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COLLEGE OF BUSINESS AND MANAGEMENT SCIENCES (COBAMS)

SCHOOL OF STATISTICS AND PLANNING

A TIME SERIES ANALYSIS OF THE CONTRIBUTIONS OF AGRICULTURE, INDUSTRY AND SERVICE SECTORS TO UGANDA'S GDP.

(2008-2024)

BY

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Declaration

I, Mirembe Persis, a Bachelor of Statistics student at Makerere University hereby declare that the work presented in this research proposal is my original work. Where other people's work has been used, it has been referenced in accordance with academic standards.

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Approval

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Definition Of Key Terms

Gross Domestic Product (GDP)

Gross Domestic Product (GDP) refers to the total monetary value of all final goods and services produced within a country during a specified period, usually measured annually or quarterly.

Agriculture Sector

The agriculture sector comprises economic activities related to crop production, livestock farming, forestry, and fishing that contribute to national output and income.

Industry Sector

The industry sector consists of economic activities involved in manufacturing, construction, mining and quarrying, electricity generation, and water supply.

Services Sector

The services sector includes economic activities that provide intangible products such as trade, transport, communication, finance, education, health services, tourism, and public administration.

Sectoral Contribution to GDP

Sectoral contribution to GDP refers to the value added by a particular sector of the economy expressed as part of the total Gross Domestic Product.

Economic Growth

Economic growth refers to an increase in the production of goods and services within an economy over time, usually measured by changes in GDP.

Time Series Analysis

Time series analysis is a statistical technique used to analyze data collected over successive time periods to identify patterns, trends, and forecast future values.

Trend

A trend is the long-term movement or direction of a variable over time, showing whether it is increasing, decreasing, or remaining stable.

Growth Rate

Growth rate refers to the percentage change in the value of a variable between two consecutive periods.

Forecasting

Forecasting is the process of predicting future values of a variable based on historical data and statistical models.

Stationarity

Stationarity is a property of a time series whereby its statistical characteristics, such as mean and variance, remain constant over time.

ARIMA Model

Autoregressive Integrated Moving Average (ARIMA) is a statistical time-series model used to analyze historical data and generate forecasts by accounting for trends and autocorrelation.

Structural Transformation

Structural transformation refers to the gradual shift of economic activity and employment from agriculture to industry and services as an economy develops.

Abstract

This study examined the contributions of Uganda's agriculture, industry, and services sectors to Gross Domestic Product (GDP) over the period 2008–2024. Secondary data were obtained from the Uganda Bureau of Statistics (UBOS) and analyzed using a quantitative time-series approach. Descriptive statistics were used to summarize sectoral performance, while linear regression trend analysis was employed to assess changes in sectoral GDP contributions over time. Differences in mean growth rates across sectors were examined using One-Way Analysis of Variance (ANOVA) with Tukey HSD post hoc tests. In addition, Autoregressive Integrated Moving Average (ARIMA) models were developed and validated to forecast sectoral GDP contributions from 2024 to 2027.

The results revealed statistically significant growth trends in all three sectors over the study period. The services sector recorded the strongest growth trend and remained the largest contributor to GDP, followed by industry and agriculture. Analysis of mean growth rates showed significant differences across sectors, with industry (1.294%) and services (1.227%) exhibiting significantly higher growth rates than agriculture (0.878%), while no significant difference was observed between industry and services. Forecast results indicated continued growth in all sectors through 2027, with services expected to maintain dominance, industry showing steady expansion, and agriculture recording the highest projected percentage increase despite remaining the smallest contributor.

The study concludes that Uganda is undergoing a service-led structural transformation characterized by sustained growth in all major sectors, although substantial disparities in sectoral performance persist. While economic growth is expected to continue, the imbalance between sectors suggests that structural transformation remains incomplete.

The study recommends strengthening agricultural productivity through investment in climate-resilient farming systems, promoting manufacturing-led industrialization, and enhancing digital transformation to ensure that growth in the services sector translates into broader employment and sustainable economic development.

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List of Abbreviations/Acronyms.

ACF	Autocorrelation Function
AIC	Akaike Information Criterion
ANOVA	Analysis of Variance
AR	Autoregressive
ARDL	Autoregressive Distributed Lag
ARIMA	Autoregressive Integrated Moving Average
BIC	Bayesian Information Criterion
df	Degrees of Freedom
EAC	East African Community
ECA	Eastern Europe and Central Asia
FDI	Foreign Direct Investment
FSD	Financial Sector Development
GDP	Gross Domestic Product
GDI	Gross Domestic Income
HCI	Human Capital Index
HSD	Honestly Significant Difference
I(1)	Integrated of Order One
I(2)	Integrated of Order Two
ICT	Information and Communication Technology
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
MA	Moving Average
NDP	National Development Plan

OECD	Organization for Economic Co-operation and Development
PACF	Partial Autocorrelation Function
q1, q2, q3, q4	Quarter 1, Quarter 2, Quarter 3, Quarter 4
SD	Standard Deviation
UBOS	Uganda Bureau of Statistics
UGX	Uganda Shilling
WDI	World Development Indicators

CHAPTER ONE: BACKGROUND

1.0 Introduction.

This chapter covers the background of the study, statement of the problem, main objective of the study, specific objectives, hypotheses, scope of the study and justification of the study.

1.1 Background of the Study.

Gross Domestic Product (GDP) is widely recognized as the central measure of economic activity and national performance. Adopted by the United Nations in 1953, GDP quantifies the total monetary value of goods and services produced within a country over a specific period. It is a critical indicator for policymakers and economists to monitor economic progress, allocate resources, and formulate development strategies. GDP can be measured in nominal terms at current market prices or in real terms, adjusted for inflation, which allows for meaningful comparison over time and between countries (Bwire, 2014). Complementing GDP, Gross Domestic Income (GDI) captures total income earned by households, including wages, rents, profits, and interest, offering insight into the distribution of economic gains within a country (Omamo et al., 2006) Understanding these measures is essential for evaluating both economic growth and equity in income distribution.

Sectoral analysis of GDP provides a deeper understanding of the structural composition of an economy and identifies the key drivers of growth. Economies are typically divided into three major sectors: agriculture, industry, and services. In Sub-Saharan Africa, agriculture historically dominated output, providing the bulk of employment and sustenance for rural populations (Smutka & Tomšík, 2014). However, structural transformation in recent decades has shifted economic activity toward industry and services, reflecting global trends toward industrialization and a knowledge-based economy. Despite this decline in GDP share, agriculture remains crucial in Uganda, supporting the livelihoods of a large proportion of the population and contributing significantly to food security (Magunda, 2020). The sector also forms the basis for agro-processing industries, which are important for value addition and export earnings.

The industrial sector, particularly manufacturing, is a key driver of sustainable economic growth and structural transformation. In Uganda, however, industrial growth has been heavily concentrated in construction rather than in manufacturing, limiting the sector's ability to generate employment, promote technological innovation, and create linkages with other sectors

(Muwanguzi et al., 2018). The potential of labour-intensive manufacturing to absorb new entrants into the labour market and drive inclusive growth remains largely untapped (Calabrese et al., 2019). Lessons from countries like South Korea and Malaysia indicate that industrialization, particularly through manufacturing, can accelerate structural transformation, increase productivity, and reduce reliance on the agricultural sector for employment (Clark, 1995).

Meanwhile, the services sector has become the largest contributor to Uganda's GDP, driven by growth in ICT, real estate, public administration, finance, and health services(Mbithi & Chekwoti, 2016). Despite its dominant share of output, the sector has a relatively low contribution to employment, indicating that GDP growth in services does not automatically translate into job creation(James et al., 2023). This divergence between sectoral output and employment creates structural imbalances in the economy, where most of the population remains in low-productivity agricultural jobs while fewer people benefit from the more productive service sector.

Uganda's economic structure has undergone notable shifts in recent decades. Between 1990 and 2015, real GDP grew at an average of 6.7% annually, while per capita GDP increased by 3.3% per year (Begumya & Tweheyo). During this period, agriculture's share of GDP fell from 56% to 24%, services increased from 32% to 55%, and industry expanded from 11% to 20%, with manufacturing remaining around 8% (Magunda, 2020). While these patterns are documented, there is a lack of rigorous time-series analysis comparing the growth trends, relative contributions, and stability of these three sectors over time. Without such analysis, it is difficult to determine whether sectoral growth is converging, diverging, or stable, limiting the evidence available for policymaking and long-term planning (James et al., 2023).

Therefore, this study seeks to fill these gaps by conducting a focused time-series analysis of agriculture, industry, and services in Uganda from 2008 to 2024. The study aims to assess trends, compare growth rates and variability, and forecast future contributions of the three sectors. The results are expected to provide updated empirical evidence on Uganda's structural economic dynamics, offering insights for policymakers, investors, and researchers interested in promoting balanced and sustainable growth.

1.2 Problem statement.

Despite agriculture being the largest sector in Uganda in terms of employment, the service sector contributes more to GDP and hence dominates economic output. This creates a structural imbalance, where most people work in a sector that generates relatively low economic value, while a smaller portion of the population benefits from the faster-growing service sector. This discrepancy is not well documented, and the reasons behind it remain unclear, which limits understanding of sectoral efficiency and productivity. To address this the study aims to analyse trends in sectoral contributions over the years to clearly understand why.

To guide structural transformation and monitor sectoral performance, Uganda operationalized the National Development Plans (NDPs) coordinated by the National Planning Authority. The 5-year National Development Plans outline the macroeconomic growth targets, medium-term specific objectives and strategies, as well as priority public sector development programmes. They set sectoral growth targets, promote value addition, industrialization, employment creation, and define measurable indicators to assess progress, providing a framework for evaluating sectoral contributions to Uganda's economic transformation.

Previous studies have explored Uganda's economic growth by focusing on factors such as human capital, physical capital, and productivity(Rumanzi et al., 2021). Financial sector development and foreign direct investment have also been shown to influence aggregate GDP growth (Omamo et al., 2006). However, these studies mostly look at overall GDP and do not examine how various sectors' contributions separately. They also rely on economic models without using detailed statistical time series analysis to track changes over time. As a result, little is known about sectoral performance and structural shifts in Uganda's economy overtime.

This study aims to analyse how agriculture, industry, and services contribute to Uganda's GDP and how their roles have changed over time. It seeks to identify growth trends in each sector, assess their contributions to overall economic growth, and highlight sectors driving growth and those underperforming. Using time series analysis, the study will provide empirical evidence to guide sector-focused policies and support sustainable economic transformation.

1.3 Main Objective.

To examine the trends and relative contributions of sectoral GDP components of agriculture, industry, and services over the study period and generate forecasts of their future trajectories.

1.4 Specific objectives.

1. To analyse the trends in GDP contributions of Uganda’s agriculture, industry and service sector from 2008 to 2024.
2. To compare the mean growth rates of GDP contributions across agriculture, industry and services over the study period.
3. To forecast the contributions of Uganda’s major economic sectors to GDP from 2024 through to 2027.

1.5 Hypotheses.

H01: There is no significant trend in the GDP contributions of agriculture over a period of 2008 to 2024.

H02: There is no significant trend in the GDP contributions of industry over a period of 2008 to 2024.

H03: There is no significant trend in the GDP contributions of services over a period of 2008 to 2024.

H04: There is no significant difference in the mean annual growth rates of GDP contributions for agriculture sector compared to industry and service sectors.

H05: There is no significant difference in the mean annual growth rates of GDP contributions for industry sector compared to agriculture and service sectors.

H06: There is no significant difference in the mean annual growth rates of GDP contributions for service sector compared to agriculture and industry sectors.

1.6 Scope of the study.

This study focuses on analysing the contributions of Uganda’s three major economic sectors (agriculture, industry, and services) to the country’s GDP over the period 2008 to 2024. It will use national-level data limited to secondary data obtained from the Uganda Bureau of Statistics.

The analysis will be limited to sectoral trends, growth rate comparisons across sectors, and the development of a model to forecast GDP contributions for each sector.

1.7 Justification of the study.

Uganda’s economy shows a structural imbalance where agriculture employs most of the population, yet the service sector contributes more to GDP. This mismatch limits income generation for most workers and raises questions about the efficiency and productivity of the country’s key sectors. Previous studies have focused on overall GDP and broad growth determinants, but they have not examined the trends and relative contributions of each sector over time.

This study will use time-series analysis to examine the contributions of agriculture, industry, and services to Uganda’s GDP from 2008 to 2024. The findings will provide updated empirical evidence on sectoral performance, structural shifts, and growth stability. This information can help policymakers and planners understand which sectors drive GDP, identify areas for investment, and develop strategies for balanced and sustainable economic development.

CHAPTER TWO: LITERATURE REVIEW.

2.0 Introduction.

This chapter reviews literature relevant to Gross Domestic Product (GDP) and its sectoral determinants, namely agriculture, industry, and services. The review is structured around the dependent variable (GDP) and the independent variables (agriculture, industrial, and service sectors), drawing evidence from global, regional (Sub-Saharan Africa and East Africa), and Uganda-specific studies.

2.1 Gross Domestic Product.

According to (Landefeld, 2000) GDP measures final purchases by households, business, and government by summing consumption, investment, government spending, and net exports, GDI measures total incomes earned by households by summing wages and salaries, rents, profits, interest, and other income. The accounts also provide information on the prices at which the output is sold and measures of real, inflation-adjusted, measures of output and income.

GDP structure and economic performance in Sub-Saharan countries was analyzed by (Smutka & Tomšík, 2014) who analyzed the period of 1990–2011. Considering the Sub-Saharan countries, their GDP had increased from about 300 billion USD to almost 1.3 trillion USD during the reference period; presented in constant prices, the growth had jumped from 411 billion USD to about 868 billion USD. Furthermore, (Smutka & Tomšík, 2014) stated that in relation to Africa, it is necessary to highlight one very specific feature of GDP structure and value development and both industrial and services sector's GDP value is growing very fast. In this specific case the value of industrial sector's GDP is growing even much faster than it is typical for the rest of the world.

Using panel econometric methods, (Onyango & Were, 2015) investigated and obtained the results highlighting the importance of the main determinants for economic growth in East Africa from the year 1975-2019. Thus, the long-run estimation empirical results obtained by the multivariate autoregressive distributed lags, ARDL (2,1,1,1) method, reveal that both FSD and FDI have positively significant effects on economic growth in the panel countries. (Gisore et al., 2014) reveal that spending on health and defense should be a priority for a government interested in promoting economic growth. Conversely, government expenditure on education and agriculture may not translate into sustainable economic growth since they will affect mainly the demand side of the economy. (Gisore et al., 2014) from a policy standpoint suggest that East Africa countries should increase government expenditure on health, which can enhance human capital formation, and on defense, which is closely associated with expenditure on security and aggregate demand.

Furthermore, (Bwire, 2014) compares GDP time series for Uganda from the Uganda Bureau of Statistics (UBOS) and the World Development Indicators (WDI), using both standard comparison and econometric techniques to derive a consistent and stable GDP series that ‘‘best’’ reflects Uganda’s economic welfare, (Bwire, 2014) discovered that although UBOS and WDI real UGX GDP year-on-year growth rate estimates have a 1.5 percentage point average absolute discrepancy per year, statistical evidence shows they are consistent, similar, and cointegrated but the UBOS real series is smoother and produces a more stable measure of GDP than does the WDI series.

2.2 Contribution of Sectors to Uganda’s GDP.

2.2.1 Contribution of Agriculture to Uganda’s GDP.

According to (Tomšík et al., 2015) agriculture continues to play a central role in Sub-Saharan African economies despite a declining share in GDP. Between 1990 and 2013, the agricultural sector’s contribution to regional GDP fell from 26% to around 10%, reflecting a structural shift toward industry and, to a lesser extent, services. Nevertheless, agriculture remains vital for employment and income generation, particularly in countries such as Tanzania, Zambia, and Kenya, where it still accounts for over 20% of GDP.

According to (Gollin, 2010) , agricultural productivity growth is essential for structural transformation, yet many Sub-Saharan African countries have experienced stagnated productivity growth, limiting the sector's contribution to GDP. Gollin notes that successful transformers like China and Vietnam achieved rapid agricultural growth before industrial expansion, challenging the notion that agriculture can be bypassed. (Christiaensen et al., 2011) further demonstrates that agricultural growth reduces poverty more effectively than other sectors, with a poverty-reducing effect approximately three times larger than non-agricultural growth, as it directly benefits the rural poor through higher farm incomes and lower food prices.

Also, (Omamo et al., 2006) examined the Strategic priorities for agricultural development in Eastern and Central Africa the distribution of agricultural GDP closely reflects the size and potential of national economies, with larger economies like Kenya, Tanzania, Uganda, the DRC, Ethiopia, and Madagascar maintaining substantial agricultural sectors. Differences in agricultural contribution are influenced by factors such as land availability, structural economic transformation, and the untapped agricultural potential in countries like Madagascar. Overall, agriculture continues to be a critical driver of economic activity, employment, and food security in East Africa. Furthermore, (Lyaro & Khamis, 2025) used time-series econometric techniques such as unit root, cointegration, and Granger causality tests on Tanzanian data (1990–2023) and found that value added by key agriculture sub-sectors influenced national income over the long and short run.

Also, (Diao et al., 2010) adds that agriculture remains a key driver of growth in early-stage structural transformations, generating significant multiplier effects that stimulate demand for non-agricultural goods and create off-farm employment. They caution against prematurely abandoning agriculture for industry and services, arguing that a balanced approach is most conducive to sustainable development. This is particularly relevant for Uganda, where strengthening agricultural productivity through targeted investments could yield substantial poverty reduction benefits while supporting broader structural transformation.

Furthermore, (Magunda, 2020) examined the Situational analysis study of the agriculture sector in Uganda and reported that Uganda's economy is primarily agrarian with the agriculture sector contributing about 24.7% of total national GDP and 54% of the country's export earnings .There has been a remarkable decline of agriculture's contribution to GDP. The agriculture sector provides employment for three quarters of the population aged between 15 and 24 years. About 78% of Uganda's population lives in the rural areas, with farming being the main economic activity. In addition, the country's manufacturing sector is dominated by agro-processing, which accounts for over 60% of the total output from approximately 50% in 1995 to the current levels of 24.7% in 2020 (Magunda, 2020).

2.2.2 Contribution of Industry to Uganda's GDP.

The industrial sector is widely regarded as a key indicator of a country's economic strength and level of development according to (Demir, 2021). (Banelienė, 2021) proves that the growth of industry share in gross value added has a higher impact on GDP growth in well-developed industrialized countries whose GDP per capita is higher than $40,000 than in industrialized countries whose GDP per capita is at a lower level under business-financed R&D investment and also shows that even if the manufacturing structures of countries with lower GDP per capita fully or partially reflect the manufacturing structures of well-developed industrial OECD economies, their industries do not have the same impact on economic growth.

According to (McMillan et al., 2014), structural transformation in Africa has not been associated with productivity growth, largely because workers have moved into low-productivity services rather than high-productivity manufacturing. This pattern is evident in Uganda, where industrial growth has been concentrated in construction rather than manufacturing. Consequently, (Newman et al., 2016) argue that African countries, including Uganda, require deliberate policies to promote manufacturing, drawing on comparative evidence from industrial development in Africa and Asia.

Then, (Muwanguzi et al., 2018) examined industrialization as a vehicle for Uganda to achieve a 1st world economy by 2040 and showed that countries such as South Korea and Malaysia successfully transitioned from agriculture-dominated economies in the 1960s by strengthening their industrial sectors, particularly manufacturing, to replace the declining contribution of agriculture to GDP. In contrast, although Uganda experienced a similar decline in agriculture's share of GDP over time, its industrial sector did not expand sufficiently to drive comparable structural transformation. Despite recording a relatively high average industrial growth rate of 9.17% since 1990 higher than Malaysia (5.32%) and Singapore (5.79%), this growth has had limited transformative impact because it has been driven largely by construction rather than manufacturing. As a result, Uganda's manufacturing base remains narrow, concentrated mainly in final-stage assembly and basic raw material processing, especially food processing. (Muwanguzi et al., 2018) believe that strengthening manufacturing is therefore considered essential for promoting value addition, creating linkages with agriculture which employs about 70% of the population and generating sustainable employment necessary for long-term economic development.

However, (Calabrese et al., 2019) highlight that industrialisation, and especially the manufacturing sector, remains crucial for Uganda. The country has the second highest (although declining) dependency ratio in the world and has one of the world's highest fertility rates. Uganda needs to create 650,000 jobs annually (that is, 1,780 jobs each day) between 2015 and 2030 to absorb new entrants to the labour market . But international experience suggests that labour-intensive manufacturing is a quick way to create the necessary employment opportunities.

2.2.3 Contribution of Service Sector to Uganda's GDP.

Growth in the services sector and a decline in the agricultural sector are structural features of economic development. In OECD countries, the services sector represents more than two-thirds of economic activity. In Eastern Europe and Central Asian (ECA) countries, the importance of the services sector for GDP and employment has substantially increased since the beginning of transition and accounts presently for more than half of the economic activity. (Fernandes, 2009) examined the trends in the structure and performance of service sectors in ECA countries during the 1997–2004 period, which represented an increasing share of total value added and total employment in the region. Furthermore, (Fernandes, 2009) established that in the Eastern European plus Baltic countries, service sub-sectors that are ICT producers or users or those that use skilled labor more intensively exhibit substantially higher growth in labor productivity.

According to (Rodrik, 2016), many developing countries are experiencing "premature deindustrialization," where economies shift from agriculture directly to services without a strong manufacturing base. This pattern is evident in Uganda, where the service sector's contribution to GDP has consistently exceeded 50% while manufacturing remains below 10%. (Ghani & O'connell, 2014) similarly note that services now account for more than half of GDP in many developing countries and are the fastest-growing sector, a finding consistent with the observed trend in Uganda. Also, (Eichengreen & Gupta, 2013) add that the service sector has become the new engine of growth in developing countries, particularly in Asia and Africa.

In Nigeria, through the analysis of descriptive quantitative statistics by (Ehigiator, 2017) showed that services currently account for about 60% of Nigeria's GDP, and its increase has been synonymous with increase in per capita GDP, indicating that the growth of services is being reflected in enhancing the economic life of Nigerian citizens, while agriculture currently employs a larger percentage of people, with an average of about 60% of total employment, services averaged about 33% and industry about 7% between 2000-2011. (Ehigiator, 2017) identified a trend that showed that the relocation of labor from agriculture has been to services, and not to manufacturing as conventional development theories would predict and again, this supports the idea that services have been contributing significantly to the Nigerian economy.

According to (Mbithi & Chekwoti, 2016), like the rest of the world, the importance of the services sector in the EAC has been on the increase and contribution of the sector to the GDP has been on the increasing, currently contributing to an average of 51 percentage points of the regions GDP. The relative contribution of the manufacturing sector and the agricultural sectors to the EAC economies has been on the decline. The service sector within the EAC countries has witnessed significant growth. (Mbithi & Chekwoti, 2016) established that both export and import trends in value terms identify post 2000 as the period of major growth in the services sector with wide variations though can be identified across the different sectors in services trade and across the EAC countries.

Also, (James et al., 2023) established that in Uganda, the service sector's contribution to GDP has averaged above 50%for the past 25 years, exceeding the contributions of both the agricultural and industrial sectors but despite this rapid growth, the service sector contribution to employment creation has been stagnant at less than 25% for most of the time. Much of the growth in Uganda's service sector has been driven by growth in the Information and Communications Technology (ICT),real estate development, public administration, health and social work activities. It is observed by (James et al., 2023) that the service sector after the glitch of the 2007–2008 financial crisis has been on an upward trend ever since then.

Furthermore, (James et al., 2023) found that there is a negative impact of GDP growth on the service sector performance both in the short and long runs. (James et al., 2023) explains that the largest share of Uganda's budget is allocated to security services. To put this into perspective, in the financial year 2021–2022, about 7.7 trillion of the 41.3 trillion shillings budget was allocated to security services (about 30.4% of tax revenue), compared to HCI (education and health) at 6.8 trillion. This large expenditure on security which does not have immediate effects on economic growth explains the negative effect of GDP growth on the service sector.

2.3 Summary of Literature.

The literature highlights the complex relationship between GDP and its key determinants: agriculture, industry, and services. Gross Domestic Product (GDP) serves as a central measure of economic performance and reflects the overall health of an economy. Evidence from Sub-Saharan Africa indicates that although agriculture's share of GDP has declined due to structural transformation, it remains vital for employment and food security, particularly in countries such as Uganda and Tanzania (Lyaro & Khamis, 2025; Magunda, 2020; Tomšík et al., 2015)

The industrial sector, more so manufacturing, is widely recognized as a driver of sustainable growth and structural transformation. Outward-oriented economies tend to achieve stronger growth outcomes (Clark, 1995). However, in Uganda, industrial growth has been concentrated more in construction than manufacturing, limiting its potential for value addition and sustainable job creation(Muwanguzi et al., 2018).

The service sector has emerged as the dominant contributor to GDP in many regions, including the East African Community and Uganda, accounting for over 50% of total output (Mbithi & Chekwoti, 2016). Despite this dominance, its contribution to employment remains relatively low. At the macro level, financial sector development (FSD) and foreign direct investment (FDI) further act as cross-sectoral drivers of economic growth (Omamo et al., 2006). Overall, the way these sectors work together shows that achieving balanced and sustainable economic growth is not simple and requires careful coordination across all sectors of the economy.

2.4 Limitations of the Study.

This study has limitations related to data scope and coverage. First, it focuses exclusively on the formal economy, omitting informal sector activities that are significant in Uganda, particularly in agriculture and services. As a result, the analysis may underestimate the actual contributions of these sectors to GDP.

Quarterly data derived via linear interpolation may not capture true within-year volatility or seasonal patterns. Results should be interpreted as smoothed quarterly estimates.

Another limitation relates to the analytical approach. The study employs a purely statistical, time-series methodology and does not investigate underlying economic policies, structural factors, or external shocks that could influence sectoral performance. While this approach allows for trend analysis, comparison of growth rates, and forecasting, it cannot explain why changes occur or how policy and structural issues might affect future sectoral contributions.

Finally, the study is geographically specific to Uganda, meaning that the findings may not be directly generalizable to other countries or regions. These limitations should be considered when interpreting the results, particularly in understanding the implications for Uganda's economic structure.

CHAPTER THREE: METHODOLOGY.

3.0 Introduction.

This chapter outlines the research design, data sources, and the statistical methods applied to examine trends, growth patterns, and variability in sectoral contributions. The chapter also describes the techniques used to test the study hypotheses and forecast future sector contributions, providing a clear framework for the data analysis presented in the study.

3.1 Research Design.

This study adopted a quantitative research design utilizing time series analysis to examine the contributions of three key economic sectors Agriculture, Industry, and Services to Uganda's Gross Domestic Product (GDP) over the period 2008–2024. The quantitative approach was appropriate because the study involved numerical data across multiple time points, allowing for statistical modelling, trend identification, and forecasting. Time series analysis was suitable because it captured the dynamic behaviour and temporal dependencies inherent in sectoral GDP contributions.

3.2 Data Source.

The study used secondary data obtained from the data portal of the Uganda Bureau of Statistics (UBOS). UBOS is the national body responsible for collecting, compiling, and publishing official statistics in Uganda.

3.3 Description of Study Variables.

The study focused on the relationship between sectoral contributions to GDP and overall economic growth**.**

3.3.1 Dependent Variable

- Gross Domestic Product

GDP refers to the total monetary value of all final goods and services produced within Uganda during a given period. In this study, GDP is represented through the contributions made by the major sectors of the economy.

3.3.2 Independent Variables.

i. Agriculture sector contribution

The agriculture sector contribution represents the share of GDP generated from agricultural activities such as crop production, livestock farming, forestry, and fishing. This variable shows how agriculture contributes to Uganda's economic output annually.

ii. Industry sector contribution

The industrial sector contribution represents the share of GDP generated from industrial activities such as manufacturing, mining and quarrying, construction, electricity generation, and water supply. This variable reflects the role of industrial development in Uganda's economic growth.

iii. Services sector contribution

The service sector contribution represents the share of GDP generated from service-related activities such as trade, transport, tourism, finance, education, and health services. This variable captures the importance of service activities in supporting economic performance.

3.4 Data Preparation and Preprocessing.

Before statistical analysis was conducted, the dataset underwent several preparation procedures to ensure accuracy and consistency.

3.4.1 Data Organization

The collected data was organized in a time series format where each observation corresponds to a specific year and includes variables representing sectoral GDP contributions.

3.4.2 Data Cleaning.

The dataset was thoroughly examined to identify potential issues such as missing values, inconsistencies, duplicate entries, and possible data entry errors. Where necessary, missing observations were verified using alternative reliable sources to ensure data accuracy and completeness. In cases where direct verification was not possible, appropriate data handling techniques were applied to maintain the integrity and consistency of the dataset for subsequent time series analysis.

3.4.3 Data Transformation and Interpolation.

Since the original dataset was available at annual frequency, the data was transformed into quarterly frequency using interpolation techniques. This was necessary to enable time series modelling using ARIMA, which requires higher-frequency observations for capturing dynamic short-run movements. The resulting quarterly series represents estimated intra-year values rather than directly observed quarterly data.

3.5 Data Analysis Methods.

The analysis involved several statistical procedures aimed at examining sectoral contributions to GDP, comparing growth patterns, and generating future projections. Analysis was done using Stata 15 and R 4.6.0. software .

3.5.1 Descriptive Analysis

Under this, the variable assessment involved the assessment of the descriptive statistics for the variables in the study. The descriptive analysis were measured by the levels of central tendency and spread for the data sets that were presented for the data, these were presented in tabular form.

Graphical techniques such as line graphs were used to illustrate trends in sectoral GDP contributions over time. These graphs helped to visualize how the contributions of agriculture, industry, and services have changed during the study period.

3.5.2 Trend Analysis Using Linear Regression (H01–H03)

To examine whether there is a significant trend in the GDP contributions of agriculture, industry, and services over time, a linear regression trend analysis was conducted.

The regression model was specified as:

$$Y_t = B_0 + B_1 t + \in_t$$

Where:

- Y_t= GDP contribution of the sector in quarter t
- t = time (quarter from 2008 to 2024)
- B_0= intercept
- B_1 = trend coefficient (slope)
- $\in_t$= error term

The slope coefficient (B_1) was tested for statistical significance using the t-test for regression coefficients. This test determines whether the estimated trend coefficient is significantly different from zero. The hypothesis test will be conducted at the 5 percent level of significance. The null hypothesis stated that the trend coefficient is equal to zero, implying that there is no significant trend in the GDP contribution of the sector over time. The alternative hypothesis stated that the trend coefficient is not equal to zero, indicating the presence of a significant trend.

If the p-value associated with the t-test statistic is less than 0.05, the null hypothesis was rejected, indicating that there is a statistically significant trend in the GDP contribution of the sector. If the p-value is greater than or equal to 0.05, the null hypothesis was rejected, suggesting that no statistically significant trend exists.

The interpretation of the results was based on both the statistical significance and the sign of the estimated slope coefficient. A positive and statistically significant value of B_1 indicated that the sector's contribution to GDP has been increasing over time, while a negative and statistically significant value indicated a decreasing trend. If the coefficient was not statistically significant, it implied that the sector's contribution to GDP had remained relatively stable over the study period. The regression analysis was performed separately for the agriculture, industry, and service sectors.

3.5.3 Analysis of Mean Growth Rates

To assess whether the mean annual growth rates and variability of GDP contributions are equal**,** statistical tests comparing means and variances was conducted.

Test for Mean Annual Growth Rates

The mean annual growth rate of GDP contribution for each sector was calculated using the percentage change formula:

$g_t = \frac{X_t - X_{t-1}}{X_{t-1}}$ x 100

Where:

g_t = Growth rate in quarter t

X_t = sector contribution in the current quarter

X_{t-1} = sector contribution in the previous quarter

To determine whether there were statistically significant differences in the mean annual growth rates among the agriculture, industry, and services sectors, this study employed a One-Way Analysis of Variance (ANOVA). ANOVA was appropriate for comparing the means of three or more independent groups, as it tested whether at least one group's mean significantly deviated from the others. The null hypothesis suggested that the mean growth rates across all three sectors were equal, while the alternative hypothesis suggested that at least one sector's growth rate differed.

The interpretation of the ANOVA results relied on the F-statistic and its corresponding p-value, assessed at a significance level of 0.05. If the p-value was less than 0.05, the null hypothesis was rejected, indicating that significant differences exist in the mean growth rates of the sectors. In that case, a Tukey Honestly Significant Difference (HSD) post hoc test was conducted to identify which specific sector pairs (e.g., agriculture vs. industry, industry vs. services) exhibit these differences. The Tukey HSD test allowed comparisons to be made between several sectors at the same time while reducing the chances of incorrectly concluding that a difference exists when it does not. This helped to ensure that the results obtained from the comparisons are reliable and not due to random variation in the data.

Conversely, if the p-value exceeded 0.05, the null hypothesis was rejected, implying that the mean growth rates across agriculture, industry, and services are statistically indistinguishable. This outcome would suggest that, on average, the sectors contribute to GDP growth at similar rates over the study period.

3.5.4 Forecasting Sector Contributions Using ARIMA.

To forecast the future contributions of agriculture, industry, and services to GDP for the next fifteen quarters ARIMA (Autoregressive Integrated Moving Average) models were applied. A univariate ARIMA model was used for each sector solely on basing on its own historical values. This approach was appropriate because the study focused on forecasting individual sector contributions without external explanatory variables.

The ARIMA model was expressed as:

ARIMA (p,d,q)

Where:

- p = number of autoregressive terms
- d = degree of differencing to achieve stationarity
- q= number of moving average terms

The analysis began by examining the stationarity of each sector's GDP contribution series, which was essential for valid time series modeling since a stationary series had a constant mean and variance over time. Stationarity was assessed using the KPSS test, which is used to determine whether a series contains a unit root and is therefore non-stationary. The test evaluated the null hypothesis that the series stationary against the alternative that it is not stationary, and the decision was based on comparing the test statistic with critical values at the 5 percent level of significance.

In cases where non-stationarity was detected, differencing was applied until stationarity was achieved, and the number of differences required was determined by the order of integration for the ARIMA model. The first difference of the series was given by:

$$Y_{1t} = Y_t - Y_{t-1}$$

Where:

Y_t was the value of the series at the current time period in that case, it was the GDP contribution of a specific sector (Agriculture, Industry, or Services) in quarter t, $Y_{t-1}$was the value of the series in the previous time period t-1, this represented the GDP contribution of that sector in the previous year and Y_{1t} was the difference between the current and previous values, showing how much the sector's contribution changes from one period to the next**.** Further differencing was to be applied if necessary, until stationarity was achieved, and the number of differences applied was determined as the value of d.

Following the achievement of stationarity, the appropriate ARIMA model was identified by determining the values of the autoregressive (p) and moving average (q) parameters, while the order of differencing was based on the number of times the series was differenced to attain stationarity. The identification of (p) and (q) was guided by examining the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots. Specifically, the PACF plot was used to determine the order of the autoregressive component (p) by identifying the lag at which partial autocorrelations drop sharply to zero or become statistically insignificant, while the ACF plot was used to determine the order of the moving average component (q) by observing the lag at which autocorrelations cut off or decay. In cases where neither plot shows a clear cut-off, a combination of autoregressive and moving average terms would be considered, suggesting a mixed ARIMA model. Several candidate models were fitted, and the most appropriate model was selected using the Akaike Information Criterion (AIC), where the model with the lowest AIC value is considered the best balance between fit and simplicity. After identifying the ARIMA model structure using the ACF and PACF plots, the model was estimated and the exact numerical values of the coefficients for the autoregressive and moving average components were determined. These coefficients indicated how strongly past values, and past errors influenced the current value of the series.

Following model estimation, diagnostic checks were performed to assess the adequacy of the fitted ARIMA model. This involved examining the residuals to ensure that they behaved like white noise, meaning they were independently distributed with constant variance and zero mean. The Ljung-Box test was applied to check for the presence of autocorrelation in the residuals. If the p-value of the Ljung-Box test was greater than 0.05, it would indicate that there was no significant autocorrelation and that the residuals behaved like white noise, suggesting that the model was adequate. Conversely, if the p-value is less than 0.05, it would indicate significant autocorrelation in the residuals, and the model would need to be re-specified and re-estimated until a satisfactory model was obtained.

Once a suitable ARIMA model was identified and validated, it was used to forecast future values of GDP contributions for the agriculture, industry, and service sectors. The forecasts covered a period of the next fifteen quarters and would provide insights into the expected future performance of each sector. The forecast results were presented using tables.

CHAPTER FOUR: RESULTS

4.0 Introduction.

Analysis and interpretation of results was conducted in this chapter according to the specific objectives. Quarterly data between 2008q1 and 2024q1 was used in this study. First, descriptive statistics and graphical analysis of the quarterly series were carried out. Following that, growth rates and variability were compared among sectors. Lastly, a Box-Jenkins ARIMA modelling technique was employed to forecast each sector contribution to GDP in the next fifteen quarters.

4.1 Descriptive Statistics.

Table 4.1 Mean score for Services, Industry, and Agriculture Sector Contributions to GDP.

Sectors	Mean	Std. Dev.	Min	Max
Services	48503.092	10346.965	31704.000	69203
Industry	29049.369	6866.916	18577.000	42588
Agriculture	27023.815	4650.873	21309.000	37483

According to Table 4.1, the descriptive statistics show that the Services sector made the largest contribution to Uganda's GDP during the study period, with an average of approximately UGX 48,503 billion. This was followed by the Industry sector, which recorded a mean contribution of UGX 29,049 billion, while the Agriculture sector contributed an average of UGX 27,024 billion. These findings indicate that the Services sector was the dominant contributor to economic output throughout the period under study.

The standard deviation results indicate that the Services sector experienced the highest level of variation over time (UGX 10,347 billion), followed by the Industry sector (UGX 6,867 billion), while the Agriculture sector was relatively more stable (UGX 4,651 billion). The minimum and maximum values further reveal growth across all sectors, with Services ranging from UGX 31,704 billion to UGX 69,203 billion, Industry from UGX 18,577 billion to UGX 42,588 billion, and Agriculture from UGX 21,309 billion to UGX 37,483 billion. The differences between the minimum and maximum values suggest an overall increase in sectoral GDP over the study period, consistent with the trends observed in the sectoral GDP series.

4.2 Analysis of the Trends in GDP Contributions Of Uganda's Agriculture, Industry And Service Sector From 2008 To 2024.

4.2.1 Trend Analysis.

Table 4.2: Linear Trend Regression Results for Sectoral GDP Contributions

	Services	**Industry**	**Agriculture**
t	543.936***	360.679***	238.069***
	(7.561)	(5.362)	(7.796)
_cons	30553.205***	17146.969***	19167.548***
	(287.006)	(203.560)	(295.922)
Observations	65.000	65.000	65.000
R-squared	0.988	0.986	0.937

Standard errors in parentheses, * $p<0.10$, ** $p<0.05$, *** $p<0.01$

From Table 4.2, the trend analysis results show that there is a growth trend for all three sectors, evident from the positive trend coefficients and p-values below 0.001. In particular, the Services sector had a quarterly growth of UGX 544 billion, followed by the industry sector, which had a quarterly growth of UGX 361 billion, and the agriculture sector, whose quarterly growth was UGX 238 billion. This shows that the Services sector is the fastest-growing sector, whereas Agriculture is the slowest-growing sector among the three.

From the high R-squared values, which range from 0.9367 to 0.9880, we can conclude that time accounts for most of the variance in GDP contribution within the three sectors. Particularly, time accounts for 98.8% in Services, 98.6% in Industry, and 93.7% in Agriculture. This implies that all the null hypotheses (H01, H02, and H03) of no significant trend in the Services, Industry, and Agriculture sectors will be rejected leading to the conclusion that all three sectors exhibited significant positive trends during the study period.

4.2.2Services Quarterly Trend.

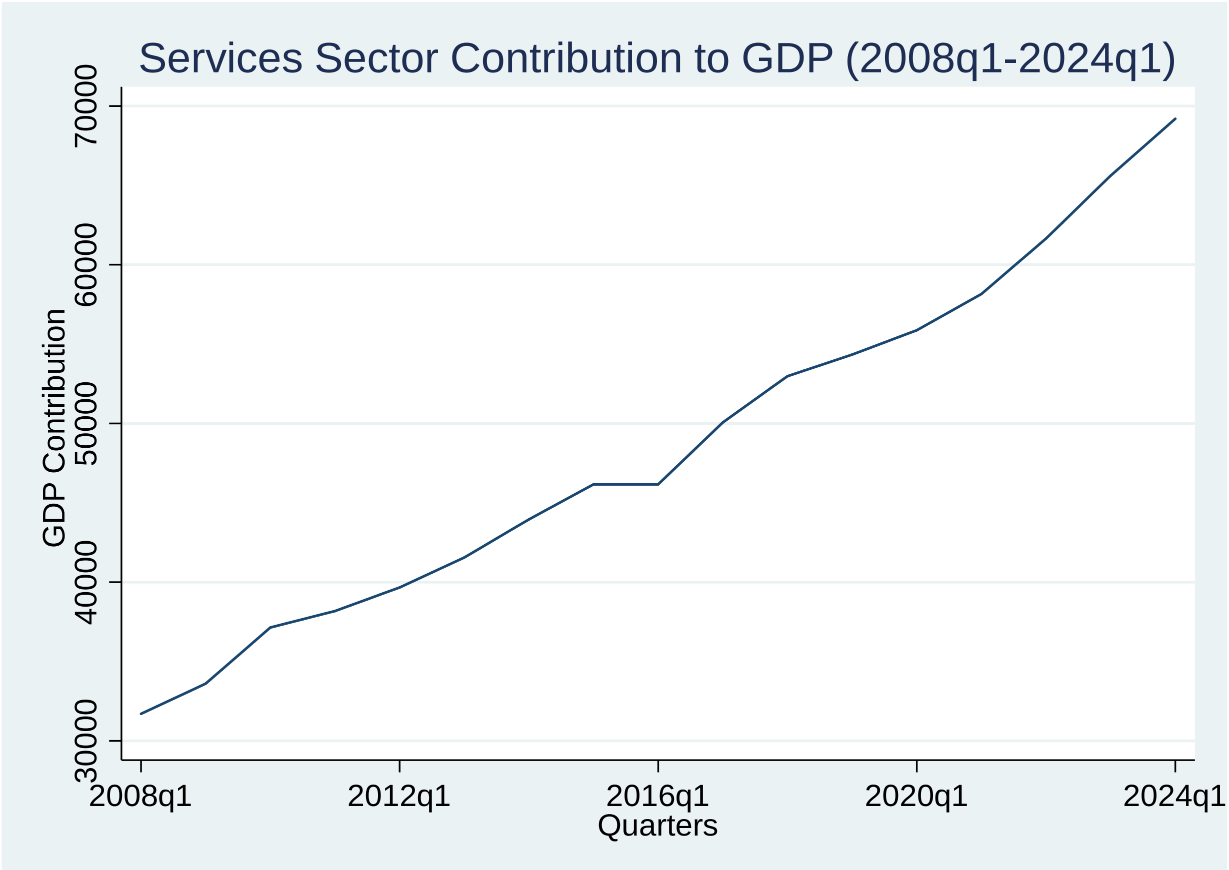


Figure 4.1 Services Sector Contribution to GDP (2008q1-2024q1).

According to Figure 4.1, there is a visible trend of growth in the Services sector, where there is an increase in the GDP contribution from UGX 31,704 billion to UGX 69,203 billion in the same study period. Although the growth path was not perfectly linear, there were no prolonged periods of decline implying that the Service sector experienced economic growth throughout the study period.

The graph further illustrates that growth increased after 2016 and showed an even faster growth pattern between 2017 and 2024. The increase is consistent with the trend analysis results where there is a positive and statistically significant trend in the Services sector ($\beta = 543.94$, $p < 0.001$). The dominant and consistently growing nature of the Services sector implies its significance as the major source of GDP in the Ugandan economy.

4.2.3 Industry Quarterly trend.

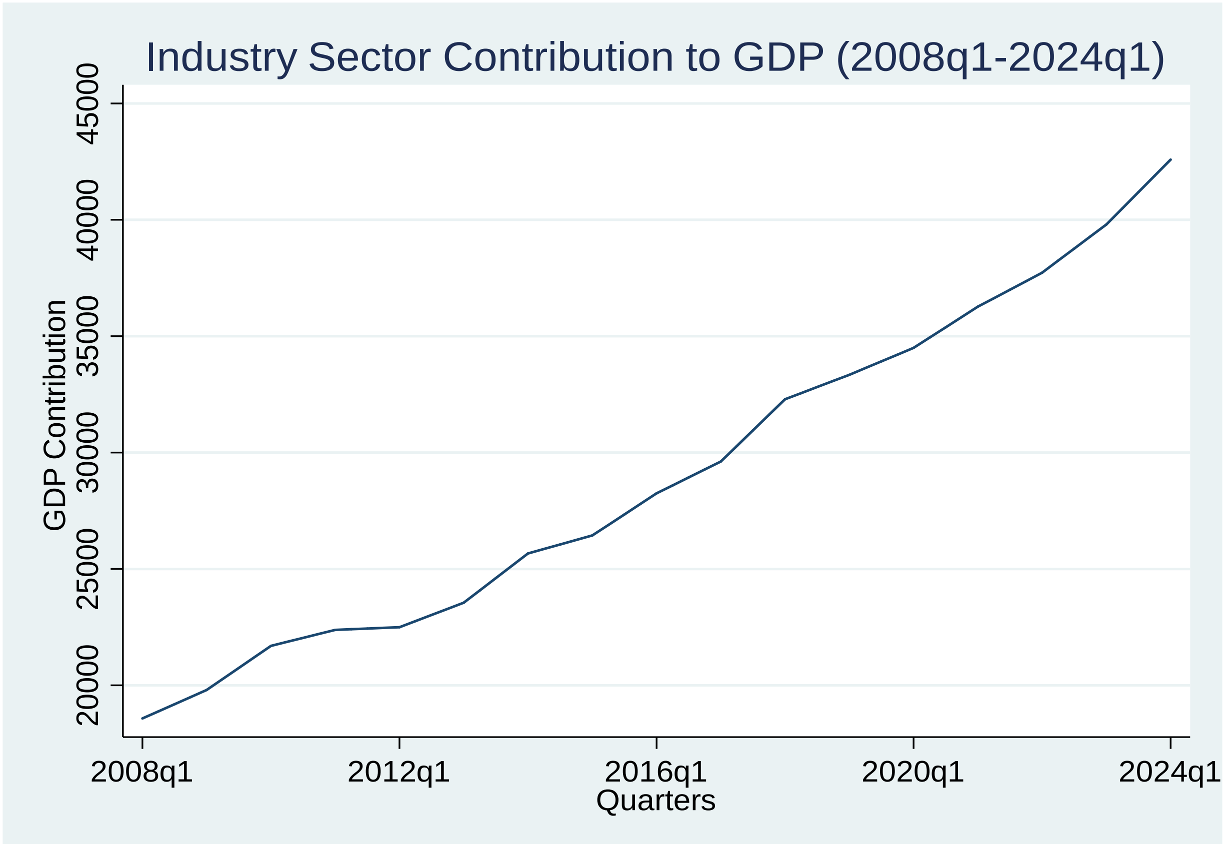


Figure 4.2 Industry Sector Contribution to GDP (2008q1- 2024q1).

From Figure 4.2, the industry sector contribution to Uganda's GDP exhibited a clear upward trend throughout the study period from 2008Q1 to 2024Q1. The graph shows that the sector's contribution increased steadily over time, with only minor fluctuations. This indicates sustained growth in industrial activities and an increasing role of the sector in supporting economic development. The consistent rise in GDP contribution suggests that the industry sector expanded considerably during the period under review.

The upward movement observed in the graph is consistent with the trend analysis results, which revealed a statistically significant positive trend in the Industry sector ($\beta = 360.68$, $p < 0.001$). The sector recorded an average quarterly increase of approximately UGX 361 billion, indicating strong growth over time.

4.2.4 Agriculture Quarterly trend.

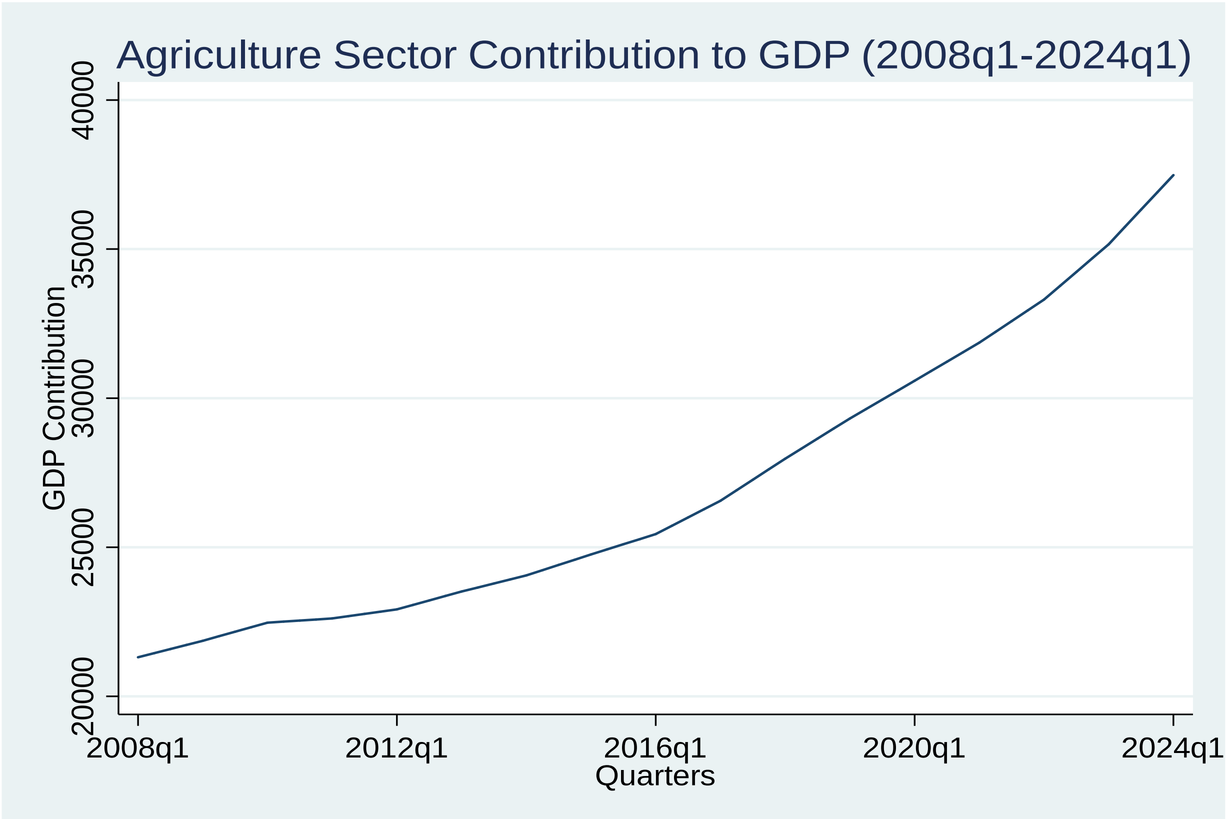


Figure 4.3 Agriculture Sector Contribution to GDP (2008q1-2024q1).

According to Figure 4.3, the agriculture sector exhibited a sustained upward trend in its contribution to Uganda's GDP over the study period. Between 2008Q1 and approximately 2016Q1, growth was relatively gradual, with the sector's contribution increasing steadily from just above UGX 21,000 billion to about UGX 25,000 billion. This period was characterized by modest but consistent gains, indicating stable growth in agricultural output.

From 2016 onwards, the sector experienced a noticeable acceleration in growth, as evidenced by the steeper upward movement of the trend line. The contribution of Agriculture to GDP increased at a faster rate, surpassing UGX 30,000 billion around 2021 and continuing to rise thereafter. By 2024Q1, the sector had reached its highest recorded contribution of approximately UGX 37,500 billion. Overall, the graph indicates that the Agriculture sector maintained growth throughout the study period, with a stronger rate of expansion observed in the latter years.

4.3 Comparison of Mean Growth Rates of the GDP contributions across agriculture, industry and services over the study period.

4.3.1 Test for Mean Growth Rates.

To begin the analysis of sectoral performance, descriptive statistics were computed for the quarterly growth rates of the Services, Industry, and Agriculture sectors over the study period to separate the means across the sectors.

Table 4.3: Descriptive Statistics of Sectoral Growth Rates.

Sector	Mean	Std. Dev.	Freq.
Services	1.227	0.582	63
Industry	1.294	0.593	63
Agriculture	0.878	0.381	63

The results in Table 4.3 show that the industry sector recorded the highest average quarterly growth rate (1.294%), followed closely by Services (1.227%), while Agriculture recorded the lowest mean growth rate (0.878%). This suggests that the industrial sector experienced relatively stronger growth performance over the study period compared to the other sectors.

4.3.2 One-Way ANOVA Results for Sectoral Growth Rates.

To determine whether there are statistically significant differences in mean quarterly growth rates among the Services, Industry, and Agriculture sectors, a one-way analysis of variance (ANOVA) was conducted.

Table 4.4: One-way ANOVA Results.

Source of Variation	Sum of Squares	df	Mean Square	F	P-value
Between groups	6.294	2	3.147	11.29	0.0000
Within groups	51.856	186	0.279		
Total	58.151	188	0.309		

According to Table 4.4, the ANOVA results indicate that the calculated F-statistic is 11.29 with degrees of freedom (2, 186) and a corresponding p-value of 0.0000. Since the p-value is less than the 0.05 significance level, the null hypothesis of equal mean quarterly growth rates across the three sectors is rejected.

This implies that there is a statistically significant difference in mean growth rates among at least two of the sectors.

However, ANOVA does not indicate which specific sectors differ, therefore a post-hoc comparison test is required to identify the exact differences in mean growth rates.

Table 4.5: Tukey Post-Hoc Pairwise Comparisons of Mean Quarterly Growth Rates.

Comparison	Contrast	Std. Error	95% Confidence Interval	Interpretation
Industry vs Services	0.067	0.094	[-0.155, 0.290]	Not significant
Agriculture vs Services	-0.349	0.094	[-0.571, -0.127]	Significant
Agriculture vs Industry	-0.416	0.094	[-0.639, -0.194]	Significant

The Tukey post-hoc results in Table 4.5 indicate that there is no statistically significant difference in mean quarterly growth rates between the Industry and Services sectors (mean difference = 0.067, $p > 0.05$). However, Agriculture differs significantly from both Services and Industry.

Specifically, Agriculture records significantly lower mean growth than Services (mean difference = -0.349) and Industry (mean difference = -0.416), both statistically significant at the 5% level as their confidence intervals do not include zero.

These results suggest that while Industry and Services exhibit similar growth performance, Agriculture lags both sectors in terms of quarterly growth rates.

4.4 Forecast the Contributions of Uganda's Major Economic Sectors To GDP From 2024 To 2027.

4.4.1 Time Series Property of Data (Stationarity test).

Stationarity was assessed using the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test (Kwiatkowski et al., 1992) which has the null hypothesis of stationarity. The KPSS test was preferred over the Augmented Dickey-Fuller (ADF) test because it directly tests for stationarity and has higher power with moderate sample sizes (Enders & Strader, 2015). The test was applied to the level, first-differenced, and where necessary, second-differenced series. The results are presented in Table 4.6.

Table 4.6 KPSS Stationarity Test Results.

Sector	Series	Test Statistic (Lag)	5% Critical Value	Decision	Final d
Services	Levels	0.236 - 0.958	0.146	Non-stationary	
	D. Services	0.126 (lag 2)	0.146	Stationary	1
Industry	Levels	0.289 - 1.220	0.146	Non-stationary	
	D. Industry	0.096 (lag 1)	0.146	Stationary	1
Agriculture	Levels	0.354 - 1.560	0.146	Non-stationary	
	D. Agriculture	0.141 (lag 4)	0.146	Stationary (borderline)	
	D2.Agriculture	0.043 - 0.060	0.146	Stationary (clear)	2

According to Table 4.6, the KPSS test results indicate that all three sectoral series were non-stationary in their levels, as the test statistics exceeded the 5% critical value of 0.146. For the Services sector, stationarity was achieved after first differencing, with the test statistic falling to 0.126 at lag 2. Similarly, the Industry sector became stationary after first differencing, recording a test statistic of 0.096 at lag 1. These findings imply that both the Services and Industry series are integrated of order one, I(1), and therefore require one level of differencing (d =1) before model estimation.

In contrast, the Agriculture sector exhibited stronger persistence. Although the first-differenced series produced a test statistic of 0.141 at lag 4, indicating borderline stationarity, second differencing resulted in substantially lower test statistics ranging from 0.043 to 0.060, confirming clear stationarity. Consequently, the Agriculture series was classified as integrated of order two, I(2), requiring two levels of differencing (d =2). Overall, the KPSS results suggest that differencing was necessary to remove non-stationarity and ensure that the series satisfied the assumptions required for ARIMA modelling.

4.4.2 Seasonality Assessment.

To formally assess the presence of quarterly seasonality, the Kruskal–Wallis's equality-of-populations rank test was applied to the series for each sector.

Table 4.7 Kruskal–Wallis Test for Seasonality.

Sector	Chi-squared (3 d.f.)	P-value	Conclusion
Services	0.071	0.9951	No seasonality
Industry	0.090	0.9931	No seasonality
Agriculture	0.090	0.9931	No seasonality

The results in Table 4.7 indicate that all three sectors exhibit very low chi-squared statistics and extremely high p-values greater than 0.99. This implies that there are no statistically significant differences in the distributions of the variables across the four quarters. Consequently, there is no evidence of deterministic quarterly seasonality in Services, Industry, and Agriculture based on this test.

4.4.3 Model Identification Using ACF and PACF.

ACF and PACF Analysis for the Services Sector.

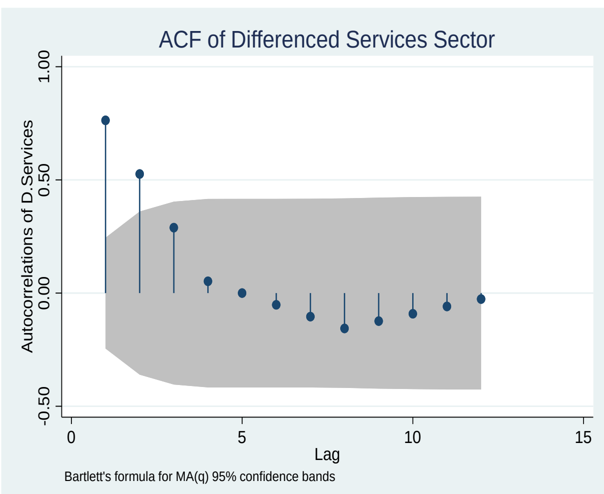


Figure 4.4 ACF of Differenced Service Sector

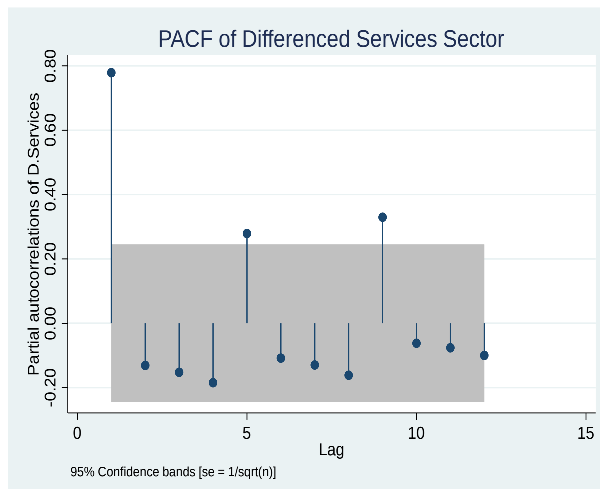
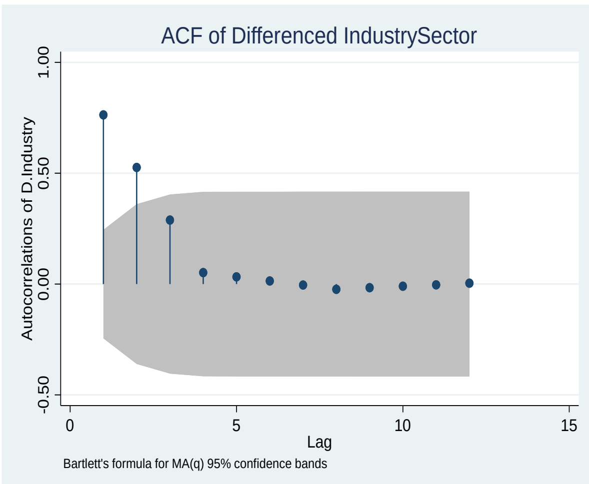


Figure 4.5 PACF of Differenced Service Sector

Figure 4.4 displays significant spikes at lags 1 and 2, with no significant spikes beyond lag 2, suggesting a moving average component of order 2 MA(2). Figure 4.5 exhibits three significant spikes at lags 1, 5, and 9, but with notable gaps at lags 2, 3, 4, 6, 7, and 8. This pattern does not represent a clean cutoff, ruling out a pure autoregressive process of any single order. Therefore, the autoregressive order p cannot be determined directly from the PACF. Instead, small p values (p = 1 or 2) are preferred to avoid overfitting, with the strong spike at lag 1 providing the primary justification for including an AR term. The absence of significant spikes at seasonal lags (4, 8, or 12) confirms no quarterly seasonality. Based on these plots, candidate models for the Services sector include ARIMA(1,1,2) and ARIMA(2,1,2), with final selection based on AIC/BIC values, Ljung–Box statistics, and residual diagnostics.

ACF and PACF Analysis for the Industry Sector.



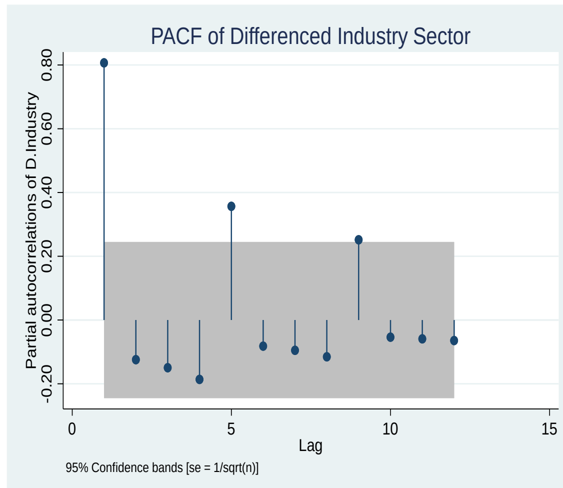


Figure 4.6 ACF of Differenced Industry Sector	Figure 4.7 PACF of Differenced Industry Sector

Figure 4.6 displays significant spikes at lags 1 and 2, with no significant spikes beyond lag 2, suggesting a moving average component of order 2 MA(2). The PACF in figure 4.7 exhibits significant spikes at lags 1, 5, and 9, but with gaps at intervening lags, indicating no clear cutoff and ruling out a pure autoregressive process. The absence of significant spikes at seasonal lags (4, 8, or 12) confirms no quarterly seasonality. Based on these plots, the moving average order is set at q = 2 due to the ACF cutting off after lag 2, while the autoregressive order is kept small (p = 1 or 2) given the mixed pattern in the PACF. Candidate models for the Industry sector therefore include ARIMA(1,1,2) and ARIMA(2,1,2), with final selection based on AIC/BIC values, Ljung–Box statistics, and residual diagnostics.

ACF and PACF Analysis for the Agriculture Sector.

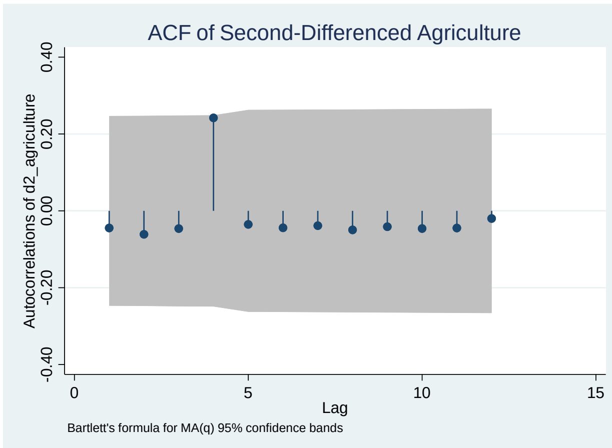
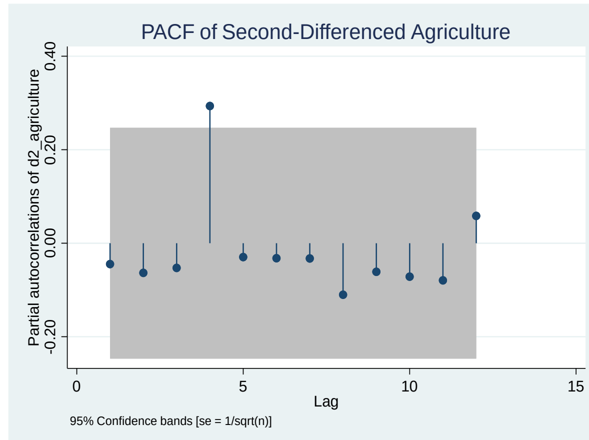
	

Figure 4.8 ACF of Second Differenced Agriculture	Figure 4.9 PACF of Second Differenced Agriculture

Figure 4.8 shows no significant spikes outside the confidence bands, indicating no remaining autocorrelation structure in the moving average component. The PACF in Figure 4.9, however, exhibits a pronounced and statistically significant spike at lag 4, with no other significant lags. The absence of repeating spikes at lags 8 and 12 rules out quarterly seasonality. While this pattern is characteristic of a pure autoregressive process of order 4 AR(4) multiple candidate models were considered to ensure robust model selection. These include the parsimonious ARIMA(1,2,0) in case the lag 4 spike occurs by chance, ARIMA(0,2,4) if the ACF is interpreted as cutting off at lag 4, ARIMA(4,2,1) to capture any residual moving average dynamics, and ARIMA(4,2,0) as the specification. Final model selection will be based on AIC/BIC values, Ljung–Box statistics, and residual diagnostics.

4.4.4 ARIMA Model Results.

This section presents the estimated ARIMA models for the Agriculture, Industry, and Services sectors. The models were selected based on ACF and PACF diagnostics and estimated using maximum likelihood.

Service Sector.

Following model identification and comparison of alternative specifications, the ARIMA(1,1,2) model was selected as the preferred model for the Services sector based on its relatively lower Akaike Information Criterion (AIC), improved log-likelihood value, and satisfactory diagnostic performance.

Table 4.8 ARIMA(1,1,2) Model Estimates for the Service Sector.

Parameter	**Coefficient**	**Standard Error**	**z-value**	**p-value**	**95% Confidence Interval**
Constant	593.1429	80.8972	7.33	0.000	[434.5874 751.6984]
AR(1)	0.5388	0.1422	3.79	0.000	[0.2602 0.8175]
MA(1)	0.0534	0.2003	0.27	0.790	[-0.3392 0.4460]
MA(2)	0.7438	0.0898	8.28	0.000	[0.5677 0.9199]
Sigma	169.2652	12.3668	13.69	0.000	[145.0268 193.5037]

Table 4.8 presents the estimated ARIMA(1,1,2) model for the Services sector. The positive and statistically significant constant term (593.14, $p < 0.001$) indicates an underlying upward trend in the Services sector over the study period. The AR(1) coefficient is positive and significant (0.539, $p < 0.001$), suggesting that changes in the Services sector exhibit persistence, whereby current changes are influenced by those observed in the previous quarter.

Among the moving average terms, MA(2) is positive and highly significant (0.744, $p < 0.001$), indicating that shocks occurring two quarters earlier continue to have a significant effect on current changes in the series.

Industry Sector.

Following model identification and comparison of alternative specifications, the ARIMA(2,1,2) model was selected as the preferred specification for the industry sector based on its lower Akaike Information Criterion (AIC), higher log-likelihood value, and strong diagnostic performance.

Table 4.9 ARIMA(2,1,2) Model Estimates for the Industry Sector.

Parameter	Coefficient	Std. Error	z-value	p-value	95% Confidence Interval
Constant	375.7182	41.6415	9.02	0.000	[294.1023, 457.3341]
AR(1)	0.7913	0.3347	2.36	0.018	[0.1353, 1.4472]
AR(2)	-0.3401	0.3281	-1.04	0.300	[-0.9832, 0.3030]
MA(1)	-0.0752	0.2228	-0.34	0.736	[-0.5118, 0.3614]
MA(2)	0.8034	0.0902	8.90	0.000	[0.6265, 0.9802]
Sigma	100.1857	6.2645	15.99	0.000	[87.9076, 112.4639]

According to Table 4.9, the estimated ARIMA(2,1,2) model for the industry sector indicates a significant dynamic structure in the differenced series. The constant term is positive and statistically significant (375.72), suggesting an underlying upward drift in industrial output over time. The AR(1) coefficient is positive and significant (0.791, $p = 0.018$), indicating short-run persistence in industrial output. For the moving average component, MA(2) is positive and highly significant (0.803, $p < 0.001$).

Agriculture Sector.

Following model identification and comparison of alternative specifications, the ARIMA(0,2,4) model was selected as the preferred specification for the agriculture sector based on its relatively lower AIC and BIC and satisfactory diagnostic performance.

Table 4.10: ARIMA(0,2,4) Model Estimates for the Agriculture Sector.

Parameter	Coefficient	Std. Error	z-value	p-value	95% Confidence Interval
Constant	7.6164	8.0813	0.94	0.346	[-8.2225, 23.4554]
MA(1)	-0.0207	0.6441	-0.03	0.974	[-1.2832, 1.2417]
MA(2)	-0.0294	0.6192	-0.05	0.962	[-1.2429, 1.1841]
MA(3)	-0.0253	0.7045	-0.04	0.971	[-1.4061, 1.3556]
MA(4)	0.3502	0.0906	3.86	0.000	[0.1726, 0.5278]
(Residual SD)	30.1920	1.3459	22.43	0.000	[27.5540, 32.8300]

According to Table 4.10, the estimated ARIMA(0,2,4) model for the Agriculture sector shows that only the fourth moving average term is statistically significant. The MA(4) coefficient is positive and highly significant (0.350, $p < 0.001$), indicating that shocks occurring four periods earlier have a meaningful and persistent effect on current changes in agricultural output. The significant result at lag four suggests that the Agriculture sector is mainly influenced by delayed shock effects, where only past disturbances at the fourth lag play a statistically important role in current movements of the series.

4.4.5 Model diagnostic checking.

The residual autocorrelation test was performed via analyzing the Autocorrelation Function (ACF) plots for the model residuals. Also, the Ljung-Box Q test was used to test for residual autocorrelation up to lag 12. In the Ljung-Box test, the null hypothesis asserts that there is no autocorrelation among the residuals, which implies that the residuals are independently distributed. Rejection of the null hypothesis would show that the model is not adequate, while accepting it would show that the model is adequate.

ACF Plots for Residuals.

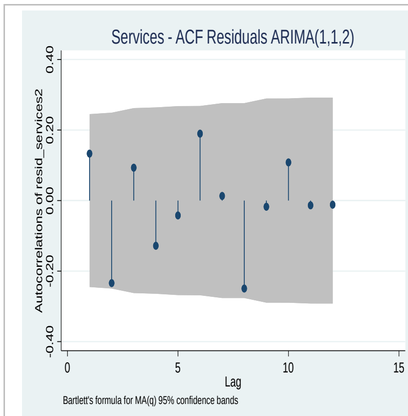


Figure 4.10 ACF Residuals for ARIMA(1,1,2) for Service Sector

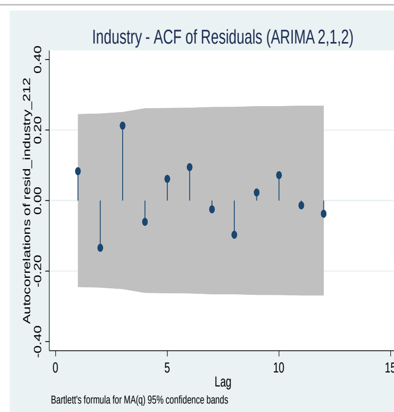


Figure 4.11 ACF Residuals for ARIMA(2,1,2) for Industry Sector

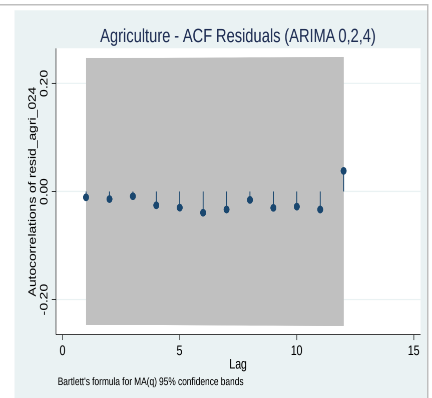


Figure 4.12 ACF Residuals for ARIMA(0,2,4) for Agriculture Sector

Across all three sectors (Services, Industry, and Agriculture), the residual ACF plots in Figure 4.10, Figure 4.11 and Figure 4.12 yield the same positive conclusion that all residual autocorrelations fall within the 95% confidence limits. This means that there is no significant serial correlation remaining in any of your models. The chosen specifications are systematically sufficient and can be confidently used for forecasting.

Table 4.11: Ljung–Box Portmanteau Test for Selected ARIMA Models.

Sector	Model	Q-statistic	df	p-value	Conclusion
Services	ARIMA(1,1,2)	15.0957	12	0.2362	No residual autocorrelation
Industry	ARIMA(2,1,2)	7.3236	12	0.8355	No residual autocorrelation
Agriculture	ARIMA(0,2,4)	0.6806	12	1.0000	No residual autocorrelation

The Ljung-Box Portmanteau test results in Table 4.11 indicate that the residuals of all selected ARIMA models behave as white noise. Since all p-values are greater than 0.05, the null hypothesis of no residual autocorrelation cannot be rejected for Services, Industry, and Agriculture sectors. This confirms that the selected models adequately capture the underlying serial correlation structure in the data and are suitable for forecasting purposes.

4.4.6 Forecast of the Sector Contributions.

Based on the validated ARIMA models (ARIMA(1,1,2) for Services, ARIMA(2,1,2) for Industry, and ARIMA(0,2,4) for Agriculture). The fitted ARIMA models were used to forecast sectoral GDP contributions for 15 quarters ahead, covering the period 2024Q2 to 2027Q4. The forecast plots for the Services, Industry, and Agriculture sectors are presented.

Forecast Plots.

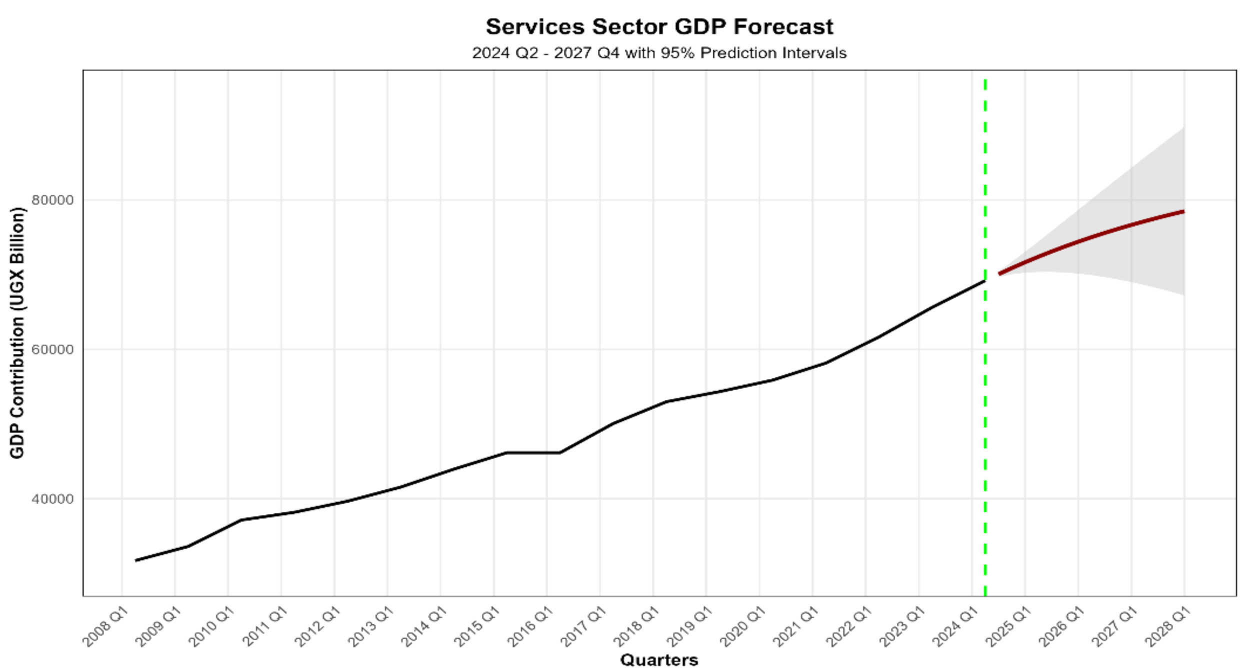


Figure 4.13 Forecast of Services Sector Contribution.

As shown in Figure 4.13, the Services sector is forecast to increase steadily throughout the projection period. The sector's GDP contribution is expected to rise from UGX 70,061.13 billion in 2024 Q2 to UGX 78,493.84 billion in 2027 Q4**.** The forecast line exhibits a consistent upward trend with no projected declines over the forecast horizon. The widening prediction intervals indicate increasing uncertainty as the forecast extends further into the future.

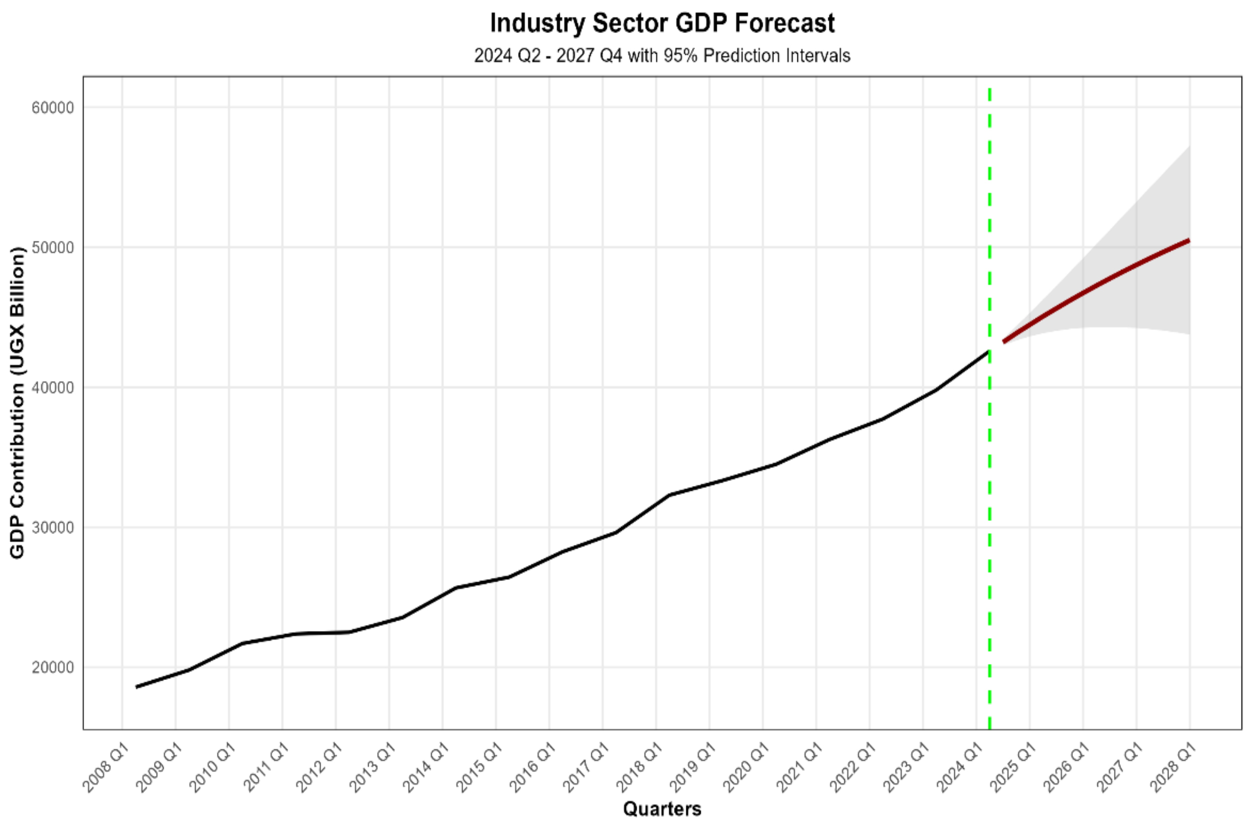


Figure 4.14 Forecast of Industry Sector Contribution.

Figure 4.14 shows that the industry sector is projected to maintain a positive growth trend during the forecast period. The sector's contribution to GDP is expected to increase from UGX 43,214.75 billion in 2024 Q2 to UGX 50,517.99 billion in 2027 Q4**.** The forecast values rise steadily across successive quarters, reflecting continued growth in the sector. The prediction intervals widen gradually over time, suggesting greater uncertainty in longer-term forecasts.

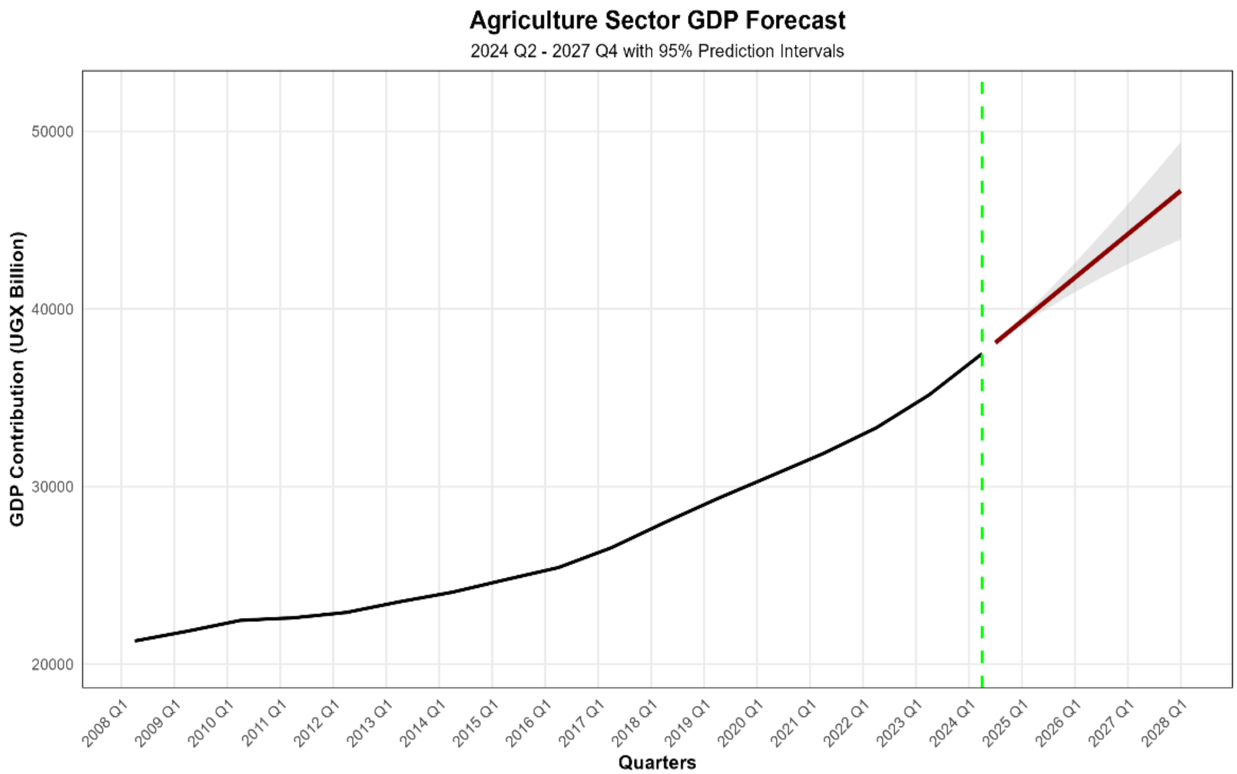


Figure 4.15 Forecast of Agriculture Sector Contribution.

The agriculture sector is also projected to experience sustained growth over the forecast horizon, as illustrated in Figure 4.15. The sector's GDP contribution is forecast to increase from UGX 38,094.49 billion in 2024 Q2 to UGX 46,654.81 billion in 2027 Q4**.** The forecast trajectory shows a continuous upward movement across all quarters, with no anticipated declines. Although the prediction intervals expand slightly over time, the forecast remains centred on a steadily increasing trend.

CHAPTER FIVE: DISCUSSION OF FINDINGS, CONCLUSION AND RECOMMENDATIONS.

5.0 Introduction.

This chapter discusses the key findings of the study in relation to the existing literature reviewed in Chapter 2 and the hypotheses stated in Chapter 1. The chapter then draws conclusions based on the results presented in Chapter 4 and provides policy recommendations

5.1 Discussion.

This section discusses the findings of the study in relation to the study objectives, research hypotheses, and existing literature. The discussion focuses on the contributions of the Services, Industry, and Agriculture sectors to Uganda's GDP, the differences in their growth performance, and the implications of the forecast results for Uganda's future economic growth and structural transformation.

5.1.1 Contribution of Services to Uganda's GDP.

The linear trend regression resulted in the rejection of the null hypothesis that there is no significant trend in the GDP contributions of services over the period 2008 to 2024. The sector exhibited the highest statistically significant positive trend. This finding aligns with (Mbithi & Chekwoti, 2016) who found that the services sector in the East African Community contributes an average of 51% of regional GDP. Similarly, (James et al., 2023) established that Uganda's service sector contribution has averaged above 50% for the past 25 years, exceeding both agricultural and industrial contributions. The highly significant positive trend confirms that services have been the fastest-growing sector, driving Uganda's structural transformation.

Services recorded a high mean growth rate of 1.227%. The post-hoc tests confirmed that Services' growth rate was not significantly different from Industry, but both were significantly higher than Agriculture, leading to the rejection of the null hypothesis that there is no significant difference in the mean growth rates for the service sector compared to the agriculture and industry sectors. The upward trend observed is consistent with (James et al., 2023) who noted that the service sector has been on an upward trend since the 2007–2008 financial crisis, driven by ICT, real estate development, public administration, and health services.

According to (Rodrik, 2016), many developing countries are experiencing premature deindustrialization, shifting from agriculture directly to services without a strong manufacturing base, a pattern evident in Uganda. (Ghani & O'connell, 2014) similarly noted that services now account for more than half of GDP in many developing countries and are the fastest-growing sector. In Uganda's case, this shift could be due to the rapid urbanization, expansion of digital financial services (mobile money and fintech), and growth in public administration and informal urban services, which collectively expand the services sector without necessarily generating proportional industrial employment.

The ARIMA(1,1,2) model was used to generate forecasts for the Services sector over the period 2024 Q2 to 2027 Q4. The forecasts indicate continued dominance of the Services sector, with GDP contribution projected to increase from UGX 70,061.13 billion in 2024 Q2 to UGX 78,493.84 billion in 2027 Q4, representing a 12.0% increase over the forecast horizon. The forecast line exhibits a consistent upward trend with no projected declines over the forecast period, reinforcing the sector's position as the largest contributor to Uganda's GDP.

5.1.2 Contribution of Industry to Uganda's GDP.

The linear trend regression resulted in the rejection of the null hypothesis that there is no significant trend in the GDP contributions of industry over the period 2008 to 2024. The sector demonstrated a robust, statistically significant positive trend. This strong performance aligns with the insights of (Demir, 2021) and (Banelienė, 2021) , who emphasized the industrial sector as a reliable barometer of a nation's developmental strength and aggregate expansion. The significant positive trend confirms that Uganda's industrial sector has been consistently expanding and contributing increasingly to GDP over the study period.

Furthermore, the post-hoc tests led to the rejection of the null hypothesis that there is no significant difference in the mean growth rates for the industry sector compared to the agriculture and service sectors, as industrial quarterly growth rates were found to be statistically indistinguishable from the high-performing service sector, but significantly higher than agriculture .This dynamic explains why, despite maintaining a high quarterly growth profile, the expansion has had limited transformative impact on employment and structural transformation.

This finding supports the concerns of (McMillan et al., 2014) who found that Africa's structural transformation often fails to increase productivity because workers move into low-productivity services rather than high-productivity manufacturing. In Uganda, industrial growth has been driven by construction rather than manufacturing, meaning the sector is expanding without creating the productive, high-value jobs needed for sustainable development. (Newman et al., 2016) stated that African countries require deliberate policies to promote manufacturing, as industrial growth alone does not guarantee structural transformation without a strong manufacturing base.

The ARIMA(2,1,2) model was used to generate forecasts for the Industry sector over the period 2024 Q2 to 2027 Q4. The forecasts indicate continued steady growth for the sector, with GDP contribution projected to increase from UGX 43,214.75 billion in 2024 Q2 to UGX 50,517.99 billion in 2027 Q4, representing a 16.9% increase over the forecast horizon. The forecast values rise steadily across successive quarters, reflecting continued growth in the sector. However, the modest nature of this growth compared to Services suggests that Uganda's structural transformation remains service-led rather than manufacturing-led under industrialization

5.1.3 Contribution of Agriculture to Uganda's GDP.

The linear trend regression results indicated a statistically significant positive trend in agriculture's contribution to GDP over the period 2008 to 2024. This led to the rejection of the null hypothesis that there is no significant trend in the GDP contributions of agriculture over the study period, confirming that the sector experienced sustained growth over time. This finding is consistent with (Magunda, 2020) who reported that agriculture remains a critical driver of economic activity and employment, particularly given that approximately 78% of the population resides in rural areas and depends on agriculture for livelihoods.

Despite this long-run growth in output, agriculture recorded the lowest mean quarterly growth rate (0.878%) compared to Industry (1.294%) and Services (1.227%). The post-hoc tests further confirmed that agriculture's growth rate is significantly lower than both sectors, leading to the rejection of the null hypothesis that there is no significant difference in mean growth rates between agriculture, industry, and services. This relatively weak performance reflects the structural transformation patterns identified by (Tomšík et al., 2015) who observed a substantial decline in agriculture's share of GDP in Sub-Saharan Africa. who observed a substantial decline in agriculture's share of GDP in Sub-Saharan Africa. Similarly, (Gollin, 2010) highlighted persistent low agricultural productivity across many African economies, which constrains the sector's ability to keep pace with other sectors. This slow growth can be attributed to continued reliance on subsistence farming, limited mechanization, and heavy dependence on rain-fed agriculture, which makes output highly vulnerable to climate variability and seasonal shocks.

The ARIMA(0,2,4) model forecasts sustained growth in agriculture over the period 2024 Q2 to 2027 Q4, with GDP contribution projected to increase from UGX 38,094.49 billion to UGX 46,654.81 billion. This represents the highest percentage increase (22.5%) among the three sectors, suggesting potential for recovery and long-term expansion. The upward projection aligns with (Diao et al., 2010) who argued that agriculture remains a key driver in early stages of structural transformation and should not be underestimated. This projected growth may be driven by increasing government investment in agro-processing, regional export demand for agricultural products, and gradual improvements in input distribution systems such as seeds and fertilizers.

5.2 Summary.

The findings indicate that Uganda is experiencing a clear but uneven structural transformation characterized by statistically significant growth across agriculture, industry, and services, with services emerging as the dominant and most dynamic sector of the economy. Services recorded the highest contribution to GDP growth and a growth rate comparable to industry but significantly higher than agriculture, reflecting a shift consistent with premature deindustrialization, driven by rapid urbanization, expansion of ICT and financial services, and growth in public administration and informal urban activities. The industrial sector also demonstrated a strong and significant upward trend; however, its transformative impact remains constrained by its reliance on construction rather than manufacturing, limiting productivity gains and high-quality employment creation despite sustained expansion. In contrast, agriculture, while exhibiting long-run growth and remaining central to rural livelihoods, recorded the weakest performance due to structural constraints such as low mechanization, subsistence-oriented production, and exposure to climatic variability. Forecasts further confirm the persistence of this pattern, with services expected to maintain dominance, industry showing steady but moderate growth, and agriculture gradually recovering, collectively indicating that Uganda's growth trajectory is service led but still faces structural imbalances that limit inclusive employment generation and deep economic transformation.

5.3 Conclusion.

The study concludes that statistically significant growth trends were observed across agriculture, industry, and services over the study period, indicating sustained expansion in sectoral GDP contributions. The analysis further shows significant differences in mean growth rates across sectors, with industry and services performing at relatively similar and significantly higher levels than agriculture. This points to a service-led structural shift in Uganda's economy, where services dominate, industry plays a secondary role, and agriculture remains the least dynamic sector. The forecast results reinforce this pattern by indicating continued growth in all sectors, with services expected to maintain dominance, industry showing steady but moderate expansion, and agriculture gradually improving but remaining the smallest contributor. However, despite this projected growth, the persistent disparities across sectors suggest that Uganda's economic expansion remains uneven and has not yet fully translated into balanced structural transformation.

5.4 Recommendations.

Based on the findings of the study, the following key recommendations are made to promote balanced and sustainable structural transformation in Uganda.

Agriculture Sector: The Ministry of Agriculture, Animal Industry and Fisheries should prioritize investment in irrigation and climate-resilient farming systems to reduce dependence on rain-fed agriculture and improve productivity.

Industry Sector: The Ministry of Trade, Industry and Cooperatives should shift industrial policy from construction-led growth towards manufacturing-led industrialization, with targeted support for labor-intensive manufacturing.

Services Sector: The Ministry of ICT and National Guidance, together with the Ministry of Finance, Planning and Economic Development, should strengthen ICT infrastructure and digital transformation to enhance productivity and ensure that services sector growth translates into meaningful employment opportunities.

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Annex

Annex 1. Forecasted Sectoral GDP Contributions (UGX Billion), 2024 Q2 – 2027 Q4.

Quarter	Services	Industry	Agriculture
2024 Q2	70,061.13	43,214.75	38,094.49
2024 Q3	70,880.76	43,861.75	38,705.82
2024 Q4	71,659.97	44,460.85	39,316.99
2025 Q1	72,400.75	45,062.78	39,928.47
2025 Q2	73,105.00	45,631.48	40,539.96
2025 Q3	73,774.52	46,194.21	41,151.44
2025 Q4	74,411.02	46,731.97	41,762.93
2026 Q1	75,016.13	47,259.51	42,374.41
2026 Q2	75,591.39	47,766.91	42,985.90
2026 Q3	76,138.29	48,262.26	43,597.38
2026 Q4	76,658.21	48,740.44	44,208.87
2027 Q1	77,152.50	49,205.97	44,820.35
2027 Q2	77,622.41	49,656.31	45,431.84
2027 Q3	78,069.14	50,094.04	46,043.32
2027 Q4	78,493.84	50,517.99	46,654.81