0.2286	−0.3376	1.0000			
RGDPU	−0.0736	0.1217	0.0438	0.4348	1.0000		
LCPS	0.8222	−0.7009	−0.4988	0.6296	0.0676	1.0000	
FS	−0.4323	0.0999	0.0293	0.0850	0.0956	−0.0245	1.0000
	Transport	**INFU**	**INTU**	**EXCU**	**RGDPU**	**LCPS**	**FS**
Transport GDP	1						
INFU	−0.6486	1.0000					
INTU	−0.4203	0.6083	1.0000				
EXCU	0.4041	−0.2286	−0.3376	1.0000			
RGDPU	−0.0749	0.1217	0.0438	0.4348	1.0000		
LCPS	0.8277	−0.7009	−0.4988	0.6296	0.0676	1.0000	
FS	−0.4312	0.0999	0.0293	0.0850	0.0956	−0.0245	1.0000
	Oil and Gas	**INFU**	**INTU**	**EXCU**	**RGDPU**	**LCPS**	**FS**
Oil and Gas GDP	1						
INFU	−0.6126	1.0000					
INTU	−0.4189	0.6083	1.0000				
EXCU	0.4267	−0.2286	−0.3376	1.0000			
RGDPU	−0.0745	0.1217	0.0438	0.4348	1.0000		
LCPS	0.8147	−0.7009	−0.4988	0.6296	0.0676	1.0000	
FS	−0.4322	0.0999	0.0293	0.0850	0.0956	−0.0245	1.0000

Source: Author's Computation.

Table A4. Lag Length Criteria on the Impact of Macroeconomic Uncertainty.

Agric Sector						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	−1627.706	NA	3208.499	19.42507	19.49945	19.45525
1	−638.7783	1918.99	0.029932	7.842599	8.214499 *	7.993534
2	−600.4318	72.58433	0.022948	7.57657	8.24599	7.848253 *
3	−583.0308	32.10902	0.022587	7.559891	8.526832	7.952323
4	−561.4236	38.84163 *	0.021161 *	7.493138 *	8.757599	8.006318

Table A4. *Cont.*

Agric Sector						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
Manufacturing Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−1700.335	NA	7617.43	20.2897	20.36408	20.31989
1	−735.3718	1872.488	0.094523	8.992522	9.364422 *	9.143457
2	−669.381	124.9112	0.052146	8.397393	9.066814	8.669077
3	−640.3189	53.62655	0.044673	8.241892	9.208833	8.634324
4	−602.8059	67.43415 *	0.034633 *	7.985784 *	9.250246	8.498964 *
Solid Minerals Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−1640.982	NA	3757.869	19.58312	19.6575	19.6133
1	−663.3558	1897.06	0.040105	8.135188	8.507088 *	8.286123
2	−621.0174	80.14038	0.029321	7.821636	8.491057	8.093320 *
3	−600.7781	37.34642	0.027901	7.771168	8.738109	8.1636
4	−578.4842	40.07593 *	0.025927 *	7.696241 *	8.960702	8.209421
Real Estate Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−1690.38	NA	6766.138	20.17119	20.24557	20.20138
1	−661.5059	1996.506	0.039232	8.113165	8.485066 *	8.2641
2	−627.4316	64.49769	0.031647	7.897995	8.567416	8.169679 *
3	−611.4247	29.53659	0.031671	7.897913	8.864854	8.290345
4	−587.0312	43.85025 *	0.028703 *	7.797990 *	9.062452	8.31117
Trade Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−1651.608	NA	4264.629	19.70962	19.784	19.73981
1	−640.2453	1962.525	0.030459	7.860063	8.231963 *	8.010998
2	−605.0062	66.70244	0.024232	7.631027	8.300447	7.902710 *
3	−588.917	29.68856	0.024227	7.629964	8.596905	8.022396
4	−564.2613	44.32149 *	0.021888 *	7.526920 *	8.791382	8.0401
ICT Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−1704.369	NA	7992.185	20.33773	20.41211	20.36791
1	−656.127	2034.089	0.036798	8.049131	8.421032 *	8.200066
2	−621.0734	66.35147	0.02934	7.822302	8.491723	8.093986 *
3	−604.7982	30.03159	0.029269	7.819026	8.785968	8.211458
4	−580.8962	42.96679 *	0.026682 *	7.724954 *	8.989416	8.238134
Finance and Insurance Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−1630.506	NA	3317.281	19.45841	19.53279	19.4886
1	−641.0272	1920.061	0.030744	7.869372	8.241272 *	8.020307
2	−607.964	62.58401	0.025101	7.666238	8.335659	7.937922 *
3	−590.3427	32.5154	0.024641	7.646937	8.613879	8.039369
4	−566.1404	43.50660 *	0.022383 *	7.549290 *	8.813752	8.06247
Construction Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−1677.491	NA	5803.664	20.01775	20.09213	20.04794
1	−649.3446	1995.094	0.033944	7.968388	8.340288 *	8.119323
2	−614.2041	66.51595	0.027036	7.740525	8.409946	8.012208 *
3	−597.0923	31.5754	0.026703	7.727289	8.69423	8.119721
4	−571.7448	45.56506 *	0.023928 *	7.616010 *	8.880471	8.12919

Table A4. *Cont.*

Agric Sector						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
Transport Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−1622.815	NA	3027.029	19.36684	19.44122	19.39703
1	−630.1914	1926.162	0.027023	7.740373	8.112274 *	7.891309
2	−598.1484	60.65284	0.022332	7.549385	8.218806	7.821069 *
3	−580.7279	32.14498	0.021976	7.532474	8.499416	7.924906
4	−556.9504	42.74280 *	0.020064 *	7.439886 *	8.704347	7.953066
Oil and Gas Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−1632.707	NA	3405.334	19.48461	19.55899	19.51479
1	−643.3261	1919.87	0.031597	7.89674	8.268640 *	8.047675
2	−606.8422	69.05891	0.024768	7.652883	8.322304	7.924567 *
3	−590.5758	30.01534	0.02471	7.649712	8.616653	8.042144
4	−567.9473	40.67739 *	0.022870 *	7.570802 *	8.835263	8.083982

Source: Author's Computation. '*' represents the selected lag-length criteria by the adopted method.

Table A5. Lag length Criteria on the Impact of Disaggregated Economic Uncertainty.

Agric Sector						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	−2962.046	NA	5,286,414	35.34579	35.47595	35.39862
1	−1755.321	2298.524	5.466906	21.56335	22.60467 *	21.98597
2	−1675.108	146.1017	3.780915	21.19177	23.14425	21.98418 *
3	−1620.625	94.69811	3.567743	21.12648	23.99012	22.28869
4	−1558.35	103.0496 *	3.088718 *	20.96845 *	24.74324	22.50045
Manufacturing Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−3035.108	NA	12,615,511	36.21558	36.34574	36.2684
1	−1849.256	2258.766	16.72636	22.68162	23.72294 *	23.10424
2	−1750.538	179.808	9.280695	22.08974	24.04222	22.88215 *
3	−1683.609	116.3297	7.55147	21.87629	24.73993	23.03849
4	−1591.106	153.0701 *	4.561745 *	21.35840 *	25.13319	22.8904
Solid Minerals Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−2974.675	NA	6,144,009	35.49613	35.62629	35.54895
1	−1779.296	2276.911	7.272739	21.84877	22.89009 *	22.27139 *
2	−1706.056	133.4022	5.46514	21.56019	23.51267	22.3526
3	−1651.227	95.29852	5.135846	21.4908	24.35443	22.653
4	−1590.256	100.8930 *	4.515800 *	21.34828 *	25.12307	22.88027
Real Estate Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−3024.012	NA	11,054,343	36.08347	36.21364	36.1363
1	−1778.095	2373.175	7.169458	21.83446	22.87579 *	22.25708
2	−1675.168	187.4744	3.783591	21.19248	23.14495	21.98489 *
3	−1621.349	93.54211	3.59865	21.13511	23.99874	22.29731
4	−1558.468	104.0533 *	3.093059 *	20.96986 *	24.74465	22.50185

Table A5. *Cont.*

Agric Sector						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
Trade Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−2985.703	NA	7,005,973	35.62741	35.75758	35.68024
1	−1756.628	2341.095	5.552588	21.5789	22.62022 *	22.00152
2	−1672.034	154.0815	3.645021	21.15516	23.10764	21.94757 *
3	−1620.989	88.7205	3.583256	21.13082	23.99446	22.29302
4	−1553.208	112.1619 *	2.905304 *	20.90724 *	24.68203	22.43923
ICT Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−3037.842	NA	13,032,744	36.24811	36.37828	36.30094
1	−1773.131	2408.972	6.758057	21.77537	22.81669 *	22.19799
2	−1671.244	185.5802	3.610909	21.14576	23.09824	21.93817 *
3	−1618.56	91.56976	3.48112	21.1019	23.96554	22.26411
4	−1555.005	105.1692 *	2.968117 *	20.92863 *	24.70342	22.46062
Finance and Insurance Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−2964.849	NA	5,465,804	35.37916	35.50933	35.43199
1	−1757.3	2300.093	5.59725	21.58691	22.62823 *	22.00953
2	−1670.579	157.9577	3.582419	21.13784	23.09032	21.93025 *
3	−1617.821	91.69743	3.450635	21.09311	23.95674	22.25531
4	−1553.349	106.6857 *	2.910199 *	20.90892 *	24.68371	22.44091
Construction Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−3011.575	NA	9,533,108	35.93542	36.06558	35.98825
1	−1765.977	2372.568	6.206312	21.6902	22.73152 *	22.11282
2	−1675.009	165.6911	3.776451	21.19059	23.14306	21.98300 *
3	−1622.146	91.88054	3.63297	21.1446	24.00823	22.3068
4	−1556.181	109.1577 *	3.009969 *	20.94263 *	24.71742	22.47462
Transport Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−2956.444	NA	4,945,359	35.2791	35.40926	35.33193
1	−1747.372	2302.995	4.973288	21.46872	22.51004 *	21.89133 *
2	−1671.952	137.3722	3.64148	21.15419	23.10667	21.9466
3	−1622.728	85.5562	3.658208	21.15152	24.01516	22.31373
4	−1557.003	108.7595 *	3.039573 *	20.95241 *	24.7272	22.48441
Oil and Gas Sector						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−2966.088	NA	5,547,023	35.39391	35.52408	35.44674
1	−1759.202	2298.831	5.725411	21.60955	22.65087 *	22.03217
2	−1672.369	158.1608	3.659585	21.15915	23.11163	21.95156 *
3	−1617.77	94.89766	3.448537	21.0925	23.95613	22.2547
4	−1556.741	100.9888 *	3.030109 *	20.94930 *	24.72409	22.48129

Source: Author's Computation. '*' represents the selected lag-length criteria by the adopted method.

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