THE EFFECT AND PERSISTENCE OF MAJOR CHANGES IN ECONOMIC POLICIES ON THE LONG-TERM PERFORMANCE (TREND) OF ETHIOPIAN AGRICULTURE

by

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Contributed Paper Presented at the 41st Annual Conference of the Agricultural Economic Association of South Africa (AEASA), October 2-3, 2003, Pretoria, South Africa

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Abstract

Agriculture in the Ethiopian economy has survived three major structural breaks, namely the 1974 change of policy in favour of a command-based economic system, the 1984 famine and the 1992 change of policy that introduced a market economy. A regression procedure was applied to analyze the effect of these breaks on the slope and intercept of agricultural GDP. In addition, statistical properties were studied to measure the degree of persistence of shocks in agricultural GDP. In the regression equation, only the 1984 famine was found to be significant. The non-significance of policy parameters in the regression equation could be associated with a lack of infrastructural facilities and the subsistence nature of Ethiopian agriculture. The study of the statistical property of agricultural GDP revealed that agricultural GDP is a trend stationary process, which implies that fluctuations on agricultural GDP series, which mostly occur due to good or bad weather conditions, are temporary and dissipate in a short period of time.

JEL Classification: C10; C13; C22; C32

Key words: Ethiopia, Structural break, deterministic trend, stochastic trend

1. Introduction

The contribution of agriculture to economic development was first formalized by Johnston and Mellor (1961), Kuznets (1964), Nicholls (1964. According to these authors, the contribution of agriculture can be classified into five functional groups, namely its supply of food and raw materials, its supply of foreign exchange, its supply of labour for industrial employment, its service as a market for non-agricultural output and its service as a source of surplus for investment or government activity.

In the context of the five functional headings highlighted above, what is the place of agriculture in the Ethiopian economy? Statistical data reveal that the sector will continue to dominate economic activity for a long time to come because it is unlikely that its contribution to GDP (over 50 per cent), employment creation (over 85 per cent) and foreign exchange (over 90 percent) will come down in the foreseeable future.

The question central to this paper is the extent to which the performance of this sector has been affected by changes in economic systems. Three different types of economic systems have been practised in Ethiopia since 1957. Each might have exerted its own influence on the long-term performance of agriculture. However, there have not been any attempts to investigate the impact of these changes, nor the extent that agriculture as a sector has in general responded to such changes. This study first focuses on measuring the significance of changes in economic systems on trends in the agricultural GDP. Second, the emphasis is on the sustained impact of these changes on economic systems (hereafter referred to as 'breaks') in the agricultural GDP. The first will be gauged on the basis of a regression analysis. The second will be measured by conducting a time series analysis in order to determine to which class of non-stationary process that agricultural GDP belongs.

2. An Overview of Agricultural Policies of Ethiopia: Past and Present

During the period 1957-1973, resource allocation was driven by the market. The country's development strategy was influenced by the development theories of the 1950s such as Arthur Lewis's (1954) "general transformation model" and Raul Prebisch's (1959) "secular decline theory". Therefore, much emphasis was placed on the mobilization of resources from agriculture to enhance growth in the non-agricultural sector.

The role of markets in resource allocation was thwarted following the introduction of a command-driven economic system in 1974. Land was nationalized in 1975 and was distributed among the tillers on an egalitarian basis. In addition, to keep pace with resource transfer objective of the government to develop the non-agricultural sectors, two new production structures, namely, producer cooperatives and state farms were introduced and various government parastatals were established. This put a limit on farmers' own production decisions and on the free operation of output and input markets. Agricultural collectivization was supported by the six annual development campaigns, by the ten-year perspective plan and by the villagization and resettlement programs.

In the sphere of marketing, government control over marketing decision of farmers was enhanced by different regulations. The regulations made it more and more tight to farmers wanting to sell their produce in open markets. Delivery requirements to marketing parastatals were tightened by changing fixed pricing system to free quota systems and free quota systems to fixed quota systems. In an attempt to evade quota deliveries, many farmers were reported to have changed their mix of production to which the government responded by introducing more stringent measures.

Since 1992, markets have once again become governors of resource allocation. With regard to the development strategy of the country, the focus of the government was changed to assign priority to developing the agricultural sector, which, for close to four decades, was neglected by policy makers despite its contribution to GDP and total employment. The new strategy is known as an agricultural development-led industrialization strategy (ADLI). The strategy has its theoretical roots in early works of

Johnston & Mellor (1961) which, for the first time, highlighted the role of agriculture in economic development, and more recent works by Mellor (1998) and De Janvry & Sadoulet (1989).

The period since 1992 has seen changes in macro-economic policies to correct macro policy distortions that were created during the time of the command-driven economic system. Firstly, stabilization policies were initiated. Measures taken included price and trade policy liberalization and exchange rate devaluation. Secondly, as part of a structural adjustment programme, short-, medium- and long-term strategies were drawn up to change farming structures in agriculture in 1993.

Major changes in the area of price and trade policy that were introduced in this period include price decontrol and elimination of parastatal monopoly on marketing and distribution of agricultural produce. These are believed to have boosted the number of traders in the output market and led to spatial integration of markets (Wolday, 1999; Asfaw & Jayne, 1998). However, constraints such as lack of effective competition, access to working capital, poor road conditions, limited storage facilities, presence of too many unlicensed grain traders and high and unsystematic tax assessment are challenging efficiency in agricultural produce markets (Wolday, 2001; Gebremeskel et al., 1998; Alemayehu, 1995).

Change in the farming structure was necessitated by production inefficiencies by state and producer cooperatives attributable largely to poor incentive structure and sub-optimal allocation of resources. In former socialist countries, such a reform was part and parcel of the land reform process which is said to have guaranteed a secure and unrestricted property right. In Ethiopia, however, reform in the farming structure was carried out without changing the existing land holding system. The existing land policy is blamed for causing land fragmentation, deforestation, lower land productivity and diminution in holding size.

In addition to changes in policies, production in the three periods just discussed has for long been constrained by civil war and the occurrence of frequent massive drought situations. Though its magnitude is scaled down to its present lowest level, compared to previous times, civil war has been a major deterrent to agricultural production by reducing the quantity and quality of the labour force in rural areas. Farmers have been major suppliers of volunteered and compulsory labor service to the military. The frequent occurrence of drought was also one source of decline in the performance of agriculture. Much of the decline in agricultural GDP corresponds to years with bad weather. Years with significant bad weather situations were reported in 1973/74, 1983/84, 1993/94 and 1997/98. Each caused a 1.2, 17, 4 and 10 per cent decline in agriculture.

3. The Effect of Policy Changes on the Performance of Aggregate Agriculture

Data on agricultural GDP were collected from the Ministry of Economic Development and Cooperation (MEDaC). Data were obtained for the period 1963 to 1998. The series was converted into natural logarithms.

With the intention of quantifying the breaks that enter into the regression equation, the characteristics of the changes in the trend lines after each break were studied. It was found that segmented trend lines could best represent the lines. Therefore, each break entering into the regression equation was represented by composite dummies.

Equations 3.1 to 3.4 below are split samples created on the basis of the breaks. These break years were identified based on the inspection of the graph of real agricultural GDP series between 1963 to 1998. The equations are used to test whether there is significant difference between any consecutive intercepts (α) and slopes (β). If the null hypothesis on the equality of the slope and intercept coefficients of any two consecutive periods is rejected, it implies that there is a significant diversion in the trend of real agricultural GDP. This may further imply that the structural break in question has introduced significant diversion in the long-run trend of agricultural GDP and hence it is significant. In this study, the effects on the long-run trend of three structural breaks are studied, namely the 1974 change to the command-based economic system, the 1983/84 drought and the 1992 change to a market–based economic system. Equation 3.1 refers to the period before 1974, equation 3.2 to the period between 1974 and 1982, equation 3.3 to the period between 1983 and 1991, and finally equation 3.4 to the period since 1992.

$$y_1 = a_1 + b_1 x_1 + u_1 \quad \text{.....(3.1)}$$
$$y_2 = a_2 + b_2 x_2 + u_2 \quad \text{.....(3.2)}$$
$$y_3 = a_3 + b_3 x_3 + u_3 \quad \text{.....(3.3)}$$
$$y_4 = a_4 + b_4 x_4 + u_4 \quad \text{.....(3.4)}$$

Where the explanatory variables x_1, x_2, x_3 and x_4 together form X or the full sample time trend variable, the dependent variables y_1, y_2, y_3 and y_4 are split sample periods and together form Y or the full sample real agricultural GDP, α = intercept, β=slope and u = error term (See Maddala, 1992 pp 312-314 for further explanations about this model).

Assuming that the error terms in the four periods have the same distribution, equations 3.1 to 3.4 were manipulated to yield equation 3.5.

$$y = f_0 + f_1 D_1 + f_2 D_2 + f_3 D_3 + j_0 x + j_1 D_{11} + j_2 D_{22} + j_3 D_{33} + u \quad \text{.....(3.5)}$$

Where, $\phi_0 = \alpha_1$, $\phi_1 = (\alpha_2 - \alpha_1)$, $\phi_2 = (\alpha_3 - \alpha_1)$, $\phi_3 = (\alpha_4 - \alpha_1)$, $\varphi_0 = \beta_1$, $\varphi_1 = (\beta_2 - \beta_1)$, $\varphi_2 = (\beta_3 - \beta_1)$, $\varphi_3 = (\beta_4 - \beta_1)$. D_i takes the value 1 for observations in period i+1, and zero otherwise. D_{ii} takes the value of t for period i+1 and zero otherwise.

If ϕ_1=0 then $\alpha_2 = \alpha_1$. If φ_1= 0 then $\beta_2 = \beta_1$. These imply respectively that there are no differences between slope and intercept coefficients for the first and the second periods, nor that the 1974 break introduced a significant difference between growth rates of these periods. Note that equation 3.5 is limited to making comparisons of parameters of interest between the first and the second and also between the first and the third periods. This

means that a supplementary regression model must be run to make comparisons between differences in growth rates between the second and the third period.

Results of the first regression equation are not reported here. In this equation, D_1 and D_{11} were not found to be significant. These imply that $\alpha_1 = \alpha_2$ and $\beta_1 = \beta_2$. This means that the changes in the economic system of the country in 1974 did not introduce a significant diversion in the trend of agricultural GDP between 1975 and 1982 from its 1961 to 1974 level.

Possible explanations for these could be that with the exception of the announcement of socialism as the new economic system of the country, and the popular land reform in 1974, major changes in economic policies were not introduced. This started to come out in the late 1970s, following the establishment of the Central Planning Supreme Council (CPSC) in 1978. The CPSC was entrusted with the responsibility of making major economic decisions of what, for whom and how to produce.

To improve the specification of our model, non-significant variables were deleted in the first round. This reduced the number of equations to three and required that the duration of the first period be extended to 1982 and the third and the fourth periods be renamed as periods 2 and 3, respectively. The result was the final model, which is reported in Table 1.

Table 1: Test results after variable deletion method was applied on equation 3.5

Equations	**Intercept**		**Slope**	
	Coefficient	**Significance**	**Coefficient**	**Significance**
1	4.10	(172***)	0.01	(6.3***)
2	3.39	(20.3***)	0.04	(5.5***)
3	2.90	(5.6***)	0.05	(3.1***)

*** Level of significance at 1%, ** level of significance at 5% and * level of significance at 10%

According to Table 1, the intercept and slope coefficients of the second and the third periods are different compared to the first period. This implies that trends in agricultural GDP registered significant shifts after the 1983/84 drought. The question that remains to be answered is whether this holds true for the period after the comprehensive macro-policy change was introduced in 1992.

It is hard to compare parameter estimates of the third and the second period with the help of equation 3.6. This is because the standard errors of parameters for the coefficients of α_2, α_3, β_2 and β_3 and also the covariances of (α_2, α_3) and (β_2,β_3) cannot be readily computed from the same equation. A separate model was thus fitted to achieve this objective. Variance covariance matrix of the coefficients obtained from the new model is reported in table 2.

Table 2: variance-covariance matrix of a **and** b

	a_1	a_2	a_3	b_1	b_2	b_3

α_1	0.0006	-0.0000	0	0	0	0
α_2	-0.0000	0.0000	0	0	0	0
α_3	0	0	0.0279	-0.0011	0	0
β_1	0	0	-0.0011	0.0000	0	0
β_2	0	0	0	0	0.2721	-0.0085
β_3	0	0	0	0	-0.0085	0.0003

According to this result, the two nulls for the equality of the parameters of interest in the second and the third period were accepted. This means that changes of policies, which have been operational since 1992, have not caused that much diversion in the long-term trend in agricultural GDP from its 1983-91 level.

According to the theory of for optimizing behevior of farm households—advocated by the neoclassical theory of production economics—farm households organize production to produce agricultural products for sale but not for home consumption. The way production decisions are made in Ethiopia contradicts this view. Productions, especially those comprising staple foods, are meant primarily for home consumption but not for sale. This reduces farmers' response to changes in incentives. The subsistence production situation is exacerbated by a host of structural factors, namely, technological constraints, credit constraints, land tenure, infrastructure, etc.

The application of modern agricultural technologies such as chemical fertilizers, improved seeds, pesticides and others are presently available to a limited number of farmers. According to MEDaC (1999), less than 25 per cent of Ethiopian farmers currently apply chemical fertilizers and improved seeds are available to only 2 per cent of the farmers. This could be attributed to financial and institutional constraints. The financial constraints refer to lack of money and productive assets which are exacerbated by imperfect credit markets, while the institutional constraint refers to the limited role that agricultural extension has played to popularize modern input use. The agricultural extension system of the country has been reorganized three times since 1970.

During 1975-1990, the amount of credit available to small farmers, who accounted for over 90 per cent of the cultivated area and for over 95 per cent of the agricultural produce, was limited by deliberate credit policies of the socialist government. In addition, small farmers were marginalized from credit allocation by higher credit prices. The allocation of lesser quantity of credit to small farmers could be attributed to the main policy focus of the socialist government, which focused on ensuring expansion of socialist production relations by creating two new production structures—producer cooperatives and state farms. Small farmers were marginalized from the credit system, which segmented the formal credit market into three and enabled the government to charge higher interest to small farmers. For example, between 1986 and 1990, bank-lending rates were 5 per cent for producer cooperatives, 6 per cent for state farms and 7 per cent for private farms.

Presently, the availability of credit to small farmers is constrained by a host of setbacks. Firstly, restriction on the buying and selling of rural lands has limited use of land to satisfy collateral requirements by newly emerging private banks. This has made small farmers rely for credit on government-owned specialized financial institutions. Secondly, the system now in place restricts farmers' choice of supplier of inputs to buy inputs at lower prices and on favourable terms (Mulat *et al*, 1998; Wolday, 2001). Input-loan delivery is coordinated by the input coordinating units (ICU). The ICU is established at various levels—Peasant Associations (PAs), district zone, regional, and federal. Requests are first submitted to PAs, and then they are submitted to district, zonal, and regional ICUs. On receipt of requests, regional states borrow the estimated loan amounts from Commercial Banks of Ethiopia (CBE) and take responsibility for loan disbursement and loan collection (Wolday, 2001).

The existing land policy has played a part in the non-responsiveness of agricultural GDP to policy changes. The policy has resulted, among others, in land fragmentation, deforestation, lower land productivity and small holding size. Land fragmentation is increasing for several reasons. Fragmented plots are believed to limit the potential increase in output by limiting application of modern inputs. Deforestation is on the rise. This has reduced areas presently covered by forests to less than 4 per cent (FAO, 1997). Lower land productivity is attributed to tenure insecurity. One source of insecurity is the fear that land will be redistributed. This is believed to have made peasants reluctant to apply sound land management practices and to make long-term investments on land (Zerihun, 2002). Decrease in holding size to its present average level of one hectare is the outcome of continuous land redistribution after land fell in state hands in 1975. Increase in area planted had for long served one source of production increase in the country. Presently, increase in areas planted is believed to have become an impossible option due to decrease in holding size to its threshold level.

Infrastructure here refers to a number of factors having a direct and/or an indirect effect on the response of agriculture to policy changes. In Ethiopia, poor road conditions are good examples of problems related to physical infrastructure. They are also major causes for the prevalence of subsistence production. Poor roads limit the availability of consumer goods in rural areas. According to Beynon (1989), non-availability of basic consumer goods in rural areas pushes marginal utility to additional cash earnings close to zero. Poor infrastructure also limits farmers' economic, social and political tie with other sectors of the economy by hampering information dissemination on output, prices and market situations in general.

Access to all-weather and feeder roads has remained to be deterrents for agricultural growth in Ethiopia for long. A report by the international road federation indicated that the country had the lowest road density (0.02) in the continent in 1991(obtained from Zerihun, 1995). Estimates show that, at present, close to 75 percent of the farms are more than half a days walk from all-weather roads (Wolday, 2001). With regard to road fleets, the country has only one railway, connecting the capital with Djibouti, and air transport is marginally used in the marketing and distribution of inputs and produce. However, since September 1997, following the launching of a Five Year Road Sector Development

Programme, a target to raise the road density by 7 percent i.e. to 0.46 km per 1000 population has been set[1].

The significance of the 1983 famine could be attributed to the effect it had on the productive, as well as non-productive assets of vulnerable farm households. Vulnerable households responded to the devastating drought in order to mitigate the effects of drought by selling their productive and non-productive assets (Webb, *et al.*, 1992). Productive assets like oxen are a major means of production the lack of which were one of the production constraints in the aftermath of the famine.

The fact that major policy changes had little effect on the trend of agricultural GDP should not be interpreted as meaning that policies had no impact at all. The 1983/84 drought was a consequence of a failure of policy design and implementation, which neglected agriculture and focused on the development of the non-agriculture sector. Policies, which gave priority to agriculture as agriculture is the largest sector in the economy in terms of employment (over 80%) and GDP contribution (over 50%), could have better prepared the economy to stand/minimize the effect of the drought.

4. The Persistence of Structural Breaks

In this section, an attempt is made to measure the extent of the sustained impact of a break or a shock on agricultural GDP. This is similar to asking how long the introduction of a major change in policy will continue to affect agricultural activity in general. A widely applied method to measure this is by studying whether agricultural GDP belongs to a trend stationary TSP (deterministic trend) or difference stationary DSP (stochastic trend) classes of non-stationary processes.

TSPs are processes where fluctuations arising from the occurrence of a break(s) are dominated by temporary deviations from the natural rate and have a tendency to dissipate in a short period of time. This has the implication that long-run movement is attributed to factors such as capital accumulation and technological change. These factors together are collectively referred to as secular components. If, on the contrary, a time series is found to be a DSP, it cannot be called trend reverting since the effect of a shock persists for a long time (Beveridge & Nelson, 1981; Campbell & Mankiw, 1989).

Therefore, characterizing agricultural GDP either as a TSP or DSP process is an indirect way of gauging the persistence of a break(s) on a time series. This is conventionally done by conducting a unit root test such as those represented by equation 4.1. They are widely known as Augmented Dickey Fuller tests (ADF).

$$\Delta Y_t = j_1 + j_2 t + a Y_{t-1} + g_i \sum_{i=1}^{m} \Delta Y_{t-i} + e_t \qquad (4.1)$$

[1] In line with government's priority areas of intervention, nearly a quarter of total capital expenditure every year is channelled into road construction.

Where, Δ stands for change, α = (1-p), p is a parameter estimate of a first-order or AR (1) process.

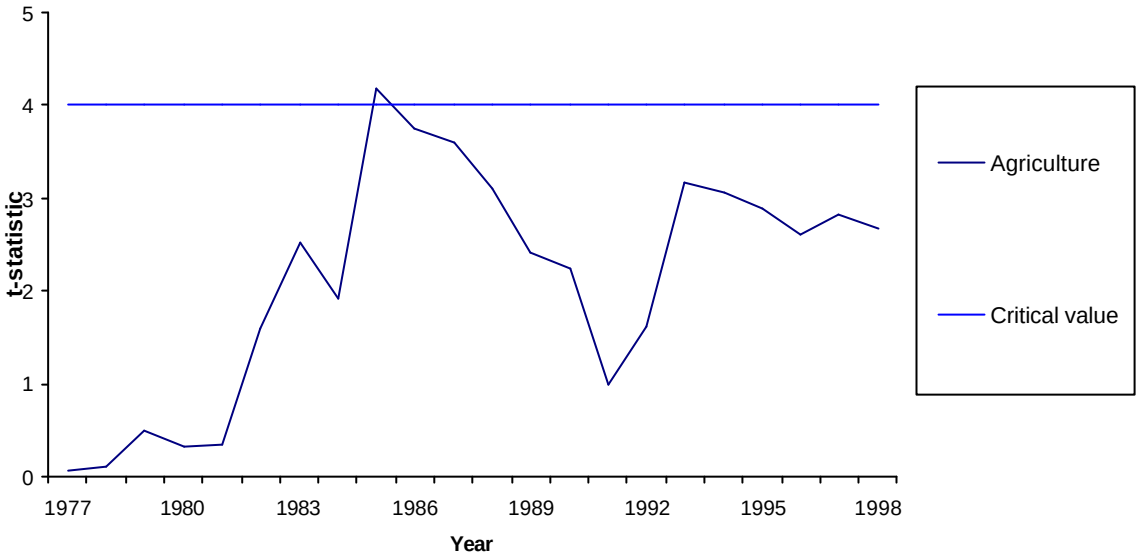

Fig 1: Recursive Analysis using the Dickey-Fuller Regression to Identify a Structural Break

In this study, however, an approach different from conventional ADF was employed to study the statistical property of agricultural GDP and hence to decide to which classes of stationary process that agricultural GDP belongs. This is because, as confirmed in the preceding section, agricultural GDP is characterized by breaks. It was shown by Perron (1989, 1990) that conventional ADF techniques have a greater likelihood of failing to reject the unit root null when in fact the true data generating process is a deterministic trend. However, our approach differs from Perron (1989, 1990) procedure by the way the break was treated. In this study, the date of structural break was treated as an unknown a priori. This means that the test on the statistical property of the series was conducted in two steps.

In step one, a recursive analysis using the Dickey-Fuller regression (equation 4.1), as applied by Blake and Fomby on US data, was employed to identify breaks (obtained from Blake, 1991). This is an important step to rescues our technique from critics commonly pointed at Perron's method. Perron's method was criticized on the basis of the argument that he picked the date of the break before analysis (Maddala, 1992). After the presence of structural break(s) in the series was confirmed in step one, test for unit root null against its deterministic trend alternative was conducted using equation 4.2.

$$Y_t = m + qDU_t + bt + gDT_t + dD(T_B)_t + ay_{t-1} + \sum_{i=1}^{k} c_t \Delta y_{t-i} + e_t \quad \text{.....(4.2)}$$

Where μ = intercept term; T_B =time of break; D (TB) = 1 if $t=T_B+1$, 0 otherwise; DU_t = 1 if $t>T_B$, 0 otherwise; DT_t = t if $t > T_B$ 0 otherwise.

Result of the recursive analysis using the Dickey-Fuller regression is reported in figure 1. According to this figure, the null hypothesis that there is no break was rejected at the 5 per cent level of significance in 1985. This means that there is a structural break in agricultural GDP series and the break occurred in 1985. The year 1985 corresponds to a severe drought year. This implies that the use of equation 4.1 to test the unit root null poses the danger of accepting the null as it assumes a constant parameter structure during the entire period (Maddala & Kim, 1998).

Information obtained in step one was utilized to conduct test for unit root using Perron's method (Table 3). This was arrived at after correction for second order serial correlation was made using Cochrane-Orcutt iterative procedure. The procedure converged after 15 iterations. According to the result, the test for unit root (i.e. $\alpha=1$) was rejected at one per cent level of significance using test statistic developed by Perron (1989). This means that agricultural GDP is a trend stationary process. The implication of this is that fluctuations in agricultural GDP are temporary deviations from the long-run trend and thus dissipate in a short period of time.

Table 3: Cochrane -Orcutt Method AR (2) converged after 32 iterations

Dependent Variable is LAGRGDP*			
Regressor	Coefficient	Standard Error	**T-Ratio [prob.]**
Constant	8.769	1.706	5.155
Time	0.007	0.010	0.699
DU	-1.166	0.377	-3.091
DT	0.048	0.015	3.157
T_B	-0.013	0.096	-0.139
LAGRGDP	-1.094	0.395	-5.301#
DLAGRGDP	0.795	0.216	3.680
R-squared	0.827	R-bar-Squared	0.827
S.E. of Regression	0.056	F-stat. F (8, 23)	19.533
Mean of Dependent Variable	4.323	S.D. of Dependent Variable	0.139
Residual Sum of Square	0.073	Equation Log-likelihood	51.852
Akaike Info. Criterion	42.85	Schwartz Bayesian Criterion	35.983
DW-statistic	1.955		

* LAGRDP is logarithm of Agricultural GDP, DLAGRGDP is lag of logarithm of agricultural GDP.

T-statistic for the null hypothesis $\alpha=1$

5. CONCLUSION

In this paper, an attempt was made to investigate the effect and sustained impact of changes in policy regimes on the performance of agriculture. The effects of the changes were measured by constructing a regression equation and testing for the significance of estimates of policy parameters. The extent of the sustained impact of a break was studied by investigating the class of non-stationary process to which agricultural GDP belongs.

Regression results obtained, based on tests on the equalities between instantaneous growth rates of agricultural GDP in consecutive periods, confirmed that changes in economic systems have had little impact on the slope, as well as intercepts of agricultural GDP series. The reason for this could be that production is at subsistence level. This is exacerbated by low level of application of modern agricultural inputs, availability of credit, land tenure and infrastructure. Theoretically, the way forward, when faced with this kind of situation, is to try to integrate farm households with the market system to improve their access to consumer goods. This needs to be done side by side with improvement in rural infrastructure, expansion in credit availability, expansion in agricultural extension and reform in the existing land policy.

Only the 1983/84 famine was significant in the regression equation. This could be associated with the effect it had on the asset base of farm households. Oxen are the most important examples of productive input while the lack of these assets constrains the productive capacity of farm households. Many households, in the drought-hit areas, fearing that they would eventually lose their livestock due to lack of water and pasture, attempted to absorb the risk by selling them. According to a study, unusually lower livestock prices are used as warning mechanisms by relief agencies that mass starvation is around the corner (Webb, et al., 1992). We can say that the drought was a cumulative effect of a failure of policy design and implementation. A policy better than those practised between 1972 and 1991 could have better prepared the economy to withstand a drought. To combat the effect of drought on the performance of agriculture, an early warning mechanism must be developed.

The result obtained regarding the extent of the sustained impact of a break on aggregate agriculture was supportive of the result from the regression equation. We found that aggregate agricultural output is a trend stationary process. The economic implication of this is that shocks to agricultural GDP, which might originate from natural or man-made factors, including major changes in policies, dissipate in a short period of time, leaving little impact on the long-term performance of agricultural GDP.

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