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ANALYSING THE EFFECTS OF CREDIT ON TOBACCO PRODUCTION

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ABSTRACT

This study examined how agricultural credit relates to tobacco production in Zimbabwe between 1980 and 2012. Time series data from FAO was used. Major crops like tobacco and cotton have been facing financial challenge in their production. This is examined through a system of equations in which both variables enter the vector auto-regression (VAR, hereafter) as endogenous variables. According to the results, the value of the coefficient of determination is 0.82 indicating that the estimated model explains about 82% variation in tobacco output while 18% variation is accounted for by the error term. This makes the estimated model capable of explaining variation in tobacco production in the Zimbabwean context. The result means that if tobacco producer price increases by 100%, tobacco output will increase by a magnitude as low as 0.01% holding other explanatory variables constant. The result suggests that if agricultural credit increases by a magnitude of 10%, tobacco output will increase by almost 6% holding constant the producer price and the increase is statistically significant at 1% level of significance. A positive shock in agricultural credit is found to facilitate a steady increase in tobacco output in the first five years. Interesting is that the magnitude of increase in response to the shock reaches a peak of almost 4.5% which is close to the 5.6 long run effect of agricultural credits on tobacco. The impulse response functions on the other hand confirmed that tobacco output significantly responds to unexpected shocks in agricultural credits with the effect lasting for at most 5 years. Therefore the government needs to promote the banking and micro-finance sector to boost the economy through growing tobacco.

Keywords : *agricultural credit production, tobacco*

INTRODUCTION

In Zimbabwe, agriculture is a source of livelihood for almost 73 percent of the country's population (Masunda, 2011; Masunda and Chiweshe, 2015). It also contributes close to 48 percent of formal national exports and about 23 percent of the country's gross domestic product (GDP) (Anfofum *et al.*, 2013). Zimbabwe's agriculture sector is dominated by tobacco which accounts for aproximately 40% of foreign currency in production earnings and contributing about 10% of the country's GDP (Muir-Leresche, 2006). It directly employs over a million people, and many more in the downstream industries. Tobacco is still the backbone of the Zimbabwean economy and examining ways of resuscitating this subsector is an essential step towards the development of the entire economy at large. In empirical literature, there are several channels through which financial developments can impact agricultural performance. The common channel is that financial credit represents a capital injection to the farmers and failure to provide adequate credit translates into inadequate working capital, and farmers will find it difficult to purchase productivity-enhancing inputs such as seeds, fertilizers, pesticides and land preparation. Tobacco is still the backbone of the Zimbabwean economy and examining ways of resuscitating this subsector is an essential step towards the development of the entire economy at large. In empirical literature, there are several channels through which financial developments can impact agricultural performance (Ndlela, 2010). The common channel is that financial credit represents a capital injection to the farmers and failure to provide adequate credit translates into inadequate working capital, and farmers will find it difficult to purchase productivity-enhancing inputs such as seeds, fertilizers, pesticides and land preparation.

Major crops like tobacco and cotton have been facing a restrained and fluctuating trend. Understanding the underlying causes of this anomaly is an imperative step towards the implementation of a country development strategy (Rukuni, 1994 and Rukuni *et al.*, 2006). Therefore, seeks to establish how agricultural credit relates to tobacco production in Zimbabwe using time series data from 1980 to 2012.

OBJECTIVES

(1) To determine the effect of credit on tobacco production

(2) To determine the responsiveness of tobacco production

to shocks in agricultural credit

(3) To assess the importance of such credit shocks on tobacco production in Zimbabwe

METHODOLOGY

The research uses methods and estimation techniques that seek to address the limitations common in earlier studies

RESULTS AND DISCUSION

The results of unit root and co-integration tests. Thereafter, post estimation diagnostic tests, empirical VECM, impulse response functions and variance decomposition results.

Examine how agricultural credit relates to tobacco production

Results for unit root tests

Stationarity or unit root tests are important in this case as they provide useful information in whether to estimate the VAR or the VECM. They also enable the researcher to determine whether or not a probe for cointegration is necessary. Augmented Dickey Fuller test was used to assess the stationarity properties of data and the empirical results of these tests are presented in table 1

Table 1: ADF unit root tests

Variable	Augmented Dickey Fuller test		Order of integration
	Level form	First difference	
Tobacco Output	0.1556	0.0000***	I(1)
Producer Price	0.1718	0.0997*	I(1)
Agriculture Credit	0.9150	0.0002***	I(1)

Note: *, *** denotes $p<0.1$ & $p<0.01$ respectively

According to the results in table 1, the null hypothesis of a unit root cannot be rejected in level form because the probability values exceed the 10% maximum significance level. This means that all the three endogenous variables are non-stationary in their level form and are exposed to spurious regression problems if not differenced. Having differenced them once, then all the values become stationary. By implication, this means that the variables are integrated of order 1 or they contain a single unit root which disappears after first differencing. Stock and Watson (1991), a combination of non-stationary time series variables is likely to share a same common stochastic trend and given this fact, the researcher had to invoke a probe for a long run relation. This was done using the Johansen (1998) method.

Johansen method results

Johansen Cointegration test is sensitive to the number of lags, the first step was to test for the optimal lag length using the AIC and BIC as indicated in the methodology section. Results of this test are presented in table 2

Table 2: Lag length selection

Lag	AIC	BIC
0	12.960	13.053
1	8.712	8.990
2	5.641*	6.104*

*Note: * denotes lag selected by the criteria*

AIC and BIC criterial suggests inclusion of two lags in the Johansen test. The main intuition behind these criterial is to choose the maximum lag which produces the minimum values of the AIC and the BIC.

Using these lags, the Johansen test for co-integration was estimated and the results are presented in table 3.

Table 3: Johansen test (Trace statistic)

Trace statistic				
Rank Matrix	**Eigen value**	**Trace Statistic**	**0.05 Critical Value**	**P-value**
r = 0	0.764967	57.38664	29.79707	0.0000***
r = 1	0.289965	11.04969	15.49471	0.2085
r = 2	0.002857	0.091555	3.841466	0.7622
Eigen value				
Rank Matrix	**Eigen value**	**Max-Eigen statistic**	**0.05 Critical value**	**P-value**
r = 0	0.764967	46.33695	21.13162	0.0000***
r = 1	0.289965	10.95813	14.26460	0.1563
r = 2	0.002857	0.091555	3.841466	0.7622

*Note: *** denotes rejection of the null hypothesis at 1% level*

The Johansen test was used estimated using assumption 3 (intercept and no trend in the co-integrating equation and VAR). Given only three endogenous variables in this study, it follows that we test three null hypotheses in the Johansen co-integration test. The starting point is to test the null hypothesis of no co-integration (i.e. full rank, r=0) and it is rejected if the p-value is less than 5% or if the Trace/Eigen value is greater than the 5% critical value. In the upper table, the trace statistic is greater than the critical value therefore the null of full rank can be rejected. The next hypothesis holds that there is at most 1 co-integrating equation. This time the trace statistic (11.04) is less than the critical value (15.49) therefore the null of 1 co-integrating equation cannot be rejected. This implies that the system contains at most 1 co-integrating equation.

The same conclusion is reached using the maximum Eigen value in the lower table. The maximum Eigen value for the first null hypothesis of no Cointegration is greater than the 5% critical value implying a strong rejection of the null hypothesis. This is also confirmed by the probability value which is way below the 5% significance level. With regards to the second null hypothesis of at most 1 co-integrating equation, the Eigen value and the probability value again suggests acceptance of the null hypothesis. This means that the system has at least 1 co-integrating equation. If the endogenous variables in a system are not cointegrated, then they will simply need to be differenced and put in a VAR but if they are cointegrated, then a VECM will be more appropriate as it shows the long run relationships as well as the short run dynamics. In this case, the endogenous variables are confirmed to be cointegrated hence a VECM was invoked. In light of this result, the following diagnostic tests were based on the Vector Error Correction Model.

Block Granger Causality/Exogeneity test

The block granger causality or Exogeneity test was used to test for weak Exogeneity and direction of causality between the endogenous variables of interests (tobacco production and agricultural credit). This test was imperative in the sense that if any of these two variables is found to be exogenous in the system, then there will be no need for estimating a system

Table 4: Block Granger Causality/ Exogeneity test

Dependent variable: Tobacco Output			
Excluded	Chi-sq	df	Prob.
Output	0.253121	5	0.0091***
All	0.253121	5	0.0091***

Dependent variable: Agricultural credit			
Excluded	Chi-sq	df	Prob.
Output	0.232770	5	0.0061***
All	0.232770	5	0.0061***

Note: *** denotes $p < 0.01$

The null hypothesis of the exogeneity test holds that the endogenous variable should be treated as exogenous, (i.e. uncorrelated with the error term or determined outside the system) and it is rejected if the probability value if less than 5%. Probability values are less than 5% significance level therefore the null hypothesis can be rejected. This means that both variables are endogenous and the direction of causality is two way. Results from an autocorrelation variables are endogenous as confirmed in table 4, it follows that estimating a system of equations is appropriate as single equation modelling would produce a small sample bias that does tests are presented.

Serial correlation LM test

Table 5: VECM Residual Serial Correlation LM Tests

Lags	**LM-Stat**	**Probability value**
1	4.944718	0.2930
2	3.444437	0.4864
3	5.447362	0.2444
4	1.502803	0.8261
5	2.512240	0.6424
6	3.328382	0.5044
7	3.235371	0.5192
8	1.186301	0.8803
9	1.277838	0.8651
10	3.944537	0.4136
11	1.520986	0.8229
12	0.662008	0.9559

The probability values are greater than 5% therefore the null hypothesis cannot be rejected. This means that the estimated vector error correction model (VECM) is free from autocorrelation.

Normality of residuals

The Jarque Bera test was used to test whether the residuals from the system follow a normal distribution. If the residuals do not conform to this assumption, Gujarati (2004) argues that the t and F statistics may not follow their standard distributions holding the central limit theory constant. Nonnormality of residuals may be a strong indication of model misspecification, endogeneity and omission of a relevant variable.

Jarque Bera test for normality of residuals

Component	Jarque-Bera	df	Prob.
1	0.211982	2	0.8994
2	0.782186	2	0.6763
Joint	0.994168	4	0.9107

The joint probability value is 91% and therefore the null hypothesis cannot be rejected. This means that the estimated VECM has normally distributed residuals.

Heteroscedasticity

Heteroscedasticity is of equal importance given the potential loss in asymptotic efficiency if it is prevalent in the system.

Heteroscedasticity test

Chi-sq	Df	Probability value
65.46584	60	0.2929

The probability value is above 5% therefore the null of homoscedasticity cannot be rejected. This result amounts to saying heteroscedasticity is not prevalent in the system. The next section presents the VECM results showing how agricultural credits relate to tobacco production in Zimbabwe.

Vector error correction model (VECM) estimates

This subsection presents the empirical results on how agricultural credit relates to tobacco production in Zimbabwe.

Table 6 : Long run impact of agriculture credit on tobacco production

Vector Error Correction Estimates			
Date: 09/03/15 Time: 09:40			
Sample (adjusted): 1983 2013			
Included observations: 31 after adjustments			
Standard errors in ( ) & t-statistics in [ ]			
Regressors	**Coefficient**	**Standard error**	**t-statistic**
Producer Price	0.0001*	5.7E-05	1.83
Agriculture credit	0.5663***	0.14673	3.86
Constant term	-121.7736		
Adj. R-squared	0.824538		
Sum sq. resids	2607.176		
S.E. equation	11.41748		
F-statistic	1.868660		
Log likelihood	-112.6837		
Akaike AIC	7.979590		
Schwarz SC	8.488424		
Mean dependent	0.814839		
S.D. dependent	12.96552		

Note: *, **, *** denotes p <0.1,p <0.05 & p < 0.01 respectively.

Value of the coefficient of determination is 0.82 indicating that the estimated model explains about 82% variation in tobacco output while 18% variation is accounted for by the error term. This makes the estimated model capable of explaining variation in tobacco production in the Zimbabwean context. The long run effect of tobacco producer price is positive as theoretically expected but is statistically significant at the margin and the size of the coefficient is relatively small to call for policy attention. The result means that if tobacco producer price increases by 100%, tobacco output will increase by a magnitude as low as 0.01% holding other explanatory variables constant. The weak significance of the price coefficient is in line with the finding obtained by Leaver (2004) when he examined the supply response of tobacco in Zimbabwe. Nerlovian adaptive model, the author observed that tobacco farmers in Zimbabwe are highly unresponsive to price changes in the long run. This is, of course against economic theory which supports a positive and significant link between output and own price. The positive and significant link between agricultural credit and tobacco production in table 8 also corroborates the essence of the recent wave of micro financial institutions in developing countries whose tenet is to offer micro loans and other forms of credits to individuals, firms, farmers and organisations in order to improve the livelihood of the rural population in general.

Table 7 : Short run impact of agriculture credit on tobacco production

Short run dynamics	1	2	3
Error Correction Term	-0.16	-0.32***	-0.001
	[-0.41]	[-6.57]	[- 0.27]
Δ (Agriculture output(-1))	-0.43	-94.22***	-0.0003
	[-1.32]	[-5.86]	[-0.06]
Δ (Agriculture output(-2))	-0.54	-53.99***	-0.003
	[-2.16]	[-4.31]	[-0.82]
Δ (Producer Price(-1))	0.001	1.17***	-5.59E-05*
	[0.45]	[10.15]	[-1.49]

Δ (Producer Price (-2))	0.0004	-0.32***	3.76E-05
	[0.21]	[-3.09]	[1.10]
Δ (Agriculture credit(-1))	8.12	2832.88***	1.810***
	[1.15]	[8.16]	[16.05]
Δ (Agriculture credit (-2))	-9.23	-2586.29***	-0.85***
	[-1.26]	[-7.13]	[-7.29]
C	15.04	1328.10	-0.012
	[1.23]	[2.20]	[-0.06]
L.R.P	-0.15	444.82	-0.52***
	[-0.01]	[0.96]	[-3.48]
Multicurrency system	1.21	-620.48	-0.39*
	[0.08]	[-0.84]	[-1.67]
E.S.A..P	-15.43	-719.12	0.25
	[-0.97]	[-0.91]	[1.00]

Note: *, **, *** denotes p <0.1,p <0.05 & p < 0.01 respectively.

In the first specification, the dependent variable is tobacco output expressed in differenced form. In equation 2 and 3, the dependent variables are producer price and agricultural credit respectively. The error correction term reveals the time taken by the model to revert back to the initial equilibrium position following an unexpected shock in the short run. The higher the error correction term in the model, the higher is the speed of adjustment and vice versa. In the first specification of interest, the error correction term carries an expected negative sign and the value of -0.16 suggests a slow speed of adjustment. Technically, the error correction term of -0.16 indicates that if there is a temporary shock in the short run, it will take about 6 years 2 months for the model to revert back to its equilibrium position. As can be seen from table, the producer price and the first lag of agricultural credit tend to correlate with tobacco output in a positive but statistically insignificant way. The positive correlation is as expected but the insignificance part of the short run dynamics is quite surprising. What this suggests is that both tobacco producer price and agricultural credit do not matter at all on tobacco production in Zimbabwe in the short to medium run. This might owe to the issue of low responsiveness of farmers due to poor institutional support, shortage of critical inputs and shortage of foreign currency among other possibilities.

Assess the responsiveness of tobacco output to short run shocks in agricultural credit

Impulse response functions were conducted to assess the response of tobacco output and agricultural credit following a temporary short run shock in the system. The results of this exercise are shown in fig. 1.

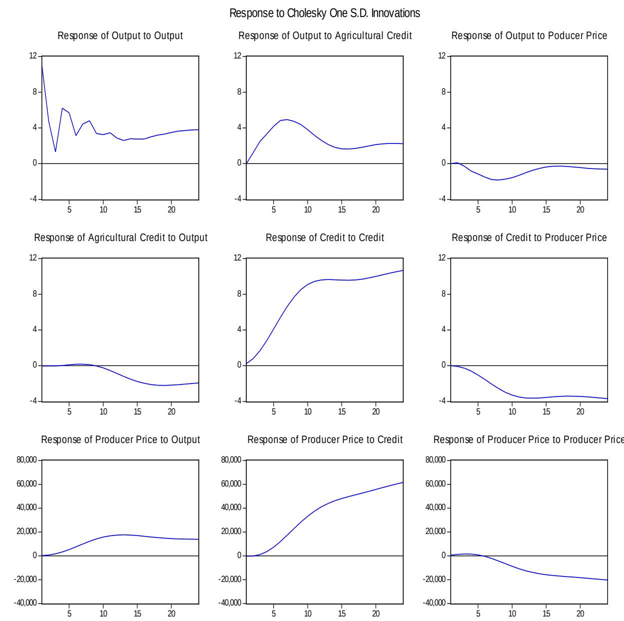

Fig. 1 : Impulse Response functions of agricultural credit and tobacco production

From the diagrams in figure, a positive shock in agricultural credit is found to facilitate a steady increase in tobacco output in the first five years. Interesting is that the magnitude of increase in response to the shock reaches a peak of almost 4.5% which is close to the 5.6 long run effect of agricultural credits on tobacco confirmed earlier by the vector error correction model in table. The gradual decline that takes effect thereafter may be an indication of diminishing marginal returns at work. According to the law of diminishing marginal returns, an increase in the input variable factor (agricultural credit in this case) on the fixed factor (land) will facilitate an increase in an increase in both marginal product and total product up to a certain level where output will start to increase at a decreasing rate.

Assess the significance of agriculture credit shocks on tobacco production in Zimbabwe

Variance decomposition of agricultural credit and tobacco production

According to Enders (2003), variance decomposition tells how much a given variable changes under the impact of its own shock and the shock of other variables. Table below shows the variance decomposition of both tobacco output and agricultural credit in Zimbabwe over a period of 24 years (Table 8).

Table 8 : Variance decomposition

Variable	Decomposition of Tobacco Output	Decomposition of Agricultural Credit	Decomposition of Tobacco Producer price
Tobacco Output (%) at year 24	66	02.4	08.6
Agricultural Credit (%) at year 24	31	86.8	82.8
Tobacco producer price (%)	03	10.7	08.5

The second column second row shows the amount of tobacco output response that is attributed to output. The result indicates that tobacco output own shocks account for a greater percentage (66%) while agricultural credits and producer price account for 31% and 3% variation respectively. The low proportion accounted for by tobacco producer price says something special about the use of producer prices as a regulatory instrument of agricultural output in Zimbabwe given that a similar result was confirmed earlier by the VECM model. A striking and interesting result is confirmed in the third column. Here, almost 83% variation in tobacco production is accounted for by agricultural credit. This is less surprising given that theoretically an increase in credit availability facilitates an increase in agricultural output which later translates into a decrease in price emanating from increased supply. The overall conclusion that can be drawn from the variance decomposition technique is that agricultural credit shocks are relatively less important in explaining variation in tobacco as they constitute less than 50%. What is actually more critical are own shocks in tobacco output while the producer price does not seem to matter at all given a percentage of less than 5%.

CONCLUSION

All variables were found to follow a non-stationary process but with 1 co integrating vector as confirmed by the Johansen Cointegration test. The main result of the study indicated that although agricultural credit seems to significantly promote tobacco production only in the long run. In the short run, the effect is positive but not significantly different from zero. The impulse response functions on the other hand confirmed that tobacco output significantly responds to unexpected shocks in agricultural credits with the effect lasting for at most 5 years.

RECOMMENDATIONS

This study recommends improvement in infrastructural development especially in the farms, roads and conducive credit facility policies. More so, the incessant security challenges in the resettled farmers because they cannot bank the land should be immediately in order to give confidence to local investors.

CONFLICT OF INTEREST

The authors of the paper declare no conflict of interest

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