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Is agriculture an engine of economic reconstruction and development in the case of the Republic of Burundi?

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Abstract. Despite its importance for the economy, the agricultural sector faces many constraints that hamper its growth. With the increase in the world population and the demand for food production, farmers need to produce more with less arable land. This study used the ARDL approach to model the long-term and short-term dynamics and proposed examining the agricultural sector's contribution to Burundi's economic growth. Econometric estimations revealed that the gross domestic product per capita, agricultural, and exports (value-added) have long-run relationships but at different levels. The study, therefore, revealed that inflation persists in the short and long term. The consumer price of agricultural products reduces the country's economic growth. Major adjustments in agricultural, environmental, and macroeconomic policy at national levels will have to be made to create the conditions for sustainable agricultural development.

1. Introduction

Feeding a growing population is one of the challenges the world is struggling with. As more and more of us are on Earth, we also have to face new social, health, and ecological constraints. Raising the standard of living implies an increase in food consumption, which means more pressure on resources. Around 60 billion tons of renewable and non-renewable resources are consumed each year in the world. The living planet report [1] estimated that 1.75 planets Earth would be needed to keep pace with this consumption of natural resources sustainably, that is to say, without leading to a degradation of ecosystems and disruption of natural balances (including the climate).

Moreover, the main modes of resource production are not sustainable. Only 29% of farms have sustainable production in the world [2]. Balogh *et al.* [3] agreed that agricultural activities exert ever-increasing pressure on environments. Their accumulation constitutes a threat to the functionality and health of ecosystems, and by extension, that of the human species.

Apart from the problems it poses on the environment, agricultural production is for improving the welfare of humans in developing countries for both domestic and export markets [4]. This sector plays a decisive role in reducing poverty, raising incomes, and improving food security [5], employs a significant proportion of the labor force [6], is an essential source of foreign exchange [7], the major product part of the basic foodstuffs and is the sole source of livelihood and income for more than half of the population of these countries. Emergent countries will not be able to make real progress on the path of economic expansion, poverty reduction, and greater food security if they do not value the

country's agricultural sector's human resources and potential productive capacities to increase its contribution to economic and social development. As the green revolution and the resulting innovation model have shown, agricultural productivity growth requires forging links between the agricultural and non-agricultural sectors [8].

Sub-Saharan African countries face numerous internal and external difficulties developing their agriculture, improving food security, and increasing their export earnings [9]. Internally, these difficulties stem from low productivity, the rigidity of production and trade structures, a limited skills base, insufficient education and skills, infrastructure failures, and inadequate institutional and policy frameworks [10]. As a result, many farmers depend on agriculture for their livelihoods, which are increasingly precarious due to threats from climate change, food insecurity, financial crises, and declining investments [11].

A small landlocked country in East Africa, Burundi is experiencing rapid population growth, where a large proportion still live in rural areas, mainly in subsistence agriculture [12]. The National Development Plan [13] has underlined the agriculture contribution of 39.6% to the entire national GDP, provides 84% of jobs, provides 95% of the food supply, and is the leading supplier of raw materials agro-industry. According to the UNDP [14], more than 90% of the population practices agriculture.On nearly one million family farms of about 0.50 ha on average per household. Almost 90% of the areas developed are devoted to food crops while contributing over 80% to agricultural GDP is 80% self-consumed [15]. Food crops mainly consist of cereals, legumes, roots and tubers, oilseeds, and bananas. These are added the cash crops of coffee, tea, cotton, oil palm, sugar cane, and cinchona - these crops represent more than half of Burundi's exports [16]. Although subsistence agriculture is dominant, it is subject to several constraints which significantly reduce its performance [17].

Numerous studies have proposed approaches that can improve the competitiveness of agriculture and alleviate other constraints they face on the supply side [18,19]. Scholars suggested increasing soil fertility, better organization of farmers, and learning new agricultural methods for better yields [20,21]. It is crucial to find effective ways of supporting smallholders to help them improve their economic and social situation, carry out structural transformations, modify their economies, improve their competitiveness in international markets, overcome the constraints they face in the world supply-side, and ultimately accelerate sustainable growth.

Empirical studies that confirm agriculture's role as an engine of growth and economic transformation and the place of small family farms have been well explored at different levels [22,23]. Downie [24], for example, introduced a concept of linkage according to which investment in an agricultural sector can have beneficial effects not on this sector alone but other linked sectors. The study of Moussa [25] revealed that the GDP per capita, agricultural value-added, and the human index has long-run relationships. His study confirms that an extension of the agriculture sector would significantly impact others' economic sectors. Bashir *et al.* [26], using the VECM, tested the relationship between economic growth and the agriculture sector. The findings show a significantly long and short-term causality in economic growth for agriculture added value. At variance, Michael [27], who used the same method, found that the value of agriculture output has no effective means on the economic growth of Nigeria. These results may unsurprisingly be a source of disagreement; African agriculture is essentially small farms [28]. The transformation requires developing factor productivity and the mutation of traditional agriculture, characterized by manufacturing the same products for generations [29]. For example, Liu *et al.* [30] found that human capital, infrastructures, and development flow positively influence the growth of agricultural total factor productivity and its components among the determinants of agricultural productivity. The induced innovation model underlines the importance of technical change for agricultural growth and that this change is often endogenous to a country's economic system [31]. In his study on Rwanda, Yuan &Mivumbi [32] used the ARDL approach to test the relationship between economic growth and labor in agriculture. The results prove that the development of the country is generated by agriculture and its investments. Moreover, the ARDL bound test performed by Ghimire *et al.* [33] to test whether agricultural export promotes Nepalese economic growth have confirmed a negative long-run relation between those variable.

Emami *et al.* [34] underlined the importance of the costs engendered by neglecting agriculture in developing countries. From his point of view, modernizing the mechanism fleet and investing in research and development of agriculture modern knowledge must be redefined to increase the agriculture contribution on countries' economies.

2. Data and methodology

The GDP per capita (constant USD) represents economic development. The data used in the study, such as agriculture value-added and inflation consumer prices (annual %), are from World Development Indicator (WDI). Goods, values of exports data are from the International Financial Statistics (IFS).

To assess the effects of agriculture on economic development in Burundi on the 1970-2016 period, the general form of this relationship is as follows:

$$GDP_t = f(AGR_t, EXP_t, INFL_t) \tag{1}$$

The logarithm form makes the relation be estimated as follows:

$$LGDP_t = \beta_1 + \beta_2 LAGR_t + \beta_3 LEXP_t + \beta_4 LINFL_t + \varepsilon_t \tag{2}$$

Where GDP= economic growth per capita, AGR= agriculture value-added, EXP= exports of agricultural output (Goods in value), and INFL= inflation, consumer prices (annual %).

Equation (2) is estimated using ARDL modeling:

$$\begin{aligned} \Delta LGDP_t = \beta_0 &+ \sum_{i=1}^{p} \beta_1 \Delta LGDP_{t-1} + \sum_{i=1}^{p} \beta_2 \Delta LAGR_{t-1} + \sum_{i=1}^{p} \beta_3 \Delta LEXP_{t-1} \\ &+ \sum_{i=1}^{p} \beta_4 \Delta LINFL_{t-1} + \delta_1 LGDP_{t-1} + \delta_2 LAGR_{t-1} + \delta_3 LEXP_{t-1} \\ &+ \delta_4 LINFL_{t-1} + \varphi_t \end{aligned} \tag{3}$$

Then, we estimate by the method of ordinary least squares (OLS) the following error correction models:

$$\begin{aligned} \Delta LGDP_t = \beta_0 &+ \sum_{i=1}^{p} \beta_1 \Delta LGDP_{t-1} + \sum_{i=1}^{p} \beta_2 \Delta LAGR_{t-1} + \sum_{i=1}^{p} \beta_3 \Delta LEXP_{t-1} \\ &+ \sum_{i=1}^{p} \beta_4 \Delta LINFL_{t-1} + \xi ECM_t + \nu_t \end{aligned} \tag{4}$$

Where Δ represents the first difference operator and ξ the speed of adjustment parameter.

3. Empirical result and discussion

3.1. Unit root tests for variables

Before testing for cointegration between variables, it is vital to conduct the unit root test to ensure that no variable is integrated into order 2. The test is essential because the ARDL approach assumes that all variables are integrated of order I (0) or I (1). If a variable is considered to be I (2), the calculated F-statistics produced by Pesaran *et al.* [35] can no longer be valid. The most frequent and widely used test is the ADF test. It is proposed that a nonparametric correction of the ADF statistics involving heteroscedastic errors. WE test the unit root by applying the test to the general model, encompassing all

cases, i.e., the trend and constant. The results of the ADF and PP unit root tests for the variables are shown in Table 1.

Table 1. Results on ADF and PP unit root test.

Variables	Statistic at level		Statistic at difference		Conclusion
	ADF	PP	ADF	PP	
LGDP	-4.0301	-1.8999	-4.9103	--5.0204	I(1)
	(0.0155)**	0.6384	(0.0013)***	(0.0010)***	
LAGR	-4.0880	-1.7429	-5.3454	-5.3272	I(1)
	(0.0134)**	0.7157	(0.0004)***	(0.0004)***	
LEXP	-2.4771	-2.5843	-6.3075	-9.5136	I(1)
	0.3374	0.2890	(0.0000) ***	(0.0000)***	
LINFL	-5.2025	-5.2147	-8.4013	-27.9782	I(1)
	(0.0005)***	(0.0005)***	(0.0000) ***	(0.0000)***	

Note: -(*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.
- Variable in () are P-value

The unit root ADF and PP tests on the studied series show that variables are not stationary except the inflation (LINFL), which is stationary at the level and first difference. The results reported in Table 1 show that all variables were confirmed to be stationary after differentiating the variables once. The Phillips-Perron, Dickey, and Fuller Augmented tests applied to the first difference in the data set to reject the hypothesis of non-stationarity for all the variables used in this study. Therefore, it is helpful to conclude that all the variables are integrated with order one I(1). No series is integrated of order two I (2) or more; applying the ARDL approach is crucial for our study.

3.2. Application of the cointegration test

To avoid the risk of cointegration and to study the existence of a long-term relationship between endogenous and exogenous variables. The study leads us to move on to the cointegration test using the new test procedure of the ARDL bounds test.

Table 2. ARDL bounds test (Null Hypothesis: No long-run relationships exist).

Test Statistic	Value	k
F-statistic	**8.597242**	3
Critical Value Bounds		
Significance	I (0) Bound	I (1) Bound
10%	2.72	3.77
5%	3.23	4.35
2.5%	3.69	4.89
1%	4.29	5.61

The F statistics calculated for the cointegration test are presented in Table 2. The Fisher statistic (F = 8.597242) is greater than the upper limit for the different significance thresholds 1%, 2.5%, 5%, and 10%. Those calculations confirm a cointegration relationship between variables. The null hypothesis of the absence of a long-term relationship is rejected, and we conclude that there is a long-term relationship between different variables.

The long-run empirical results presented in Table 3 show that agriculture in economic growth is significant and positive for the long run in our estimations. An increase in agricultural production will result in an increase of 0.26% in economic growth. This result is consistent with theoretical and empirical predictions. Besides, the sign of the coefficient associated with exports is positive and highly

significant for the country. This result is eagerly awaited and essential. The role of agricultural export products in stimulating growth has been confirmed in numerous studies [36,37].

Moreover, Osabohien *et al.* [38] have also shown that the share of agricultural exports has boosted economic growth in Nigeria. However, based on the theoretical argument that, at a high level, inflation negatively affects economic growth, its negative impact has been confirmed in the estimations. These results are also confirmed by Zaroog *et al.* [39], who assessed the impact of inflation on some macroeconomics indicators in Sudan.

Table 3. Long- run coefficients.

Variable	Coefficient	Std. Error	T-Statistic	Prob.
LAGR	0.265918	0.070031	3.797136	0.0007
LEXP	0.491162	0.062796	7.821580	0.0000
LINFL	-0.008009	0.003141	-2.549702	0.0165
C	-2.180323	1.186618	-1.837426	0.0768
R^2	0.978096	F-Stat	13.95417	
R^{-2}	0.908002	DW	2.339	

Dependent variable: LGDP
Selected model: ARDL (1,3,3,4)

Table 4. Short-term estimation results.

Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LAGR)	0.660532	0.063946	10.329578	0.0000
D(LAGR(-1))	0.124140	0.082438	1.505856	0.1433
D(LAGR(-2))	0.222070	0.055375	4.010270	0.0004
D(LEXP)	0.133510	0.019446	6.865829	0.0000
D(LEXP(-1))	0.024424	0.023822	1.025275	0.3140
D(LEXP(-2))	-0.112912	0.022634	-4.988687	0.0000
D(LINFL)	-0.000364	0.000823	-0.441748	0.6621
D(LINFL(-1))	0.001339	0.000725	1.847479	0.0753
D(LINFL(-2))	0.001447	0.000747	1.938528	0.0627
D(LINFL(-3))	-0.002343	0.000696	-3.368552	0.0022
ECT(-1)	-0.439183	0.079914	-5.495699	0.0000

Dependent variable: LGDP

The results presented in Table 4 show that the short-term coefficients of agriculture and exportation are highly significant and positive. However, the share of agriculture in economic growth is more significant in the short term than in the long term. The element that most directly influences a country's agricultural production potential is the availability of arable land. By comparing the area potentially cultivable, current land uses, and population growth forecasts, agricultural production will face the scarcity of the cultivable areas due to population growth. The foreseeable increase in population numbers will have a significant impact on food needs.

As expected, in the EC term, the coefficient of the return force towards equilibrium ECT(-1)= 0.439183 is negative and significant at the 5% level. There is an error correction mechanism, and therefore, error correction model is validated. This coefficient, which expresses the degree to which the variable GDP (growth rate) will be recalled towards the long-term target, is estimated at -0.439183 for our ARDL model, thus reflecting a relatively rapid adjustment to the long-term target. The negative sign on the error correction term confirms the expected convergence process in long-term dynamics.

4. Statistical validation of the model used

After interpreting the results of this model, we are interested in verifying the three main hypotheses: hypotheses of the normality of the errors, heteroskedasticity, test of autocorrelation of errors, and the test on the stability of the model.

The result on residual diagnostic (Table 5) accept the hypothesis of homoscedasticity [ARCH (0.6504)> (0.05)], and the model is exempt of autocorrelation [Breusch-Godfrey (0,0963> 0.05)].

Table 5. Diagnostic on residues.

	Normality Test	ARCH test	LM test
Long-run	0.534353 (0.765538)	0.621714 (0.6504)	2.2263 (0.0963)

Values in () denote probabilities

The CUSUM test, which is based on the dynamics of the forecast error, makes it possible to detect the structural instabilities of the regression equations over time. Figure 1 shows that the curve does not intersect the corridor (dotted lines); the stable model. For the model used in the study, the CUSUM statistics remain in their interval; therefore, we generally reject the hypothesis of a structural change. We can then conclude that the object model of this study is stable.

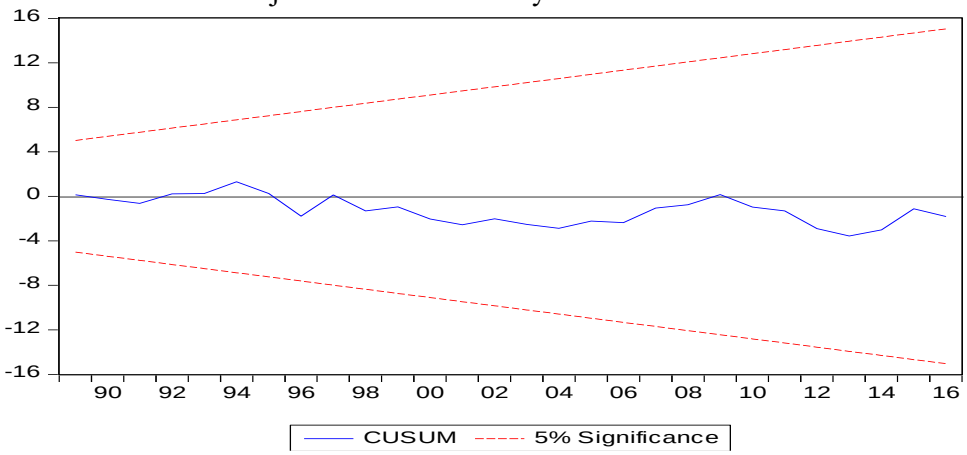

Figure 1. CUSUM stability test.

5. Conclusion

Fertile fields, good crops, high quality and abundant yields, modern large-scale animal husbandry, food and financial security, decent accommodation, a better life for all are advantages and assets that Burundian land can provide to small as well as large-scale farmers and even to the inhabitants of the country. Nevertheless, these potentials remain largely untapped due to the difficulties to which the agricultural sector is subjected. This study applied an autoregressive model with staggered delays ARDL (Auto Regressive Distributive Lags) to assess the share of agriculture in Burundi's economy.

The results of the study proved a positive and significant share of agriculture in economic development. In the short term, the contribution of agriculture to the country's development is more significant than in the long term (0.66% against 0.26). Given the increasingly intense pressures on agricultural resources (demographic pressure and climatic phenomena), agricultural production should meet the food needs by creating new sustainable varieties. Forward new technologies to ensure a stable supply of adequate nutritional value, to which all groups have access.

However, the share of agricultural exports in economic development is essential in the long term. Authorities need to popularize local knowledge and provide learning opportunities to make farmers expert in their production. The country needs to orient research around the development of varieties offering a better yield internally than elsewhere. The study, therefore, revealed that inflation persists in the short and long term. The consumer price of agricultural products decreases the economic growth of

the country. Export taxes must be introduced to encourage producers to sell their domestic stock rather than sell their goods abroad.

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