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P. UWIMANA, C. MUGEMANGANGO, Mary KIPSAT, Timothy SULO and S. NSABIMANA

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Jönköping International Business School (JIBS),
Jönköping University, P.O. Box 1026,
SE-551 11 Jönköping, Sweden,
Web: http://www.ju.se/earp, E-mail: EARP@ju.se

Preface

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Editor: Almas Heshmati
Professor of Economics
Jönköping International Business School (JIBS),
Jönköping University, Room B5017,
P.O. Box 1026, SE-551 11 Jönköping, Sweden,
E-mail: Almas.Heshmati@ju.se

An Analysis of Causality between Tea Exports and its Determinants in Rwanda

P. Uwimana[1], C. Mugemangango[2], Mary Kipsat[3], Timothy Sulo[4], S. Nsabimana[5]

1. UR-CAVM (Rwanda), 2. UR-CST (Rwanda), 3.Professor in Maseno University (Kenya), 4. Moi University (Kenya), 5. UR-CAVM
[1] Corresponding author:
Department of Rural Development and Agricultural Economics
University of Rwanda, Kigali, Rwanda
E-mail: uwipla@gmail.com
[2] Department of Mathematics
University of Rwanda, Kigali, Rwanda
E-mail: mucypro2@yahoo.fr
[3] Maseno University, Kisumu, Kenya, E-mail: mjkipsat@yahoo.com
[4] Moi University, Eldoret, Kenya
[5] Department of Rural Development and Agricultural Economics
University of Rwanda, Kigali, Rwanda, E-mail: uwipla@gmail.com

Abstract

Tea growing in Rwanda started in 1952 and by 2002 tea had become the country's largest export item. However, an increase in tea farm land has been constrained by population growth, impacting the quantity of tea that the country produces. Tea exports are volatile and are influenced by the real effective exchange rate, incomes of major trading patterns, total investments as a proportion of GDP, tea world market prices and coffee world market prices. There is little recent empirical research on factors affecting Rwandan tea exports. This study assesses the causality between tea exports and their determinants in Rwanda. The study applies a causal research design and uses time series data collected from different sources. It uses the Granger causality test to test for predictability between exports and their factors. The research concludes that non-causality in the long term was possible because before the late 1980s Rwanda had an economy that was based on a pre-structural adjustment program when exports were under total control. Short-run causality was possible because after the 1980s, a decline in world tea prices may have led to an increase in exports as demand increased in the short run. What is needed now are more investments in tea factories, diversification of commodities that are exported, prioritizing forward selling or contracting and widening niche markets for tea products.
Key words: GDP, exports, economic analysis, Granger causality test, time series.

JEL Classification Codes: F11; O13; Q13; Q17;

1. Introduction

Tea has been cultivated and consumed in China for more than 2,000 years. Today it is the most widely consumed caffeine containing beverage in the world. Its worldwide consumption is second only to water. Tea arrived in London for the first time in 1652 (Kurian et al., 2007).

In Africa, many tea companies took the strategic decision to develop new sources of tea production in perceived 'safer' countries. Kenya, Uganda, Tanzania and Malawi already had some tea estates, conditions for growing tea were fundamentally good and they were expected to remain British colonies and protectorates for many decades. Substantial investments began in the tea cultivation on the continent in the 1950s. Kenya in particular had excellent growing conditions and good transport infrastructure for exports via Mombasa (Tyler, 2013).

Tea growing in Rwanda started in 1952. Two principal varieties of tea are grown in Rwanda: the China plant (*C. sinensis sinensis*) and the clonal Assam plant (*C. sinensis assamica*). Growing tea requires a large area. In 1999 the total area under tea cultivation in Rwanda was 12,541 ha which went up to 14,394 ha in 2008 with 1,407 ha that had not been exploited (Mupenzi et al., 2011). Since its introduction, tea production has increased steadily, from 60 tons of black tea in 1958, to 17,800 tons in 2001. Although Rwanda had made modest attempts to grow tea since the Second World War, it was only in the 1960s that the industrial cultivation of tea was established (Alinda and Abbot, 2012).

By 2002 tea had become Rwanda's largest export, with export earnings from tea reaching US$ 18 million or 15,000 tons of dried tea. Existing foreign investments were concentrated in commercial establishments, mining, tea, coffee and tourism (Global Tenders, 2014).

However, there was the dual issue of low capacity of tea processing factories and poor pruning and plucking practices. These were issues of efficiency and could be addressed by reducing waste within the system which would have led to gains without directly affecting crop yields. There were some factories that either had to work at over-capacity or refuse crops because of lack of capacity. This reduced both the quality and quantity of tea production (Alinda and Abbot, 2012).

Our study investigates how tea exports fared over the period 1982-2012. Our study is centered on a dynamic time series procedure to test the validity of hypotheses of exports and variables which affected them in Rwanda.

The Government of Rwanda set a strategy for tea with a two-fold objective: increasing production and improving quality. Production was to be increased by expanding and consolidating land dedicated to tea farming and re-investments were to be made in factories to increase production capacity. However, this strategy was constrained by some challenges mainly the dual issue of low capacity of tea processing factories and poor pruning and plucking practices. Targeting each tea farmer to farm 0.5 ha for tea was also constrained by population growth in Rwanda that was estimated to be growing by 3.6 per cent per year. There were also some factories that either had to work at over-capacity or refuse crops because of lack of capacity. This reduced both the quality and quantity of tea production and brought challenges to tea exports. Further, the black tea market was saturated and this pushed down prices. The impact of this was that Rwanda's tea export earnings and volumes changed over time (Nuwangira, 2013).

Although tea exports play a big role in Rwanda's economic growth thereby contributing to its achieving its 2020 Vision, there are very few recent empirical studies that investigate the factors which are leading to both volatility in exports and prices of tea over the long term. Taking into consideration these issues, it is important to investigate the factors that affected tea exports in Rwanda in 1982-2012. Finding the factors that affected tea exports may throw light on the real causes of volatility in both the quantity of tea exported and its prices. Hence, the research question of our study is: Is there a causal linkage between the quantity of tea exported and what are its determinants?

The overall objective of our study is to test for a causal linkage between the quantity of tea exported and the real effective exchange rate, incomes of major trading partners, total investments as a proportion of GDP, tea prices in the world market and coffee prices in the world market.

We started with the hypothesis that the real effective exchange rate, incomes of major trading partners, total investments as a proportion of GDP, tea prices in the world market and coffee prices in the world market did not have a statistically significant effect on the quantity of tea exported by Rwanda.

Both coffee and tea production declined by 18 per cent and 6 per cent respectively and coffee prices fell by 4 per cent; however coffee and tea exports in 2010 reached US$56.1 million and US$55.7 million respectively (GoR, 2011). Although the export sector is growing, Rwanda lags behind other African nations in terms of exports as a percentage of GDP (GoR, 2011). This shows how much Rwanda's exports are influenced by factors like world prices, exchange rate especially for tea which is an important cash crop and the main source of foreign currency for the country (GoR, 2010). Since very few studies have looked at the linkage between tea exports and these factors over the period 1982-2012 our study helps in filling this gap so that strategies can be worked out to improve tea exports. The findings of our study will also help improve tea trade in Rwanda thus leading to a sustainable achievement of economic growth.

Our study uses secondary data collected from the NAEB headquarters, FAOSTAT and the World Bank website. We also use investments in the tea sector as a proportion of GDP for our study. However, data on this was not available so we had to use data on the general investments as a proportion of GDP. As most of the economic models on exports include capital and labor among the independent variables, we wanted to consider the population that has been involved in the tea sector for the period under study. However, data on this was not available. Some missing data like REER for 2012 was obtained by the extrapolation method using SPSS but the obtained data might not correspond to the actual figures.

2. Literature Review

According to Markusen et al., (1995) international trade is the exchange across national borders of goods, services and factors and the impact of this trade on domestic and global economies. International trade is a result of the interactions between individuals in one nation with persons in other nations. According to Seyoum (2009), the factors which affect exports include currency exchange control/risks, taxation, tariffs and inflation which originate outside a business enterprise. Such variations require managers who are aware of global threats and opportunities. Hence, firms must consider the following

factors: the success of the product in domestic markets, participation in overseas trade shows, advertising and market data. Conventional commodity models usually incorporate the real foreign income (of trading partners) and real exchange rate (proxy for relative prices) as explanatory variables in the estimation of export supply functions in general (Alemayehu, 1999; Balassa et al., 1989; Branchi et al., 1999; Klaassen 1999; Mckay et al., 1998; Ndung'u and Ngugi, 1999; Ogun 1998; Whitley, 1994; in Were et al., 2002). In their study on tea exports Were et al., (2002) focus on the following explanatory variables: real exchange rate (RER$K), real foreign income (income of major trading partners (YTRADI)) and total investments as a proportion of GDP (INVGDP).The inclusion of income and real exchange rate is standard in trade models. The additional variable—investments to GDP ratio—is a proxy for capital formation to capture supply constraints (Were et al., 2002).

Abdulai and Jaquet (2002) in Sinoha (2006) tested the ELG hypothesis for Côte- D'Ivoire for the period 1961-97. The authors examined the short-run and long-run relationship between economic growth, exports, real investments and labor force. The time series techniques that they used were co-integration and ECM (Error Correction Model). The authors found evidence of one long-run equilibrium relationship among all variables. They also found causality, both in the short-run and in the long-run, flowing from exports to economic growth. Further, they also found bidirectional causation between the variables. They concluded that Côte d'Ivoire's recent trade reforms (promoting domestic investments and recovering international competitiveness) had contributed to export expansion, diversification and potentially future economic growth in the nation. According to Faridi (2012) a group of researchers like Jung and Marshall (1985); Darrat (1987); Chow (1987); Kunst and Marin (1989); Sung-Shen et al., (1990); Bahmani-Oskooee et al., (1991); Ahmad and Kwan (1991); Serletis (1992); Khan and Saqib (1993); Dodaro (1993); Jin and Yu (1995); and Holman and Graves (1995) have examined the causality relationship between growth in exports and economic growth using the Granger causality test. The studies concluded that there existed some evidence of a causality relationship between exports and growth.

The main problem with the causality test is that it is not useful when the original time series is not co-integrated. Some recent studies have investigated the impact of exports on growth by applying the technique of co-integration and ECM.

Were et al., (2002) found that the immediate price effect (depreciation of the real exchange rate) was statistically insignificant while the same variable lagged one-period was significant but negative. This could be explained by the fact that adjustments to price response in the short run are not likely to be considerable. Nonetheless, improvements in investments as a proportion of GDP (both current and lagged) had a positive influence on the volume of tea exports in the short run. Surprisingly, the incomes of trading partners had a negative sign. This can be explained by shifting markets for Kenyan commodities, especially with economic integration and a decline in exports to the European Union.

According to Alam (2010) devaluation or no devaluation, floating or no floating have been a tug-of-war between fund banks and intellectuals for a long time with a conservative disposition in third-world countries. One of the merits that the advocates of depreciation of a local currency commonly put forward is its contribution to increased export earnings. In fact in an era of devaluation Bangladesh, like many other third world countries, placed exports as one of the foremost reasons for devaluing their local

currencies against the US$. One study shows that there was no causality run from depreciation of the real exchange rate of the taka to Bangladesh's export earnings. This result is in line with the findings of CPD and many other Bangladeshi researchers over the years (Hussain, 2000) who found Bangladesh's export price inelastic and that the depreciation of the taka did not have much impact on exports. So, for Bangladesh's exports to be price elastic, policies that help increase the share of domestic goods that can be exported by the expansion of the production base are needed. This will also help in the diversification of export items. However, the impact of exchange rate depreciation might not have been the same for all sub-sectors of exports. This is why the relationship between exchange rate and various sub-sectors of exports need to be considered and analyzed separately. Nabli and Marie-Ange (2002) in Alam (2010) show that exchange rate over-valuation caused huge losses in exports of MENA (Middle Eastern and North African) countries by decreasing their export competitiveness: 'For the MENA region as a whole, exchange rate policy explains losses in competitiveness and in manufactured exports. RER overvaluation has reduced on average the ratio of manufactured exports to GDP by 18 percent a year. Manufactured exports which averaged 4.4 percent of GDP from 1970 to 1999 could have reached 5.2 percent of GDP if no overvaluation had taken place. These losses were more concentrated in the 1970s and 1980s than in 1990s due to the higher overvaluation of the currencies during those two sub-periods.'

According to Ferris (2005) the quantity exported by a given nation is the dependent variable which has the following independent variables: price in exporting country, prices in competing exporting countries, prices in importing countries, world market prices, population, purchasing power, production in importing nations, demands for inventory, consumption maintenance, (price inelastic) demand, border protection policies, export subsidies from competing exporting nations, transportation costs and livestock numbers (for feed demand). Our study used the quantity of tea exported as the explained variable and the following different explanatory variables which affect tea exports: the real exchange rate, incomes of major trading partners, total investments as a proportion of GDP, world market tea prices and world market coffee prices.

3. Methodology

Our study applied a causal (explanatory) research design to explain the cause-effect relationship between the variables. Since our study conducted a time series data analysis, secondary data was collected from different sources like WITS, the World Bank, FAOSTAT and NAEB websites. The study investigated relationships between tea exports as the explained variable and the following different explanatory variables which affect tea exports: the real exchange rate, incomes of major trading partners, total investments as a proportion of GDP, world market prices for both tea and coffee. The real effective exchange rate was deflated to 2007 constant Rwandan franc (2007=100); the GDP deflator used was for 2005 constant Rwandan franc (2005=100).To analyze the data statistical packages E-views, PcGive and SPSS were used.

The international trade theory that we used (neo-classical trade theory) is based on David Ricardo's principle of comparative advantage which states that a country has a comparative advantage in producing a good if the opportunity cost of producing that good in terms of another good is lower in that country than it is in the other countries. The neo-classical trade theory assumes two factors of production (labor and capital),

equal technology in all countries, perfect competition, constant returns to scale and factor mobility between sectors but not between countries (Appleyard et al., 2001). In the neo-classical trade theory, trade can take place due to a comparative advantage which is explained through differences in relative factor endowments-factor abundance (Heckscher-Ohlin theorem-HO).

The Heckscher-Ohlin theorem states that a country will produce and export a good whose production makes intensive use of the relatively abundant factors of production before trade. This country should limit the production and increase the imports of the good whose production makes intensive use of expensive factors of production before trade (Appleyard et al., 2001 in Were et al., 2002).

We evaluate the neo-classical trade theory in a neo-classical production function framework incorporating an additional factor of production (exports) into the production function. Exports are incorporated into the production function to capture their relationship with aggregate output. The augmented neo-classical production function is specified as:

(1) $Y = F(K, L, EXP)$

where, Y= aggregate output (real GDP), K is capital, L is labor force and EXP is total real exports of goods and services.

Because of their importance in production, economic theory says that both capital and labor have positive effects on overall output. Because of its positive externalities, the ELG hypothesis says that exports must have a positive effect on aggregate output.

Conventional commodity models usually incorporate the real foreign income (of trading partners) and real exchange rate (proxy for relative prices) as explanatory variables in estimating the export supply functions in general (Alemayehu, 1999; Balassa et al., 1989; Branchi et al., 1999; Klaassen 1999; Mckay et al., 1998; Ndung'u and Ngugi, 1999; Ogun 1998; Whitley, 1994; in Were et al., 2002). Our study adopted a similar approach with the following explanatory variables: the real effective exchange rate (REER$FRws), foreign incomes (incomes of major trading partners (inc)), total investments as a proportion of GDP (invGDP), coffee prices, tea prices and dummies to capture structural change variables with 1 standing for the presence of structural change and 0 otherwise.

The inclusion of income and real exchange rate is standard in trade models. The additional variables are investments to GDP ratio as a proxy for capital formation to capture supply constraints and dummies for structural change variables.

Granger Causality Equation

According to Kónya et al., (2004) the concept of Granger causality is based on the idea that a cause cannot come after its effect. More precisely, variable X is said to Granger-cause another variable, Y, if the current value of Y(y_t) is conditional on the past values of X ($x_{t-1}, x_{t-2}, \ldots\ldots, x_0$) and thus the history of X is likely to help predict Y. Note that this is causality for one-period ahead.

To test the hypothesis Ho, the following Granger causality model was used:

(2) $\Delta Y_t = a_1 + \sum_{j=1}^{n} \beta_{1t} \Delta Y_{t-j} + \sum_{j=1}^{n} \gamma_{1t} \Delta X_{t-j} + \varepsilon_{1t}$

(3) $$\Delta X_t = a_2 + \sum_{j=1}^{n} \beta_{2t} \Delta Y_{t-j} + \sum_{j=1}^{n} \gamma_{2t} \Delta X_{t-j} + \varepsilon_{2t}$$

ΔY_{t-1} is the lagged difference of the dependent variable at time t

ΔX_{t-1} is lagged difference of the independent variable at time t

The null hypothesis was $\gamma_j = 0$ for all j versus the alternative hypothesis that $\gamma_j \neq 0$ for at least some j. If the coefficients $\gamma_s$were statistically significant, then X caused Y.

Data Analysis

Our study used both descriptive and inferential statistics in the analysis. Software packages such as PcGive, SPSS and E-views were used as tools for computation. The first stage of data processing and analysis was concerned with a descriptive analysis of data to present the main characteristics of Rwanda's tea exports and their determinants. While dealing with time series data it has to be ensured that the individual time series are either stationary or that they are co-integrated otherwise the regression analysis will not be correct (Gujarati, 1999). Two or more time series are said to be co-integrated if they have a common stochastic trend (Stock and Watson, 2007). We used the two-step method put forward by Engle and Granger (1987) to test the mutual long term causalities of relevant indices; if it was proved that long term causality existed then their short term causalities were tested using the Wald test. The final stage of data analysis was to test for predictability between exports and factors of exports using both model and the Granger causality test (F-test). Causality testing involved examining whether the lags of one variable could be included in another equation. To test for the direction of causation between exports and factors of exports, the F-statistics testing of the hypothesis that the coefficients on all the values of one of the variables in the Granger causality model (for example, the coefficients on X_{1t-1}, X_{1t-2}, …, X_{1t-q1}) were zero. This null hypothesis implies that these regressors had no predictive content for Y_t beyond that contained in the other regressors and the test of this null hypothesis is called the Granger causality test (Stock and Watson, 2007). According to Granger (1988) in Alam (2010), the Granger causality test is used to examine whether the past value of a variable series X will help predict the value of another variable series at present, Y, taking into account the past value of the Y (Granger, 1988).

In our study, Granger causality from determinants of tea exports to the quantities of tea exported was established when the coefficients of the lagged differences of the dependent variables were found to be jointly statistically significant and helped explain and predict the quantities of tea exported over and above what the lagged differences of quantities of tea exported could predict. Our study also carried out diagnostic tests in order to validate the results.

4. Results and Discussion

The unit root test and the co-integration test were done as pre-tests and depending on the outcomes, testing for causality was done using the VAR model.

Unit Root Tests

Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests are used to test for stationarity of the data. Both the tests were done to check the order of integration of these variables. The results are given in Table 1. Based on the PP test statistics, it was seen that all variables had a unit root (non-stationary) at level and stationarity after first difference (integrated of order one). However, the standard Augmented Dickey-Fuller (ADF) showed that out of six variables, five had a unit root meaning that lnreer I(1), lnp I(1), lninvgdp I(1), lncoffprice I(1) and lninc I(2), while lnexp was I(0) variable. Noticeably, with a mixture of I (0), I (1) and I (2) variables in the ADF unit root test it would not have been possible to perform the Johansen procedure of co-integration. This should have given a good justification for using the bounds test approach, or the ARDL model proposed by Pesaran et al. (2001). However the correlogram test was carried out to check if variables having different levels of integration in ADF behaved the same way in the correlogram test. Both the PP and correlogram tests confirmed that all variables were stationary at first difference I (I) allowing us to do the Johansen co-integration test. We also allowed for a linear deterministic trend for variables.

Table 1: Results of Augmented Dickey- Fuller and Phillips-Perron Tests

variables	ADF	I(d)	PP	I(d)
Lnexp	-17.95 (-2.99)	I(0)	-5.14 (-2.97)	I(1)
Lncoffprice	-5.94(-2.97)	I(I)	- 5.96 (-2.97)	I(1)
Lnp	-7.95 (-2.97)	I(1)	-7.99 (-2.97)	I(1)
Lnreer	-4.98 (-2.97)	I(1)	-5.69 (-2.97)	I(1)
Lninvgdp	-7.82 (-2.97)	I(1)	-8.42 (-2.97)	I(1)
Lninc	-3.87 (-2.99)	I(2)	-4.68 (-2.97)	I(1)

Source: Authors' computations using secondary data (2014).
Note: Dummies were not included in the unit root analysis.

The Johansen Co-integration Test

The Johansen co-integration test was carried out to find out whether there was a long-run relationship among the variables; all variables had to be at level form. Other preconditions for performing this test were that the variables had to be non-stationary at level but when converted into first difference they had to become stationary and integrated of the same order. The PP test allowed running the co-integration test.

The null hypothesis in the Johansen co-integration test was that there was no co-integrating equation against the alternative hypothesis (H_1) stipulating that there was at most one co-integrating equation. Both trace and maximum eigenvalue showed that there were three co-integrating equations because the Max-eigen statistics of 17.26 is less than 21.13 and trace statistic of 3.31 is less than 3.84 (the critical value at 5 per cent) with p-values greater than 0.05. Therefore, co-integration relationships reflected the long term balanced relationship between relevant variables (they moved together in the long run). Consequently, a restricted VAR (Vector Error Correction) model was run to test for the short-run relationship. If the variables were not co-integrated, the unrestricted VAR

model would been run (Engle and Granger, 1987 in Alam, 2010). Table 2 gives the results of the co-integration test.

Table 2: Results of the Co-integration Test

		Trace test				Max-Eigen test		
Hypoth-esized n of CEs	Eigen value	Trace Statistic	Critical values 5%	Prob**	Hypoth-esized n of CEs	Max-Eigen Statistic	Critical values 5%	Prob**
r=0*	0.969	236.888	95.75	0.000	r=0*	97.376	40.078	0.000
r≤ 1*	0.896	139.511	69.819	0.000	r≤ 1*	63.391	33.877	0.000
r≤ 2*	0.781	76.120	47.856	0.000	r≤ 2*	42.490	27.584	0.000
r≤ 3*	0.461	33.629	29.797	0.017	r≤ 3	17.266	21.132	0.160
r≤ 4*	0.373	16.364	15.495	0.037	r≤ 4	13.0575	14.264	0.077
r≤ 5	0.111	3.306	3.841	0.069	r≤ 5	3.306	3.841	0.069

Note: Trace test indicated 5 co-integrating equation(s) and the Max-eigenvalue test indicated 3 co-integrating equation(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level and ** are MacKinnon-Haug-Michelis (1999) p-values. N of CEs denotes number of co-integrating equations.

Long -Run Elasticities in the Co-integrating Equation

Three steps were involved in VECM: Lag order selection, the Johansen test of co-integration and VECM. The optimal number of lags to be included in the model was found to be two.

Table 3 gives the following results: if the price of coffee increased by 1 per cent in the long run, then the quantity of tea exported went up by 10.44 per cent. These results match economic theory because tea and coffee are substitutes. Farris et al., (1987) have shown that two goods are substitutes if as the price of one goes up, more of the other is purchased, ceteris paribus.

If the incomes of major trading partners went up by 1 per cent, the quantity of tea exported increased by 5.89 per cent corresponding to the economic theory of consumption stipulating that if income goes up consumption also goes up. Given that tea is a perennial crop, these results are true for the long run.

In case there was a 1 per cent increase in investments as a proportion of GDP in Rwanda, the long run response was that the quantity of tea exported increased by 35.30 per cent.

A 1 per cent increase in the world prices of tea led to a 56.24 per cent decrease in the quantity of tea exported.

The same increase in the real exchange rate (depreciation of 1 per cent of REER) resulted in a 0.82 per cent increase in the quantity of tea exported. Although it is statistically insignificant with a t-value of 0.59, this view is in agreement with the findings of De Broeck et al., (2001) who concluded that there was clear evidence of productivity-based exchange rate movement (the Balassa-Samuelson effect).

Table 3: Long -Run Elasticities in the Co-integrating Equation

Variables	Coefficients	Standard Error	t-statistic
Ln of Quantity of Tea Exported	1.00		
Ln of Income of Major Trading Partners	5.89	0.45	13.01
Ln of Investment as Proportion of GDP	35.30	2.55	13.85
Ln of Tea World Price	-56.24	2.73	-20.56
Ln of Real Effective Exchange Rate	0.82	1.38	0.59
Ln of Coffee World Price	10.44	0.80	13.02
Constant	-231.51		

Source: Data analysis used in the study (2014).

Quantity of Tea Exported by Rwanda 1982-2012

Figure 1 gives the quantity of tea exported by Rwanda. It shows that from 1988 to 1989 Rwandan tea exports increased. This corresponded with an increase in incomes of its major trading partners. The figure also shows that from 1993 to 1995 there was a decrease in the quantity of tea exported; this can be explained by the fact that during this period there was war and the Tutsi genocide and economic activities were paralyzed. The figure also shows that since 1998 the quantity of tea exported has followed an increasing trend; this confirms what has been found previously that in 1998 the quantity exported increased compared to previous years due to the relative political stability in the northern part of Rwanda. Political instability in major trading partners too can influence demand and that was the case in 1998 because Pakistan had a foreign currency shortage due to a World Bank embargo and could not import tea (NAEB, 1998).

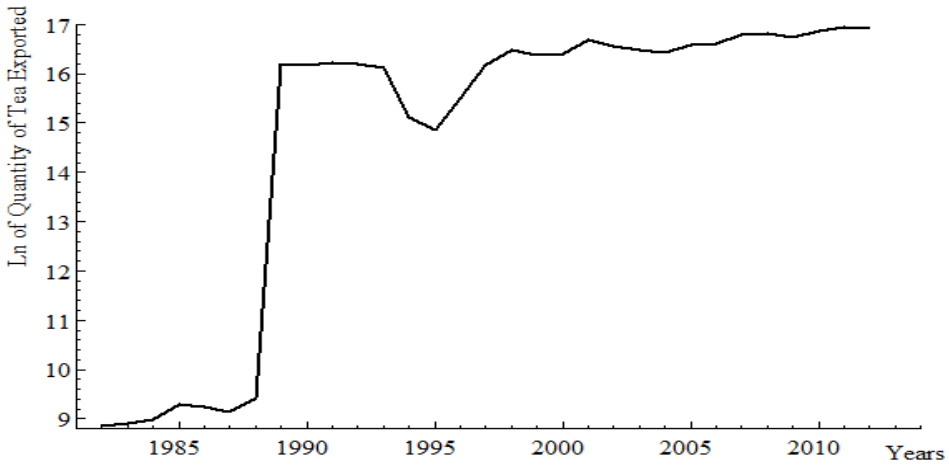

Figure 1: Quantity of Tea Exported by Rwanda (1982-2012)
Source: Data Analysis done in this study (2014).

OLS Model: Econometric Estimation Results and Discussion

Results of the OLS model regression are given in Table 4. These indicate that from the statistical point of view the R^2 of 0.54 is statistically significant, since the computed *F* value of about 3.30 is significant as its p-value is almost zero (0.01). As Gujarati (2004) says, the *F* statistic tests the hypothesis that all the slope coefficients are simultaneously zero, that is, all the explanatory values jointly have no impact on the regressand. Therefore, all independent variables in the model jointly influence the dependent variable. The model estimation shows that only the real effective exchange rate was significant among the six variables and that is a sign of existing multicollinearity in independent variables. The Durbin-Watson statistic for this regression was 0.65. This statistic was not within the acceptable range of 1.50 to 2.50, indicating that the residuals were serially correlated. However as Gujarati (2004) puts it, R^2 of less than d indicates that the estimated regression is not incorrect.

Table 4: OLS Model Estimation

Variable	Coefficient	Standard Error	t-statistic	Probability
Constant	83.19	22.37	3.72	0.00
Coffee prices	-0.39	1.42	-0.28	0.78
Incomes of major trading partners	0.19	0.22	0.88	0.39
Investments as proportion of GDP	-6.04	4.45	-1.36	0.19
Tea prices	5.02	3.66	1.37	0.18
REER	-12.30	2.98	-4.13	0.00
Dummy for 2001-04	-1.38	1.99	-0.69	0.49
Dummy for 1988-89	-1.04	2.24	-0.47	0.65
Dummy for 1992-95	0.08	1.49	0.05	0.96
R-squared	0.546	Mean dependent var		14.71
Adjusted R-squared	0.380	S.D. dependent var		3.109
S.E. of regression	2.447	Akaike info criterion		4.865
Sum squared resid	131.759	Schwarz criterion		5.282
Log likelihood	-66.415	Hannan-Quinn criter.		5.001
F-statistic	3.303	Durbin-Watson stat		0.655
Prob(F-statistic)	0.012			

Source: Authors' computation using secondary data (2014).

Wald Test Results for Short-Run Causation

The probability of Chi-square statistic was less than 5 per cent for the joint influence of tea exports lagged once and twice on current tea exports. Thus, it can be said that lag 1 and lag 2 of the quantity of tea exported jointly affected exports in the short run. The probability of Chi-square statistic was less than 10 per cent for incomes of major trading partners lagged once and twice. Thus, it can be said that lag 1 and lag 2 of incomes of major trading partners jointly affected tea exports in the short run.

Granger Causality Test of Quantity of Tea Exported on its Determinants

Tables 5 and 6 summarize the results obtained in tests of predictive content (Granger causality tests). Table 5 shows that the F-statistic testing the null hypothesis that coefficient on lnexpt-1 is zero in the REER equation was 5.06 and had a p-value less than 0.05 was rejected, so the quantity of tea exported was a useful predictor of changes in REER given one lag in REER. The results differ from Alam's (2010) results who found that REER lagged once was not a good predictor of exports. We proved that bidirectional Granger causality existed between the quantity of tea exported and the dummy for the period 1988-89. SAPs and a decline in coffee prices in the 1980s as substituted by the dummy contained information that was useful for forecasting changes in the quantity of tea exported and vice versa.

The Granger predictability tests for a one-year lag are presented in Table 5.

Table 5: Granger Predictability Test Results for Variables Lagged Once

Variable A	Variable B	F- statistic	probability	Decision on the null hypothesis. Yes if Ho is true and no otherwise
Lninc	lnexp	0.23	0.64	yes
Lnexp	lninc	2.89	0.10	yes
lninvgdp	lnexp	0.15	0.70	yes
Lnexp	lninvgdp	1.03	0.32	yes
lncoffprice	lnexp	0.41	0.53	yes
Lnexp	lncoffprice	0.00	0.95	yes
Lnp	lnexp	0.60	0.44	yes
Lnexp	lnp	0.04	0.84	yes
lnreer	lnexp	0.00	0.98	yes
Lnexp	lnreer	(5.06)**	0.03	no
D0104	lnexp	0.00	0.94	yes
Lnexp	D0104	0.28	0.60	yes
Lnexp	D8889	(6.77)***	0.01	no
D8889	lnexp	(21.35)***	0.00	no
Lnexp	D9295	0.34	0.56	yes
D9295	lnexp	2.23	0.15	yes

Note: *significant at the 0.1 level, ** significant at the 0.05level, *** significant at the 0.01leve.
Source: Analysis of secondary data (2014).

The null hypothesis (Ho) is that variable A does not Granger cause variable B. Table 6 shows that for both REER and the quantity of tea exported the F-statistic was 2.98 with p-value less than 0.1 so the quantity of tea exported was Granger causing the real exchange rate at the 10 per cent level. This contradicts Alam's (2010) findings that RER did not Granger cause exports both in the short and long run. This does not necessarily mean that a change in the quantity of tea exported in the two previous years will cause a change in the real exchange rate; rather it means that the past values of the quantity of tea exported appear to contain information that is useful for forecasting changes in the real exchange rate beyond that contained in the past values of REER (Stock et al., 2007). We proved that bidirectional Granger causality existed between the quantity of tea exported and the dummy for the period 1988-89. SAPs and a decline in coffee prices in

the 1980s as substituted by the dummy contains information that is useful for forecasting changes in the quantity of tea exported and vice versa.

The Granger predictability tests of a two-year lag are presented in Table 6.

Table 6: Granger Causality Results for the Variable Lagged Twice

Variable A	Variable B	F- statistics	probability	Decision on the null hypothesis. Yes if Ho is true and no otherwise
Lninc	lnexp	0.39	0.68	Yes
Lnexp	lninc	1.97	0.16	Yes
lninvgdp	lnexp	0.04	0.96	Yes
Lnexp	lninvgdp	0.17	0.84	Yes
lncoffprice	lnexp	0.28	0.76	Yes
Lnexp	lncoffprice	0.84	0.45	Yes
Lnp	lnexp	0.29	0.75	Yes
Lnexp	lnp	1.97	0.16	Yes
Lnreer	lnexp	0.06	0.94	Yes
Lnexp	lnreer	(2.98)*	0.07	No
D0104	lnexp	0.00	0.99	Yes
Lnexp	D0104	0.19	0.83	Yes
Lnexp	D8889	(6.82)***	0.00	No
D8889	lnexp	(72.70)***	0.00	No
Lnexp	D9295	0.19	0.82	Yes
D9295	lnexp	0.16	0.86	Yes

Note: *Significant at the 0.1level, ** significant at the 0.05level, *** significant at the 0.01level.
Source: Analysis of secondary data (2014).

The null hypothesis (Ho) is that variable A did not Granger cause variable B when the F-test was applied. The Granger causality tests in both lagged once and lagged twice variables proved that independence was suggested between the quantity of tea exported and other independent variables meaning that the coefficients were not statistically significant in both regressions. R-squared was 0.77>0.50, Prob (F-statistic) of 0.087< 0.1 meaning that 77 per cent of the variations in the quantity of tea exported were explained by variations in independent variables included in the model. However the latter could jointly influence the dependent variable (quantity of tea exported) at the 10 per cent level of significance. R-square of 77 per cent allowed us to conclude that the model was good.

5. Conclusion

We performed the predictive content tests for estimating bidirectional causation between tea exports and its determinants. Unidirectional causation flew from the quantity of tea exported to the real effective exchange rate. It was proved that bidirectional causation existed between the quantity of tea exported and the dummy for the 1988-89 period in both one and two-year periods of time (lags). The result of non-causality in the long term among all variables may be possible because before the late-980s it was a period of a pre-SAPs economy when exports were controlled. Short run causality was possible because after the 1980s, there was a decline in world tea prices in the short run which may have led to an increase in exports as demand increased. Additionally, a bidirectional

predictive content existed between the quantity of tea exported and SAPs in the late 1980s implying that economic policies can help in predicting tea exports.

The limitations of this study include the nature of the data and the sample size used. In the variables used as determinants of tea exports, labor and production were not included in the model. Thus, the effect of tea exports' determinants should be empirically re-examined including these factors.

Investments in tea factories should be improved, there should be diversification of commodities that are exported because the quantity of tea exported influences REER: The export sector relies greatly on tea and hence ease in forward selling or contracting should be prioritized and the niche markets for tea products should be widened.

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