ANALYSIS OF INFLATION ON EXPORT PERFORMANCE IN TANZANIA: GRANGER - CAUSALITY ANALYSIS (1971 – 2012)

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Abstract

The objective of this study was to determine empirically the causal relationship between inflation and export in Tanzania. Annual time series data covering the period between 1971 and 2012 was used. The Augmented Dickey Fuller (ADF) test was conducted to find the existence of unit root in each of the time series variables and the maximal order of integration (*d*) for both variables and it was found that there was no unit root. The Engle and Granger test and Johansen's Cointegration test were used to test for cointegration and it was revealed that there was no long-run relationship between the variables.

Furthermore, the directions of causality between the two variables were studied based on the Granger Causality test and found that there was one way causality from export to inflation (i.e. Export granger-cause Inflation). The study therefore, proved that there was unidirection causality from export to inflation in Tanzania for the period from 1971 to 2012.

Key Words:
Inflation (Average consumer prices), Export (Export growth rate), Cointegration, and Granger Causality.

1.0 Introduction

Inflation is a sustained increase in the general price level of a national economy measured either at the retail or wholesale level. The annual rate of change in this price level, commonly expressed in index numbers, is the inflation rate (Houck, 2001). Gokal and Hanif, (2004) found that inflation not only reduces the level of business investment, but also the efficiency with which productive factors are put to use.

According to the Economic and Social Research Foundation (ESRF) (2009), Tanzanian economy continued to experience inflationary pressures originating from the lagged effects of soaring world oil prices in 2007 and 2008, compounded by severe food supply shocks in the region and poor short rains in some areas of Tanzania in the first half of 2009. During this period the annual inflation rate reached a peak at 13.5 percent in December, 2008 which was driven by food inflation of 18.6 percent while non-food inflation was at 6.0 percent. Moreover, in May, 2011 Kagira (2011) shows that Tanzania put export bans which have been motivated by concerns relating to food security, where the Government issues export restriction to safeguard the economy from depleting its foods stock. It had halted food exports to tame rising prices of staple goods, which have pushed its inflation rate higher for six consecutive months. Tanzania's inflation rose to 8.6 per cent in April, 2011 from 8.0 per cent in March, 2011 on higher food and fuel prices, reflecting rising inflation across east Africa. Furthermore, Kagira (2011) noted that export ban has impact for instance in Sumbawanga, before export ban prices were higher. For example price were 35,000/= to 38,000/= per bag of maize at farmers residence but following export ban closure the price is 25,000/= per bag at farmers residence and 35,000/= per bag at National Food Reserve Authority (NFRA). In other development, following cross border trade ban on maize from Tanzania, price of one bag of maize in Democratic Republic of Congo (DRC) has gone up to Tsh 80,000 - 100,000 of which farmers in Rukwa

region would have benefited since the ban does not guarantee food security to fellow Tanzanian since cost of transport is prohibitive because of poor road network.

Following a study by Prachowny (1970), one of the alleged costs of inflation is loss of competitiveness in international markets if the rate of change of prices is higher in domestic country than in the rest of the world. This external cost of inflation is severe for countries which rely heavily on foreign markets.

Since 1966 the trend of inflation in Tanzania shows inflation has always been a two-digit. According to Solomon and Wet (2004), inflation in the 1970s has been limited to fluctuate between 10 per cent and 20 per cent. At the end of the 1970s and the beginning of 1980s, a radical increase was recorded. Inflation rose to the level of 30 percent. It stabilised at this level, only dropping to 20 per cent at the end of 1980s.

The government of Tanzania's strategy for reducing inflation and increasing economic growth has, since 1986, focused on tight monetary policy and increased output production. According to Kilindo (1997) these strategies were formulated followed recognition of the perverse impact of the inflation on output and productivity, purchasing power of wages, balance of payments, real interest rates and government fiscal operations. The combined effects of these reforms have generally had a positive impact on the economy.

2.0 Literature Review

2.1 Inflation and Export

Various studies show that there is less agreement about the precise relationship between inflation and export performance, and the mechanism by which inflation affects economic activity at the macroeconomic level which creates significant debate both

theoretically and empirically. According to Gylfason (1998), high inflation may be a symptom of economic mismanagement, imperfect institutions, and other factors that together help undermine export performance and economic growth. Rapid inflation can retard exports and growth through one or all of these channels. Furthermore, Houck (2001) examined that with fixed exchange rates, the exports of the rapidly-inflating nation would tend to dwindle, and their imports would tend to rise. However, if a time lag exists in the rate at which exchange values adjust in response to differential inflation, then the nation with the more rapid inflation will find its exports slipping and its imports rising. Because the value of its currency will not be falling fast enough to maintain equal commodity price relatives. However, Edwards (1985) empirically examine that a resource-based export boom will typically result in a balance of payments surplus and in the accumulation of international reserves. If this increase in reserves is not sterilized, the monetary base will increase and an excess supply of money may develop and the final effect will be inflation. Thus, commodity export booms generate short run increases in inflation. Study by Prachowny (1970) in six developed countries explore that both the theoretical conclusions and empirical evidence point to the possibility that aggregate export prices rise more slowly than GNP prices if the inflation is cost push or domestic demand-pull, with opposite results for foreign demand-pull inflation.

Since, there was limited literature on the link between inflation and export in Tanzania, and still there was no clear agreement between scholars about inflation and export relationship. This study therefore embarks on this analysis to empirically determine the relationship between inflation and export for Tanzania from 1971 to 2012.

2.2 Conceptual Framework

The conceptual framework in Figure 1.0 shows the link that exists between Inflation and Export.

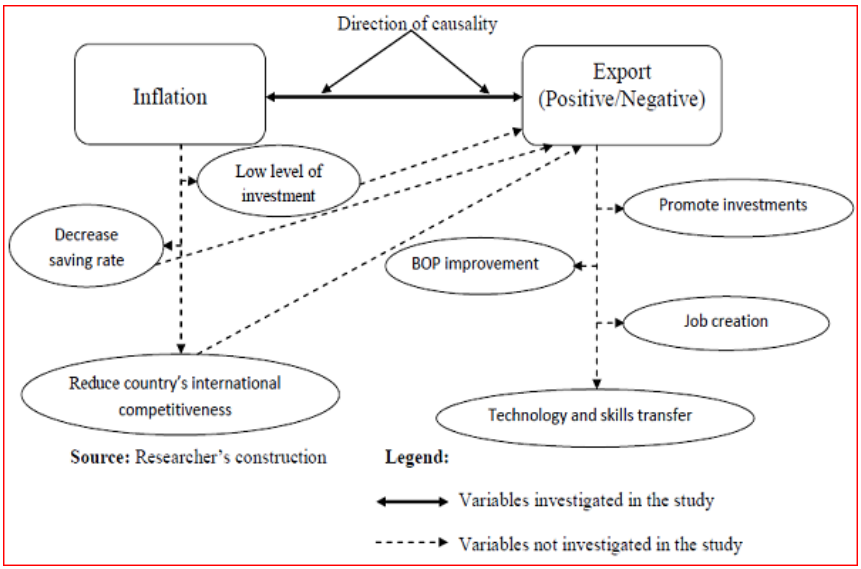

Figure 1: Conceptual framework

Figure 1 depicts that; inflation can lead to uncertainty about the future profitability of investment projects. This leads to more conservative investment strategies than would otherwise be the case, ultimately leading to lower levels of investment and economic growth. Inflation may also reduce a country's international competitiveness, by making its exports relatively more expensive, thus leads to worsening of balance of payments and ultimately low economic growth. When inflation is higher, it implies that more money is used to fetch few goods, this leads to low saving rate thus little money available for investment purposes. This situation leads to failure of many enterprises and fall of productivity hence few outputs for export.

For the case of export, as it increases lead to promotion of investment and increase of job opportunities. Furthermore, export cause transfer of technology and skills from advanced countries to least advanced countries which results to more production hence balance of payment (BOP) improvement.

2.3 Theoretical Framework

This study employed two econometric models in the procedure followed by Ahmed and Mortaza (2005). The first econometric model examined the short-run and long-run relationship between inflation and export by applying the Johansen (1990) cointegration test and the associated Error Correction Model (ECM) and the second applied the Granger causality test to determine the direction of causality between the two variables of inflation and export.

3.0 Data and Methodology

3.1 Data

The relationship between inflation and export was captured. Average consumer prices were used as a proxy for inflation while export growth rate was used as a proxy for Export. Statistical study design was used to analyse data covering the period from 1971 to 2012. The data was accessed from the International Monetary Fund database at *http://www.imf.org/external/pubs/ft/weo/2012/02/weodata* and Africa Development Bank database at *http://www.afdb.org.database*.

3.2 General Econometric Model

The primary model showing the relationship between inflation and export was specified as follows: -

$$EXPO = f(INFL) \quad \text{---------- (1)}$$

$$EXPO = \alpha_o + \alpha_1 INFL + \varepsilon_t \quad \text{---------- (2)}$$

Where:

EXPO is Export growth rate as a proxy for Export

INFL is Average consumer prices as a proxy for Inflation

α_o is the constant term, 't' is the time trend, and 'ε' is the random error term

3.3 Regression Model

In order to test for Inflation influence on Export, Export growth rate data was regressed as a function of Average consumer prices and in order to test for Export influence on Inflation, Average consumer prices data was regressed as a function of Export. The granger causality test was done after co integration test. If the two variables are co integrated the following estimation models would be employed: -

$$EXPO_t = \alpha_0 + \sum_{i=1}^{n} \beta_{1i} EXPO_{t-1} + \sum_{i=1}^{m} \gamma_{1i} \Delta INFL_{t-1} + \delta_1 ECT_{t-1} + \varepsilon_{1t} \quad \ldots\ldots(1)$$

$$\Delta INFL_t = \alpha_1 + \sum_{i=1}^{n} \beta_{2i} \Delta INFL_{t-1} + \sum_{i=1}^{m} \gamma_{2i} EXPO_{t-1} + \delta_2 ECT_{t-1} + \varepsilon_{2t} \quad \ldots\ldots(2)$$

Where:

EXPO is the Export growth rate

INFL is the Average consumer prices

ECT is Error correction term

Δ Indicates variable differenced once

If the co integration relationship between the variables *INFL* and *EXPO* does not exist the *ECT* would be removed and the equations (1) and (2) now would became;

$$EXPO_t = \alpha_0 + \sum_{i=1}^{k+d} \beta_{1i} EXPO_{t-1} + \sum_{i=1}^{k+d} \gamma_{1i} \Delta INFL_{t-1} + \varepsilon_{1t} \quad \ldots\ldots(3)$$

$$\Delta INFL_t = \alpha_0 + \sum_{i=1}^{k+d} \beta_{2i} INFL_{t-1} + \sum_{t-1}^{k+d} \gamma_{2i} EXPO_{t-1} + \varepsilon_{2t} \quad \text{..... ....} \quad (4)$$

Where:

$EXPO_t$, is the Export growth rate,
$INFL_t$, is the Average consumer prices,
k is the optimal lag order, d is the maximal order of integration of the variables in the system and ε_{1t} and ε_{2t} are error terms that are assumed to be white noise, and
Δ Indicates variable differenced once

Equation (3) postulates that current *EXPO* is related to past values of itself as well as that of *INFL* and equation (4) postulates a similar behaviour for *INFL*.

The following four cases can be distinguished from the two equations: -

1. One direction causality from *INFL* to *EXPO* exists if the estimated coefficients on Inflation in equation (3) are statistically different from zero as a group (i.e. $\Sigma\gamma_{1i} \neq 0$) and the set of estimated coefficients on *EXPO* in equation (4) are not statistically different from zero (i.e.$\Sigma\gamma_{2i} = 0$).
2. Conversely, one direction causality from *EXPO* to *INFL* exists if the estimated coefficients on *INFL* in equation (3) are not statistically different from zero as a group (i.e. $\Sigma\gamma 1i = 0$) and the set of estimated coefficients on *EXPO* in equation (4) is statistically different from zero (i.e.$\Sigma\gamma 2i \neq 0$).
3. Two way, or bilateral causality, is suggested when the sets of *INFL* and *EXPO* coefficients are statistically significantly different from zero in both regressions.
4. Finally, independence i.e. neither *INFL* nor *EXPO* causes one another, is suggested when the sets of *INFL* and *EXPO*

coefficients are not statistically significant in both regressions.

Generally, since the future cannot predict the past, if variable *INFL* (Granger) causes variable *EXPO*, then changes in *INFL* should precede changes in *EXPO*. Therefore, in a regression of *EXPO* on other variables (including its own past values) if we include past or lagged values of *INFL* and it significantly improves the prediction of *EXPO*, then we can say that *INFL* (Granger) causes *EXPO*. A similar definition applies if *EXPO* (Granger) causes *INFL*.

3.4 Estimation Techniques

We used the Seemingly Unrelated Regression (SURE) technique in estimating the Bivariate Time Series Model. SURE was used in this case in order to estimate the two equations together. However, since each regression contains the same number of lagged endogenous variable, the OLS estimation of each equation separately produces identical (and efficient) estimates (Gujarati, 2004).

4.0 Regression Results and Discussions

The estimation results are presented in five steps: The first step was to find the existence of unit root in each of the time series variable and to find the maximal order of integration (*d*) for both Inflation and Export. This was done by the use of Augmented Dickey Fuller (ADF) unit root test. Secondly, the optimal lag order (*k*) was found by using Likelihood Ratio (LR), Forecast Prediction Error (FPE) Criteria, Akaike Information Criteria (AIC), Hannan Quinn Information Criteria (HQIC) and Schwartz Bayesian Information Criteria (SBIC). Thirdly, Cointegration and the associated Error Correction Model were conducted to test if there was short run and long run relationship between Inflation and Export. This was done by using the Engle and Granger

method and Johansen's test for cointegration. Fourthly, the established maximal order of integration and the selected VAR length was used to estimate the model by using the Seemingly Unrelated Regression technique. Lastly the Granger Causality test was performed to test the stated hypotheses.

4.1 The Augmented Dickey Fuller Unit Root Test

The Augmented Dickey Fuller (ADF) test was conducted on Export growth rate (percentage) as a proxy for Export and Average consumer prices (percentage) which was diffenced once as a proxy for Inflation. This was done in order to find the existence of unit root in each of the time series variable and the maximal order of integration (*d*) for both Inflation and Export.

The ADF test results in Table 1(a) implies that the coefficient of average consumer prices compared with the critical values 1%, 5% and 10% was stationary at first difference thus, the null hypothesis of non-stationary is rejected and it is safe to conclude that the variable is stationary and integrated at order one, i.e. $I(1)$. Likewise , results in Table 1(b) implies that Export growth rate is stationary even at 1% level of significance at order zero i.e. $I(1)$. Thus, the maximal order of integration for the two variables is one i.e. $I(1)$.

Table 1(a): The ADF test for Average consumer prices differenced once (INFLd1)

dfuller INFLd1, trend regress lags(1)

Interpolated Dickey-Fuller Number of obs = 39

	Test statistic	Critical values		
		1%	5%	10%
Z(t)	-5.317	-4.334	-3.580	-3.228

MacKinnon approximate p-value for Z(t) = 0.0002

Table 1(b): The ADF test for Export growth rate (EXPO)

dfuller EXPO, trend regress lags(0)

Interpolated Dickey-Fuller Number of obs = 41

	Test statistic	Critical values		
		1%	5%	10%
Z(t)	-5.198	-4.233	-3.536	-3.202

MacKinnon approximate p-value for Z(t) = 0.0001

4.2 Optimal Lag Order (*k*)

Furthermore, the Likelihood Ratio (LR), Forecast Prediction Error (FPE) Criteria, Akaike Information Criteria (AIC), Hannan Quinn Information Criteria (HQIC) and Schwartz Bayesian Information Criteria (SBIC) were conducted to find the optimal lag order (*k*). Table 2 provides the output of the choice criteria for selecting the order of VAR model.

Table 2: The Selection Order Criteria of VAR model

Varsoc EXPO INFLd1

Selection order criteria

Sample: 1976 – 2012 Number of obs = 37

lag	LL	LR	Df	P	FPE	AIC	HQIC	SBIC
0	-298.74				39359.2*	16.2562*	162869*	16.3433*
1	-296.934	3.612	4	0.461	44345.5	16.3748	16.4669	16.636
2	-295.616	2.6368	4	0.620	51396.8	16.5198	16.6733	16.9551
3	-294.869	1.494	4	0.828	61640.3	16.6956	16.9105	17.3051
4	-290.792	8.1529	4	0.086	62044.7	16.6915	16.9678	17.4752

Endogenous: EXPO INFLd1

Exogenous: _cons

Key: * means zero(0) lag order of the VAR model is acceptable by respective choice criteria.

Based on Table 2 results, the FPE information criteria, AIC, HQIC and SBIC all selects zero (0) lag. Thus, zero (0) lag order of the VAR model is selected in order to preserve some degree of freedom for the estimation.

4.3 Co integration Test and Associated Error Correction Model

The Engle and Granger method and Johansen's test for cointegration were performed to test if there was short run and long run relationship between Inflation and Export.

4.3.1 Engle and Granger Method

In order to test for cointegration, the Engle and Granger method was performed as follows:- The differenced average consumer prices was regressed on export growth rate and vice versa there after the obtained residues were plotted on graph to see if there

was a pattern between errors and lastly the residues were tested for stationarity. Figure 2 and Table 3 provides result for residues graph and regression of average consumer prices differenced once on export growth rate respectively, while Table 4 provides the ADF test for residuals. Results for Table 4 indicates that the residues were not stationary since test statistic coefficient is greater than the critical value at 1%, 5% and 10% therefore it proved that there was no cointegration on the two variables.

Figure 2: Residues scatter plot

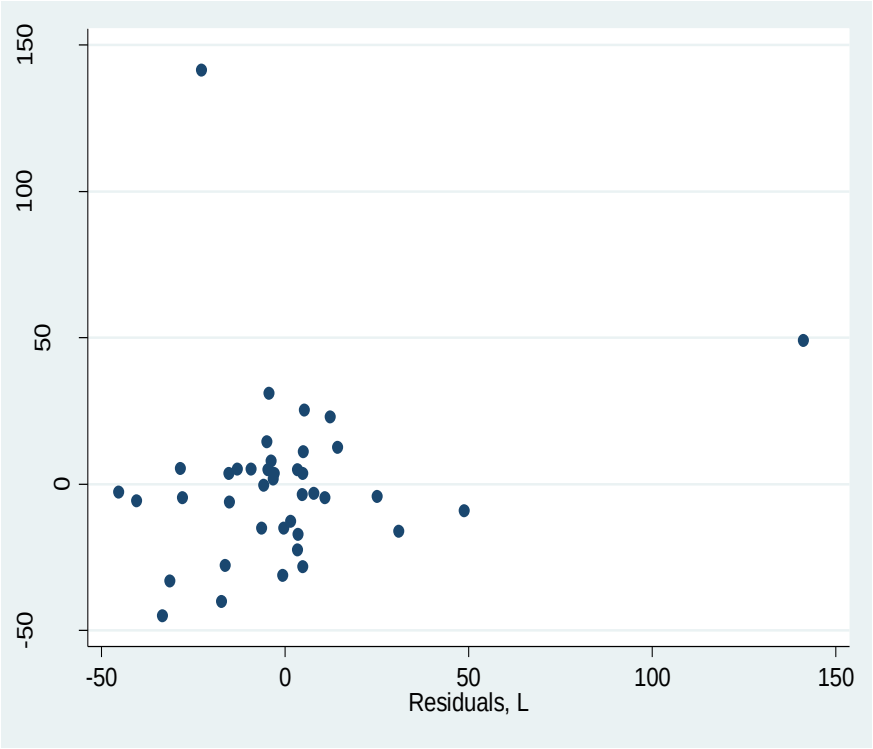

Table 3:Regression of INFLd1 on EXPO

Source	SS	Df	MS	Number of obs = 41
Model	53.9050225	1	53.9050255	F(1, 39) = 1.39
Residual	1515.26027	39	38.2291322	Prob > F = 0.2460
Total	1569.16529	40	39.2291322	R-squared = 0.0344
				Adj R-squared = 0.0096
				Root MSE = 6.2332

INFLd1	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
EXPO	-.0388621	.0329931	-1.18	0.246	-.105597	.0278727
_cons	.6989569	1.043323	0.67	0.507	-1.411363	2.809277

Table 4: ADF test for residuals

dfuller res, lags (15)

Interpolated Dickey-Fuller Number of obs = 25

	Test statistic	Critical values		
		1%	5%	10%
Z(t)	-1.519	-3.750	-3.000	-2.630

MacKinnon approximate p-value for Z(t) = 0.5240

4.3.2 Johansen's Test for Co integration

The Engle and Granger method shows that there was no cointegration. Thus, a more powerful test of Johansen's was introduced to check for cointegration. This test was based on maximum likelihood estimation and two statistics: maximum eigenvalue and a trace-statistics.

Table 5 indicates that the maximum rank is zero since the coefficient of trace statistic is smaller than critical value. Therefore, the Null of having no rank (rank = 0) accepted and

conclude that there is no co integration i.e. no long run relationship.

Table 5: Johansen's Test for Cointegration

Vecrank EXPO INFLd1, trend(constant) lags(6)

Johansen tests for cointegration

Trend: constant — Number of obs = 35

Sample: 1978 – 2012 — lags = 6

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	22	-274.74614	.	12.3992*	15.41
1	25	-270.56783	0.21240	4.0425	3.76
2	26	-268.54655	0.10908		

***** Indicates acceptance of Null hypothesis (r = 0) i.e. No co integration

4.4 Model Estimation (Seemingly Unrelated Regression)

From the results obtained in Section 4.3.1 and 4.3.2 it is proved that there was no co integration relationship between the variables $INFL_t$ and $EXPO_t$ therefore the ECT was removed and the equation (1) and (2) became;

$$EXPO_t = \alpha_0 + \sum_{i=1}^{1} \beta_{1i} EXPO_{t-1} + \sum_{i=1}^{1} \gamma_{1i} \Delta INFL_{t-1} + \varepsilon_{1t} \quad \text{.....(3)}$$

$$\Delta INFL_t = \alpha_0 + \sum_{i=1}^{1} \beta_{2i} \Delta INFL_{t-1} + \sum_{t-1}^{1} \gamma_{2i} EXPO_{t-1} + \varepsilon_{2t} \quad \text{.....(4)}$$

Using the established maximal order of integration (d*max* = 1) and the selected VAR length (*k =0)* the following augmented VAR (*1*) model was estimated using the SURE technique:
Table 6(a) and 6(b) give a summary of the output from the Seemingly Unrelated Regression:

Table 6(a): Seemingly Unrelated Regression (SURE)

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
EQN1	39	2	29.27016	0.0521	2.14	0.3427
EQN2	39	2	4.015126	0.5960	57.53	0.0000

Source: ***Own estimation***

Table 6(b): Seemingly Unrelated Regression (SURE)

		Coef.	Std. Err.	t	P>t	[95%Conf.Interval]	
EQN1	EXPOg1	.2147583	.1575615	1.36	0.173	-.0940566	.5235732
	INFLd1	-.352284	.4919645	-0.72	0.474	-1.316517	.6119487
	_cons	8.649349	4.97674	1.74	0.082	-1.104882	18.40358
EQN2	INFLdg1	.5118151	.0674851	7.58	0.000	.3795468	.6440835
	EXPOg1	-.0202054	.0216135	-0.95	0.343	-.062867	.0218562
	_cons	.3134335	.682683	0.46	0.646	-1.024601	1.651468

4.5 Granger-Causality Test and Hypothesis Testing

Lastly the Granger Causality test was conducted using F-test and chi2 to verify if the coefficients γ_{1i} and γ_{2i} of the lagged variables are significantly different from zero in the respective equations (3) and (4). The results of the granger causality test are as follows:

1) $\Delta INFL_{t-1}$ - - - - -► $EXPO_t$, lag (1)
H0: Δ INF L_{t-1} does not Granger-cause $EXPO_t$,
F(1, 39) = .14544427, Prob > F = .705
Chi2 (1) = .46989688, Prob > chi2 = 0.4930

2) $EXPO_{t-1}$ - - - - -► Δ INF L_t, lag (1)

H0: $EXPO_t$ does not Granger-cause Δ INF L,
F(1, 39) = .53703081, Prob > F = .468
Chi2 (1) = 1.7350226, Prob > chi2 = 0.1878

From the results above it is clearly seen that the computed F values (**.14544427)** in case (1) is less than critical values (**.705)**, this implies that the null hypothesis was accepted that there was no causality between Inflation and Export, while for case (2) the computed F values (**.53703081)** is gretaer than critical values (**.468)**, this implies that the null hypothesis was rejected, therefore there was causality between Export and Inflation. Thus, it is clearly evidenced that there was a unidirection causality from export to inflation; no bi-direction causality and also the variables were not independet to each other.

5.0 Conclusions and Policy Implications

The objective of this study was to find out if there is existence of a relationship between Inflation and Export in Tanzania. The methodology employed was the Cointegration and Granger causality test. The average consumer prices (INFL) was used as a proxy for Inflation and the export growth rate (EXPO) was used as a proxy for Export to examine the link. The studys' scope was from 1971 to 2012.

The Augmented Dickey-Fuller test (ADF) was carried out to test for the stationarity of the investigated variables. The null hypothesis being that there is presence of a unit root was rejected at all levels for export and inflation which was differenced once.
The result for cointergration test found that for the periods 1971 to 2012, there was no co-integrating relationship between Inflation and Export for Tanzania data. Thus, we could not found any long-run relationship between Inflation and export for Tanzania.

This study tried to find out evidence on the existing relationship between Inflation and Export by testing whether inflation granger-cause export; export granger-cause inflation; export and inflation granger-cause each other; and if there was independence between inflation and export.

The Granger causality test revealed that there is a relationship between inflation and export of unidirection from EXPO to INFL and there is no causality from INFL to EXPO. Therefore these findings confirmed the postulated theory that export leads inflation in the case of Tanzania. Thus it is a high time to bringforth policy measures that will regulate export so that to control inflation.

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CHAPTER 2

Appendix 1

Data Used in the Analysis

Year	INFL (percentage)	EXPO (percentage)
1971	4.77	4.72
1972	7.64	8.77
1973	10.40	-5.95
1974	19.60	-2.82
1975	26.06	-9.27
1976	6.86	32.18
1977	11.60	-9.78
1978	6.57	-24.27
1979	12.95	0.20
1980	30.20	-4.21
1981	25.65	-15.64
1982	28.93	-24.62
1983	27.06	-31.96
1984	36.15	0.70
1985	33.28	17.67
1986	32.43	-10.33
1987	29.95	155.08
1988	31.19	59.39
1989	25.85	7.09
1990	35.83	7.69
1991	28.70	-10.52
1992	21.85	22.93
1993	25.28	33.74
1994	34.08	-0.49
1995	27.43	48.49
1996	20.98	1.04

Year	INFL (percentage)	EXPO (percentage)
1997	16.09	-11.98
1998	12.80	9.85
1999	8.80	19.97
2000	6.00	17.56
2001	5.15	17.15
2002	5.32	7.70
2003	5.30	19.47
2004	5.40	8.34
2005	5.03	13.54
2006	7.25	-3.27
2007	7.03	16.84
2008	10.28	19.60
2009	12.14	5.09
2010	7.20	30.28
2011	12.69	19.10
2012	15.30	32.10