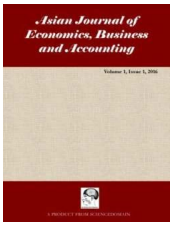

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The Relationship between Exports and Inflation in Kenya: An Aggregated Econometric Analysis

Evans Ovamba Kiganda[1*], Nelson Obange[1] and Scholastica Adhiambo[1]

[1]Department of Economics, Maseno University, Kenya.

Authors' contributions

This work was carried out in collaboration between all authors. Author EOK designed the study, performed the statistical analysis, wrote the protocol, wrote the manuscript, managed the analyses of the study and managed the literature searches. Authors NO and SA supervised the author EOK. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This paper tries to identify the relationship between exports and inflation in Kenya: An aggregated econometric analysis.
Study Design: The analysis is based on the demand pull theory of inflation and on applied correlation research design using monthly time series data from Central Bank of Kenya for the 132 months between January 2005 and December 2015.
Methodology: Vector autoregressive analytical techniques of Johansen cointegration, vector error correction, variance decomposition, impulse response and Granger causality are employed in order to comprehensively analyze the relationship between inflation and exports in Kenya.
Results: The results indicate that inflation has a significant positive long run relationship with total exports. This is a conclusion supported by variance decomposition and impulse analysis with a coefficient of 1.39 at 5% level of significance, implying that a percentage increase in total exports increases long-run inflation in Kenya by 1.39%.–In the short run, past values of total exports influence inflation negatively and there is a unidirectional causality from total exports to inflation.

**Corresponding author: E-mail: eovamba@yahoo.com;*

Conclusion: Total exports are found to affect inflation in Kenya critically; it is recommended that the government adopts trade policies targeting a reduction in total exports as they are likely to lower the shortage of these products in the domestic market, lowering thereby their prices and their contribution inflation in Kenya.

Keywords: Inflation; exports; aggregate analysis.

1. INTRODUCTION

1.1 Background of the Study

Inflation is the continuous process characterizing the rise of the general price level in the economy and entails a continuous reduction in the value of money [1]. This threatens macroeconomic stability, prompting the concern of the policymaker in any country. [2]. Although inflation as asserted by Kabundi (2012) remains an issue of concern for policy makers and the general public, [3,4,5,6] asserted that, there is no consensus on the causes of the rise in inflation. A common view is that expansionary monetary policy with rapid increase in money supply is the main cause.

Kenya's government commitment to the maintenance of a stable macroeconomic framework is anchored on key macroeconomic objectives which include containing average annual inflation rate to below 5 percent [7]. The Central bank of Kenya's (CBK's) objective of maintaining inflation rate below the 5 percent target has remained elusive for most of the years averaging over 8 percent which may be attributed to lack of proper identification of inflation determinants where studies on the determinants of inflation in Kenya such as [3,5,8,9,10] focused on broad money supply (M2), output, exchange rates, food and non-food world prices, world energy prices and domestic agricultural supply shocks as the main causes of inflation. This makes the effect of other factors such as exports on inflation in Kenya uncertain. Further, Studies on the exports - inflation relationship conducted world over such as [11,12,13,14,15] among others depict mixed results and failed either to conduct causality tests or employ impulse and variance decomposition analysis. This led to lack of information on the direction of causality between exports and inflation and how a shock in exports would influence inflation. Thus the studies remain inconclusive in providing a comprehensive analysis for the relationship between exports and inflation. This study therefore comprehensively determined the relationship between exports and inflation in Kenya by employing vector autoregressive (VAR) analysis techniques.

1.2 Statement of the Problem

The relationship between exports and inflation remain debatable and inconclusive where empirical studies have posted mixed results such as [11,16,12,13,15] that range from positive effect, negative or no effect with inadequacies in the analytical techniques where the studies either failed to conduct causality tests, variance decomposition or impulse response analysis. This implied lack of consensus on the effect of total exports on inflation, lack of knowledge on either the direction of causality and how a one standard deviation shock on total export influences inflation. Thus, the studies inconclusively and incomprehensively analyzed the relationship between inflation and exports. Thus, this study determined the relationship between total exports and inflation in Kenya by employing vector autoregressive (VAR) analysis techniques of Johansen cointegration, error correction, variance decomposition, impulse response and Granger causality analysis to bridge the gap of inconclusiveness in the analysis of the relationship between exports and inflation.

1.3 Objectives of the Study

1.3.1 Main objective

The purpose of this study was to establish the relationship between exports and inflation in Kenya: An aggregated econometric analysis.

1.3.2 Specific objectives

i. To determine the long run and short run effect of total exports on inflation in Kenya
ii. To determine the causality between total exports and inflation in Kenya

1.4 Research Hypothesis

i. H_0: Total exports has no long run and short run effects on inflation in Kenya.

ii. H_0 : There is no causality between total exports and inflation in Kenya

1.5 Scope of the Study

This study on the relationship between total exports and inflation in Kenya was conducted based on monthly time series data obtained from the Central Bank of Kenya (CBK) spanning 132 months from January 2005 to December 2015. In January 2005, the month on month inflation declined from a double digit of 10.4 percent in December 2004 to 9.9% [17]. Overall month-on-month inflation remained within the Government target range to November 2015, but exceeded the CBK 7.5 per cent upper bound of the target range in December 2015 [4,18].

1.6 Significance of the Study

Effect of total tax on inflation remains debatable among scholars, an attribute to inadequacies in the analytical methodologies employed. This study analyzed the relationship between total exports and inflation in Kenya by employing robust VAR techniques which involved cointegration, error correction, causality, impulse response and variance decomposition that produced results that provides comprehensive knowledge to policy makers and academia on the relationship between total exports and inflation. Hence the study forms useful material for regulating inflation in Kenya by advocating for policies targeting total exports as a determinant that highly influence inflation in Kenya. This may lead to the achievement of the desired elusive inflation target over years and reverse the negative effects inflation has caused to the economy.

2. LITERATURE REVIEW

2.1 Theoretical Review

This study was modeled on demand pull theory of inflation. The theory postulates that inflation results from a rise in aggregate demand. The factors influencing inflation as outlined by [19,20] comprises increase in consumption, investment, government expenditure, exports, money supply, decrease in taxation, higher wages, firms' mark-up prices, imports, exchange rates, price expectations among other structural factors. As applied to this study, the demand - pull theory of inflation hold exports among the main determinants of inflation. This study therefore hypothesized the relationship between inflation and exports model (2.1) which also included total money supply, total government expenditure, total tax and total imports as intervening factors.

$$INFM_t = f(MS_t, TTAX_t, TEXP_t, TEXPEN_t, TIMP_t, \mu_t) \quad (2.1)$$

Where; $INFM_t$ - inflation, MS_t -total money supply, $TTAX_t$ -total tax, $TEXP_t$ - total exports, $TEXPEN_t$ -total government expenditure, $TIMP_t$ -total imports and μ – error term (capturing other factors).

2.2 Empirical Literature

Investigating the long run and short run significance of macroeconomic variables such as exports, broad money, gross domestic product and household final consumption expenditure towards the consumer price index in Malaysia [15] employed Augmented Dickey-Fuller, Johansen system co-integration, Vector Error Correction (VEC) model tests for the period 1960 to 2012. The results showed that all the variables were integrated of order one, in the long run, broad money, export of goods and services, gross domestic product and household final consumption expenditure were significantly positively related to the consumer price index. This implied that an increase in broad money, exports, gross domestic product and household final consumption expenditure causes inflation to increase. The VECM indicated consumer price index to be error correcting in the short run and there was no causality between the factors and consumer price index and. As much as the study employed robust analysis techniques, the failure to employ impulse response and variance decomposition makes the study inadequate in outlining the relationship between exports, broad money, gross domestic product and household final consumption expenditure with consumer price index. This is attributed to the fact that knowledge on how shocks in the factors influence consumer price index remains uncertain.

Examining factors affecting inflation in Jordan, [12] used quarterly data from 2000 to third quarter of 2010 by applying the concepts of cointegration, Error Correction Model, analysis of Variance Decomposition and Impulse Response Function. The results indicated that the variables of national exports, imported inflation, credit facilities, GDP, money supply were and inflation

were integrated of order one. National exports, imported inflation and credit facilities had a positive long run relationship with inflation. It was also noted GDP had a negative relationship with inflation while money supply had an insignificant effect on inflation in Jordan. The impulse responses and variance decomposition analysis also indicated that shocks on national exports, imported inflation, GDP, credit facilities and money supply influenced inflation from the second period in Jordan. Despite the employment of robust data analysis techniques in this study, lack of causality analysis makes the study inconclusive in providing a comprehensive overview of relationship between inflation and its determinants of national exports, imported inflation, GDP, credit facilities and money supply and inflation. This is because the study failed to answer the direction of causality among the variables.

Analyzing the determinants of high food prices in Pakistan [13] used Autoregressive Distributed Lag approach and error correction model for long-run and short-run, respectively based on time series data for the period 1972-73 to 2009-10. The findings of the study showed that food exports contributed towards high food prices while food imports caused the reduction in the food prices. Similarly, [21] in investigating the factors affecting food price inflation in Pakistan during 1990–2013 by applying econometric tests of Augmented Dickey Fuller, Vector Error Correction model and Johansen co-integration test showed that all the variables were integrated of order one and that food exports had positive and significant long run impact on food price inflation in Pakistan. They concluded that because food inflation occurs due to high demand of food items only those products with excess supply should be exported. In spite of the fact that the studies employed different cointegration techniques for varying time periods they consented on the positive effect of food exports on inflation. However, their studies fell short of conducting causality, impulse response and variance decomposition analysis. This makes the findings inadequate in providing a conclusive relationship analysis between food exports and inflation given that there are uncertainties on the direction of causality and how a shock in food price influences inflation.

Exploring the determinants of inflation in Pakistan for the period 1971 to 2012 [11] applied Johansen cointegration and Error Correction Model (ECM). The results showed that exports of goods and services had a significant negative effect on inflation because higher exports increased domestic production which leads the firm to achieve economies of scale and cost of production decline. In the same way [22] analyzed the major determinants of inflation in Bangladesh using data for the period from 1978 to 2010. The findings based on correlation coefficients indicated a weak negative association between imports, exports, government revenue, money supply and inflation. On the other hand, long run analysis indicated that exports had a negative effect on inflation in Bangladesh. Despite the fact that the studies consented on negative effect of exports on inflation, lack of information on the direction of causality and how shocks in exports influence inflation given that causality, variance decomposition and impulse response analysis tests were not conducted makes the studies inconclusive on the relationship between exports and inflation.

Olatunji [23], examined the factors affecting inflation in Nigeria using time series data were employed for the study. Use of unit root, cointegration and error correction analysis indicated that the study variables were normally distributed and integrated of order one. Total export, interest rate and crude oil exports were found to have a negative impact on inflation while total imports and food price index exerted a positive effect. Total government expenditure had an insignificant effect on inflation with inflation in the short run correcting disequilibrium at the rate of 70% in the next period. The review of the study indicated that important relationship analysis techniques such as causality, variance decomposition and impulse response analysis tests were not utilized making the study findings inconclusive for analyzing relationship between inflation and its determinants of exports, interest rate, crude oil imports and food price index.

The review of studies on the exports and inflation relationship depicted inadequate synthesis for the relationship between exports and inflation. Although the studies investigated cointegration and error correction aspects, it was noted that the studies reported mixed results and failed either to conduct causality tests or employ impulse and variance decomposition analysis. This made it impossible to tell the direction of causality between exports and inflation and how a shock in exports would influence inflation. This made the studies inconclusive in providing a comprehensive analysis for the relationship between exports and inflation.

3. RESEARCH METHODOLOGY

This study was conducted using correlation research design based on monthly time series data. According to [24], the design is used to establish relationships. The study conducted an analysis of the relationship between total exports and inflation in Kenya by use of cointegration test, error correction mechanism, Granger causality test, impulse response and variance decomposition analysis.

3.1 Measurement of Variables

The variables in this study were measured as below;

1. **Inflation**- Measured by consumer prices (monthly %). Inflation as measured by the consumer price index reflects the percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as monthly [25].
2. **Exports of goods and services -** represent the value of all goods and other market services provided to the rest of the world which include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services [25].
3. **Imports of goods and services** - The value of all goods and other market services received from the rest of the world which include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services [25].
4. **Total money supply (MS)** – Also referred to as total liquidity (M3+T) where T is non-bank holdings of government paper (securities) [4].
5. **Total government expenditure -** It is the government expenditure on capital overheads and current expenditure for purchase of goods and services at all levels of government measured by the development expenditure plus recurrent expenditure
6. **Total tax** - This is total value of direct and indirect taxes obtained by summing excise duty, import duty, income tax and value added tax (VAT).

3.2 Data Collection

Secondary data used in the study was collected from official published documents of the Central Bank of Kenya. The analysis was based on monthly time series data on Inflation (consumer price index- monthly %), Government expenditure, exports, imports, taxation and money supply.

3.3 Data Analysis

3.3.1 Stationarity tests

To identify the time series property of stationarity for each of the variables, Augmented Dickey Fuller (ADF), DF- GLS, Phillips-Perron (PP) and Kwiatkowski –Phillips-Schmidt-Shin (KPSS) unit root tests.

3.3.2 Cointegration and vector error correction mechanism

Johansen approach, which is a multivariate autoregressive approach based on the trace test and the maximum eigenvalue likelihood ratio tests was employed by the study to establish long run relationship. The Johansen model a VAR of order p was expressed as model (3.1) and reparameterized as model (3.5) for error correction analysis;

$$z_t = A_1 z_{t-1} + A_2 z_{t-2} + ... + A_p z_{t-p} + \mu_t \qquad (3.1)$$

Where:

$z_t = n \times 1$ Vector of variables that are integrated of order one

$\mu_t = n \times 1$ Vector of innovations

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + ... + \Gamma_{p-1} \Delta z_{t-p+1} - \Pi z_{t-1} + \mu_t \qquad (3.2)$$

Where: $\Pi = -\sum_{j=1}^{p} \left(I - A_j \right)$ and $\Gamma_i = -\sum_{j=i+1}^{p-1} A_j$

3.3.3 Impulse response analysis and variance decomposition

The study involved generating impulse response and variance decomposition using the VAR results to trace the effect of a one standard

deviation shock of innovations on exports on inflation and the percentage variation in inflation due to a change in exports.

3.3.4 Granger causality

Pair wise Granger causality was employed involving the following models;

$$\Delta INFM_t = \alpha_i \sum_{j=1}^{p} \Delta x_{t-j} + \beta_i \sum_{j=1}^{p} \Delta INFM_{t-j} + \varepsilon_{1t} \quad (3.3)$$

$$\Delta x_t = \alpha_i \sum_{j=1}^{p} \Delta x_{t-j} + \beta_i \sum_{j=1}^{p} \Delta INFM_{t-j} + \varepsilon_{1t} \quad (3.4)$$

The study tested the following hypothesis;

H_0 : No causality,

H_1 : Causality exists

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

Table 1 results indicated that the mean value for the variable of inflation rate (INFM) as 8.47%, the maximum and minimum values as 19.70 % and 1.85 %. This indicated that on average inflation in Kenya has remained above the 5% target. The value of skewness of 0.09327 lies between -3 and +3, JB-statistic of 0.893149 was less than $\chi^2(2df) = 5.99147$ an indication that the variable of inflation is normal distributed. Total exports is also normally distributed based on JB-test and the maximum and minimum values of sh.59.4 billion and sh.17.2 billion indicated there was a lot of fluctuations in exports in Kenya over years.

4.2 Stationarity Analysis

The results in Table 2 based on the power of test for PP, DF- GLS and KPSS tests revealed that the series of inflation (INFM) and total exports (TEXP) were stationary after first difference. The first objective of this study was to determine the long run and short run relationship between total exports and inflation in Kenya. The findings as depicted in Tables 3 and 4 based on trace test and Maximum Eigen value indicated that there was a long run relationship between total exports and inflation in Kenya.

4.3 Cointegration

Tables 3 and 4 test results indicated that there existed a long run relationship between total exports and inflation based on the trace test and Maximum Eigen value test indicating 6 cointegrating equations. Table 5 on normalized cointegration results after reversing the signs indicated a significant positive long run relationship between total exports and inflation in Kenya. Thus the null hypothesis of no cointegration between total exports and inflation in Kenya was rejected at 5% level of significance. This implied that a percentage increase in level a percentage increase in total exports increases inflation in Kenya by 1.39% in the long run. The findings of positive long run relationship between total exports and inflation in Kenya conformed to the findings of [12,15] who investigated the determinants of inflation in Jordan and Malaysia respectively. This was also consistent to the a priori expectation of a positive relationship. The positive relationship between inflation and total exports as argued by [13] may be due to a shortage of food products in the country since the main exports for Kenya are agricultural products. High demand and reduced supply causes price to rise.

4.4 Vector Error Correction Mechanism

The vector error correction mechanism (VECM) results in Table 6 indicated that in the short run past values that past values of total exports had a significant negative short run relationship with inflation in Kenya at 5% level of significance for lags 1 to 4. This implied that the null hypothesis of no relationship between total exports and inflation in the short run was rejected whereby a percentage increase in total exports decreased inflation in Kenya by approximately 0.3%. This was consistent with the findings of [22,23].

4.5 Diagnostic Tests

Diagnostic test results in Tables 7 to 11 on lag length determination, multicollinearity, serial correlation, heteroscedasticity and normality test indicated that the acceptable lag for VECM was 7 and the residuals were normally distributed, free from the problem of autocorrelation and heteroscedasticity and there was no problem of multicollinearity.

Table 1. Descriptive statistics test results

	Mean	Max	Min	Std Dev	Skewness	Kurtosis	Jarque-Bera	P-value	Obs
INFM	8.4758	19.720	1.8500	4.8279	0.09327	2.6427	0.8931	0.1000	132
TEXP	34149.64	59405.00	17178.00	10355.87	0.036066	2.010055	5.418568	0.058799	132

Source: Author (2017). Note that INFM in % while TEXP in 000,000

Table 2. Unit root test results

Variable			ADF – Coeff	PP- Coeff	KPSS- Coeff	ADF P-value	PP P-value	KPSS- P-value	DF-GLS P-value	Inference
	Level	Intercept	-0.064353	-0.049284	0.084708	0.0633	0.0735	0.0000	0.2690	-
		None	-0.017508	-0.016741	-	0.1329	0.1859	-	-	-
		I & T	-0.06427*	-0.047982	0.095074	0.0068	0.0632	0.0000	0.0571	-
INFM										
	1st diff	Intercept	-0.58057*	-0.58057*	-0.00052*	0.0000	0.0000	0.6723	0.0030*	I(1)
		None	-0.57995*	-0.57995*	-	0.0000	0.0000	-	-	I(1)
		I & T	-	-0.58195*	-0.00190*	-	0.0000	0.4459	0.0000*	I(1)
TEXP	Level	Intercept	-0.030957	-0.050428	34149.64	0.2577	0.0779	0.0000	0.1131	-
		None	0.006075	0.002191	-	0.4362	0.7915	-	-	-
		I & T	-0.42744*	-0.34059*	17536.41	0.0000	0.0000	0.0000	0.06214	-
	1st diff	Intercept	-1.82970*	-1.37901*	237.0840*	0.0000	0.0000	0.4203	0.0210*	I(1)
		None	-1.80303*	-1.37277*	-	0.0000	0.0000	-	-	I(1)
		I & T	-	-	180.3760*	-	-	0.7612	0.0000*	I(1)

*Source: Author (2017), Note. * Implies stationary at 5% level of significance (p-value< 0.05 for ADF, DF-GLS & PP and p-value > 0.05 for KPSS), I (0) indicate stationary at level and I (1) indicate integrated of order 1*

Table 3. Cointegration rank test (Trace) results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical value	Prob.**
None *	0.595716	424.6110	95.75366	0.0001
At most 1 *	0.514713	314.1233	69.81889	0.0001
At most 2 *	0.496331	225.9155	47.85613	0.0001
At most 3 *	0.415005	142.2434	29.79707	0.0001
At most 4 *	0.338274	76.83298	15.49471	0.0000
At most 5 *	0.194969	26.45864	3.841466	0.0000

*Source: Author (2017). Trace test indicates 6cointegrating eqn (s) at 0.05 level, * denotes rejection of null hypothesis at the 0.05 level and ** MacKinnon-Haug-Michelis (1999) p-values, included 122 observation after adjustment*

Table 4. Cointegration rank test (Maximum Eigenvalue) results

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.595716	110.4877	40.07757	0.0000
At most 1 *	0.514713	88.20788	33.87687	0.0000
At most 2 *	0.496331	83.67205	27.58434	0.0000
At most 3 *	0.415005	65.41044	21.13162	0.0000
At most 4 *	0.338274	50.37434	14.26460	0.0000
At most 5 *	0.194969	26.45864	3.841466	0.0000

*Source: Author (2017). Max-eigenvalue test indicates 6 cointegrating eqn (s) at 0.05 level, * denotes rejection of null hypothesis at the 0.05 level and ** MacKinnon-Haug-Michelis (1999) p-values, Sample 130, included 122 observation after adjustment*

Table 5. Normalized cointegration coefficients

INFM	MS	TEXP	TEXPEN	TIMP	TTAX
1.000000	-1.627465*	-1.39037*	0.590368*	0.859409*	-1.37714*
	(0.28014)	(0.48392)	(0.22475)	(0.32192)	(0.26456)
	[-5.80947]	[-2.87314]	[2.62678]	[2.66964]	[-5.20540]

*Source: Author (2017). Standard error and t-statistics in parentheses ( ) and [ ] respectively, Sample 130, included 122 observation after adjustment with t-critical value 1.98 at 5% significance level. * indicate significant at 5% level of significance*

Table 6. VECM test results

Variable:	D(INFM)	D(MS)	D(TEXP)	D(TEXPEN)	D(TIMP)	D(TTAX)
D(TEXP(-1))	-0.272089*	0.227037*	-2.038825*	1.507441*	2.378830*	0.128461*
	(0.06849)	(0.08472)	(0.71394)	(0.37052)	(0.92251)	(0.03044)
	[-3.97250]	[2.67997]	[-2.85574]	[4.06845]	[2.57865]	[4.22014]
D(TEXP(-2))	-0.256963*	0.224082*	-3.322340*	1.533780*	1.587326	0.132284*
	(0.06548)	(0.08099)	(0.68256)	(0.35423)	(0.88197)	(0.02910)
	[-3.92411]	[2.76666]	[-4.86744]	[4.32990]	[1.79975]	[4.54584]
D(TEXP(-3))	-0.224444*	0.199899*	-3.898669*	1.559555*	0.525270	0.137698*
	(0.06165)	(0.07626)	(0.64264)	(0.33352)	(0.83039)	(0.02740)
	[-3.64042]	[2.62140]	[-6.06661]	[4.67605]	[0.63256]	[5.02547]
D(TEXP(-4))	-0.167462*	0.162544*	-3.557106*	1.342527*	-0.229798	0.122535*
	(0.05609)	(0.06938)	(0.58468)	(0.30344)	(0.75549)	(0.02493)
	[-2.98544]	[2.34284]	[-6.08383]	[4.42436]	[-0.30417]	[4.91516]
D(TEXP(-5))	-0.077075	0.105431	-2.436085*	0.848054*	-0.476799	0.081208*
	(0.04611)	(0.05704)	(0.48066)	(0.24945)	(0.62109)	(0.02049)
	[-1.67155]	[1.84850]	[-5.06817]	[3.39970]	[-0.76768]	[3.96330]
D(TEXP(-6))	-0.042271	0.052042	-1.091119*	0.331575*	-0.100650	0.034070*
	(0.02965)	(0.03667)	(0.30901)	(0.16037)	(0.39928)	(0.01317)
	[-1.42591]	[1.41932]	[-3.53105]	[2.06756]	[-0.25208]	[2.58694]
D(TEXP(-7))	-0.010197	0.013527	-0.262141*	0.676388	-0.077456	0.755509
	(0.01182)	(0.01462)	(0.12321)	(0.63940)	(0.15920)	(0.52523)
D(MS(-1))	-0.310034*	0.470848	4.040953	1.662778*	2.965193*	1.393943*
	(0.07827)	(0.96804)	(8.15808)	(0.42338)	(1.05414)	(0.34778)
	[-3.96108]	[0.48639]	[0.49533]	[3.92739]	[2.81290]	[4.00812]
D(MS(-2))	-0.284639*	-0.414146	3.433565	1.508123*	2.611879*	1.258140*

Variable:	D(INFM)	D(MS)	D(TEXP)	D(TEXPEN)	D(TIMP)	D(TTAX)
	(0.06583)	(0.86890)	(7.32259)	(0.38002)	(0.94618)	(0.31217)
	[-4.32385]	[-0.47663]	[0.46890]	[3.96854]	[2.76045]	[4.03030]
D(MS(-3))	-0.340261*	-0.864930	2.356988	1.239346*	2.008638*	1.015895*
	(0.10604)	(0.74959)	(6.31710)	(0.32784)	(0.81626)	(0.26930)
	[-3.20880]	[-1.15387]	[0.37311]	[3.78034]	[2.46078]	[3.77235]
D(MS(-4))	-0.045623	-0.858908	1.278652	0.884754*	1.254540	0.723241*
	(0.49024)	(0.60636)	(5.11003)	(0.26520)	(0.66029)	(0.21784)
	[-0.09306]	[-1.41650]	[0.25022]	[3.33618]	[1.89998]	[3.32006]
D(MS(-5))	-0.092794	-0.640461	0.003355	0.518710	8.581538	0.427195*
	(0.35211)	(0.43551)	(3.67022)	(0.19048)	(4.74246)	(0.15646)
	[-0.26354]	[-1.47060]	[0.00091]	[2.72317]	[1.80951]	[2.73038]
D(MS(-6))	-0.973483	-0.300106	-1.558965	0.227055	4.735017	0.192181*
	(1.21424)	(0.26498)	(2.23309)	(0.11589)	(2.88547)	(0.09520)
	[-0.80172]	[-1.13256]	[-0.69812]	[1.95923]	[1.64098]	[2.01871]
D(MS(-7))	-0.394719	-0.083175	-1.307096	5.138291	2.013959	4.655433
	(0.29148)	(0.11314)	(0.95349)	(4.94838)	(1.23205)	(4.06481)
D(TEXPEN(-1))	0.133137*	-0.105036*	-0.216243	-7.776868*	-0.929732*	-4.695270*
	(0.03203)	(0.03961)	(0.33384)	(1.73255)	(0.43137)	(1.42319)
	[4.15692]	[-2.65150]	[-0.64774]	[-4.48869]	[-2.15529]	[-3.29912]
D(TEXPEN(-2))	0.058845	-0.112645*	-0.252743	-7.051797*	-0.772740	-3.585934*
	(0.03552)	(0.04393)	(0.37025)	(1.92151)	(0.47842)	(1.57841)
	[1.65667]	[-2.56393]	[-0.68262]	[-3.66992]	[-1.61519]	[-2.27186]
D(TEXPEN(-3))	0.037425	-0.101004*	-0.129379	-5.241666*	-0.398766	-2.185436
	(0.03835)	(0.04744)	(0.39977)	(2.07472)	(0.51656)	(1.70426)
	[0.97588]	[-2.12920]	[-0.32363]	[-2.52645]	[-0.77196]	[-1.28234]
D(TEXPEN(-4))	0.033150	-0.069538	0.147138	-3.740780	-0.041790	-1.383674
	(0.03669)	(0.04538)	(0.38247)	(1.98493)	(0.49421)	(1.63051)
	[0.90352]	[-1.53221]	[0.38470]	[-1.88459]	[-0.08456]	[-0.84862]
D(TEXPEN(-5))	0.025642	-0.040680	0.329639	-2.648014	0.148339	-1.064779
	(0.03009)	(0.03722)	(0.31364)	(1.62773)	(0.40527)	(1.33709)
	[0.85218]	[-1.09304]	[1.05100]	[-1.62681]	[0.36602]	[-0.79634]
D(TEXPEN(-6))	0.012326	-0.014427	0.355461	-1.894710	0.218906	-1.005979
	(0.01939)	(0.02399)	(0.20216)	(1.04917)	(0.26122)	(0.86184)
	[0.63569]	[-0.60141]	[1.75829]	[-1.80591]	[0.83800]	[-1.16725]
D(TEXPEN(-7))	0.002855	-0.006298	0.167848*	-0.836684*	0.144841	-0.544034
	(0.00759)	(0.00939)	(0.07913)	(0.41068)	(0.10225)	(0.33735)
	[0.38011]	[-0.67073]	[2.12109]	[-2.03732]	[1.41653]	[-1.61268]
D(TIMP(-1))	-0.150913*	0.110733*	0.439785	8.910286*	-0.606776	7.498417*
	(0.04017)	(0.04968)	(0.41869)	(2.17290)	(0.54101)	(1.78491)
	[-3.75704]	[2.22882]	[1.05038]	[4.10065]	[-1.12156]	[4.20100]
D(TIMP(-2))	-0.108801*	0.077283	0.617936	7.467836*	-1.665252*	6.149093*
	(0.03729)	(0.04613)	(0.38874)	(2.01743)	(0.50230)	(1.65720)
	[-2.91739]	[1.67543]	[1.58961]	[3.70166]	[-3.31524]	[3.71052]
D(TIMP(-3))	-0.039874	0.059525	0.924453*	4.588994*	-1.966255*	3.542828*
	(0.03560)	(0.04404)	(0.37113)	(1.92606)	(0.47955)	(1.58215)
	[-1.11989]	[1.35166]	[2.49092]	[2.38258]	[-4.10019]	[2.23925]
D(TIMP(-4))	0.021563	0.047772	1.180329*	1.350287	-1.609028*	0.585268
	(0.03344)	(0.04137)	(0.34861)	(1.80918)	(0.45045)	(1.48614)
	[0.64475]	[1.15485]	[3.38584]	[0.74635]	[-3.57204]	[0.39382]
D(TIMP(-5))	0.035883	0.024530	1.101930*	-0.221014	-1.111071*	-0.813266
	(0.02751)	(0.03402)	(0.28670)	(1.48790)	(0.37046)	(1.22223)
	[1.30458]	[0.72105]	[3.84348]	[-0.14854]	[-2.99917]	[-0.66540]
D(TIMP(-6))	0.021491	0.005508	0.723792*	-0.503011	-0.565368*	-0.874392
	(0.01746)	(0.02160)	(0.18202)	(0.94462)	(0.23519)	(0.77595)
	[1.23071]	[0.25504]	[3.97650]	[-0.53250]	[-2.40385]	[-1.12686]
D(TIMP(-7))	0.006340	-0.000578	0.247428	-0.253998	-0.204736	-0.362173
	(0.00682)	(0.00844)	(0.07111)	(0.36906)	(0.09189)	(0.30316)
	[0.92936]	[-0.06851]	[3.47934]	[-0.68823]	[-2.22808]	[-1.19465]
D(TTAX(-1))	-0.288658*	0.224770*	0.445338	1.332508*	2.341782*	9.241414*
	(0.07034)	(0.08700)	(0.73319)	(0.38051)	(0.94739)	(3.12566)
	[-4.10373]	[2.58352]	[0.60740]	[3.50190]	[2.47182]	[2.95663]
D(TTAX(-2))	-0.307188*	0.215873	0.398599	1.085241*	2.022689*	6.754595*

Variable:	D(INFM)	D(MS)	D(TEXP)	D(TEXPEN)	D(TIMP)	D(TTAX)
	(0.06918)	(0.08556)	(0.72107)	(0.37422)	(0.93172)	(3.07396)
	[-4.44061]	[2.52298]	[0.55279]	[2.90000]	[2.17091]	[2.19736]
D(TTAX(-3))	-0.318339*	0.178592	0.105260	0.773541*	1.296219	4.394580
	(0.06567)	(0.08122)	(0.68448)	(0.35523)	(0.88445)	(2.91798)
	[-4.84779]	[2.19885]	[0.15378]	[2.17758]	[1.46557]	[1.50603]
D(TTAX(-4))	-0.290653*	0.122704	-0.324634	0.537151	0.651046	2.978792
	(0.05644)	(0.06981)	(0.58832)	(0.30533)	(0.76020)	(2.50807)
	[-5.14959]	[1.75766]	[-0.55179]	[1.75925]	[0.85641]	[1.18768]
D(TTAX(-5))	-0.206645*	0.071405	-0.511495	0.363227	0.203459	2.117569
	(0.04246)	(0.05251)	(0.44256)	(0.22968)	(0.57186)	(1.88668)
	[-4.86703]	[1.35970]	[-1.15575]	[1.58145]	[0.35579]	[1.12238]
D(TTAX(-6))	-0.106099*	0.027176	-0.453470	0.243212	-0.088040	1.594624
	(0.02558)	(0.03164)	(0.26662)	(0.13837)	(0.34451)	(1.13661)
	[-4.14797]	[0.85900]	[-1.70082]	[1.75769]	[-0.25555]	[1.40296]
D(TTAX(-7))	-0.026568*	0.009767	-0.161596	0.102203	-0.114048	0.751965
	(0.00965)	(0.01193)	(0.10056)	(0.05219)	(0.12994)	(0.42871)
	[-2.75387]	[0.81849]	[-1.60692]	[1.95829]	[-0.87769]	[1.75403]

*Source: Author (2017). Standard error and t-statistics in parentheses ( ) and [ ] respectively, Sample 130, included 122 observation after adjustment with t-critical value 1.98 at 5% significance level. * indicate significant at 5% level of significance*

Table 7. Lag length test results

Lag	AIC	SC	LR
1	-4.857801	-5.679549	318.8993
2	-5.108557	-4.795025*	338.3934
3	-5.241294	-4.791091	350.2015
4	-5.234944	-4.646654	353.184
5	-5.246045	-4.518231	357.2548
6	-5.484542	-4.615737	375.2993
7	-5.650262*	-4.638976	388.6660*
8	-5.514483	-4.359198	383.6262

*Source: Author (2017). Note. * denotes optimal lag length with minimum AIC and SC values and Maximum LR value*

4.6 Impulse Response and Variance Decomposition Analysis

Fig. 1 indicated that the response of inflation to one standard deviation shock on total exports had an explosive positive effect on inflation up to the 25th month that dampened and fizzled out after the 44th month. The results corroborated the cointegration findings at 5% level of significance and were consistent with the findings of [23,15]. Further, Table 12 test results on variance decomposition indicated that in the first period the variation in inflation in Kenya was due to its own shock but variation in inflation due to shocks on total exports was evident from the second period and increased over time.

4.7 Causality Analysis

The second objective of this study was to determine the causality between total exports and inflation in Kenya. Table 13 results indicated that there was unidirectional causality from total exports to inflation in Kenya at 5 % level of significance. The results implied that the null hypothesis of no causality between total exports and inflation in Kenya was rejected at 5% level of significance an indication that exports determined inflation in Kenya. The finding conformed to the results of [15] who investigated the determinants of inflation in Malaysia.

Table 8. Variance inflation factors – multicollinearity test

Variable	Centred VIF
TEXPEN	1.204100
TEXP	1.256722
TTAX	1.443491
TIMP	1.447691
MS	1.041099

Note. The rule of thumb is that if VIF Exceeds 10, the variable is said to be highly collinear (Author, 2017).

Table 9. VEC residual serial correlation LM test results

Lags	LM-statistic	Prob
1	50.0082*	0.0604

*Note. * indicate accept null hypothesis of no serial correlation at 5% significance level (Author, 2017)*

Table 10. VEC residual heteroscedasticity test results

Chi-sq	Df	Prob
1740.814*	1806	0.8614

*Note. * indicate accept null hypothesis of no heteroscedasticity at 5% significance level (Author, 2017)*

Table 11. VEC residual normality test results

Component	Jarque-Bera	Prob
Joint	251.7308*	0.1117

*Note. * indicate accept null hypothesis of normal distribution for residuals at 5% significance level (Author, 2017)*

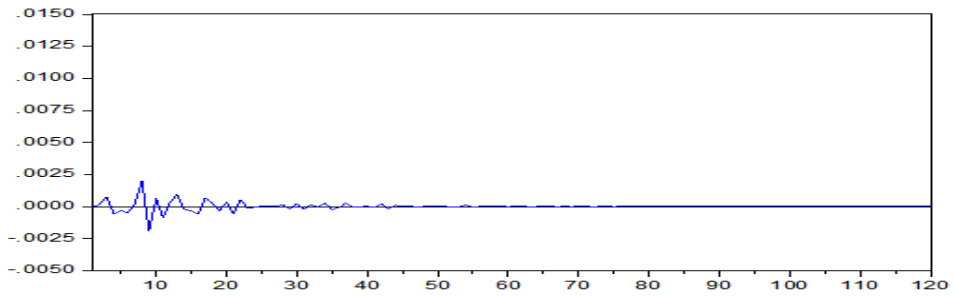

Fig. 1. Response of inflation to total exports (Author, 2017)

Table 12. Variance decomposition of inflation

Period	S.E.	INFM	TEXP
1	0.012512	100.0000	0.000000
2	0.013322	92.62957	2.418857
3	0.013506	91.42194	3.090403
4	0.014120	84.65441	5.860365
5	0.014334	84.15639	5.940785
6	0.014910	78.08346	6.686022
7	0.015497	77.06787	6.323398
8	0.016243	73.97253	8.231395
9	0.016574	71.09838	7.984066
10	0.016760	70.35517	7.852601
11	0.017567	69.64649	8.612182
12	0.017751	68.93583	8.435024

Source: Author (2017)

Table 13. Granger causality results

Pair wise granger causality tests			
Null hypothesis:	**Obs**	**F-Statistic**	**Prob.**
TEXP does not Granger Cause INFM	123	4.00193*	0.0250
INFM does not Granger Cause TEXP		0.58610	0.4454

*Note. * indicate significance at 5% level of significance (Author, 2017)*

5. CONCLUSION AND RECOMMENDATIONS

In general, the findings of this study clearly indicated that all the time series variables of inflation total exports and other intervening variables were integrated of order one. A long run equilibrium, short run and causality relationship was exhibited between total exports and inflation in Kenya.

The first objective of this study was to determine the long run and short run relationship between total exports and inflation in Kenya. There was a significant positive long run relationship between total exports and inflation in Kenya that was supported by impulse and variance decomposition analysis whereby an increase in total exports led to an increase in inflation in Kenya. The second objective was to establish the causality relationship between total exports and inflation in Kenya. There was a unidirectional causality from total exports to inflation in Kenya. In conclusion based on the study findings, total export was established as a determinant of inflation in Kenya.

This study therefore recommends that the government of Kenya needs to advocate for a trade policy that strikes a balance between the local demand and the output for domestically produced products. This will ensure that only surplus is exported to reduce shortage of domestically produced commodities that may be brought about by curtailing unwarranted exports of domestically produced products especially food products at the expense of local consumers. This will reduce total exports and hence a reduction in price for the products.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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