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AGRICULTURAL PRODUCTION AND ECONOMIC GROWTH IN TANZANIA: IMPLICATION FOR SUB SECTORAL CONTRIBUTION

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ABSTRACT

This paper attempts to examine the role of agricultural sub sectors in contributing to economic growth of Tanzania. It provides empirical evidence from time series data for the period from 1971 to 2013. It employs the Ordinary Least Square (OLS) and Newey-West estimators to analyse the contributive effect of crop, livestock and fishery sub sectors to economic growth in Tanzania. The primary finding reveals that, agricultural sub sectors have positive effect to Tanzanian economic growth. A comparative analysis provides a suggestive evidence that livestock production exhibits the highest contributive effect to economic growth followed by crop and fishery sub sectors respectively. The policy outlook implies that more resources should be reallocated in livestock sub sector in order to boost the overall performance of agricultural production as one of the key out of poverty strategies for economic growth in Tanzania.

***Keywords**: Agriculture, Crop, Fishery, Livestock, Economic Growth.*

1.0 INTRODUCTION

Three quarters of the global poor reside in rural areas and highly depend on farming, thus, agricultural sector stands as one of the major contributors in the world's economic growth, pathway out of poverty and environmental sustainability (UNDP, 2012). Agriculture is very important in global poverty reduction strategies, it is spelled out as a salient productive sector in most developing countries due to its significant share of Gross Domestic Product (GDP) and total employment share it captures in such economies (IDA, 2009). In the case where a huge employment percentage is captured by agriculture, a significant enhancement in agricultural incomes is vital to stimulate the overall economic growth (FAO, 2012). The importance of agriculture in most African economies advocates that schemes planned to promote the early stages of economic growth cannot do away with agriculture. Tanzania is one of the typical countries in Sub Saharan Africa with a population of roughly 59 million people growing at 2.9 per cent per annum. It covers the eighth largest land area of 945,000 square kilometres in Sub-Saharan Africa. It is heavily dependent on agriculture primarily on production of coffee, cotton, tea, cashew nuts, sisal, maize, rice, wheat, cassava and tobacco, which have significant contribution to GDP (Worldometers, 2020; World Bank, 2013).

Agriculture remains one of the largest sectors in Tanzania and its performance has a significant effect on economic growth (URT, 2013). The sector comprises of three main sub sectors namely crops, livestock and fishery. Despite a huge employment share of about 65 per cent of the total population captured by the sector in Tanzania, its share in GDP contribution has over time experienced a declining trend (Eliamoni and Fengying, 2015). For instance, the share has fallen from 29 per cent in 2001 to 24 per cent in 2010 (see figure 1) with an average slow annual growing rate of only four percent (URT, 2013). This pops up a question; given the underpinning sub sectors in agricultural sector, which one has the highest contributive potential to GDP growth? Thus, this paper attempts to examine the role of agricultural sub sectors (crop, fishery and livestock) in contributing to economic growth of Tanzania. In order to infer empirical evidence in addressing the research question, the study tested the following hypotheses; (i) There is significant effect of crop production on GDP growth (ii) There is significant effect of fishery production on GDP growth (iii) There is significant effect of livestock production on GDP growth.

Revealing a sub sector of highest contributive potential to GDP growth will provide relevant government authorities with important insight in developing policies that emphasize boosting of agricultural production through such a sub sector. Consequently, more resources will be pulled into the sub sector in order to significantly increase agricultural production. This is imperative way in improving agricultural sector production for national economic growth and poverty reduction of the rural poor who are heavily depending on agriculture for their economic welfare. Therefore, the study attempts to answer the research question by applying appropriate econometric techniques (OLS and Newey-West) to analyze time series data from 1971 to 2013.

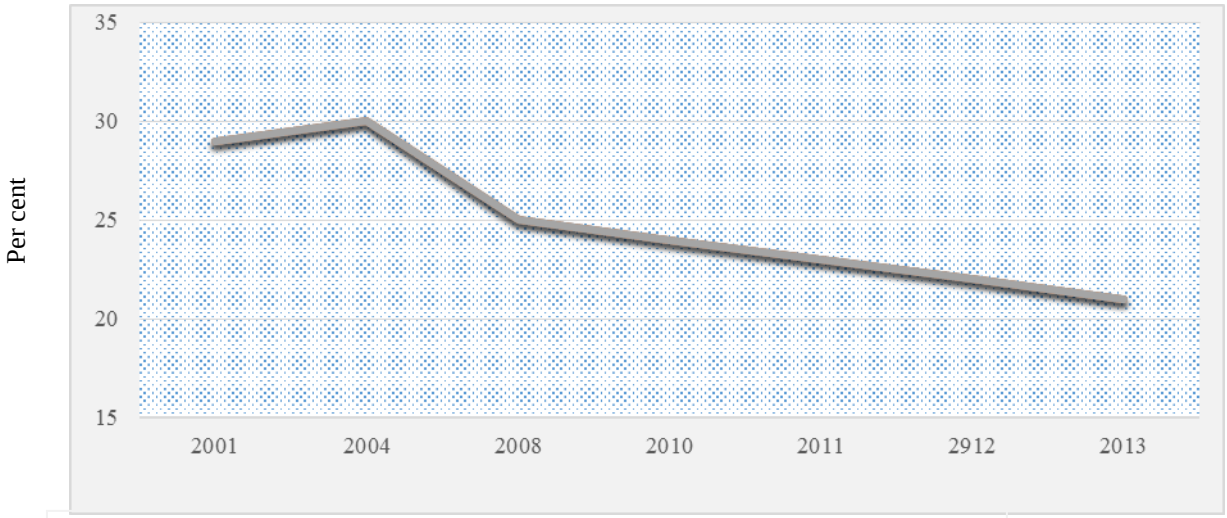

Figure 1: Share of Agricultural Sector to GDP Growth (2001 to 2013)

Source: UTR (2013) Ministry of Agriculture Food Security and Cooperatives

2.0 LITERATURE REVIEW

2.1 Definition of Key Terms/Variables

Agriculture is a science, art, or practice of cultivating the soil, producing crops, and raising livestock and in varying degrees the preparation and marketing of the resulting products (Merriam-Webster, 2020). Generally, agricultural sector contributes to economic growth through the three major production areas namely crop production, livestock keeping and fishing (Salako, 2015).

Crop production involves production of major food and cash crops. Major food crops include maize, paddy, sorghum, millet, cassava, beans, irish potatoes and sweet potatoes. On the other hand, major cash crops include cotton, tea, coffee, sisal, tobacco and cashew nuts (URT, 2011).

Livestock sub sector includes production of livestock products such as meat, milk, and eggs. Tanzania has attained the third position in livestock keeping in Africa after Ethiopia and Sudan. Between 2000/2001 and 2009/2010 the estimated production of livestock products increased from 323,000 to 449,673 tonnes **(**FAO, 2020**).**

Salako (2015) and URT (2015) define fishing as an activity which involves breeding collecting, capturing, gathering, snaring or trapping of fish or aquatic flora from water bodies for domestic consumption and commercial purpose. FAO (2020) declared that, the Fishery sub sector in Tanzania employs about 150,000 full time artisanal fishermen. URT (2009) indicated that fish is an important source of animal protein in Tanzania which contributes up to 27 per cent consumption of the total animal protein. FAO (2020) added that fish contributes more than 60 per cent of the World supply of protein, especially in developing countries.

Economic growth is a continuous process by which the productive capability of a nation is increased over time to raise the level of national output (Todaro and Smith, 2008). The term economic growth is used to show an increase in total gross domestic product (GDP). Normally, it is measured as the rate of change of gross domestic product (GDP) over a specified period of time. It denotes the market value of the amount of goods and services produced and not the way in which they are produced (Encyclopedia Britannica, 2020).

2.2 Performance of Agricultural Sector to Economic Growth in Tanzania

Agriculture is one of the largest sectors in Tanzania and its performance has a significant effect on economic growth. The sector contributes 29.1 percent of the total GDP and accounts for 30 percent of the total export earnings. Sales of agricultural products accounts for about 70 percent of rural households incomes (FAO, 2020).

In 1990s, the average agricultural growth was 3.6 per cent, which was higher than that of 1970s and 1980s where annual agricultural growth averaged between 2.9 and 2.1 per cent respectively. The growth rate of agriculture has been on an average of 4.3 per cent during the period from 2000 to 2013. However, the growth rate slowed down within 2000s from 4.5 per cent in the first half of the decade to 3.9 percent in later years of the decade (URT, 2014).

Food crop production grew at a rate of three percent which is almost the same rate of population growth and accounts for about 65 per cent of agricultural GDP with cash crops accounting for only about 10 per cent where the remaining 25 per cent is captured by livestock sub sector. National data show significant progress towards the objective of a sustained five per cent growth rate with an increase of the five year moving average agricultural GDP growth rates from about 3.3 per cent from 1991 to 2000 to 4.3 per cent over the 1999 to 2003 periods (URT, 2004).

Livestock is the key agricultural sub sector in Tanzania where about 36 per cent of farm households are engaged in livestock keeping, in which one per cent is of pure livestock farmers and 35 per cent is crop livestock mix farmers (URT, 2007). Livestock production provides about 25 per cent of agricultural GDP where about 40 per cent originates from beef production, 30 per cent from milk production, and the remaining 30 per cent is from poultry and small stock production (Njombe and Msanga, 2010).

Fishery is important to Tanzanian economy providing employment, income, and foreign export revenue. The sector is responsible for over four million jobs (about 35 per cent of the 14 million in rural employment) and contributes about 1.4 per cent to the country's GDP (USAID, 2015). In 2009 the fishery sub sector contributed a share of 1.3 per cent to GDP. The per capita fish consumption is 8 kilogram and about 30 per cent of animal protein consumption in Tanzania is from fish (URT, 2009). Although the fishery sub sector grew by 5 per cent in 2008, its growth declined to 2.7 per cent in 2009 and has continued declining. In 2013, it experienced the lowest growth rate (2.2 per cent) compared to all other sectors and sub sectors of the Tanzanian economy (USAID, 2015).

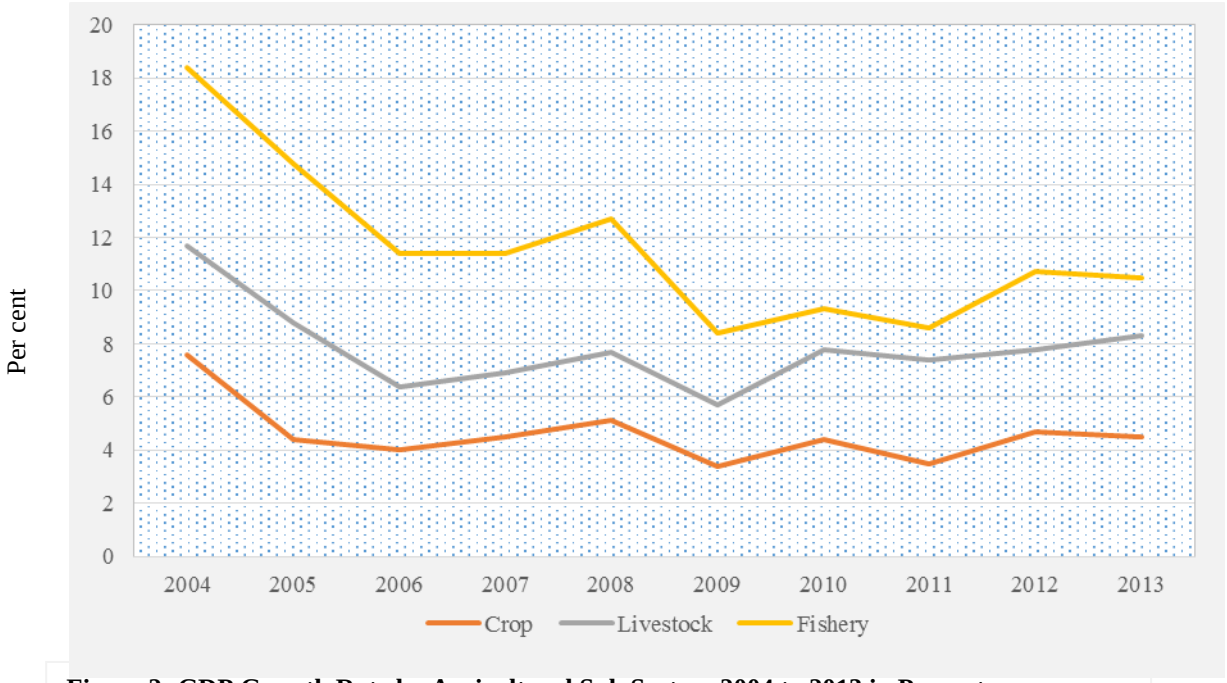

Figure 2: GDP Growth Rate by Agricultural Sub Sectors 2004 to 2013 in Percentage
Source: UTR (2013), Ministry of Agriculture Food Security and Cooperatives.

2.3 Relevant Empirical Literature

Parente and Rogerson (2002) carried out a study on the role of agriculture to national economic development. They employed structural transformation approach using both cross-sectional and panel data for 62 developing countries from 1960 to 1990. The findings indicated that growth in agricultural production is important in explaining growth in GDP per worker.

Onunze (2012) analysed the influence of agricultural development to economic growth of Nigeria employing Ordinary Least Square (OLS) technique from the year 1980 to 2010. The study found that the production of agriculture sector has positive influence on economic growth in Nigeria.

Uma (2013) examined the effect of agriculture on economic growth in Nigeria using time series data from 1970 to 2009. Specifically the study examined the effect of crop production, livestock, forestry and fishing on the economic growth. It employed OLS method on time series data analysis. The study found that only forestry had significant contribution to economic growth while livestock, fishing and crop production had insignificant impact to economic growth.

Eliamoni and Fengying (2015) appraised the role of agriculture to economic growth and poverty reduction in Tanzania using quantitative research approach on time series data from 1965 to 2013. The study discovered that the increase in population and poor public services in rural exacerbating poverty accelerates shifting from agriculture to non-agricultural activities especially for educated youth group with negative impact on economic growth.

Chongela (2015) studied on contribution of agricultural sector to Tanzanian economy. He employed OLS model estimation to analyze time series data covering 1981 to 2010. He revealed that, agricultural sector is the key contributor to the national economy by contributing 25.88 per cent of the national growth. Additionally, he found that 18.93 per cent, 4.70 per cent and 2.25 per cent were contributed by crops, livestock and fishery sub sectors respectively.

Joaquin (2010) examined the contribution of agricultural sector to sustainable development in Jamaica using time series data from 1996 to 2007. He used forward and backward linkage approach linking agricultural sector to other sectors. He concluded that, agriculture is important to alleviate poverty and encourage rural development in Jamaica.

Chandio et al. (2015) investigated the contribution of agricultural subsectors to agricultural GDP growth rate in Pakistan. They employed time series data from 2001 to 2015 and confirmed that crops and livestock contributes largely on GDP growth while forestry and fishery have lowest contribution.

As indicated in the literature, most of similar studies took place in other economies apart from Tanzania except for two studies by Chongela (2015) and Eliamoni and Fengying (2015). However, Eliamoni and Fengying (2015) examined agricultural effect on GDP at sectoral level while Chongela (2015) carried out a study at sub sectoral level. In his study Chongela (2015) did not take into account time series stationarity which may lead into spurious regression results. Unlike the previous studies, this paper provides the answer to research question through a robust, reliable and valid findings in two folds; first, it executes a unique critical analysis by two econometric techniques (OLS and Newey-West) for comparable results which yield justifiable robust findings. The Newey-West estimator strongly addresses serial autocorrelation and heteroscedasticity issues in time series data which was not employed in previous literature. Second, it thoroughly takes into account time series properties of data through intensive treatment of preestimation tests on time series stationarity to avoid spurious regression results.

2.4 Conceptual Model

Figure 3 illustrates the expected relationship that exists between agriculture (crops, livestock production and fishing) and economic growth. Agriculture has a positive correlation with economic growth. In this case it provides agricultural households with income resulting from sales of crops, livestock products as well as fishes. In aggregate terms, the income accrued by households contributes to national income. Again, exports of agricultural products from crops, livestock and fishery industries generates foreign exchange necessary for national balance of payment (BoP). Agricultural sector provides employment opportunities to most Tanzanians living in rural areas who rely on agriculture for their livelihood.

On another side, if the economy maintains steady economic growth, it will create better standard of living as well as better investment climate.

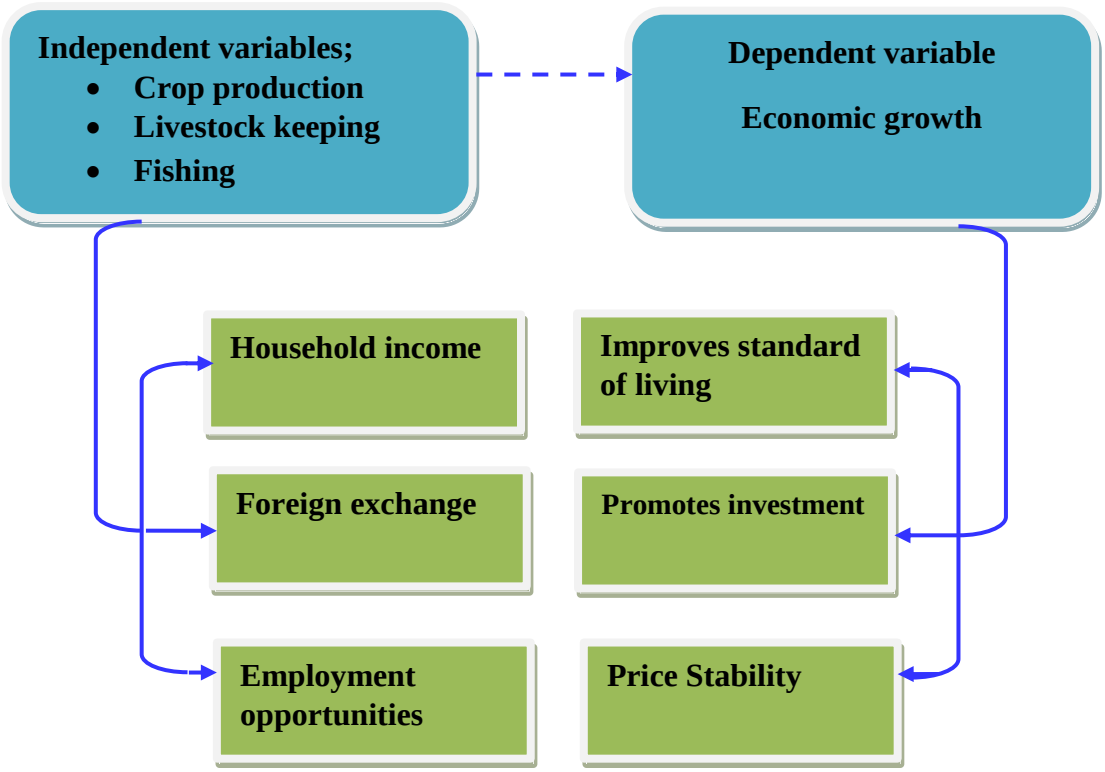

Figure 3: The Contribution of Agriculture to Economic Growth

Legend Indicates leads to.

Causal effect relationship on variable(s) under study

Source: Researcher's Construction.

Specifically, stable and sustainable economic growth results from provision of good and affordable health and education services, improved infrastructure for high productivity, maintenance of peace, law and order, good governance, price stability and high employment rate.

3.0 METHODOLOGY AND DATA

3.1 The Model

The relationship between dependent variable and explanatory variables is given by;

$$Y_t = f(X_t, Z) \quad \ldots\ldots(1)$$

Where; *Y* is national output , *X* is treatment variable, *Z* is a vector of control variables while $_t$ is time.

The explanatory variables included in the model are treatment variable *X* in this case agricultural sub sectors (A_s) namely; Crop, Fishery and Livestock which are in annual output in Tanzanian Shillings (TZS). A vector of control variables *(Z)* captures GDP determinants including the key sectors in the economy which are Industrial (*IND*) and Service sectors (*SER*) in annual outputs (in TZS). Other control variables are annual Imports (*IMP*), Inflation (*INF*) and Exports (*EXP*); all in annual percentage growth.

Therefore, the appropriate representative relationship is given by;

$$GDP_t = f(A_{St}, IND_t, SER_t, IMP_t, INF_t, EXP_t) \quad \ldots\ldots(2)$$

Thus, the first empirical estimation model (OLS technique) is given by;

$$GDP_t = \beta_0 + \beta_1 A_{St} + \beta_2 IND_t + \beta_3 SER_t + \beta_4 IMP_t + \beta_5 INF_t + \beta_6 EXP_t + \varepsilon_t \dots\dots\dots\dots\dots(3)$$

where; GDP is a proxy for economic growth which is in (TZS) annual GDP growth, β_0 is constant, β_1 is coefficient of the study's interest from each of the three aforementioned sub sectors in agriculture and ε is an error term while $_t$ is time.

Although the first differencing tries to account for heteroskedasticity and serial correlation issues which violate the classical assumption of OLS estimation, the study futher implements the second model of Newey-West estimator. Newey-West strongly addresses the error term heteroskedasticity and serial correlation issues by yielding efficient estimates through robust heteroskedasticity and autocorrelation consistent (HAC) standard errors (Newey and West, 1987). The study employs both models for robustness checks of the results by verifying OLS with Newey-West estimator results. The Newey-West addresses heteroskedasticity and autocorrelation of error term to provide reliable robust standard errors under the following models. Standard error corrected estimates for serial correlation is indicated as;

$$s.e(\hat{\beta}_1) = \sqrt{\frac{\sum_{t=1}^{T}\sum_{t*=t-L}^{t+L} x_1 x_2}{(\sum_{s=1}^{T} x^2{}_s)} e_t e_{t*}} \dots\dots(4)$$

Standard error corrected estimates for serial heteroskedasticity.

$$s.e(\hat{\beta}_1) = \sqrt{\frac{\sum x^2{}_t e_t{}^2}{\sum (x_t{}^2)^2}} \dots\dots(5)$$

3.2 Data and Source

The data on dependent variable (GDP growth) used in the study were accessed from World Development Indicators (WDI), data on treatment variables (crop, fishery and livestock sub sectors) were obtained from the Tanzania National Bureau of Statistics (NBS). Similarly, data for control variables on imports, inflation and exports were accessed from WDI. The remaining data on industrial and service sectors were obtained from NBS. After data cleaning by eliminating outliers and observations having missing values the remained sample period was from 1971 to 2013.

4.0 Estimation of Results and Discussion

4.1 Pre Estimation Tests

Granger and Newbold (1974) argue that scholars had not taken into account the caution of high autocorrelation in the error terms from conventional regression models. They concluded that aggregate macro data are interlinked and that in estimations at their levels the standard results are typically misleading. The resulting test statistics would tend to reject the null hypothesis instead of accepting it. Therefore time series must be subject to unit root test to ensure they are stationary prior to any subsequent regression. Before performing the unit root tests, the study conducts an investigation on the properties of the key time series in this study to see whether they are stationary or not. The series, *GDP*, crop (*CRP*), fishery (*FHG*) and livestock (*LIVS*) series are graphed at their levels.

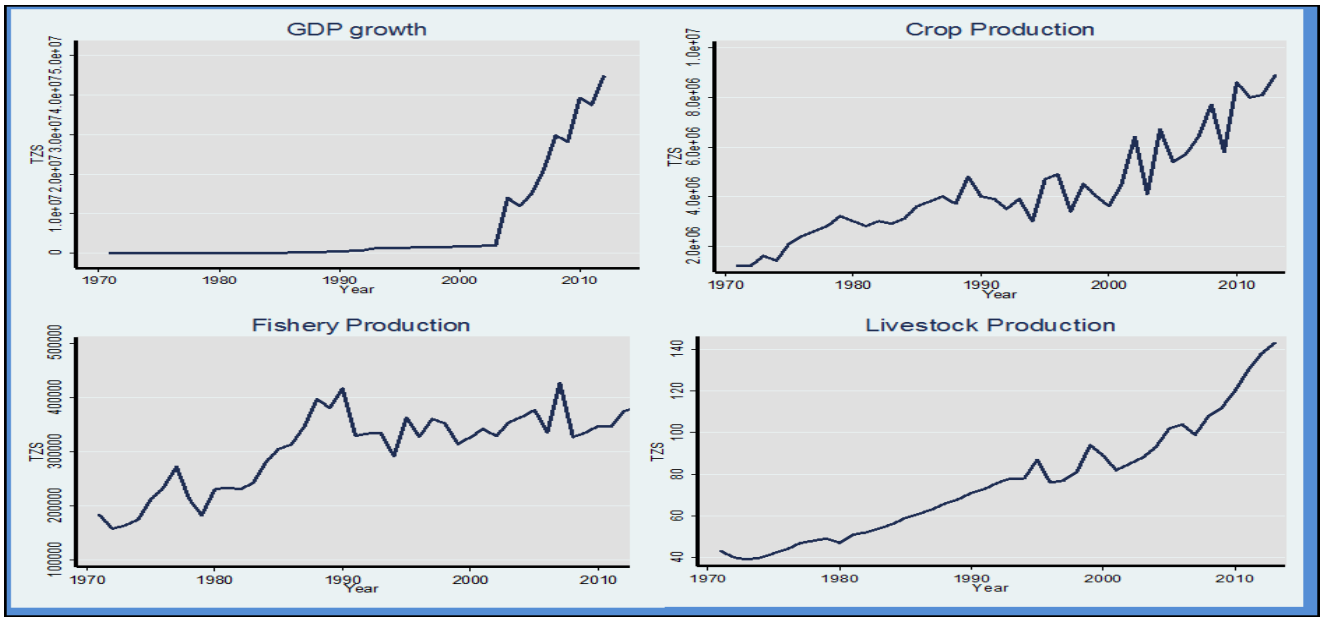

Figure 4: Plots of the Level Series of GDP, Crops (CRP), Fishing (FHG) and Livestock (LIVS)
Source: Author's computation, 2019

According to Rehman, Iqbal, and Siddiqi (2010) a visual plot of the data is usually the first step in any time series analysis that provides a clear picture of data to be used. The study, therefore, plots at levels the key time series in a line graph to depict clear pictorial properties of each time series data based on stationarity. The graphical presentations of the series at levels on *GDP, CRP, FHG and LIVS* are shown in Figure 4.

As it can be observed from the graphical presentations the GDP growth line graph trends upward portraying a characteristic of nonstationary series. Similarly, the line graphs for CRP, FHG and LIVS clearly trend upward as time changes depicting nonstationary behavior. Jordaan and Eita (2009) and Okwo, Agu, and Ugwunta (2012) opined that the fact that time series are moving together, suggests that they have a mean and/or variance changing over time and this may also suggest that there is a long run equilibrium relationship between these variables. The first step, therefore, prior to empirical estimation is to observe the univariate characteristics of the time series data by testing for stationarity behavior of the variables used in the analysis.

4.2 Unit Root Tests

One property of economic time series is that of non-stationarity behavior of the series. In this study, non-stationarity is tested using the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) unit root tests. While the ADF approach is biased for small samples and accounts for the autocorrelation of the first difference of the series in a parametric fashion by estimating additional nuisance parameters, the Phillips-Perron approach deals with the phenomenon in a nonparametric way and it is not biased for small samples. Definitely, the Phillips-Perron unit root test makes use of nonparametric statistical methods to take care of the serial correlation in the error terms without adding lagged difference terms (Gujarati and Porter, 2009). These tests were used to investigate the null hypothesis that all the variables are not stationary (have unit roots) against the alternative hypothesis that they do not have unit roots at levels of all variables as well as in their first differences. Both tests include three models; constant, constant and trend, and no constant and trend where stationarity property must be satisfied in all the three models (Hossain, 2013). The three estimations based on constant, constant and trend, and no constant and trend follows the following respective equations;

1) With constant

$$\Delta Z_t = \delta_1 + \gamma Z_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta Z_{t-i} + \varepsilon_t \quad \text{.....(6)}$$

2) With constant and trend

$$\Delta Z_t = \delta_1 + \delta_2 t + \gamma Z_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta Z_{t-i} + \varepsilon_t \quad \text{.....(7)}$$

3) Without constant and trend

$$\Delta Z_t = \gamma Z_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta Z_{t-i} + \varepsilon_t \quad \text{.....(8)}$$

Where $\Delta Z_t = (Z_t - Z_{t-1})$, is the first difference of the series Z_t; $\Delta Z_{t-1} = (Z_{t-1} - Z_{t-2})$ is the first difference of the series Z_{t-1}. Yet again $\delta_1, \delta_2, \gamma$ and α_i are parameters to be estimated, and ε_t is a stochastic disturbance term. In the ADF approach we test whether a variable follows a unit root process. The null hypothesis is that the variable contains a unit root and the alternative hypothesis is that the variable was generated by a stationary process.

$H_0 : \gamma = 0$ (Z_t is non stationary or contains a unit root)

$H_1 : \gamma < 0$ (Z_t is stationary or contains no unit root)

Table 1: Augmented Dickey-Fuller (ADF) Test Results

Test Results for Unit Root on the Level of Series						
Variables	Constant		Constant and Trend		No Constant and Trend	
	Test Statistics	Critical Values	Test Statistics	Critical Values	Test Statistics	Critical Values
GDP	-3.235**	-2.952	-4.620***	-4.224	-0.965	-2.633
CRP	-1.252	-3.634	-4.487***	-4.224	0.550	-2.633
FHG	-2.024	-3.634	-2.986	-4.224	0.347	-2.633
LIVS	1.859	-3.634	-0.945	-4.224	3.950***	-2.633
Test Results for Unit Root on the First Differenced Series						
Variables	Constant		Constant and Trend		No Constant and Trend	
	Test Statistics	Critical Values	Test Statistics	Critical Values	Test Statistics	Critical Values
GDP	-12.038***	-3.641	-11.882***	-4.233	-12.073***	-2.634
CRP	-13.274***	-3.641	-13.210***	-4.233	-12.410***	-2.634
FHG	-9.672***	-3.641	-9.648***	-4.233	-9.488***	-2.634
LIVS	-6.135***	-3.641	-6.629***	-4.233	-4.854***	-2.634

Source: Author's computation, 2019

Note: ** and *** denote significance at 5% and 1% respectively

Table 2: Phillips-Perron (PP) Test Results

Test Results for Unit Root on the Level of Series						
Variable	Constant		Constant and Trend		No Constant and Trend	
	Test Statistics	Critical Values	Test Statistics	Critical Values	Test Statistics	Critical Values
GDP	-3.130	-3.634	-4.810***	-4.224	-0.384	-2.633
CRP	-0.477	-3.634	-4.805***	-4.224	2.051	-2.633
FHG	-1.817	-3.634	-2.958	-4.224	0.697	-2.633
LIVS	2.798	-3.634	-0.684	-4.224	5.080***	-2.633
Test Results for Unit Root on the First Differenced Series						
Variable	Constant		Constant and Trend		No Constant and Trend	
	Test Statistics	Critical Values	Test Statistics	Critical Values	Test Statistics	Critical Values
GDP	-13.528***	-3.641	-13.350***	-4.233	-13.258***	-2.634
CRP	-15.618***	-3.641	-15.944***	-4.233	-12.521***	-2.634
FHG	-9.756***	-3.641	-9.866***	-4.233	-9.400***	-2.634
LIVS	-6.149***	-3.641	-6.798***	-4.233	-4.891***	-2.634

Source: Author's computation, 2019

Note: ** and *** denote significance at 5% and 1% respectively

Accepting the null hypothesis implies that the time series Z_t contains a unit root, whereas rejecting it implies that the time series Z_t is stationary. The ADF and PP unit root tests results for *GDP CRP, FHG and LIVS* are reported in Table 1 and Table 2.

Table 1 indicates the ADF test results of the key variables of the study at their levels; GDP, *CRP, FHG.and LIVS*. The test statistics of *GDP CRP LIVS* series in their levels are greater than their corresponding critical values at 0.01 and 0.05 levels of significance in absolute values in at least one of the three equations (of constant, constant and trend and no constant and trend). This suggests that we reject the null hypothesis and thus these series are stationary. However, this does not satisfy the requirement of full stationarity of each series in all the three equations (Hossain, 2013). The remaining variable *FHG* indicates the test statistic less than its corresponding critical values at 0.01 level of significance implying that it is non-stationarity.

Similarly, the PP test results in Table 2 show that the test statistics of *GDP, CRP, FHG and LIVS* at their levels are greater than their corresponding critical values at 0.01 level of significance in absolute values. It means that, these series are stationary in at least one of three equations (of constant, constant and trend and no constant and trend which do not meet the full stationarity requirement in all three equations). Thus, all the series are transformed by first differencing and retested for stationarity and results are indicated in second parts of Table 1 and Table 2.

The ADF test results in Table 1 portray that, the test statistics for the first differenced series of *GDP, CRP, FHG.and LIVS* are greater than their corresponding critical values at 0.01 level of significance in absolute values in all equations with constant, with constant and trend, and without constant and trend. Similarly, the PP test results in Table 2 indicate similar results for *GDP, CRP, FHG and LIVS* in all three equations. Consequently, the null hypothesis of non-stationarity of the first differenced *GDP, CRP, FHG and LIVS* series is rejected in favour of the alternative hypothesis meaning that the variables *GDP, CRP, FHG and LIVS* are stationary in their first differences also confirmed by the plots in Figure 5.

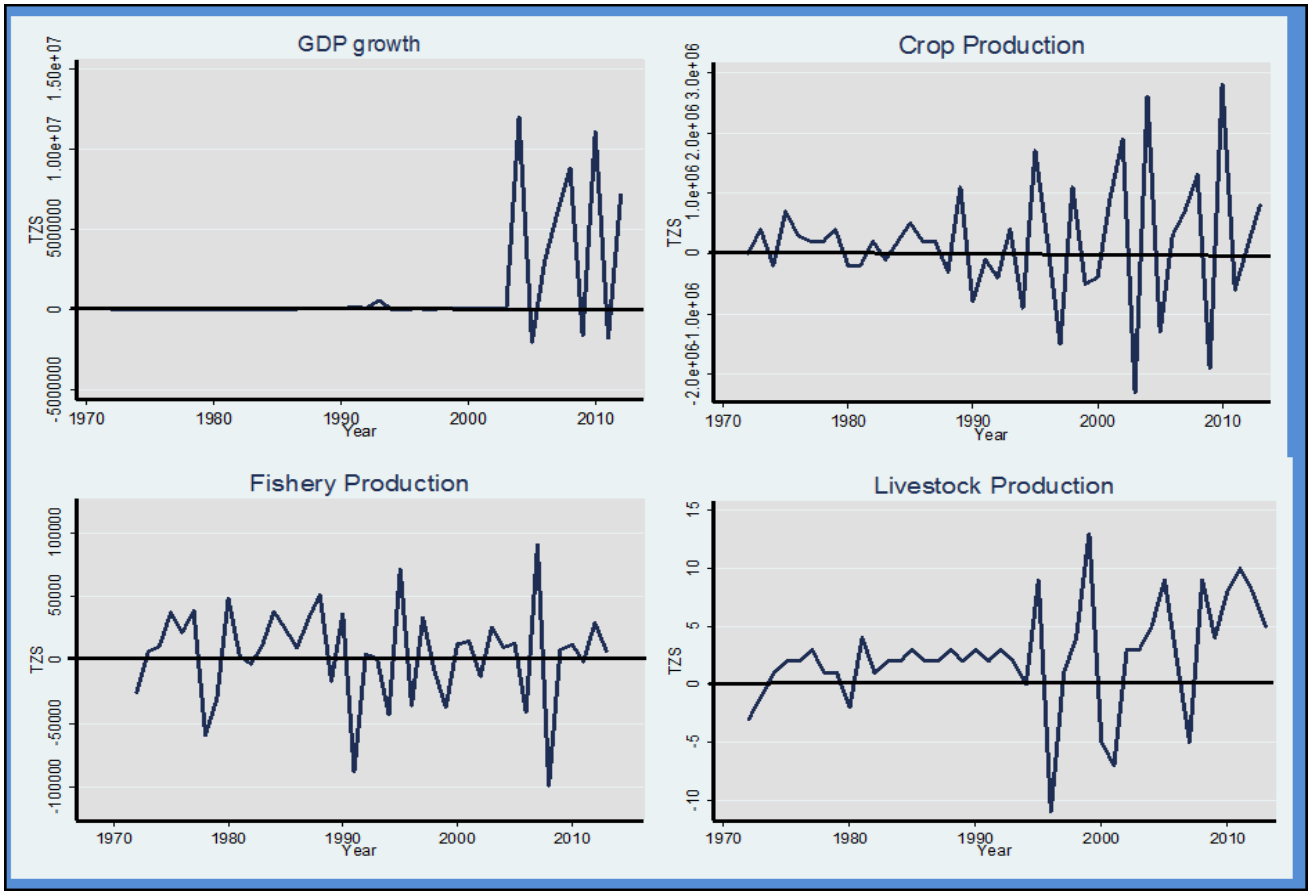

Figure 5: Plots of the First Difference Series of (Log) Variable
Source: Author's computation, 2019

A comparison of the plots in selected variable at their levels in Figure 4 with differenced series in Figure 5 indicate that the variables in the later demonstrate random fluctuations around a constant mean and constant variance. The differenced series do not trend upward or move together as time changes. This confirms that the first difference series of *GDP, CRP, FHG and LIVS* have achieved stationarity. Consequently, the pictorial representation in Figure 5 suggests that the results are consistent with the null hypothesis that each variable is stationary and therefore, further econometric analyses can be carried out.

43 Main Findings and Robustness Checks

The regression results presented in Table 3 are used to determine the effect of agricultural sub sectors on economic growth in Tanzania. The focus of the results is on the coefficient estimates of crop, fishery and livestock sub sectors which are the core variables of the study.

Two estimations are carried out for robustness of the results. The first one is OLS followed by Ney-Wey estimation technique. For validity of results in each technique two regressions were carried out to verify results consistency by redefining dependent variable from annual GDP growth in TZS in the first regression into GDP per capita in the latter regression. The baseline OLS results based on dependent variable defined as annual GDP growth in TZS are presented in Table 3 in which the primary variable of our interest is presented in the first row.

Table 3: Baseline Results; Dependent Variable – Annual GDP Growth in TZS

Variables		(1)		(2)		(3)
Agriculture	Crop →	110.5924***	Fishery →	13.2460*	Livestock →	135.9782***
		(30.360)		(6.924)		(26.029)
Industry		5.8258		-20.7850		-19.6258
		(25.580)		(26.850)		(21.122)
Service		-31.7775		17.5391		158.6844**
		(72.347)		(93.426)		(77.350)
Import		-31.3359		-35.7324		-18.5917
		(66.336)		(74.753)		(58.350)
Inflation		-107.8368***		-139.8531***		-111.7921***
		(25.628)		(29.596)		(22.421)
Export		1.8172***		2.0870***		1.6084***
		(0.099)		(0.063)		(0.109)
Constant		-205.1847		330.7484		-5,883.9709***
		(1,425.749)		(2,301.316)		(2,061.160)
R-squared		0.890		0.900		0.880
Observations		43		43		43

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Hypotheses Testing - Baseline Results

The study tests three pieces of hypotheses in order to realize comparable findings based on heterogeneous contribution of agriculture sub sector to economic growth in Tanzania indicated in the results presented in Table 3.

Hypothesis 1: There is significant effect of crop production on GDP growth

The first hypothesis tested by the study is the null hypothesis that, there is no significant effect of crop production on GDP growth *($H_o : \beta_1 = 0$)* against alternative hypothesis that, there is significant effect of crop production on GDP growth *($H_1 : \beta_1 \neq 0$).* According to Greene (2008), if the *p* value is less than 0.01, 0.05 or 0.1, the null hypothesis is rejected and the alternative one is accepted. For the case of crop sub sector indicated in the first column, the *p* value is less than 0.01 thus, the null hypothesis is rejected and alternative one is accepted that, β_1 which is a coefficient of crop sub sector is statistically significant exhibiting a positive magnitude value of 110.5924. Therefore, when other variables are held constant (ceteris paribus), a unit increase in crop production will result into the increase in GDP growth by 110.5924, which is in millions of TZS.

Hypothesis 2: There is significant effect of fishery production on GDP growth

The second hypothesis tested by the study is the null hypothesis that, there is no significant effect of fishery production on GDP growth *($H_o : \beta_1 = 0$)* against alternative hypothesis that, there is significant effect of fishery production on GDP growth *($H_1 : \beta_1 \neq 0$)*. The result of fishery sub sector in the second column indicates that, the *p* value is less than 0.1 thus, the null hypothesis is rejected and alternative one is accepted that, β_1 which is a coefficient of fishery sub sector is statistically significant exhibiting a positive magnitude value of 13.2460. Therefore, when other variables are held constant

(ceteris paribas), a unit increase in fishery production will result into the increase in GDP growth by 13.2460, which is in millions of TZS.

Hypothesis 3: There is a significant effect of livestock production on GDP growth

The last hypothesis tested by the study is the null hypothesis that, there is no significant effect of livestock production on GDP growth *($H_o : \beta_1 = 0$)* against alternative hypothesis that, there is significant effect of livestock production on GDP growth *($H_1 : \beta_1 \neq 0$)*. The result of livestock sub sector in the third column indicates that, the *p* value is less than 0.01 thus, the null hypothesis is rejected and alternative one is accepted that, β_1 which is a coefficient of livestock sub sector is statistically significant exhibiting a positive magnitude value of 135.9782. Therefore, when other variables are held constant (ceteris paribus), a unit increase in livestock production will result into the increase in GDP growth by 135.9782, which is in millions of TZS.

The overall finding provide suggestive evidence that, of all the three sub sectors in agriculture analyzed in this study, livestock has the highest potential of boosting agricultural production in Tanzania. The possible reason could be the sustainable expansion in livestock products exports to international markets including the recent new market niches in Qatar and United Arab Emirates, Vietnam, Oman and Mozambique which promotes the increase in livestock production particularly in beef section. International markets generates foreign currency earnings necessary in improving GDP growth. Another reason could be improvement made on markets infrastructure including renovation and installation of weighing scales in the auctions which increase the number of livestock sold through registered markets that captures livestock sales which were previously not captured in the national accounts (BOT, 2017).

4.4 Robustness Checks

In this part the study attempts to verify the baseline results by checking consistency of the results after redefining dependent variable from annual GDP growth into annual percentage growth in per capita GDP. The results are presented in Table 4 where the variable of this study's interest is presented in the first row. Similar results to the baseline regression are indicated where all sub sectors exhibit positive and statistically significant coefficient estimates. Livestock is the leading sub sector in contributive effect on per capita GDP growth followed by crop sub sector while the last one is fishery sub sector confirming consistency of the previous baseline results.

Table 4: Dependent Variable – Annual Percentage Growth in Per Capita GDP

Variables		(1)		(2)		(3)
Agriculture	Crop →	0.1362***	Fishery →	0.0341***	Livestock →	0.1494***
		(0.044)		(0.008)		(0.041)
Industry		-0.0015		-0.0251		-0.0339
		(0.037)		(0.033)		(0.033)
Service		0.0037		0.1907		0.2070*
		(0.105)		(0.113)		(0.123)
Import		0.0569		0.0193		0.0735
		(0.096)		(0.091)		(0.092)
Inflation		-0.0245		-0.0870**		-0.0308
		(0.037)		(0.036)		(0.036)
Export		-0.0004***		-0.0001		-0.0006***
		(0.000)		(0.000)		(0.000)
Constant		-1.2796		-6.3152**		-6.8841**
		(2.069)		(2.791)		(3.265)
		0.466		0.449		0.484
Observations		43		43		43

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Next, as part of robustness checks, the study strongly attempts to address the serial autocorrelation and heteroscedasticity problem embodied in time series by employing the Newey-West estimator. Although the first differencing of variables prior to OLS estimation attempts to address this problem, it does not do so adequately as it may yield inefficient estimates due to biased standard errors (Newey and West, 1987). The study estimated the effect of the three sub sectors by using the Newey-West method. A key requirement for this methodology is that we need to find a truncation parameter *'m'* based on the following rule of thumb formula;

$$m = (0.75)T^{1/3}$$

where; *T* is number of periods.

Thus

$$m = (0.75)43^{1/3}$$
$$m = 2.625 \sim 3.$$

Table 5 presents the results of the Newey-West estimator executed based on truncation parameter *(m=3)* in which the variable of this study's interest is presented in the first row. Similar results to the OLS regression are indicated where all sub sectors exhibit positive and statistically significant coefficient estimates at 0.01 and 0.05 significance levels. The suggestive evidence from the baseline finding is corroborated by the Newey-West finding. The results indicate nonsymmetrical magnitudes on the three sub sectors where livestock sub sector shows the highest magnitude of 135.9782 followed by crop and fishery sub sectors indicating the magnitude values of 110.5924 and 13.2460 respectively.

Table 5: Dependent Variable – Annual GDP Growth in TZS

Variables		(1)		(2)		(3)
Agriculture	Crop →	110.5924***	Fishery →	13.2460**	Livestock →	135.9782***
		(37.801)		(5.942)		(31.704)
Industry		5.8258		-20.7850		-19.6258
		(22.128)		(19.955)		(14.259)
Service		31.7775		17.5391		158.6844**
		(45.425)		(48.346)		(75.691)
Import		-31.3359		-35.7324		-18.5917
		(38.704)		(51.516)		(35.392)
Inflation		-107.8368***		-139.8531***		-111.7921***
		(32.024)		(36.534)		(27.988)
Export		1.8172***		2.0870***		1.6084***
		(0.144)		(0.101)		(0.159)
Constant		-205.1847		330.7484		-5,883.9709***
		(1,878.965)		(2,028.924)		(1,969.600)
Observations		43		43		43

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Lastly, in robustness checks the study attempts to verify the results of the Newey-West estimator by checking consistency of the results after redefining dependent variable from annual GDP growth into annual percentage growth in per capita GDP. The results are presented in Table 6 where the variable of this study's interest is presented in the first row. Similar results to the ones of the GDP growth dependent variable are indicated where all sub sectors exhibit positive and statistically significant coefficient estimates at 0.01 and 0.05 significance level. Livestock is the leading sub sector in contributive effect on per capita GDP growth followed by crop sub sector while the last one is fishery sub sector confirming the consistency of the Newey-West estimator baseline results based on GDP growth dependent variable.

Table 6: Dependent Variable – Annual Percentage Growth in Per Capita GDP

Variables		(1)		(2)		(3)
Agriculture	Crop →	0.1362**	Fishery →	0.0341***	Livestock →	0.1494***
		(0.064)		(0.009)		(0.047)
Industry		0.0015		0.0251		0.0339
		(0.041)		(0.031)		(0.022)
Service		0.0037		0.1907*		0.2070**
		(0.113)		(0.102)		(0.082)
Import		0.0569		0.0193		0.0735
		(0.127)		(0.128)		(0.114)
Inflation		-0.0245		-0.0870**		-0.0308
		(0.036)		(0.035)		(0.029)
Export		0.0004***		0.0001*		0.0006***
		(0.000)		(0.000)		(0.000)
Constant		-1.2796		-6.3152**		-6.8841*
		(3.030)		(2.938)		(3.591)
Observations		43		43		43

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

5.0 CONCLUSION AND POLICY IMPLICATIONS

This paper attempts to assess the role of agricultural sub sectors in contributing to economic growth of Tanzania. Specifically the study analysed times series data from 1971 to 2013. The study employed OLS and Newey-West methods to empirically analyse the contributive effect of crop, livestock and fishery sub sectors to economic growth. In order to infer empirical evidence it tested three hypotheses to realize autonomous effects of crop, livestock and fishery sub sectors on economic growth. The primary finding indicates that, all agricultural sub sectors included in the study have positive influence on economic growth in Tanzania.

Crop production potentially indicates a positive and significant influence to economic growth at one per cent significance level. Therefore, allocating enough resources to crop production will scale up economic growth by a maximum value of 110.5924, which is in millions of TZS for each unit increase in crop production (ceteris paribus).

Fishery production indicates a positive and significant influence to economic growth at ten per cent significance level. Therefore, allocating enough resources to fishery production will boost economic growth by a maximum value of 13.2460, which is in millions of TZS for each unit increase in fishery production (ceteris paribus).

Livestock production indicates a positive and significant influence to economic growth at one per cent significance levels. Therefore, allocating enough resources to the crop production will scale up economic growth by a maximum value of 135.9782, which is in millions of TZS for each unit increase in crop production (ceteris paribus).
A comparative analysis of the results among the three sub sectors confirms that, livestock ranks the highest in contributive effect to GDP growth as compared to crop and fishery sub sectors. Thus, Tanzania has a great potential in improving agricultural production through strategic enhancements in livestock production of which Tanzania ranks in top three producers in Africa (UTR, 2012).

In the light of the study's findings, policy makers should develop policies emphasizing on resources allocation to livestock sub sector which indicates the highest contributive effect to economic growth in Tanzania.

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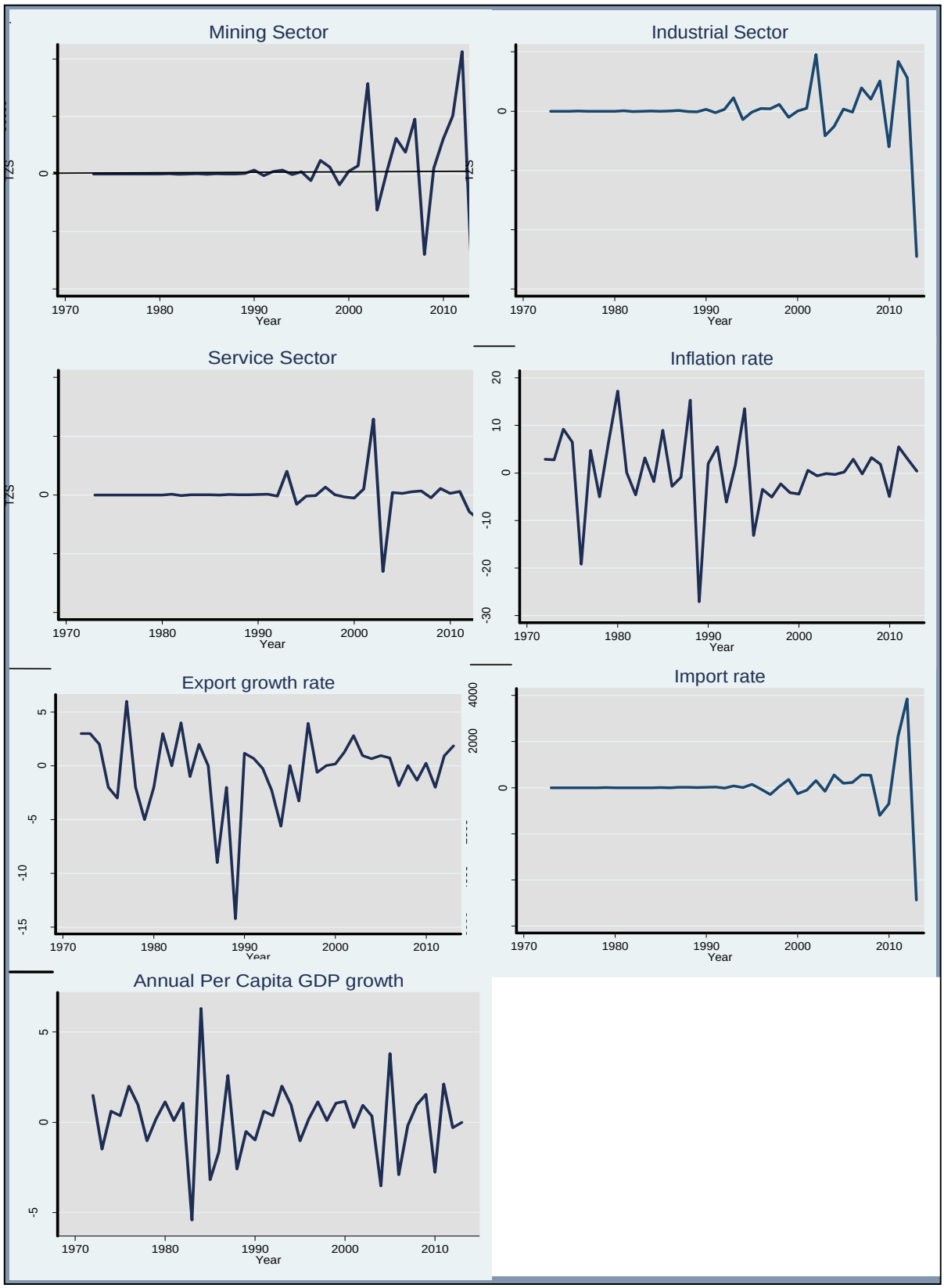
APPENDICES



Appendix I: Control Variables Graphical Presentation of Unit Root Test After Differenced Process