Agro-processing Output and Agricultural Sector Employment: Evidence from South Africa

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Abstract: This paper empirically examined the relationship between agro-processing sub-sector output and agricultural sector employment in South Africa by using time series data from 1975-2015. The study employed ARDL-bounds testing approach to examine the existence long-run equilibrium relationship. The result of the ARDL test confirmed the existence of long-run relationship among the variables examined. The long-run estimate result revealed that the relationship between agro-processing output and agricultural sector employment is negative in the long-run. The study further examined the causality between agro-processing output and agricultural sector employment using TYDL causality test and it observed a unidirectional causal relationship running from agro-processing output to agricultural sector employment. While it is deduced that agro-processing sector output is found to be unable to promote agricultural sector employment, this study recommends stimulation of agricultural export for agricultural sector employment generation in South Africa.

Keywords: Agro-processing; Agricultural Sector Employment; ARDL-Bound Testing; TYDL; South Africa

JEL Classification: C13; C22; O11; O47; O55

1. Introduction

The role of the agricultural sector in development cannot be understated. Various literatures have emphasized that the agricultural sector provides food, income and employment generation, and thus it can be considered as an operational tool for households food and nutritional security, poverty reduction and promotion of economic growth in developing countries (Alderman, 2007; Anríquez & Stamoulis, 2007; Dethier and Effenberger, 2012). However, the potentials of the agricultural sector for employment generation and as a driver of growth has become doubtful as economics move in the process of development and much more in the era of

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availability of efficient less labour-demanding production technologies, and climate change that has affected agricultural size negatively. Never the less, despite these facts about the agricultural sector, many governments of developing countries believe that the sector remain a viable target sector in tackling the growing youth unemployment. In South Africa, unemployment rate has been consistently high for more than fifteen years, it was estimated to be 24.9 percent, 24.7 percent, 25.1 percent and 25.3 percent respectively between the year 2012 and 2105 (South Africa Reserve Bank, 2016). Similarly, employment level in South Africa ranges between 38.7 percent and 39.4 percent from 2010 to 2014 (World Bank, 2016). This makes the country to be categorized among top ten countries with low employment in the world (World Bank, 2016). This high level of unemployment is unacceptable for an economy to be considered sustainable. Nevertheless, the government is unrelenting in ensuring that unemployment rate is reduced. This is seen in recently launched plan, frameworks and programmes where job growth is a key priority. Some of these are; the National Development Plan 2030, the Industrial Policy Action Plans (IPAPs) 2014, National Growth Path Framework (2011), Medium Term Strategic Framework 2014-2019. In the NGP 2030 and IPAP 2014, agro-processing sub-sector was identified as one having capability of creating desired jobs as a result of the strong upstream (backward) and downstream (forward) potentials and linkages of the agro-processing sector with other sectors in the economy, which makes the sub-sector important.

Agro-processing sector is a subsector of secondary sector that uses and develops raw materials and intermediate products obtained from the agricultural, forestry and fisheries sector (FAO, 1997) and transforms them into more usable commodities for human consumption, animal feed, fuel or industrial raw material (FAO, 1997; Mhazo *et al*., 2012). The process creates avenue for the conversion of farm produce to final consumer good and in the process reduces wastage, increases the length of time for which the processed goods remains usable, fit for consumption, and saleable resulting in value addition, creates wider market for processed good, employment and generate more income transfer to the farmers (Chengappa, 2004). Considering the aforementioned i.e. unemployment rate in South Africa, the potential of agricultural sector in employment creation, and linkages of agro-processing sector with other sector, this paper aim to answer the question that can agro-processing sector promote agricultural employment in South Africa?. This is based on the logic that increase in agro-processing output requires an increase in inputs from the agricultural sector, which indicates an increase in output and employment generation in the agricultural sector. The remaining part of the paper is structured as follows: following the introduction, section 2 is brief review of literature, section 3 describes the model estimation and data. Section 4 presents the analytical techniques employed, section 5 is empirical results, and conclusion is presented in section 6.

2. Theoretical and Empirical Review

Theoretically, the importance of agro-processing in economic development cannot be understated. This is explained in the Three-sector theory of economy put forward by Fisher (1939), Clark (1957), and Fourstire (1954), and the Hirschman hypothesis. The theory describes structural transformation in the process of economic development as a sequential domination by the primary sector (agriculture), followed by secondary sector (manufacturing) and finally the tertiary sector (trade and service). An observed basic pattern is the decline in the relative importance of the agricultural sector as per capita income increases, and an increasing importance of the industrial and service sectors respectively (Kwiatkowski and Krzetowska, 2015). The Hirschman (1958) linkage hypothesis on the other hand emphasis the ability of an industry to influence the performance of another sector in the economy. For instance, an industry could generate demand or encourage investment in the product of another industry through a backward linkage and forward linkage (Meier, 2001; FAO, 1997).

Further explaining the term "linkage", Fisher (1993) explains that economists do refer to the connection between sectors as linkages and they differentiated between forward linkage and backward linkage. A sector is said to have a forward linkage with the rest of the economy when the sector or its output are being used as input in other sector economic activities. While on the other hand backward linkage is viewed from the perspective that a sector is a procurer of factor inputs form the other sectors in the economy. Hence, the 'linkage hypothesis' postulates that the best development path lies in selecting productive sectors where expansion will promote progress in other sectors of the economy (Ncube et al (2015). It therefore logically disapproves the Balanced Growth Theory that emphasized a simultaneous growth in all sectors of the economy of a country. According to Anríquez and Stamoulis (2007), input-output matrix reflects the linkages between sectors in an economy. The matrix shows how the total output of each sector is distributed between final consumers (households, government and intermediate inputs users), it also describe how each sector sells inputs to all the other sectors of the economy. This inter-sectoral linkage could further be viewed from an output-employment relationship or output-investment relationship.

Empirically, there are numerous scholarly literature that have attempted to examine the relationship between output and employment at the aggregate level in order to validate Okun's law. This law may however not be appropriate for an inter-sectoral analysis. Sahin *et al*., (2015) attempted bivariate analyses to examine relationships between output and employment at aggregated level and disaggregated level. Only long-run linkage was found between aggregate output and sectoral employment in seven out of nine sectors examined in the economy of Turkey. Also short-run relationship was found to only exist for two out of the nine sectors examined. This indicates that in the long run, there would be absence of jobless growth in the Turkish economy which is a case of increased economic growth characterised by low employment rate. It is can also be inferred from their study that employment generation policies need to be sector specific.

Sahin *et al*., (2014) from their study did not establish any form relationship between aggregate level output and employment in Turkey. However at employment disaggregate level, the study found that there exist a long-run relationship between aggregate output and employment at a disaggregate categories, that is by status and location (formal versus informal). Adian *et al*., (2014) explored the non-linear dynamics among employment, output and real wages in Canada. Using a VAR framework that provides methodology for assessing dynamic relationship among the economic variables of interest of their study, their established a bi-directional causality exist between employment growth and GDP growth, suggesting that output growth can be used in predicting future employment growth and vice versa.

Caporale and Škare (2014) examined the short and long-run relationship between employment growth, inflation and output growth. The findings of the study established a positive relationship between employment and output growth in the short run. Causality relationship was found to coming from output to employment, but this linkage becomes negative in the long run. Akcoraoglu (2010) empirically investigated the relationship existing between employment and economic growth in Turkey between 1995Q1- 2007Q4. Short-run and long-run relationships was found to exist between the two variables. Furthermore, a bi-directional causal relationship between GDP and employment was established. These point to the fact that economic growth should be considered as a condition for long term employment growth and vice versa.

Sassi and Goaied (2016) investigated employment-output relationship panel data set of 15 industries over 1983–2010. Output–employment elasticities was estimated using the mean group estimator. The study established the existence of a long-run relationship between employment intensities and value added in all the industries examined. The estimated long-term employment intensity of output growth is positive significant at the 5 per cent level for most industries except for mining sector where it is negative and hotels, bars and restaurants sector which is shown to be insignificant. Their study identified the ability of agriculture to create jobs in the long-run to be very weak.

In the study of Muzindutsi *et al*., (2014) where the interaction between manufacturing sector output and aggregate non-agricultural sector employment was examined, using VAR model, manufacturing output growth was found to be directly related to an increase in aggregate employment rate in the short-run. Whereas in the long-run, manufacturing output growth was followed by a decline in non-agricultural employment in the country (South Africa). In the study of Yusof (2008), no long-run direct relationship between output and employment was established. Thus, any productivity affect employment through wages.

It is observed from the briefed literature review reported above and those not reported that studies have considered this employment-output relationship from aggregated level, sectoral level, and aggregate-sectoral level point of view. Considering the subject empirically from an inter-sectoral point of view will assert the theoretical opinion and also establish if agro-processing could be a driver of agricultural employment in South Africa or not.

3. Model Specification and Data

The mathematical representation of link between agricultural sector employment, agro-processing output and other selected agricultural sector level variables is specified as follows:

$$AE_t = f(AP_t, AExp_t, AImp_t, GCF_t, Intr_t, UL_t) \quad 1$$

Where AE is the agricultural sector employment, AP is agro-processing sub-sector output (the sector has 11 sub-sectors), Exp is agricultural sector export, Imp is agricultural sector import, GCF is agricultural sector gross capital formation, Intr is agricultural sector interest rate, and UL is unit cost of labour in the agricultural sector. Data for a period of 1975 to 2015 were obtained from South Africa Reserve Bank (SARB), South Africa Abstract of Agricultural Statistics, and Quantec website. All variables were transformed into standardized form for the analysis.

4. Analytical Technique

4.1. Auto-Regressive Distributed Lag (ARDL) Bound Testing Approach

ARDL-bounds approach developed by Pesaran *et al*., (2001) has several advantages when compared to other known cointegration methods (Pesaran et al, 2001; Oyakhilomen and Zibah, 2014; Odhiambo, 2015). The ARDL-bound model used in this study is expressed as follows:

$$\Delta AE_t = \emptyset_0 + \sum_{i=1}^{p} \Delta\emptyset_1 AE_{t-i} + \sum_{i=0}^{p} \Delta\emptyset_2 AP_{t-i} + \sum_{i=0}^{p} \Delta\emptyset_3 Exp_{t-i} + \sum_{i=0}^{p} \Delta\emptyset_3 Imp_{t-i} + \sum_{i=0}^{p} \Delta\emptyset_4 GCF_{t-i} + \sum_{i=0}^{p} \Delta\emptyset_5 Intr_{t-i} + \sum_{i=0}^{p} \Delta\emptyset_6 UL_{t-i} + \propto_1 AE_{t-1} + \propto_2 AP_{t-1} + \propto_3 Exp_{t-1} + \propto_3 Imp_{t-1} + \propto_4 GCF_{t-1} + \propto_5 Intr_{t-1} + \propto_6 UL_{t-1} + u_t \quad (2)$$

In testing the hypothesis of no cointegration or otherwise among the variables, the F-test of the joint significance of the coefficients of the lagged levels of the variables was employed. The null hypothesis of no cointegration between agricultural employment, agro-processing output, export, import, gross capital formation, interest rate and unit cost of agricultural labour is given as:

$$H_0 = \emptyset_1 = \emptyset_2 = \emptyset_3 = \emptyset_4 = \emptyset_5 = \emptyset_6$$

The alternative hypothesis is given as:

$$H_0 \neq \emptyset_1 \neq \emptyset_2 \neq \emptyset_3 \neq \emptyset_4 \neq \emptyset_5 \neq \emptyset_6$$

Decision on the rejection or acceptance of the null hypothesis is based on the lower and upper bounds critical values which are put forward by Pesaran *et al*., (2001). The null hypothesis of no cointegration is rejected if the calculated F-statistics is above the upper bound critical value. Also, if the F-statistics falls below the lower bound critical value, the null cannot be rejected. If the F-statistics is between the lower bound and upper bound critical values, the result becomes inconclusive.

The conditional ARDL model is used to estimate the long-run impact if a cointegration relationship is established. The ARDL model specified as:

$$AE_t = \emptyset_0 + \propto_1 AEM_{t-1} + \propto_2 AP_{t-1} + \propto_3 Exp_{t-1} + \propto_3 Imp_{t-1} + \propto_4 GCF_{t-1} + \propto_5 Intr_{t-1} + \propto_6 UL_{t-1} + u_t \quad (3)$$

4.2. Toda–Yamamoto–Dolado–Lütkepohl (TYDL) Granger Non-causality Test

The Toda–Yamamoto–Dolado–Lütkepohl (TYDL) granger causality approach proposed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) was employed in order to investigate the causal relationship between agricultural sector employment and agro-processing output. TYDL approach is applicable regardless of the order of integration of the series and regardless of the existence of the cointegration relationship between variables being examined (Lean and Smyth, 2010). TYDL granger causality test suggested VAR framework with p= (k + d_{max}) lag length with respect to this study is expressed as follows:

$$\begin{bmatrix} AE_t \\ AP_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + \begin{bmatrix} \beta_{11,1} & \beta_{12,1} \\ \beta_{21,1} & \beta_{22,1} \end{bmatrix} \begin{bmatrix} AE_{t-1} \\ AP_{t-1} \end{bmatrix} + \cdots + \begin{bmatrix} \beta_{11,k} & \beta_{12,k} \\ \beta_{21,k} & \beta_{22,k} \end{bmatrix} \begin{bmatrix} AE_{t-k} \\ AP_{t-k} \end{bmatrix} + \begin{bmatrix} \beta_{11,p} & \beta_{12,p} \\ \beta_{21,p} & \beta_{22,p} \end{bmatrix} \begin{bmatrix} AE_{t-p} \\ AP_{t-p} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \quad (4)$$

The optimal lag length k is selected on the basis of the Schwarz Bayesian Criterion (SBC). The study applied the standard Wald tests to the first k VAR coefficient matrix (but not all lagged coefficients) in order to draw the inference about the direction of Granger causality. We test the hypotheses:

$$H_0: \beta_{AE\ AP,i} = 0\ for\ all\ i \leq k \rightarrow AP\ does\ not\ Granger\ cause\ AE\ \ H_0: \beta_{AP\ AE,i} = 0\ for\ all\ i \leq k \rightarrow AE\ does\ not\ Granger\ cause\ AP$$

5. Results and Discussion

5.1. Unit Root

Table 1. Augmented Dickey Fuller (ADF) Test

Variable	Level		First Difference		Decision
	ADF Stat	p-value (5%)	ADF Stat	p-value (5%)	
AE	-1.824	0.674	-5.812	0.000	I (1)
AP	-2.384	0.382	-7.620	3.27E-07	I (1)
Exp	1.899	0.999	-3.691	0.050	I (1)
Imp	6.461	1.000	-3.714	0.048	I (1)
GCF	-2.036	0.564	-4.870	0.003	I (1)
Intr	-1.416	0.838	-5.848	0.000	I (1)
UL	-1.788	0.692	-6.350	2.55E-05	I (1)

Source: Authors Computation from E-views 9

The result of the ADF test in Table 1 shows that all variables considered are I(1) at their first differencing. This justifies the use of bound approach to cointegration in this study. ARDL-Bound test cointegration approach requires regressors to be I(1) or a mix of I(1) and I(0), the regressand must however be I(1).

5.2. Cointegration

The cointegration result in Table 2 shows clearly that the calculated value of F-stat 2.92 is greater than the upper bond values of 2.87 at 10%. This confirms the existence of long run relationship among the variables. This denotes that we may proceed to long-run and short-run analysis.

Table 2. Bounds Testing for Cointegration Analysis

F Test:					
			Pesaran *et al*., (1999)a		Conclusion
F-statistic	Degree of Freedom	Critical Value Bounds	I(0) Bound	I(1) Bound	Cointegrated
2.92	6	10 %	1.75	2.87	
		5%	2.04	3.24	
		2.5%	2.32	3.59	
		1%	2.66	4.05	

Source: Authors Computation from E-views 9

5.3. Long-run Estimate

The result of the estimated coefficients of the long run relationship in Table 3 indicates that agro-processing sub-sector output has a negative but significant influence on agricultural employment at $P<0.10$. The estimated coefficient of agro-processing output of -0.23 implies that 1 standard deviation increase in agro-processing sub-sector output will reduce agricultural employment by about 0.23 standard deviation all things being equal.

Table 3. ARDL Long-run Estimate

ARDL (1, 2, 0, 1, 0, 1, 0) selected based on Schwarz criterion						
Dependent variable: Agricultural Sector Employment (AE)						
39 observations used for estimation from1975 to 2014						
Regressors	AP	Exp	Imp	GCF	Intr	UL
Coef.	-0.23***	1.05***	-2.08*	-0.85***	-0.17	1.26*
Std. Error	0.11	-.055	0.75	0.48	0.12	0.43

*,**, and *** denote statistical significance at 1%, 5% and 10% respectively

Source: Authors Computation from E-views 9

This suggest that output expansion in the agro-processing sector is as a result of efficiency technological intensive method of production. This is similar to the findings of Muzindutsi et al (2014) where manufacturing production was found to be having reduction effect on employment opportunities in South Africa in the long-run. Agricultural sector import and gross capital formation were found to be negatively related to agricultural employment. Their coefficients implies that one standard deviation increase in import and gross capital formation of the agricultural sector will lead to reduction in agricultural employment by 2.08 and 0.85 standard deviation respectively. Here agricultural import have the largest reduction effect on agricultural employment. Only export and unit cost of labour were found to have positive effect on agricultural employment. It is seen from Table 3 that 1 standard deviation increment in export will lead to about 1.05 standard deviation in agricultural employment in South Africa the long-run. Also, the 1.26 coefficient of unit cost of labour indicates that if the cost of labour per unit increases by 1 standard deviation, on average agricultural sector employment will increase by 1.264 standard deviation in the long-run all things being equal. Similar pattern is observed in the short-run as well except for interest rate that is positively significant.

5.4. Causality Test

The Table 4 reporting the direction of causality between the agro-processing sub-sectors output and the agricultural sector employment show that the there is a unidirectional causality from agro-processing sub-sectors output to agricultural sector employment. This implies that the history of agro-processing output could forecast agricultural employment and not vice versa.

Table 4. TYDL Causality (Modified WALD) Test

Null Hypothesis:	Observations	Chi-Square	Probability Value
AP does not Granger Cause AE	37	4.077366	0.0435
AE does not Granger Cause AP	37	0.054881	0.8148

Source: Computed by Authors from E-views 9

6. Conclusion

This paper used annual time series data from 1975 to 2015 to establish the relationship between agricultural sector employment and agro-processing sub-sector output and other agricultural sector variables in South Africa using ARDL bound test for co-integration and TYDL Granger causality. The first major finding of this study with respect to output-employment relationship is that agro-processing sub-sector output have a negative effect of agricultural sector employment in the long-run. The causality test revealed that there is a unidirectional causality from agro-processing output to agricultural sector employment in the long-run, no reverse causality is observed. The implication of these findings is that while agro-processing sector can be used to predict agricultural sector employment in South Africa, the sector cannot be an avenue for policy makers as a target for employment generation in the agricultural sector. From the analysis, expansion of agricultural sector export is seen to be imperative for agricultural sector employment growth in the long-run. Hence the South African government should look into stimulating agricultural export aggressively in the country by enacting relevant export expansion strategies.

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