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Research article

VERTICAL PRICE TRANSMISSION OF AGRI-FOOD ALONG THE SUPPLY CHAIN IN TANZANIA

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ABSTRACT

The study focused on estimation of long run dynamics vertical price transmission of agri-food along the supply chain in Tanzanian context. The agri-food products explored in the paper include: maize grains, rice, sorghum grains, wheat grains and dry beans. The Error Correction Mechanism (ECM) was employed to calibrate the vertical price transmission of agri-food along the agri-food supply chain. The empirical results revealed that monthly producer and consumer prices of agri-food were vertically transmitted from the upstream to downstream due to the fact that agri-food prices were cointegrated, implies that monthly producer and consumer prices of agri-food have long run economic relationships, which enable prices to move closely together.

Key words: Agri-food supply chain, Error Correction Mechanism, Tanzania, Vertical Price Transmission.

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1. INTRODUCTION

A couple of studies have examined on spatial and vertical price transmission in agricultural commodity markets in Sub Saharan Africa (SSA) using cross sectional data. These studies include: Abdulai, (2007) for Southern and Eastern Africa, Rapsomanikis and Karfakis (2007) for Tanzania, Meyers (2008) for Malawi, Van (2007) for Tanzania, Kaspersen and Foyn (2010) for Uganda, and Minot (2011) for Sub Saharan Africa. However, the present paper is examined the vertical price transmission based on long run dynamics of time series data.In Tanzania, even though from 1980s since then there has been an increasing awareness of the links between agriculture and other sectors of the economy particularly food processing, still understanding of price transmission along the agri-food supply chain is low among agri-food producers, wholesalers, processors, distributors, retailers and consumers thus, hindering them from taping the advantages that price transmission along the agri-food supply chain offers (Makweba, 2009). This has been influenced by factories with large capacity and advanced technologies which tend to have power on dictating market price.

Moreover, the presence of asymmetric price transmission of agri-food supply chain on market innovations such as product processing, packaging, labelling, grading, standardization, pricing, promotions, positioning, storage and transportation among the key market actors such as producers, wholesalers, processors, distributors, retailers and consumers along the agri-food supply chain have distorted the market price because traders are disintegrated based on trade mentality of maximizing their own profit margins rather than satisfying consumer demand.

However, in an attempt to solve the problem of asymmetric price transmission of agri-food supply chain in the country, the government of Tanzania has adopted the Public Private Partnership (PPP) policy which enables local and multinational investors to invest in the agri-food sector, this allows producers to produce the agri-food products and supply to the processing plants which process and supply the agri-food products to consumers.

Hence, the study focused on bridging the knowledge gap in the scientific research of price transmission of agri-food supply chain in the field of agricultural economics. However, the empirical findings of the study are going to provide insights to economic school of thoughts in price transmission of the agri-food stakeholders such as producers / farmers, processors, distributors, wholesalers, retailers and consumers as well as researchers, scholars and policy makers. The study also designed to provide future inputs for government interventions in terms of economic policies in the agri-food system.

2. METHODOLOGY

2.1 Types of data

Time series data on monthly producer and consumer prices of agri-foods from 1981 to 2010 were collected from National Bureau of Statistics (NBS), Ministry of Industry, Trade and Marketing of the United Republic of Tanzania. However, the empirical analysis adopted in this study follows the Error Correction Mechanism (ECM) first developed by Sargan (1984) and popularized by Engle and Granger (1987). Furthermore used by Hendry (1986), and Banerjee et al. (1993). This model was employed to calibrate the price transmission of agri-food along the agri-food supply chain from the upstream to downstream in Tanzanian context. The Error Correction Mechanism (ECM) was estimated by using Ordinary Least Squares (OLS) based on long run dynamics.

2.2 Model specification

2.2.1 Stationarity and unit root

The time series data is said to be covariance stationary if its mean and variance are constant over time and the value of covariance between the two time periods depends only on the distance or lag between the two time periods, and not on the actual time at which the covariance is computed (Gujarati 2007). In other words, the error structure is time invariant. If a time series is not stationary in the sense defined above, it is called a nonstationary time series. However, studies in empirical economics always involve nonstationary trending variables, such as income, consumption, money demand, stock price, trade flows, and exchange rates. In other words, economic time series data tend to exhibit non-stationary stochastic processes of the form expressed below.

$$Y_t = \delta + \psi Y_{t-1} + \mu_t \quad \text{……} \quad (1)$$

Where δ is a drift parameter, ψ is a coefficient of Y_{t-1} which implies unit root when its value is equal to one and u_t is a white noise error term. More precisely, Yt could be characterised as having a unit root and a random walk with a drift. A random walk model is an example of a nonstationary time series, even if δ equals zero.

2.2.2 Cointegration

Two or more variables can be cointegrated if they have equilibrium or long run economic relationships between them. The significance of error correction mechanism is modeling cointegrated time series data. According to Engle and Granger (1987), when two or more variables are cointegrated, means that there exists a valid error correction model describing their long run economic relationships, with the implication that cointegration between variables involved is a prerequisite for the error correction model. The concept of cointegration developed by Engle and Granger (1987), therefore, provides a formal statistical support for the use of Error Correction Mechanism (ECM) which can be expressed as shown in equation 2 and 3 below.

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \mu_t \quad \text{……} \quad (2)$$

Where:

$$\Delta Y_t = Y_t - Y_{t-1} \quad \text{……} \quad (3)$$

ΔY_t = Price change Y_t= Current price Y_{t-1} = Lag price

ECM is appropriate if two conditions are met:

i Each variable is nonstationary and integrated to degree 1, written as I (1). This means that the variable follows a random walk, but the first difference (Y_t - Y_{t-1}) is stationary, written as I(0).

ii The variables are cointegrated, meaning that there is a linear combination of the variables that is stationary. Two prices (producer, and consumer prices) were analyzed at a time, so that the cointegrating equation can be depicted as:

$P_{pt} = \beta_1 + \beta_2 C_{pt} + \mu_t$ or $\mu_t = P_{pt} - \beta_1 - \beta_2 C_{pt}$ ………………………………………. (4)

Where:
P_{pt}= Producer price (farm gate price) in Tanzanian Shilling per kilogram (TZS/kg)
C_{pt} = Consumer price in Tanzanian Shilling per kilogram (TZS/kg)
β_1, β_2 = Parameters to be estimated
μ_t = Error correction term

The Augmented Engle Granger (AEG) test was carried out to test for cointegration as expressed in regression equation (5) below.

$\Delta\hat{}\mu = \eta\hat{}\mu_{t-1} + v_t$ ……………………………………………………………………….. (5)

Where: $\hat{}\mu$ = OLS residual estimator, $\hat{}\mu_{t-1}$ = OLS residual estimator lagged by one period
η = coefficient of residual, v = error term, ^ = *OLS estimator*

3. RESULTS AND DISCUSSION

The analysis of price transmission of agri-food from the upstream to downstream was carried out by employed error correction mechanism whereby unit root and cointegration tests were undertaken. The unit root was carried out to test for nonstationarity and stationarity of time series data of monthly producer and consumer prices of agri-food grains (maize, rice, sorghum, wheat and dry beans). The cointegration test was carried out to test for long run economic relationships of monthly producer and consumer prices of food grains.

Unit root test

The unit root test is the univariate test for checking stationarity and nonstationarity of time series data. The Augmented Dickey-Fuller (ADF) test was employed to test for stationarity and nonstationarity of econometric time series data of producers and consumers monthly prices of food grains. The results revealed that nonstationarity was present in the time series data, i.e. Yt~I (1). In order to remove nonstationarity the time series data were transformed into stationarity by first differencing them. Then tau (= t) statistical value was computed using Augmented Dickey-Fuller t-test by dividing the slope coefficient of the producer and consumer prices lagged by one period to its standard error and then compared to critical tabulated tau (τ) statistical value. The computed absolute |τ| tau (τ) value was less than the critical absolute |τ| tau (τ) value which leads to acceptance of the null hypothesis (δ = 0) and concludes that even though the time series data were first differenced still there was statistically significant nonstationarity of time series data at 5% level of significance (Table 1).

Cointegration test

Cointegration test is the bivariate or multivariate test for testing the long run economic relationships of price time series data from the upstream to downstream. The Augmented Engle-Granger (AEG) test was employed to test for cointegration of monthly prices of producers and consumers of food grains (maize, rice, sorghum, wheat and dry beans). The empirical results showed that the monthly prices time series data were cointegrated (symmetric price transmission). The absolute |τ| tau (= t) statistical value was computed using Augmented Engle-Granger (AEG) method by dividing the slope coefficient of the producer and consumer prices estimated error term lagged by one period to its standard error and then compared to critical tabulated tau (τ) statistical value. When the computed absolute |τ| tau (τ) value was greater than the critical absolute |τ| tau (τ) value the null hypothesis was rejected and concluded that there was statistically significant cointegration of time series data at 5% level of significance. The results imply that monthly prices of agri-food are moving on tandem thus they are transmitted from the upstream to downstream (Table 2 and Figures 1-5).
Similar results have been reported by Abdulai (2007) for spatial and vertical price transmission in food staples market chains in Sothern and Eastern Africa, he revealed that prices of maize market are spatial and vertical

integrated. Rapsomanikis and Kafarkis (2007) for cointegration of agricultural commodity markets in Tanzania, they pointed out that regional agricultural commodity markets are integrated.

4. CONCLUSION AND POLICY IMPLICATIONS

The monthly producer and consumer prices of agri-food were symmetrically vertically transmitted from the upstream to downstream as confirmed by the cointegration procedure. This was influenced by magnitude, speed and nature of the adjustments along the agri-food supply chain to the market shocks that are generated at different levels of the marketing process. The speed with which markets adjust to shocks is determined by the actions of market agents who are involved in the transactions that link producers and consumers, i.e. wholesalers, processors, distributors, and retailers. Hence, trade liberalization policies which offset the price transmission of agri-food along the supply chain are highly encouraged to continue being implemented by the marketing institutions to make sure that market power is mitigated along the supply chain.

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Appendices

Appendix I: Tables

Table 1: Unit root test of monthly prices of agri-food products

Product name	Price name	Variable	Coefficients	Std error	t-statistics	P-value
Maize grains	Producer price	Constant δ1	1.4556	1.1677	1.2465	0.2134
		ψYt-1	-0.0051	0.0084	-0.6082	0.5434
	Consumer price	Constant δ1	2.8132	1.9066	1.4755	0.1409
		ψYt-1	-0.0096	0.0091	-1.0504	0.2942
rice	Producer price	Constant δ1	2.5957	2.2943	1.1314	0.2587
		ψYt-1	-0.0001	0.0059	-0.0215	0.9828
	Consumer price	Constant δ1	3.3449	2.9625	1.1291	0.2596
		ψYt-1	-0.0010	0.0066	-0.1559	0.8762
sorghum grains	Producer price	Constant δ1	2.8464	1.7391	1.6367	0.1026
		ψYt-1	-0.0145	0.0099	-1.4678	0.1430
	Consumer price	Constant δ1	2.2472	2.4545	0.9155	0.3605
		ψYt-1	0.0006	0.0089	0.0618	0.9507
wheat grains	Producer price	Constant δ1	2.4629	2.0149	1.2223	0.2224
		ψYt-1	-0.0034	0.0073	-0.4658	0.6416
	Consumer price	Constant δ1	5.4001	4.2562	1.2688	0.2054
		ψYt-1	-0.0082	0.0111	-0.7370	0.4616
dry beans	Producer price	Constant δ1	2.3767	2.4376	0.9749	0.3302
		ψYt-1	0.0015	0.0065	0.2321	0.8165
	Consumer price	Constant δ1	3.9547	3.3373	1.1849	0.2368
		ψYt-1	-0.0032	0.0077	-0.4106	0.6816

Table 2: Cointegration results of monthly producer and consumer prices of agri-food products by Error Correction Model developed by Engle-Granger (1987)

Agri-food product name	Variable	Coefficients	Std error	t-statistics (computed absolute tau |τ| value)	tabulated critical absolute |τ| tau value	P-value
Maize grains	$\hat{\mu}_{t-1m}$	-0.1406*	0.0272	-5.1727	-2.875	<0.0001
Rice	$\hat{\mu}_{t-1r}$	-0.1475*	0.0278	-5.3282	-2.875	< 0.0001
Sorghum grains	$\hat{\mu}_{t-1s}$	-0.1406*	0.0272	-5.1727	-2.875	<0.0001
Wheat grains	$\hat{\mu}_{t-1w}$	-0.1410*	0.0275	-5.1287	-2.875	<0.0001
Dry beans	$\hat{\mu}_{t-1b}$	-0.5121*	0.0462	-11.0845	-2.875	<0.0001

Note: * implies significant at 5% level of significance. m-maize, r-rice, s-sorghum, w-wheat, b-beans, [1]n = 360.

Appendix II: Figures

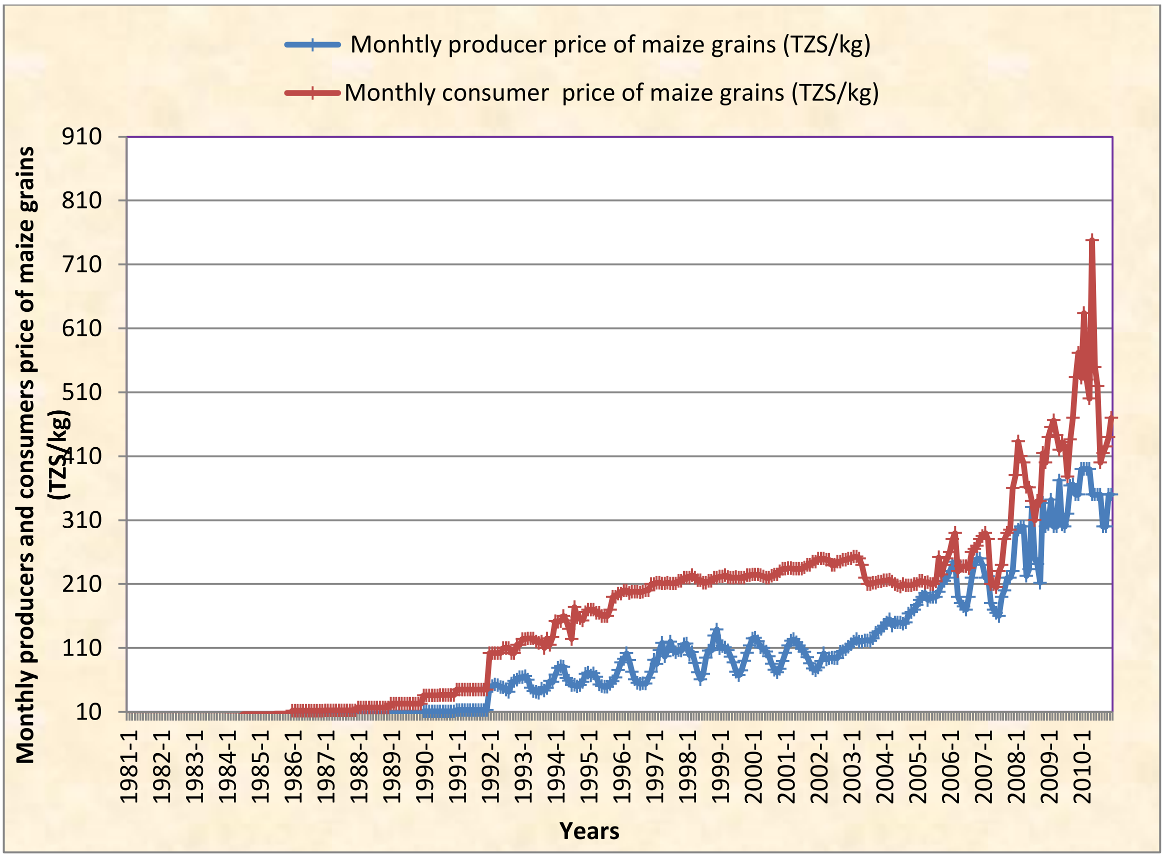

Figure 1: Tanzania Mainland: Trends of monthly producer and consumer prices of maize grains from 1981 – 2010 in Tanzanian Shilling per kilogram (TZS/kg).

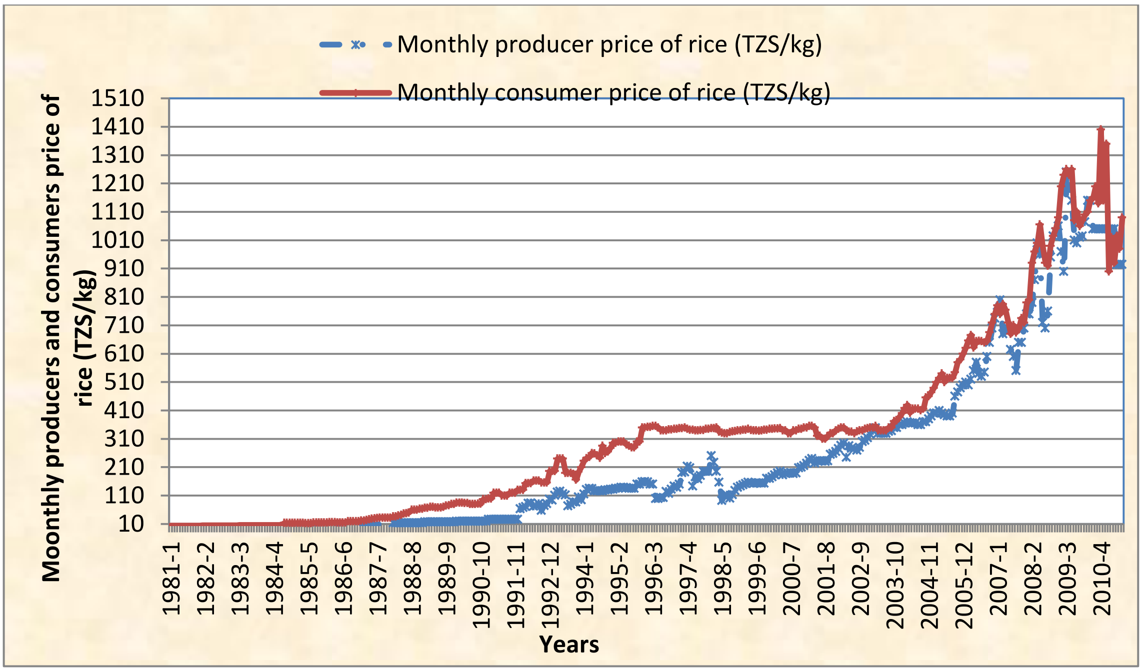

Figure 2: Tanzania Mainland: Trends of monthly producer and consumer prices of rice from 1981 – 2010 in Tanzanian Shilling per kilogram (TZS/kg).

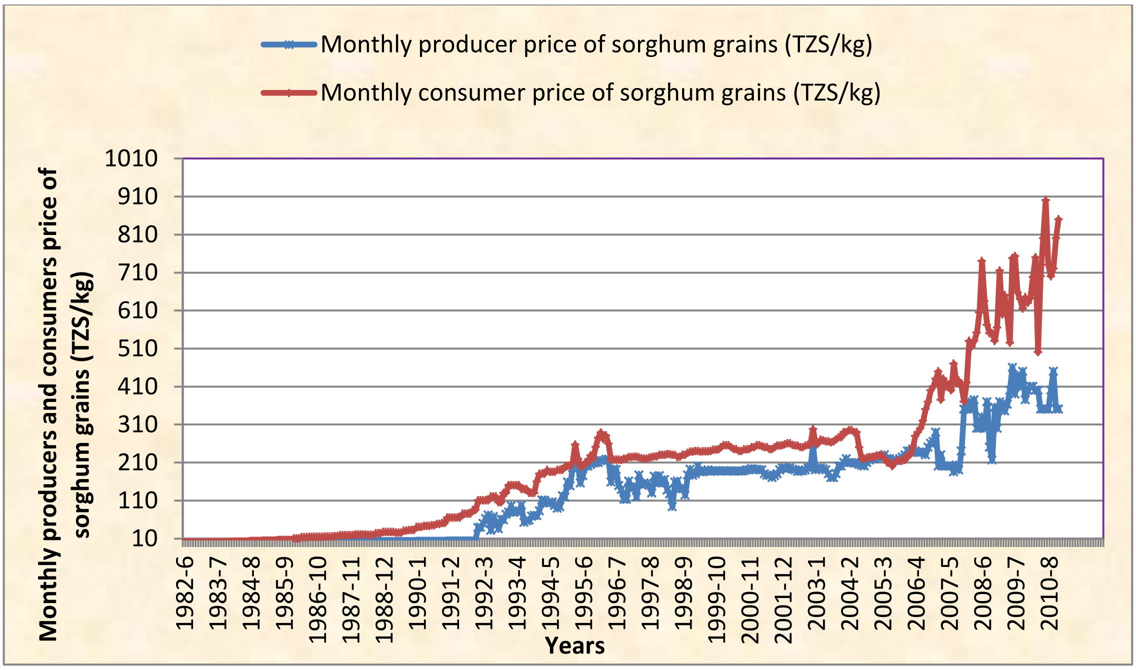

Figure 3: Tanzania Mainland: Trends of monthly producer and consumer prices of sorghum grain from 1981 - 2010 in Tanzanian Shilling per kilogram (TZS/kg).

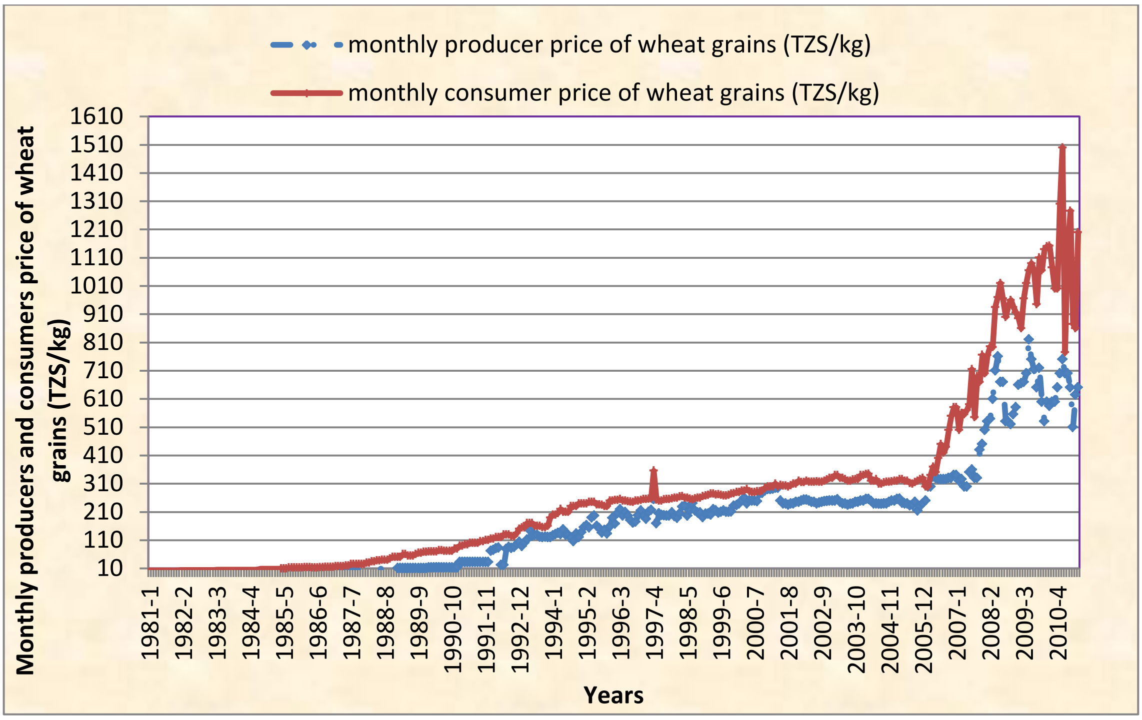

Figure 4: Tanzania Mainland: Trends of monthly producer and consumer prices of wheat grains from 1981 – 2010 in Tanzanian Shilling per kilogram (TZS/kg).

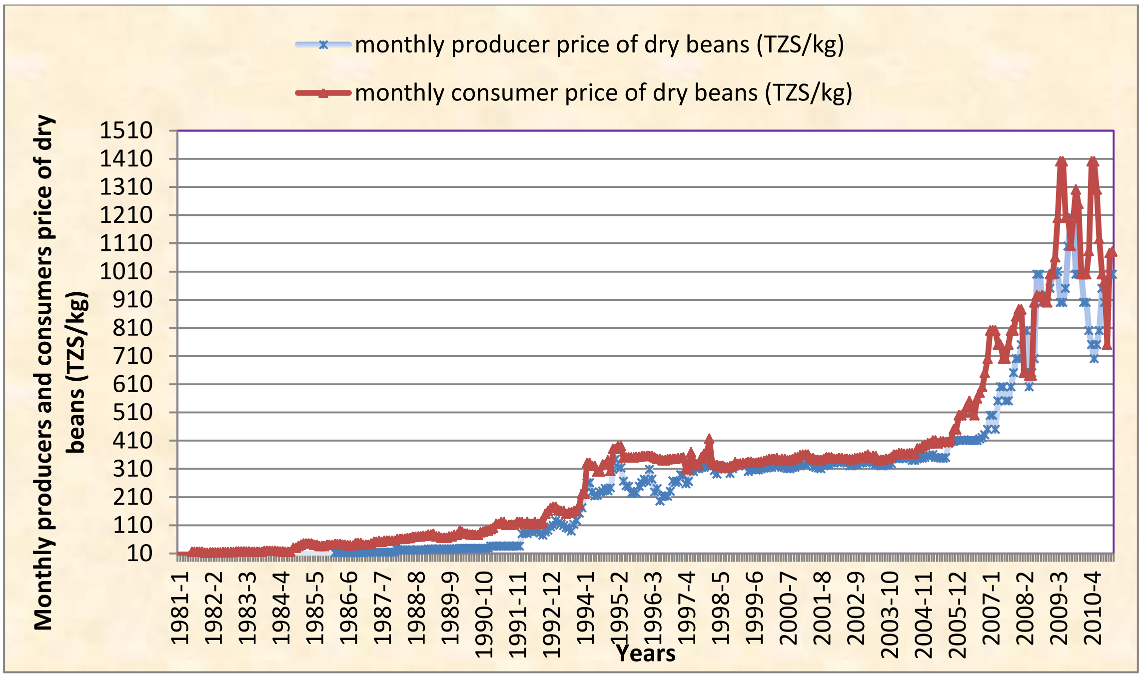

Figure 5: Tanzania Mainland: Trends of monthly producer and consumer prices of dry beans from 1981 – 2010 in Tanzanian Shilling per kilogram (TZS/kg).

The exchangeability of TZS: 1 US$ = 1400 TZS applicable to the 2010 exchange rate.

[1]n = number of observations.