# Are Price Changes in the World Market Transmitted to Markets in Less Developed Countries?
# A Case Study of Sugar, Cotton, Wheat and Rice in Tanzania

Fredy T. M. Kilima

Department of Agricultural Economics and Agribusiness,
Sokoine University of Agriculture, Morogoro, Tanzania

**IIIS Discussion Paper No. 160**

**Are Price Changes in the World Market Transmitted to Markets in Less Developed Countries?**

**A Case Study of Sugar, Cotton, Wheat and Rice in Tanzania**

**Fredy T. M. Kilima**

# Are Price Changes in the World Market Transmitted to Markets in Less Developed Countries?  A Case Study of Sugar, Cotton, Wheat, and Rice in Tanzania

Fredy T. M. Kilima

June 2006

# Are Price Changes in the World Market Transmitted to Markets in Less Developed Countries?  A Case Study of Sugar, Cotton, Wheat, and Rice in Tanzania

Fredy T. M. Kilima[1]

**Abstract.** This paper investigates the extent to which world market price changes are transmitted through changes in border prices into local producer prices for four agricultural product markets in Tanzania: sugar, cotton, wheat and rice. The changes in the marketing channels for each of these products resulting from market liberalization are described. The statistical analysis finds that, in general, Tanzanian border and world market prices for these products do not move closely together, although there is evidence that border prices are influenced by world market price levels but not vice versa. The absence of monthly price data at producer level for these products did not permit a detailed examination of the relationship between farmgate prices and either border prices or world market prices. However, the qualitative discussion suggests that the extent of price transmission is likely to be imperfect. These results have implications for the interpretation of simulation results modelling the potential impact of trade policy changes on Tanzanian producers and consumers. They also underline the need for concerted efforts by policy makers to reduce the extent of monopoly power in these marketing chains and to improve the degree of price transmission.

**1.**

---

[1]  Department of Agricultural Economics and Agribusiness, Sokoine University of Agriculture, Morogoro, Tanzania.

**Introduction**

Most industrialized countries have supported agriculture using domestic subsidies (e.g. producer subsidies), export subsidies, and restrictions on market access. Attempts are now being made to discipline these trade policies through round-table negotiations in the World Trade Organization (WTO) Doha Development Round. Their objective is the reduction and removal of the distortionary price and trade policies of WTO member countries by moving domestic prices closer to international prices. The thrust behind these changes is that free trade would allow countries to compete fairly in the world market. The anticipated impact of the trade reforms on Least Developing Countries (LDCs) is greater access to rich country markets.

While trade reforms may offer greater opportunity for developing countries to participate in international trade, there are several barriers that might cause local markets to be less responsive to economic signals arising from external markets. Winters, McCulloch and McKay (2004), for example, have indicated that transfer costs are generally higher in LDCs than in developed countries, and often attenuate border shocks as they pass through to households for importable goods and exacerbate the shocks for exportable goods. Moreover, economic signals can even get lost completely if markets are monopolized; a typical characteristic of markets in developing countries dominated by marketing boards or the private monopolies that often emerge when the markets are liberalized.

The extent of price transmission from world to domestic prices is a critical parameter in empirical trade models which attempt to assess the impact on prices, output, consumption and welfare in one country of trade policy reform in another country. For example, a study by Giblin and Matthews (2005) attempted to capture the impact of European Union (EU) unilateral trade liberalization on Tanzania, Uganda and other Sub-Saharan African (SSA) countries, on one hand, and on the EU, on the other hand. The study found that Sub-Saharan African producers would benefit from the higher world market prices resulting from EU reform, while consumers would be made worse off. This conclusion is based on the assumption that there is a flexible pass-through of price signals across the markets. However, the realism of this assumption remains to be verified.

Empirical evidence regarding the degree to which world market shocks are transmitted to domestic markets is limited (Baffes and Gardner, 2003 review some of the evidence). Hazell *et al.* (1990) argue that world price shocks have been transmitted to LDCs in the dollar value of export unit values; however, the effect has not been fully transmitted to producers either due to exchange rate misalignment or other domestic distortions. Quiroz and Soto (1993) also found that transmission of international price shocks in agriculture was either negligible or completely non-existent. On the other hand, Morriset (1998) examined the difference between world and domestic prices in industrialized countries and found upward movements in world price were passed through to domestic markets and not vice-versa. Understanding the extent to which prices are transmitted across borders and regions of a country is imperative to assess how producers and consumers in local markets are likely to respond to price changes in external markets.

Tanzanian studies on price linkages such as Ashimogo (1995) and Gjolberg, Guttormsen and Temu (2004) have assessed price integration between pairs of segmented regions within the country. To the author's best knowledge, no study so far has examined the integration between world and local market prices in Tanzania. The findings of these earlier studies provide useful insights into the degree of price integration in local markets and highlight policy intervention measures needed to improve market efficiency. However, knowledge of the degree of price transmission between world and domestic markets is generally lacking. This study attempts to examine price linkages between world and domestic prices for a number of commodity markets in Tanzania. Four markets are selected for analysis: sugar, cotton, wheat and rice.

This paper is organised into four sections including this introduction. Section 2 reviews different approaches used to model price transmission. Section 3 gives a brief analysis of the four commodity markets in Tanzania, discusses the data used and presents the empirical results. A summary of findings and concluding remarks are presented in Section 4.

## 2. Literature Review

Techniques to test for the degree of spatial integration between spatially separated markets have evolved over time. Many of the early studies applied to agricultural markets in LDCs appealed to the simple idea that prices in spatially separated markets should be highly correlated (Ejiga, 1977; Jasdawalla, Jones, 1972, 1966: Lele, 1967, and Loveridge, 1991). The use of correlation coefficients to test for market integration has many flaws because common components like population growth, climatic patterns, and inflation might induce systemic effects across markets. Other synchronous common factors such as monopoly procurement of agricultural products at identical prices from different markets might also induce systemic effects in price series (Harris, 1979, Heytens, 1986). Another limitation related to the use of correlation coefficients to test for spatial price linkage is the potential for independent price variation within the margin or band created by transaction costs (Lele, 1971).

Regression-based procedures have also been used to test for spatial price integration (Monke and Petzel, 1984; Isard, 1977; Mundlak and Larson, 1992; Gardner and Brooks, 1994). However, the use of regression-based tests has several shortcomings. The models are intrinsically static in nature because adjustment lags are not explicitly recognized and contemporaneous arbitrage conditions are assumed to hold. Also, nonstationarity of price data may invalidate standard econometric tests thus giving misleading results regarding the degree to which price signals are being transmitted from one to another market. The limitations related to the neglect of transaction costs and price variation within the transaction cost band also apply to regression tests.

Time-series analysis techniques are widely used to test for the dynamic nature of interregional commodity trade and arbitrage activities. These tests typically use one or more techniques such as Granger causality, dynamic regression tests, impulse response

4

analysis of structural or non-structural vector autoregressive (VAR) models, and co-integration analysis. A brief summary of these tests follows.

Granger causality (GC) tests are typically conducted within the VAR framework following Granger (1969). The approach is used to test for spatial price integration in terms of lead and lag relationships among dynamically interrelated prices. Alexander and Wyeth (1994); Koontz, Garcia and Hudson (1990); Mendoza and Rosegrant (1995); and Uri, Chomo, Hoskin, and Hyberg (1993) are some of the empirical applications of GC tests. Granger causality tests may provide some inferences about the existence of statistically significant lead/lag linkages among prices. However, GC tests, taken alone, indicate only whether the relationship between contemporaneous and lagged prices is statistically different from zero. Inferences from GC tests do not reveal the nature of the relationship. Thus, it is necessary to supplement Granger causality test results with other inferential procedures. Other limitations associated with correlation coefficients and standard regression approaches to testing for market integration also apply to GC tests.

Dynamic regression models, notably pioneered by Ravallion (1986), are alternative, dynamic versions of standard regression models and GC tests. Timmer (1987) extended the usefulness of Ravallion's approach through construction of an index of market connection (IMC) that gives an easily understandable measure of short-run market integration between two markets. Several studies have used the IMC to test for market connectedness (Ashimogo, 1995; Teklu, von Broun, and Zaki, 1991; Nyange, 1999; and Webb, von Braun, and Yohannos, 1992). Nonetheless, the interpretation of the IMC is still ambiguous; a larger value, for example, might indicate that markets are not integrated or that markets are integrated but transport costs exhibit a higher degree of persistence. Similarly, a low IMC suggests that markets are not isolated but it is unclear how connected the markets are. Therefore, prior knowledge about market structure and institutions is crucial to support the interpretation of the IMC (Alexander and Wyeth, 1994).

Impulse response VAR models measure the spread of a price shock and provide additional information regarding the dynamic time-path of price adjustments, which allows examination of the extent of price adjustment over time (Goodwin, Grennes, and MucCurdy, 1999). However, analysts have interpreted impulse response functions (IRFs) differently. While some have indicated that IRFs represent dynamic disequilibrium adjustments, others have argued that IRFs reflect equilibrium adjustments to economic shocks. Overall, analysts have suggested to interpret IRFs with great care because IRFs are normally specified to ensure that prices form a causally recursive system (Cooley and LeRoy, 1985; Leamer, 1985).

Co-integration tests are tests of long-run tendencies. The use of these tests has been justified on the assertion that arbitrage behaviour prevents prices in spatial markets from drifting too far apart. The assumption inherent in this assertion is that transport costs are stationary. Ignoring transaction costs that might prevent spatial arbitrage thereby inhibiting price transmission, and failure to account for discontinuous or bidirectional

trade, are the major limitations of co-integration analysis (Barrett, 1996; Baulch, 1997; Goodwin and Piggott, 2001).

The limitations of the modeling approaches discussed above have contributed to the development and application of more sophisticated approaches to measure market integration such as the threshold autoregressive model (Obstfeld and Taylor, 1997; Goodwin and Piggott, 2001) and Baulch's (1997) parity bound model. However, these sophisticated techniques are inherently difficult to model and require specific computer skills or software.

In summary, measuring the degree of price transmission lacks a single explicit empirical test because of market dynamic relationships that arise due to inertia or discontinuity in trade as well as non linearities that arise due to distortions in arbitrage. In this study, co-integration and causality techniques have been used to test for price transmission. The testing procedure follows that suggested by Rapsomanikis et al (2003) and is outlined in Appendix 1.

Prior to testing for co-integration price series were tested for stationarity using the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1981). The ADF test was conducted for each series at the level and first difference. To test for co-integration a unit root test was applied to the static regression as shown below (Goodwin and Schroeder, 1991).

$$P_t^1 - \alpha - \beta P_t^2 = \mu_t \tag{1}$$

In equation (1) above $P_t^1$ and $P_t^2$ are logarithmic commodity prices and $\mu_t$ are deviations from price parity.

An autoregressive distributed lag (ADL) model for the Granger-causality test was developed following the Engle and Granger (1987) specification provided below:

$$P_t^1 = \alpha + \beta_0 T + \sum_{j=1}^{j} \beta_j P_{t-j}^1 + \sum_{k=1}^{k} h_k P_{t-k}^2 + \varepsilon_t \tag{2}$$

where $T$ is the time trend, $\varepsilon_t$ is the error term, and other terms are as defined in equation (1).

Lags for the ADL model were selected to minimize the Akaike's Information Criterion.

Granger causality tests were specified as:

$$P_t^1 = \alpha + \beta_0 T + \sum_{j=1}^{j} \beta_j P_{t-j}^1 + \sum_{k=1}^{k} h_k P_{t-k}^2 + \varepsilon_t \tag{3}$$

$$H_0 : h_1 = h_2 = ... = h_k = 0$$

$$P_t^2 = \delta + \phi_0 T + \sum_{j=1}^{j} \Omega_j P_{t-j}^1 + \sum_{k=1}^{k} \varphi_k P_{t-k}^2 + \upsilon_t$$

$$H_0 : \varphi_1 = \varphi_2 = ... = \varphi_k = 0$$

(4)

## 3. Institutional and Statistical Analysis of Commodity Markets

### 3.1 The Sugar Industry in Tanzania

Sugarcane is an important commercial crop in Tanzania and is the main source of sugar produced for export and domestic consumption. Most sugarcane is grown in estates owned by the sugar processing factories as well as contract growers. There are four sugar estates in the country namely Kilombero and Mtibwa estates in Morogoro region, Tanganyika Planting Company in Kilimanjaro, and Kagera sugarcane estates in Kagera region. In general, total sugar production is often below the country's annual demand for the commodity (Ministry of Agriculture and Food Security, 2005). Statistics also indicate that Tanzania is a net importer of refined sugar (Figure 1). According to the TRA export records for 1998-2004, Tanzania imported sugar from a range of countries but four countries (South Africa, India, Netherlands, Zambia) accounted for 88% of the total (Table 1). During the same period, sugar exports went largely to Democratic Republic of Congo (DRC) (84.0%) and Kenya (14.9%).

Prior to formal liberalization of agricultural markets in the early 1990s the Sugar Development Corporation (SUDECO) monopolized the sugar market. Liberalization has accorded freedom to private firms and foreign trade to enter the sugar industry. Statistics show that a large proportion of the sugar output has been purchased and merchandised by local as well as foreign entrepreneurs. However, in spite of the fact that the industry has been liberalized not all aspects of the supply chain are completely free of government interventions. The newest Sugar Industry Act, 2001 (URT, 2002), among other things, still empowers the Sugar Board of Tanzania to register all sugarcane outgrowers in the country and to issue permits for sugar imports and exports.

Sugar in Tanzania is mainly produced during the dry season (June-November). The produced sugar is normally stored and sold at the factories. Traders (both local traders and licensed exporters) buy sugar from the factory and ship it to local demand points or export markets via outlets such as major ports and border regions. Since domestic production cannot satisfy local demand, sometimes it is hard for traders to get sufficient sugar at the factories, especially when the factories are contracted to produce sugar for export or sugarcane production is low. When sugar stocks at the factories are depleted, "scarcity signals" are sent to the market and sugar vendors and agents might overreact to the shock by creating artificial price hikes.

Analysts argue that sugar scarcity has been a major problem that limits market efficiency in the industry. Tarimo and Takamura (1998) reveal some arbitrage activities linked with low production such as illegal export of sugar or sugar hoarding by vendors to create artificial shortages. Furthermore, they argue that sugar scarcity empowers local vendors to determine prices in remote areas, which are often higher than prices in towns. These

7

distortions in local markets may cause ex-factory prices to be less stable than FOB or CIF prices.

This review provides background information for assessing linkages between ex-factory prices and FOB sugar price in Tanzania and the linkage between FOB sugar prices in Tanzania and the selected world market reference price. Because Tanzania is a net sugar importer, the domestic market price should be more influenced by the import parity (CIF) price than the export parity (FOB) price. However, CIF unit values for Tanzanian sugar imports were not available. In the following analysis, the influence of the world market reference price on both the FOB price and the ex-factory price is investigated.

Ex-factory price and FOB prices for refined sugar were obtained from the Sugar Board of Tanzania. The world market reference price for refined sugar was based on the Free Market, Coffee, Sugar, and Cocoa Exchange (CSCE) contract no. 11, nearest future position (http://www.imf.org/external/np/res/commod/datar.csv). Both series are in monthly terms and were transformed into common units namely US$ per metric ton. Farm gate prices for sugar cane could not be obtained. The absence of producer prices prevented price transmission analysis from the factories to the producers.

Ex-factory and world market sugar prices are displayed in Figure 2 whereas FOB and the world market reference prices are displayed in Figure 3. Before testing for price integration the author calculated the shares of ex-factory prices in FOB prices and found that most of the shares were greater than one implying that, for the data period, ex-factory sugar prices were higher than FOB sugar prices (Figure 4). Two propositions could explain why the ex-factory prices are higher than FOB prices. First, sugar scarcity might cause spot prices at the factories to be higher than the expected or "quoted" FOB prices. Second, the transaction time needed to import or export the sugar might be long thereby inducing delays in price response.[2] Therefore, it is likely that local shocks might have more impact on domestic sugar prices than external shocks. The sugar price linkages were investigated further following the analytical frame in Appendix 1.

First, the dynamic properties of the sugar prices were investigated using the Augmented Dickey Fuller (ADF) test for the presence of a unit root (Tables 2 and 3). Unit root tests applied to prices in levels failed to reject the null hypothesis of non stationarity. However, when applied to first differences the tests rejected the null, indicating that the differenced series were stationary. Following the proposed analytical framework the series were tested for the order of integration using the Johansen approach. Bivariate co-integration test results provided in Tables 4 and 5 rejected both the null of no co-integration and the null of one co-integrating vector, which suggests that the order of integration was not the same. This suggests a lack of integration between these markets.

Therefore, a Granger causality test was conducted following the specification in equation (3). Test results for Granger causality are summarized in Tables 6 through 9. Test results indicate that the world market sugar price Granger-caused the ex-factory sugar price but not vice versa. The test also indicates that the world market reference price for sugar

---

[2] While the author believes that the former is more likely, he could not verify independently the later.

Granger-caused the FOB sugar prices in Tanzania (Table 5). It appears that, over time, changes or shocks to the international sugar price do pass through to the domestic and export markets, but that they are not sufficiently strong to drive the ex-factory price of refined sugar. Granger-causality from the international to the ex-factory sugar price indicates that the sugar mills take some account of the international sugar price when setting the ex-factory price.

## 3.2    The Cotton Industry

In Tanzania, cotton is the second largest export crop after coffee and it contributes significantly to export earnings. Ninety percent of cotton is produced in Mwanza, Shinyanga, Mara, Tabora, Kigoma, and Singida regions, which are commonly known as as the Western Growing Area (WGA). The rest is produced in Morogoro, Coast region, Arusha, Mbeya, Tanga, Kilimanjaro, and Iringa.

Prior to formal liberalization, cooperative unions and the Tanzanian Cotton Board oversaw production, marketing and export of cotton. Market reforms that began in 1990 changed the role of the Cotton Board from buying cotton to proving fee-based services to cooperative unions. The relaxation of price controls in 1992 allowed a system that required the announcement of indicative cotton prices instead of a compulsory price to emerge. The process of reforming the sector became effective in 1994 when the monopoly power held by the marketing board and unions was eliminated and private firms were allowed to participate in cotton marketing and ginning. The increased participation of the private sector became notable in 1996/97 when they handled almost half of the cotton. The private sector was able to rapidly increase its market share because these firms paid higher prices than the unions and marketing board and paid promptly. In general, there is a consensus that market reforms have improved the ginning capacity and marketing efficiency, and have increased the producer's share of export prices. However, during the same period, input prices increased considerably and cotton quality deteriorated (Baffes, 2002; Kähkönen and Leathers, 1999).[3] Kähkönen and Leathers compared producer prices and export prices and found that the producer price as a percentage of export prices ranged between 29-111% (Figure 6).

Following the liberalization of cotton marketing in Tanzania four main marketing channels emerged at the farm level: 1) producers selling cotton directly to cooperative unions; 2) producers selling their cotton at farm-gate to private traders or at a nearby buying station to a private trader who assembles cotton from several farmers and then transports it to a private ginnery; 3) producers selling cotton directly to private ginneries; and 4) producers selling cotton to the Tanzania Cotton Lint and Seed Board (TCLSB). Most of the private ginneries are located in the western cotton growing areas; as a result most private traders operate in the WGA. Producers in other areas continue to rely on cooperative unions. Kähkönen and Leathers indicate that in the 1996/97 season 69% of

---

[3] Quality deterioration is attributable to increased cotton disease transmission and the pooling of cotton from growers producing different cotton varieties. After market reform traders were allowed to buy and distribute seeds from various sources, which accelerated inter-regional disease transmission (Gibbon, 1999).

cotton produced was sold to private ginneries, 20% was sold to cooperative unions, and the rest to private traders.

Kähkönen and Leathers also identified that contract farming was fairly common in Tanzania. The emergence of contract farming was attributable to deliberate efforts by cooperative unions and private ginneries, which contracted farmers to produce cotton and promoted out grower schemes, respectively. In these contracts buyers provided inputs, either seed or both seeds and fertilizers. On their part, farmers agreed on the acreage requirement and to sell whatever quantity was harvested on contracted farms. Some of these contracts were formal, in the sense that producers signed contracts specifying the minimum quantity of cotton to be sold, as well as minimum prices, though the price could be adjusted in case farm-gate prices turned out to be higher than expected.

After ginning cotton lint is either sold domestically or exported. According to TCLSB statistics cotton lint exported between 1981/82 and 1995/97 production years ranged between 50% to almost 100%. Therefore, Tanzania is a net exporter of cotton (Figure 6). Detailed analysis of total cotton exports from 1998 to 2004 reveals that Tanzania exported cotton to many countries including Bulgaria (15.72%), United Arab Emirates (10.42%), Burundi (8.75%), Switzerland (6.72%), Belgium (6.18%), France (5.79%), Bangladesh (5.69%), United Kingdom (5.44%), Indonesia (3.53%), India (3.41%), China (3.21%), Italy (2.61%), and Japan (1.75%). During the same period Tanzania imported small amounts of cotton mainly from United Arab Emirates (47.66%) and India (35.47%).

While market reform has had many positive impacts on cotton marketing and producer prices there have been mixed feelings about cotton supply response after the reforms. Baffes (2002) cites a World Bank study which found a unit short-run supply response elasticity for cotton, arguably reflecting the farmer's flexibility to switch backward and forward between cotton and other food crops. The reforms also meant a gradual decrease and eventual elimination of subsidy to the textile industry. The removal of subsidy to the industry coupled with increased global competition forced some firms out of the business thereby creating domestic shocks that might have discouraged cotton production. Dixon *et al*. (2004) observed that decline in prices of traditional export commodities has caused smallholders to reduce areas under crop cultivation and to shift to new cash crops or other food crops.

On the other hand McKay, Morrissey, and Vaillant (1997) maintain that the potential for agricultural sector response to liberalization of agricultural prices and marketing might be quite significant, though not for the production of traditional export crops such as coffee, tea, and cotton. Baffes and Ajward (1998) examined the degree to which price linkages in cotton markets in different countries have improved over time; two interesting conclusions emerged from their analysis. Price linkages have improved over time, but the improvement is mainly a result of short-run price transmission and to a very limited extent a result of long-term co-movement.[4] Price linkages between Western African

---

[4] The short-run transmission is mainly attributable to improvement in technology that has occurred as well as liberalization of cotton markets or alteration of the role played by governments in the cotton market.

countries and Central Asia were higher than linkages between any other pair consisting of the U.S and Central Asia and Greece. The relatively high price linkages between Western Africa and Central Asia were attributable to the relatively large volume of cotton trade.[5]

In spite of the fact that cotton procurement competition in Tanzania has improved after market reforms, rules about permits and licences required to enter into the business hinder competition. Kähkönen and Leathers reported that, in addition to business registration, buyers of cotton also required separate licences for seed cotton buying and cotton ginning. Furthermore, they indicated that ginneries were assigned specific areas to buy cotton, and cotton movement from one zone to another was restricted. Consequently, the ginneries were granted monopoly power over cotton procurement in their zones thereby limiting competition and reducing efficiency in ginning.

This information on cotton production and marketing in Tanzania provides the basis for interpreting and discussing statistical tests of price transmission, which are presented next. The analysis of price transmission is between the world market reference price for cotton and FOB cotton price in Tanzania. Since producer prices could not be obtained, statistical inferences regarding transmission of FOB price to farm-gate are not provided. The world market reference price used was CIF Liverpool-cotton price, also available at (http://www.imf.org/external/np/res/commod/datar.csv). FOB cotton prices were calculated as the unit value of cotton exports based on trade statistics from the Tanzania Revenue Authority.

The approach used to test for sugar price transmission was also adopted to investigate the relation between the cotton price series. A summary of unit root test for cotton prices is presented in Table 10. Unit root tests applied to prices in levels for both the world market cotton reference price and FOB cotton price in Tanzania failed to reject the null hypothesis of non stationarity. Similar tests applied to differenced prices rejected the null hypothesis for a single mean equation. Co-integration tests results presented in Table 11 rejected both the null of no co-integration and the null of one co-integrating vector. Therefore, the series were tested for GC. Granger-causality results presented in Tables 12 and 13, show that the world market reference price Granger-caused the FOB cotton prices in Tanzania. This analysis suggests that though the series tended to drift apart from each, some signals from the world market were transmitted to local markets. The outcome is consistent with Baffes and Ajward (1998) and prior expectation because cotton produced in Tanzania is widely traded in the world market.

## 3.3    The Wheat Industry

Wheat in Tanzania is mainly produced in the northern highlands (Arusha and Kilimanjaro regions) and in the southern highlands (Iringa, Mbeya, and Rukwa regions). While wheat production in the southern highlands is predominantly small scale, production in the northern highlands is mainly in large scale farms. Large-scale mechanized, small- to

---

[5] Cotton produced in West Africa was exported almost entirely to Central Asia, hence making both markets subject to the same demand shocks. Conversely, countries that have no strong trade linkages are subjected to both domestic and world market shocks, which reduce the degree of price linkages.

medium-scale mechanized, and hand-tool production are the three modes of wheat production in Tanzania. According to the Market Development Bureau (1989), wheat consumption in Tanzania is higher in urban areas (83%) than in rural areas (17%). Wheat demand is essentially in the form of wheat flour, which is both an intermediate product and final product (Mlay *at el*., 1989).[6] Despite the fact that wheat accounts for only 1.3% of the per capita calorie intake, its economic importance cannot be ignored for two reasons. First, most wheat consumed in Tanzania is imported implying that price shocks in wheat exporting countries might have significant impacts on foreign reserves. Second, effective wheat demand is in urban areas where population growth is high (estimated rates of growth are 3.89% in urban and 0.69% in rural areas, UN Population Division, 2001) and wheat demand is bound to increase as the population grows (Mlay *at el*., 1989).

Wheat marketing in Tanzania has gone through major transformation over time. Prior to agricultural market reforms, the state controlled agricultural markets. The state controlled markets curtailed the role of private traders through restrictions on quantity handled and procurement rights at the farm-level. The aim of these policies was to ensure self-sufficiency in food (World Bank, 1994). Thus, wheat along with other major food crops such as maize, rice, cassava, millet, sorghum, and beans were bought by state owned institutions. To enforce this policy, road-blocks were established along major outlets to minimize inter-regional trading.[7] Parallel to granting the purchase right to the state institutions was the establishment of minimum prices for various crops at different stages of the marketing chain (Suzuki and Bernard, 1987).

The adopted pricing policy coupled with the uncompetitive procurement created three economic distortions worth mentioning. First, the marketing institutions procured crops at the "set prices" regardless of transportation costs. Therefore, to maintain the system, when operating costs were unbearable the government was compelled to subsidize marketing activities. Second, uncompetitive procurement meant that the producers' price was by and large a residual after all the intermediary handling charges were deducted (Ibid.). Third, when the minimum price for a particular crop was set above the "competitive market price", it encouraged production in regions far from main consumption centres thereby encouraging transfer of resources to production of that crop and raising production costs for other crops (Putterman, 1995; World Bank, 1999). Consequently the marketing institutions accumulated deficits and the distortions were augmented and became unmanageable.

In an attempt to restore macroeconomic balance and efficiency to the economy, the government adopted reform programs prescribed by the International Monetary Fund and the World Bank. The reform process was gradual, and a comprehensive reform was achieved by 1991, when all restrictions on traders were lifted. The lifting of the restrictions on traders brought about active participation of the private traders in grain procurement (Coulter and Golob, 1992; Santorum and Tibaijuka, 1992).

---

[6] Hotels, restaurants and other food industries use wheat flour to produce other final products. On the other hand individuals and some institutions buy wheat flour for direct consumption.

[7] Available evidence suggests that illegal trading thrived through the use of informal routes.

In summary, wheat markets and marketing channels have changed significantly after market liberalization. Prior to market reforms, consumers mainly bought wheat from official channels, which were the National Milling Cooperative (NMC), Regional Trading Centres (RTC) and National Distributors Limited (NDL). A smaller portion of wheat was supplied by private channels through private traders and open markets, as well as stocks retained by smallholder producers (Mlay *et al*.). After market reforms the private market supplied most the wheat through the following channels: inter-regional traders buying wheat from producers and shipping it to major markets in urban areas; small-scale millers buying wheat for milling and selling flour to buyers in major markets, agents, or specific firms; commercial millers buying wheat locally or importing it from abroad and selling wheat flour via agents; private traders buying wheat from producers and selling it to millers and individual producers selling wheat in specific target markets. In-depth analysis of the wheat marketing is provided below.

Mlay *et al.* analysis of private marketing margins indicates that retail to farm gate spreads were large, reflecting high costs of transportation and the risk of holding grain while in transit. However, the analysis also indicates that price shocks were mainly absorbed by middlemen rather than consumers. Thus, in a short-term perspective, middlemen acted as shock absorbers, lowering their margin when farm-gate prices were rising and raising their margin when prices were falling. Mlay *et al*. also calculated farm level prices as a percentage of final consumer prices and found that 53.5% of the consumer price went to producers and the rest to the marketing sector. Similar analysis for official markets indicates that producers received only 40% of the average retail price, possibly reflecting inefficiency blended in the official marketing system, which has been discussed above.[8]

Deldago, Minot, and Tiongco (2004) also estimated the evolution of spreads between prices in different parts of the country and Dar-es-salaam and found that spreads were higher for wheat than rice and maize. Nevertheless, they also found that in Dar-es-salaam, which was a wheat supplying market, the spreads were significantly lower for wheat, rice, and to lesser extent maize. This analysis reveals two realities of the wheat market in Tanzania. First, wheat is imported all year round-even when domestic production is high; since Dar-es-salaam is the biggest import port and a major supplier of imported wheat in the country, it is likely for wheat price spreads between Dar-es-salaam and other regions to be high.[9] Second, wheat is one of the tradable crops in Tanzania and its price should be influenced by changes in the world market and exchange rate.

The foregoing discussion has provided a detailed review of the wheat industry in Tanzania. In the reminder of this section international wheat marketing and market linkages are discussed. Analysis of wheat imports and exports using data from the TRA shows that Tanzania relies heavily on wheat imports (Figure 7). The TRA database shows that during 1998-2005 Tanzania imported wheat mainly from Australia (55.15%) and

---

[8] This discussion could have been extended to include the analysis of transportation cost. However, data were not available.
[9] Transaction costs involved in shipping wheat from importing regions to others might differ across regions because of differences in road infrastructure and travel distances.

Pakistan (29.77%). During the same period Tanzania exported wheat to DRC (23.31%), Burundi (21.28%), Rwanda (19.90%), Kenya (10.47%), Uganda (10.18%), United Arab Emirates (4.82%) as well as to a number of other countries.

In the above discussion it has been argued that Tanzania is a net importer of wheat and wheat prices might be influenced by changes in the world market and exchange rates. To test the validity of this argument we applied the analytical framework to the wheat price series presented in Figure 2. The world market reference price used was No. 1 Hard Red Winter, ordinary protein, FOB Gulf of Mexico, which is available at (http://www.imf.org/external/np/res/commod/datar.csv). Unit values of wheat imports were calculated from trade data of the Tanzanian Revenue Authority. First the series were tested for stationarity using the ADF test (Table 14). The test statistics rejected the null for both series in levels, but failed to reject the null under zero mean equation for the differenced price. The series were tested for cointegration and results rejected both null hypotheses of zero and one cointegrating vectors (Table 15). Therefore, GC tests were performed. Results for these tests are summarized in Tables 16 and 17. The GC test show that the world market reference price for wheat Granger-cause the CIF wheat price in Tanzania, and not vice-versa. These findings indicate that the two series drifted apart from each other but some price shocks from the world market were transmitted through to Tanzania.

In addition to assessing linkages between the world and local wheat markets, linkages between local markets in Tanzania and its export markets for wheat products were also assessed. This additional analysis was motivated by the fact the TRA officials revealed that some wheat imported to Tanzania was re-exported in the form of wheat flour to other countries. Detailed analysis of wheat flour exports indicated that between 1998 and 2000, Tanzania exported wheat flour to DRC (49.79%), Rwanda (20.52%), Uganda (17.47%), Burundi (6.61%), Malawi (3.23%), and Comoros (1.59%). African countries, taken together, imported 99.91% all wheat flour exported of which 76.98% went to "politically unstable" countries of DRC, Burundi, Rwanda, and Zimbabwe. These statistics might provide a basis for assessing multiple sources of price shocks in Tanzania; for example, one might ask the question; *what are the impacts of macro-economic instability in DRC, Burundi, Rwanda, and Zimbabwe on price changes in Tanzania*?

The author attempted to answer the above question using price linkages between CIF wheat prices in Tanzania and corresponding FOB prices for wheat flour exported from Tanazania, which are displayed in Figure 9. The comparison of these series was based on the assumption that wheat processing costs were constant. Using the proposed analytical frame the series were tested for stationarity using the ADF test. The tests applied to prices in levels failed to reject the null hypothesis of non stationarity, but when applied to first difference the test rejected the null hypothesis (Table 18). The series were tested for the order of cointegration, the test rejected both the null hypotheses of zero and cointegrating vectors (Table 19). Extension of the analysis to GC tests indicated that FOB prices of exported wheat Granger-caused the CIF wheat prices in Tanzania (Table 19), which implies that import prices for wheat in Tanzania were jointly determined by some price

shocks, which passed through from the world market as well as from countries in the neighbourhood.

## 3.4    The Rice Industry

In Tanzania, rice is the second most preferred staple after maize (URT, 1995). It is estimated that rice constitutes 16.6% of cereal consumption in Tanzania (Food Strategy Unit, 1989). According to World Bank (2000) rice is a tradable commodity, has high-income elasticity of demand, and its local prices are influenced by international prices and the exchange rate. Gabagambi (1998) indicates that rice is highly preferred in urban areas, institutions such as hospitals and schools, and in restaurants. Two reasons might explain the observed preference in rice consumption. Most of the people in non-rice growing rural areas of Tanzania are poor and cannot afford to buy rice on a regular basis. The preference for rice in restaurants and institutions is mainly due to its convenience in terms of catering (Gabagambi).

In general, paddy is mainly produced in small scale farms of 0.5-2.4 hectares and is rain-fed. There are only a few large scale irrigated farms under the ownership of the National Agricultural Food Corporation (NAFCO). Kanyeka *et al*. cited by Isinika, Ashimogo, and Mlangwa (2005) indicate that 74% of the total paddy area in the country is rain-fed lowland rice, 20% is upland rice, and 6% is irrigated.

Most rice produced in the country is marketed by the private sector. The general institutional architecture of grain markets and how the market structure has evolved over time has been provided in section 4.3. Despite the fact that market reforms might have common impacts to all grain markets, the actual marketing chains that emerged after reforms could be commodity-specific. Thus, rice marketing chains after the reforms are discussed next.

A study by Gabagambi identified seven market participants in rice marketing, namely producers, local assemblers, millers, inter-regional traders, wholesalers, retailers and consumers. The marketing channels resulting from the interactions of these participants are shown in Figure 10. Since a large number of market participants are involved in the chain, it is unlikely that price signals can pass through from consumers to farm levels without being distorted, especially in segmented markets. However, the inference regarding the transmission of border price to farm gate is purely qualitative.[10]

In the context of international trade, Tanzania is linked to the world market through rice imports and exports. Statistics indicate that the country is a net importer of rice (Figure 13). Between 1998 and 2004, Tanzania imported rice mainly from Vietnam (39.20%), Thailand (12.91%), China (11.36%), Pakistan (7.06%) and India (5.64%). During the same period Tanzania exported rice to Rwanda (53.81%), Kenya (28.98%), Uganda (9.70%), Comoros (2.40%), DRC (1.69%), and Burundi (1.45%). In brief, during the data

---

[10] The discussion is not backed up by statistical inferences because information on farm-gate prices, transaction costs, price spreads, and traders' margin could not be obtained.

period, 98.76% of rice exported from Tanzania was bough by African countries. During the same period joint imports by Burundi, DRC, Rwanda, and Zimbabwe were 56.95%.

Since Tanzania is a net importer of rice (Figure 11), the author tested for price linkages between CIF prices for imported rice and a world market rice reference price. The price series are shown in Figure 12. The ADF tests applied to the series are presented in Table 22. The tests fail to reject the null hypothesis of non stationary for both prices in levels and first differences. The rice price series were also tested for cointegration and results rejected both null hypotheses of zero and one cointegrating vectors (Table 23) Finally the author tested for GC between the series (Tables 24 and 25). Results for GC tests indicated that the world market reference price for rice Granger-caused the CIF rice price in Tanzania.

## 4. Summary of Major Findings and Concluding Remarks

This study has investigated whether there is a flexible pass-through of price shocks from the world market to specific commodity markets in Tanzania. Co-integration and Granger causality techniques were used to test for price linkages. For the analysed commodity prices (sugar, cotton, wheat, and rice), the co-integration results indicate that the CIF/FOB prices in Tanzania were not well integrated with commodity prices in the world market. However, Granger-causality tests revealed the existence of a unidirectional-causal relationship, whereby commodity prices in the world market Granger-caused prices in Tanzania. The two methodologies taken together imply that commodity prices in the world market and local markets in Tanzania drifted apart from each other, but some shocks from the world market passed through to Tanzania though not vice-versa. In-depth analysis of trade networks indicated that Tanzania responded simultaneously to price shocks from the world market and from neighbourhood markets.

This imperfect price transmission may be the result of export procedures, quantitative restrictions, internal taxes, intensity of competition and contingency trade remedies which influence traders' choice to export the commodities to nearby countries or other foreign countries. Furthermore, it is important to note that multiple membership of overlapping regional trade agreements such as the Southern African Development Community (SADC) and Eastern African Community (EAC) also creates shocks that affect responses to external changes in commodity prices. Therefore, the magnitude and direction of price transmission depend on the relative influence of price shocks in regional markets and the world reference markets on local markets in Tanzania.

However, the poor price linkages between domestic commodity markets in Tanzania and the world market are more likely to be an outcome of the continuing large distortions in local markets such as bureaucratic licensing procedures, monopoly procurement, poor exchange of market information, and high transaction costs.

In conclusion, the findings of this study have two major implications. First, the impact of ongoing trade reform in world markets might not have significant effects because there is only partial transmission of price shocks from the world market to Tanzania. Second, for

the trade reform to have a greater impact there must be concerted efforts by policy makers to reduce the monopoly power held by marketing institutions/regulators which distorts commodity prices.
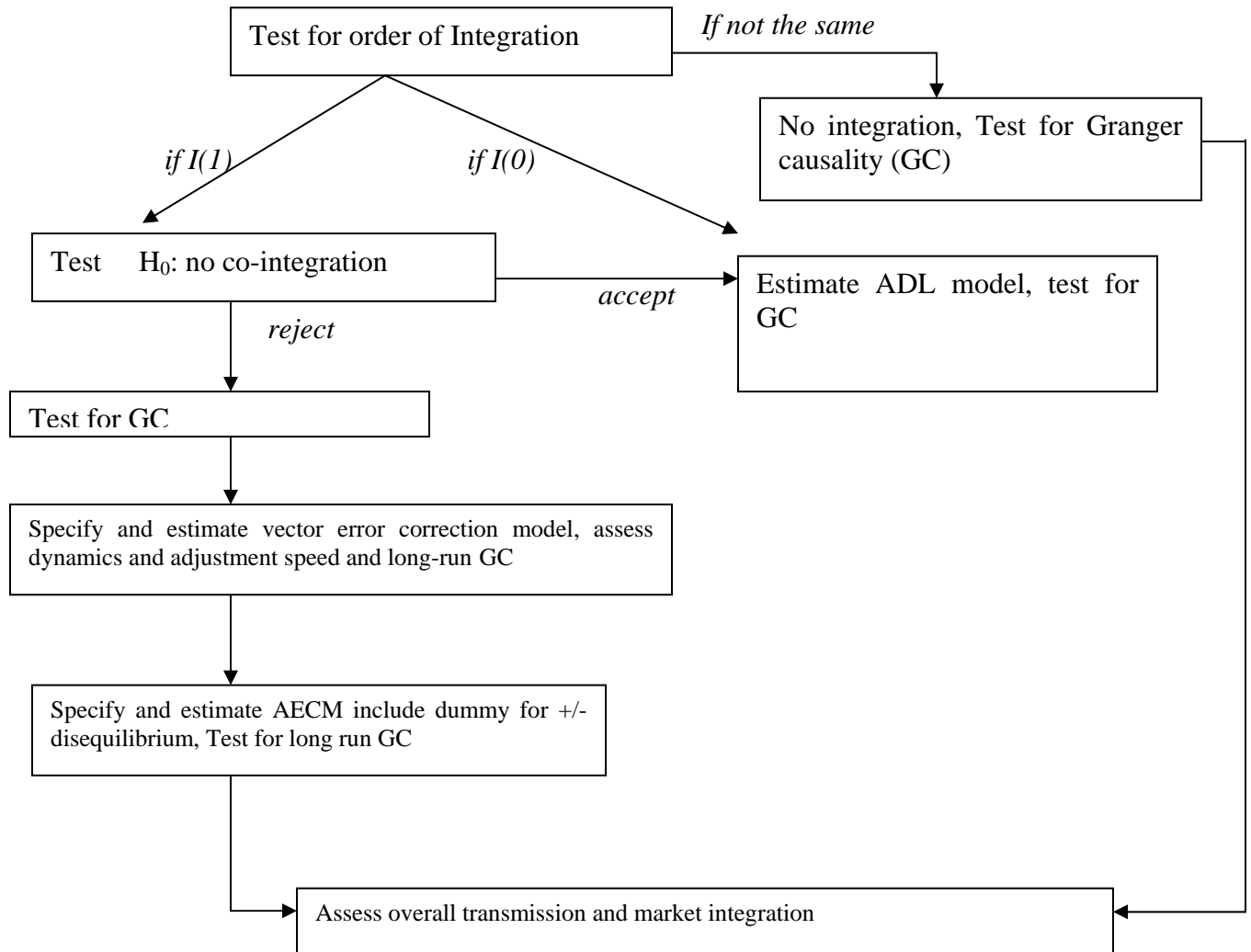
**References**

Alexander, C. and J. Wyeth (1994). "Cointegration and Market Integration: An application to the Indonesian Rice Market." *The Journal of Development Studies* 30 (**2**): 303-328.

Ashimogo, G. C. (1995). "Peasant Grain Storage and Marketing in Tanzania: A Case Study of Maize in Sumbawanga District." Verlag, Berlin.

Baffes, J. (2002). "Tanzania's Cotton Sector: Constraints and Challenges in Global Environment, Africa Region Working Paper Series No. 42, December 2002.

Baffes, J. and M. L. Ajwad (1998). "Detecting Price Linkages: Methodological Issues and an Application to the World Market of Cotton." Development Economic Research Group, the World Bank, Washington Group, DC.

Baffes. J. and B. Gardner (2003). "The Transmission of World Commodity Prices to Domestic Markets Under Policy Reforms in Developing Countries." *Policy Reform* 6 (**1**): 159-180.

Barrett, C. B. (1996). "Measuring Integration and Efficiency in International Agricultural Markets." *Review of Agricultural Economics* 23: 19-32.

Bulch, B. (1997). "Testing for Food Market Integration Revisited." *Journal of Development Studies* 33: 512-534.

Collier, P. (1997) "Ugandan Trade Policy: Liberalisation in an Environment of Limited Credibility", *World Economy* 20: 649-65.

Cooley, T. F., and S. F. Leroy (1985). "A theoretical macroeconometrics: A critique." *Journal of Monetary Economics* 16: 283-308.

Coulter, J., Golob, P., 1992. Cereal marketing liberalization in Tanzania. *Food Policy*, 17 (6): 420-430.

Delgado, C., N. Minot, and M. Tiongco (2004). "Evidence and Implication of non-tradability of food staples in Tanzania 1983-1998." Markets, Trade and Institutions Division, International Food Policy Institute, Washington, DC, pp 36.

Dickey, D. and W. Fuller (1979). "Distribution of the estimator for autoregressive time series with unit root.", *Journal of the American Statistical Association* 74:427-431.

Dixon, J., A. Tanyeri-Abur, H. Wattenbach and B. Ndisale (2004). African Farmers and Differentiated Response to Globalization, Food and Agricultural Organization (FAO), Roma, Italy. Internet resource available at http://www.unifi.it/eaae/cpapers/03%20Dixon_Tanyeri-Abur_Wattenbach_Ndisale.pdf

Ejiga, N. O. O. (1977). "Economic Analysis of Storage, Distribution, and Consumption of Cowpeas in Northern Nigeria." Ph.D dissertation, Cornell University.

Engle, R. F. and C. W. J. Granger (1987). "Cointegration and Error Correction : Representation, estimation, and testing." *Econometrica* 55:251-276

Food Strategy Unit (1987). "Food self-sufficiency policy and food needs assessment in Tanzania. " Food Policy Series Papers, no. 1. Dar es salaam. pp 39.

Gabagambi, D. M. (1998). "Evaluation of Agricultural Marketing Efficiency in Tanzania: A case Study of Paddy and Cotton in Ulanga District." Unpublished M. Sc. Dissertaion, Sokoine University of Agriculture, Morogoro, Tanzania. pp 136.

Gardner, B. and K. M. Brooks (1994)**.** "Food Prices and Market Integration in Russia: 1992-93." *American Journal of Agricultural Economics* 76:641-646.

Gjolberg, O., A. G. Guttorrmsen, and A.Temu (2004). "Mulfunctioning Commodity Markets: Empirical Evidence from Tanzania." Department of Economics and Resource Management, Agricultural University of Norway. Discussion Paper # D-27/2004.

Goodwin K. B. and N. E. Piggott (2001). "Spatial Market Integration in the Presence of Threshold Effects." *American Journal of Agricultural Economics* 83 (*2*): 3002-317.

Goodwin B. K. and T. C. Schroeder (1991). Cointegration Tests and Spatial Price Linkages in Regional Cattle Markets. *American Journal of Agricultural Economics*, May 1991: 452-464.

Granger, C. W. J. (1969). "Investigating causal relations by econometric models and cross-spectral methods." *Econometrica* 37: 424-438.

Harriss, B. (1979). "There is a method in my madness: Or it is vice-versa? Measuring Agricultural Performance." Food Research Institute Studies 17:197-218.

Hazell, P. B. R., M. Jaramillo, and A. Williamson (1990). "The relationship between the world price instability and the prices farmers receive in developing countries." *Journal of Agricultural Economics*, 41: 227-243.

Heytens, J. P. (1986). "Testing Market Integration." *Food Research Institute Studies*, XX (**1**): 25-41.

Isard, P. (1977). "How Far Can We Push the 'Law of One Price'?" *American Economic Review* 67:942-948.

Isinika. A. C., G.C. Ashimogo, and J. E. D. Mlangwa (2005). From Ujamaa to structural adjustment—Agricultural intensification in Tanzania. In the African Food Crisis, Lessons from the Asian Green Revolution, CABI publishing, UK: 197-217.

Jasdawalla, Z. Y. (1966). "Marketing Efficiency in Indian Agriculture, Allied Publishers Private Ltd., Bombay, India.

Jones, W. O. (1972). "Marketing Staple Food crops in Tropical Africa. Cornell University Press, Ithaca, New York.

Kähkönen, S. and H. Leathers (1999). "Transaction cost analysis of maize and cotton marketing in Zambia and Tanzania". Agriculture, natural resources and rural enterprise, office of sustainable development, bureau for Africa, U.S. agency for international development, technical paper no. 105.

Koontz, S. R., P. Garcia and M.A. Hudson (1990). "Dominant-satellite relationships between live cattle cash and futures markets." *Journal of Futures Markets* 10:123-136.

Leamer, E. E. (1985). "Vector autoregressions for causal inference?", Carnegie-Roschester Conference Series on public policy 22;255-304.

Lele, U. J. (1967). 'Market Integration: A Study of Sorghum Prices in Western India." *Journal of Farm Economics* 49: 147-159.

Lele, U. J. (1971). Food Grain marketing in India: Private Performance and Public Policy." Cornell University Press, Ithaca, New York.

Loveridgr, S. (1991). Marketing in Rwanda—Imports and infrastructure. *Food Policy* 16: 95-104.

Market Development Bureau (MDB) (1989). "Review of Cotton". Ministry of Agriculture and Livestock Development, Dar es salaam, pp 102.

McKay, A., O. Morrissey, and C. Vaillant (1998). "Aggregate Export and Export Crop Supply Response in Tanzania." Center for International Research in Economic Development and International Trade, Credit Research Paper, No. 98/4.

Mendoza, M. S. and M. W. Rosegrant (1995). "Pricing behaviour in Phillipine corn markets: Implications for market efficiency." Research Report 101, International Food Policy Report Research Institute, Washington, DC.

Ministry of Agriculture and Food Security (2005). Dar es salaam, Tanzania.

Mlay, G. I., G. C. Ashimogo, A. E. Temu, and R. V. Kurwijila (1989). "Wheat Production and Marketing in Tanzania: A case Study". Report prepared for FAO, pp 102.

Monke, E. and T. Petzel (1984). "Market Integration: An Application to International Trade in Cotton." *American Journal of Agricultural Economics* 66:481-487.

Morriset, J. (1998). "Unfair trade? The increasing gap between world and domestic prices in commodity markets during the past 25 years." *The World Bank Economic Review*, 12: 503-526.

Mundlak, Y. and D. F. Larson (1992). "On the Transmission of World Agricultural Prices." *World Bank Economic Review,* 6:399-422.

Nyange, D. A. (1999). "Estimation of Inter-regional Maize Market Integration in Tanzania and its Determinants." *Journal of Rural Problems* 135: 59-71.

Obstfeld, M. and A.M. Taylor (1997). "Nonlinear Aspects of Goods-Market Arbitrage and Adjustment; Heckscher's Commodity Points Revisited." *Journal of Japanese International Economics* 11: 441-479.

Putterman, L. (1995). "Economic Reform and Smallholder Agriculture in Tanzania: A Discussion of Recent Market Liberalization, Road Rehabilitation, and Technology Dissemination Efforts." *World Development* 23 (2): 311-326.

Quiroz, J. and R. Soto (1993). "International price signals in agricultural markets: do government care?" Mimeo, the World Bank, October.

Rapsomanikis, G., Hallam, D. and Conforti, P., 2004. "Market integration and price transmission in selected food and cash crop markets in developing countries: review and appliations", in FAO, *Commodity Market Review 2003-04*, FAO, Rome.

Ravallion, M. (1986). "Testing market Integration." American Journal of Agricultural Economics 68: 102-109.

Rodrik, D. (1999). "The New Global Economy and Developing Countries: Making Openness Work, Overseas Development Council, Washington.

Santorum, A.and A. Tibaijuka (1992). "Trading responses to food market liberalization in Tanzania", *Food Policy* 17: 431-442.

Suzuki, Y., and A. Bernard (1987). "Effects of Pan territorial Pricing Policy for Maize in Tanzania." International Food Policy Research Institute.

Tarimo, A. J. P., and Y. T. Takamura (1998). "Sugar Production, Processing and Marketing in Tanzania." *African Study of Monographs*, 19(1): 1-11.

Teklu, T., J. von Broun, and E. Zaki (1991), "Drought and Famine Relationship in Sudan: Policy Implications." Research Report 88, International Food Policy Research Institute, Washington, DC.

Tom, G. and A. Matthews (2005). "Global and EU Agricultural Trade Reform: What is in it for Tanzania, Uganda and Sub-Saharan Africa?" IIIS Discussion Paper No. 74.

United Nations Population Division, *World Urbanization Prospectus: The 2001 Revision*, Internet Resource Available at:
http://www.un.org/esa/population/puplications/WUP2001_CH4.pdf

United Republic of Tanzania (URT) (2002). Sugar Industry Act, 2001.

Uri, N.D., G. V. Chomo, R. Hoskin and B. Hyberg (1993). "The integration of the market for soybeans and soybean products." Food Policy 18: 200-213.

van Meijl, H. and F. van Tongeren (2001). "Multilateral trade liberalization and developing countries: a north–south perspective on agriculture and processing sector." 77th EAAE Seminar / NJF Seminar No. 325, August 17-18, 2001, Helsinki.

Webb, P., J. von Braun, and Y. Yohannos (1992). "Famine in Ethiopia: Policy Implications of Coping Failure at National and Household Levels." Resaerch Report 97, International Food Policy Research Institute, Washington, DC.

Winters. L. A., N. McCulloch and A. Mckay (2004). 'Trade Liberalization and Poverty: *Journal of Economic Literature* 42: 72-115

**Appendix 1: A Conceptual Framework for Testing Price Integration**

```
┌─────────────────────────────┐   If not the same
│ Test for order of Integration├──────────────────────┐
└───────┬──────────────┬──────┘                       ▼
        │              │              ┌──────────────────────────────┐
   if I(1)          if I(0)           │ No integration, Test for Granger│
        │              │              │ causality (GC)                 │
        ▼              ▼              └──────────────────────────────┘
┌──────────────────────────┐              │
│ Test   H₀: no co-integration├──────────┐ │
└──────┬───────────────────┘   accept   ▼
       │                      ┌──────────────────────────────┐
     reject                   │ Estimate ADL model, test for │
       ▼                      │ GC                           │
┌──────────────────┐          └──────────────────────────────┘
│ Test for GC      │
└──────┬───────────┘
       ▼
┌─────────────────────────────────────────────┐
│ Specify and estimate vector error correction │
│ model, assess dynamics and adjustment speed  │
│ and long-run GC                              │
└──────┬───────────────────────────────────────┘
       ▼
┌─────────────────────────────────────────────┐
│ Specify and estimate AECM include dummy for +/-│
│ disequilibrium, Test for long run GC          │
└──────┬───────────────────────────────────────┘
       ▼
┌─────────────────────────────────────────────┐
│ Assess overall transmission and market       │
│ integration                                  │
└─────────────────────────────────────────────┘
```

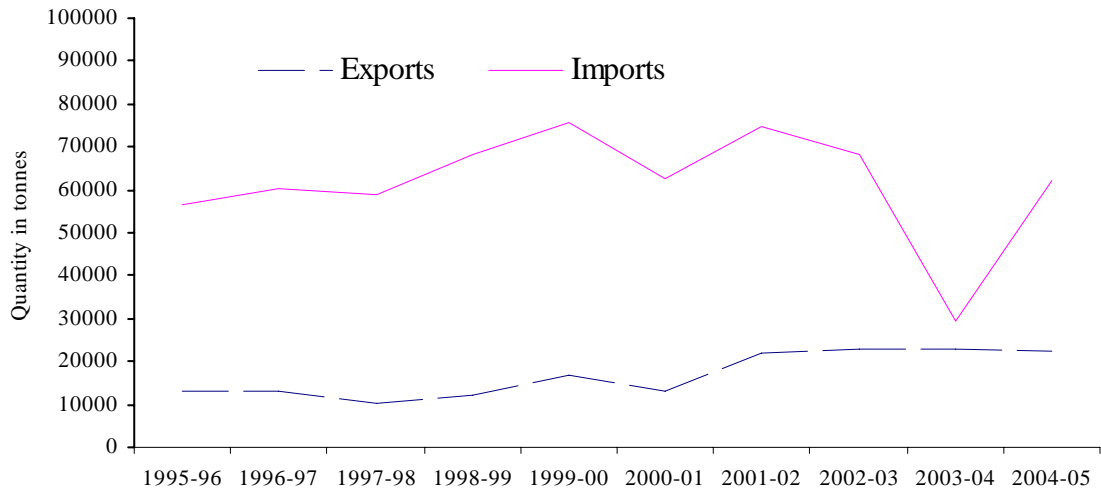**Source: Rapsomanikis, Hallam and Conforti (2004)**

**Figure 1:   Quantities of Sugar Imported to and Exported from Tanzania**
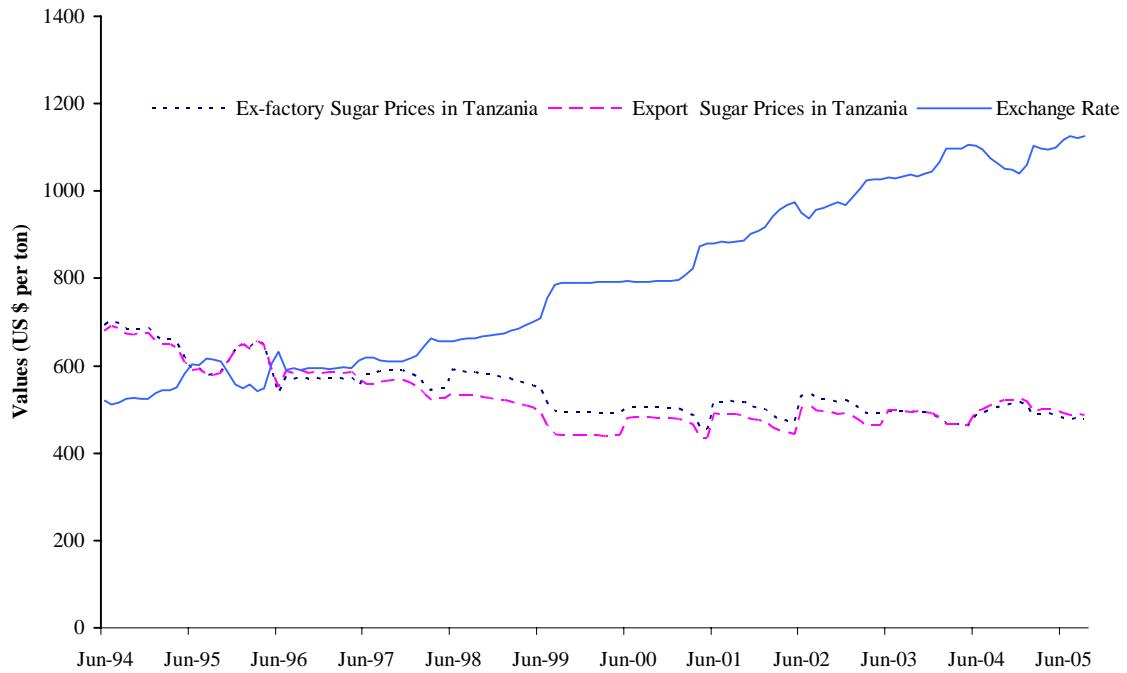


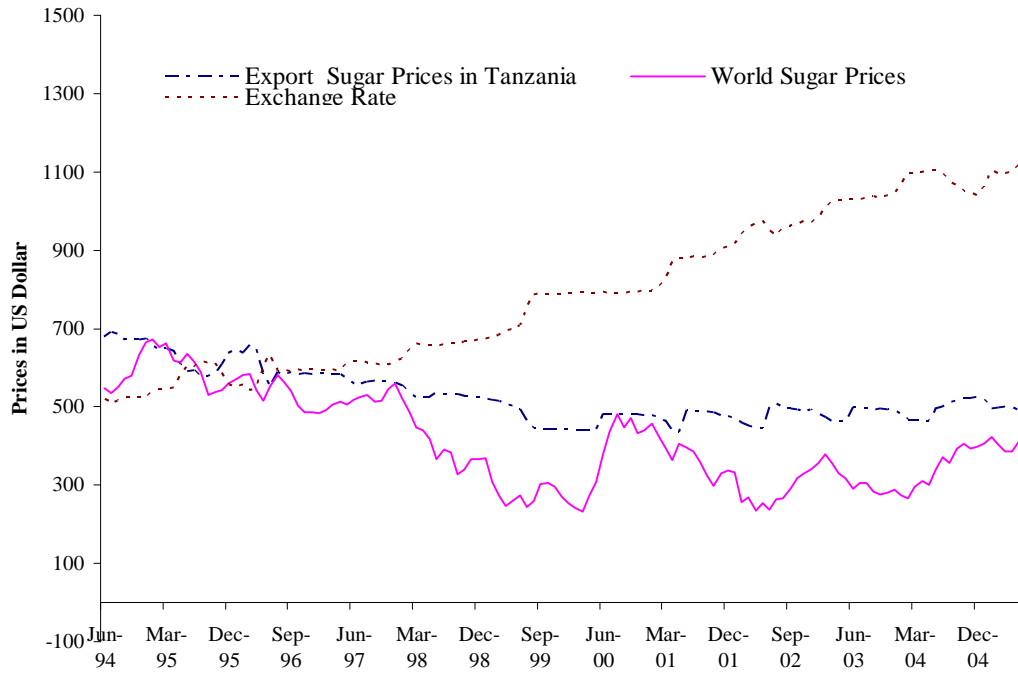**Figure 2:    Ex-factory and FOB Sugar Prices in Tanzania**

**Figure 3:** **World Market Sugar Prices and FOB Sugar Prices in Tanzania**
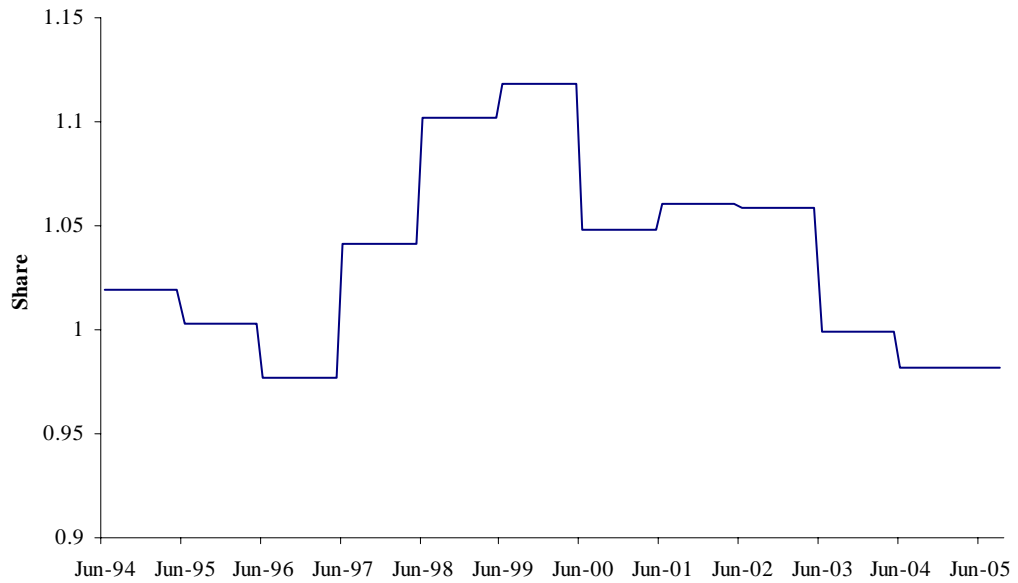


**Figure 4:  Ex-Factory Sugar Prices as a Percentage of FOB prices**
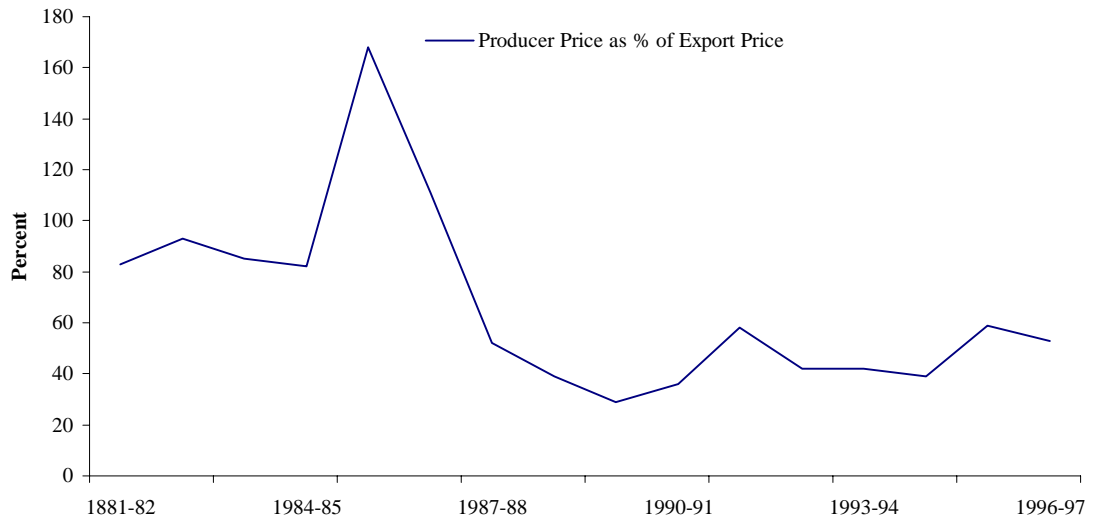
**Figure 5:    Cotton Producer Price as Percentage  of Export Price**
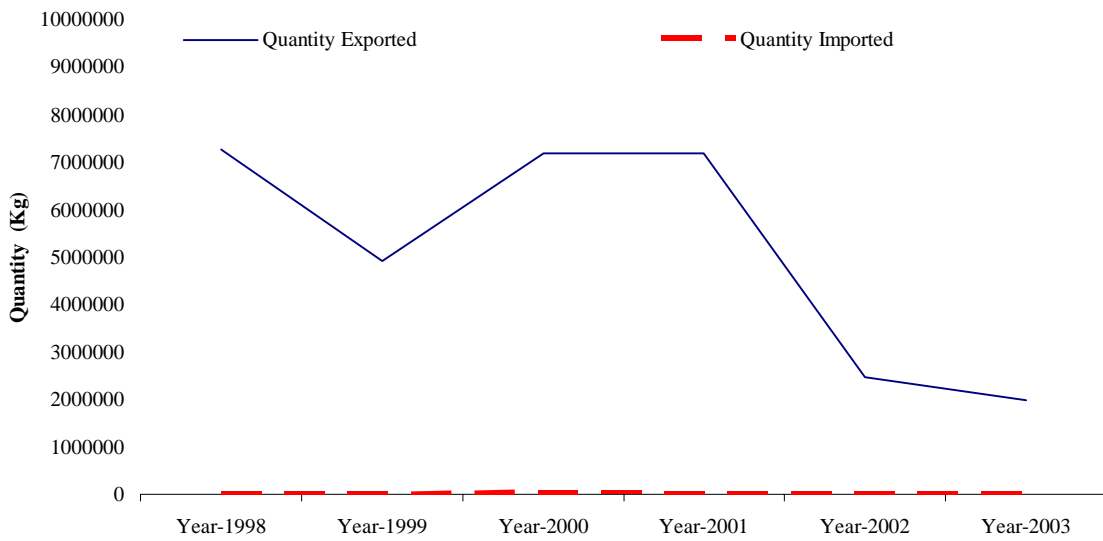


**Figure 6:    Quantity of Cotton Imported to and Exported from Tanzania**
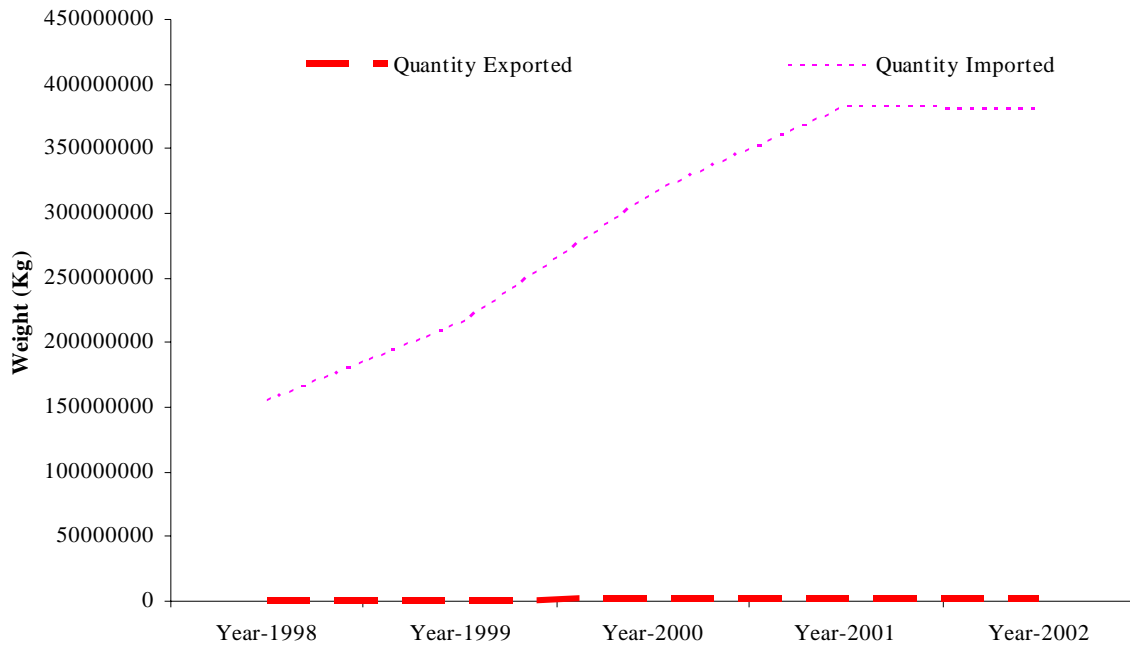
**Figure 7:** **Quantities of Wheat Imported to and Exported from Tanzania**
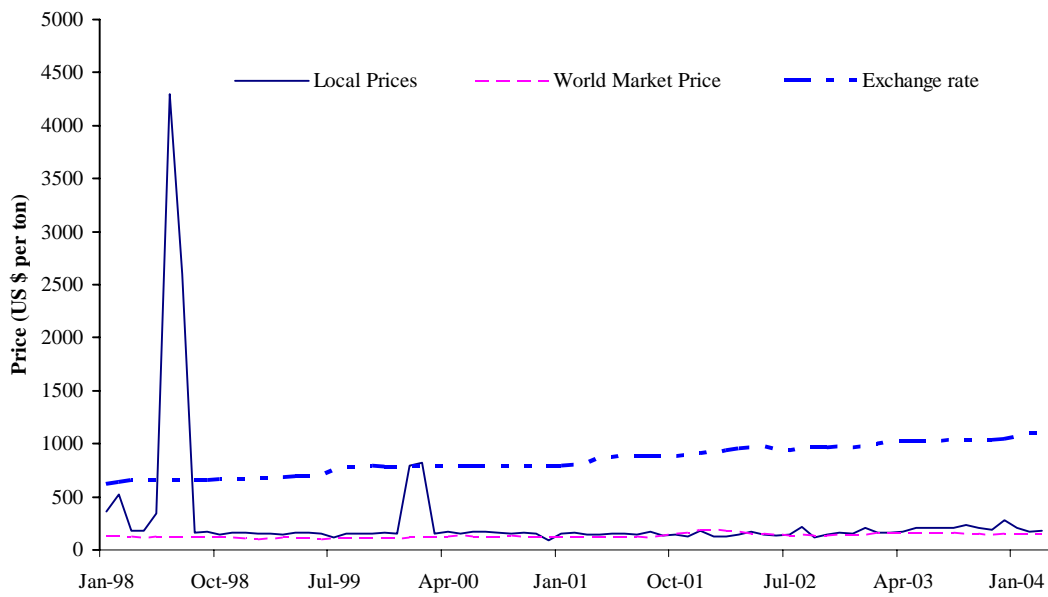


**Firure 8:** **World Market Wheat Price and and CIF Wheat Prices in Tanzania**
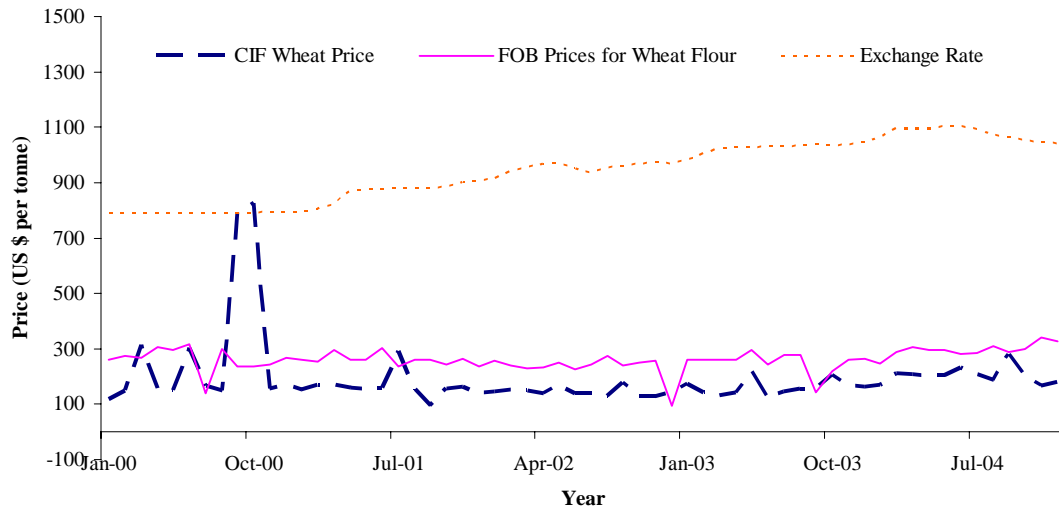
**Figure 9:   CIF Wheat Price and FOB Price of Wheat Flour in Tanzania**

**Figure 10: Wheat Marketing Chain in Tanzania**

Producers

Local Assemblers

Millers → Inter-regional Traders

Wholesalers

Retailers

Consumers
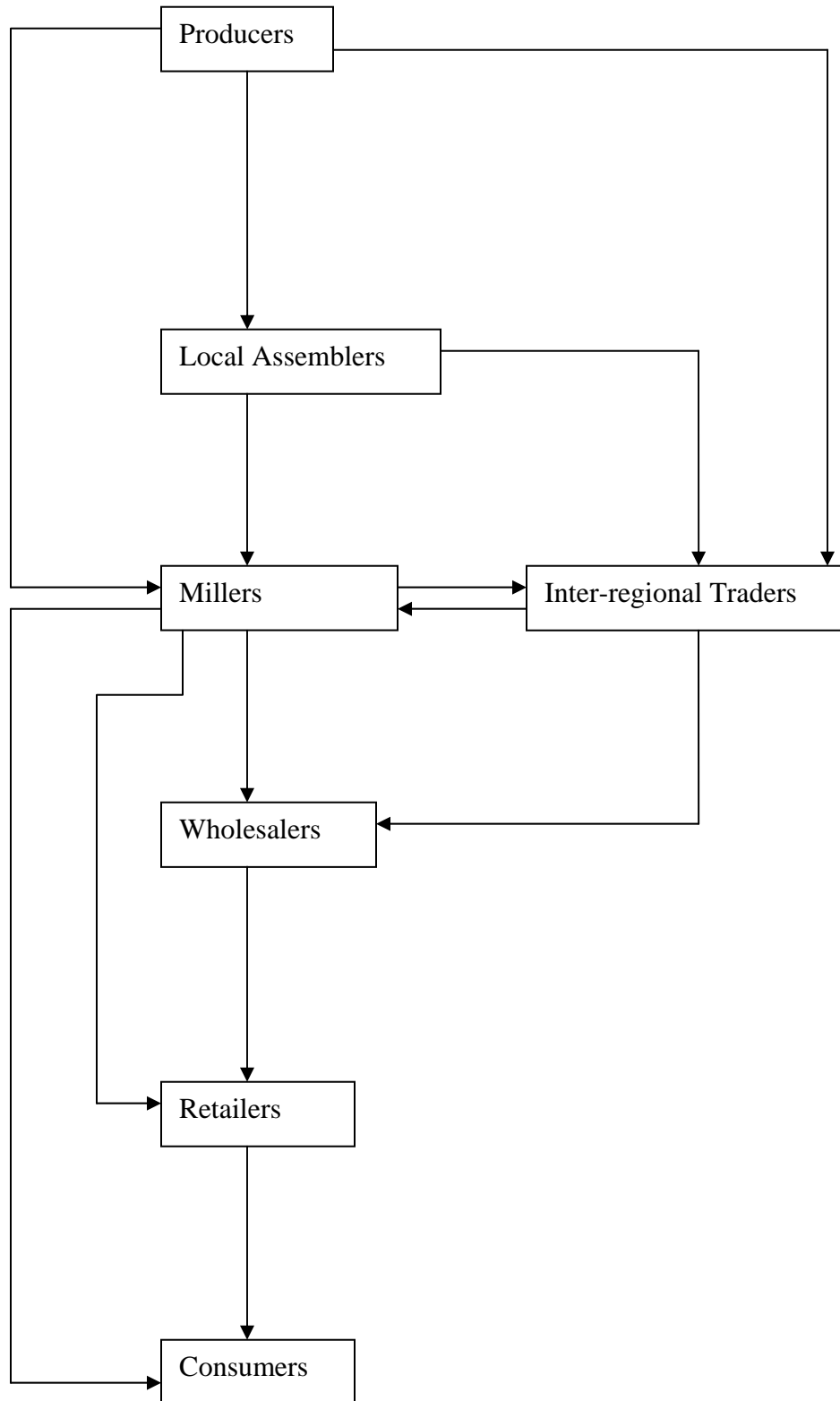
**Source**: Gabagambi (1998).

**Figure 11:    Qunatities of Rice Imported to and Exported from Tanzania**



**Figure 12:    World Market Broken Rice Price and CIF Prices for Broken Rice in
Tanzania**

**Table 1        Sugar Imported to Tanzania: 1998-2004**

| Country of Origin | Amount (Kg) | Share |
|---|---:|---:|
| South Africa | 855815 | 43.31 |
| India | 350300 | 17.73 |
| Netherlands | 279500 | 14.14 |
| Zambia | 244000 | 12.35 |
| Thailand | 105000 | 5.31 |
| Belgium | 86000 | 4.35 |
| Germany | 43000 | 2.18 |
| United Arab Emirates | 7502 | 0.38 |
| Italy | 1900 | 0.10 |
| China | 1580 | 0.08 |
| Denmark | 1205 | 0.06 |
| United Kingdom | 417 | 0.02 |
| **Total** | 855815 | 100.00 |

**Source:** TRA database (2005).

**Table 2:    Augmented Dickey-Fuller Unit Root Tests (*Tau* Statistics) for FOB Sugar Prices in Tanzania ( $P_t^{sugd}$ ) and World Market Sugar Price ( $P_t^{sugI}$ )**

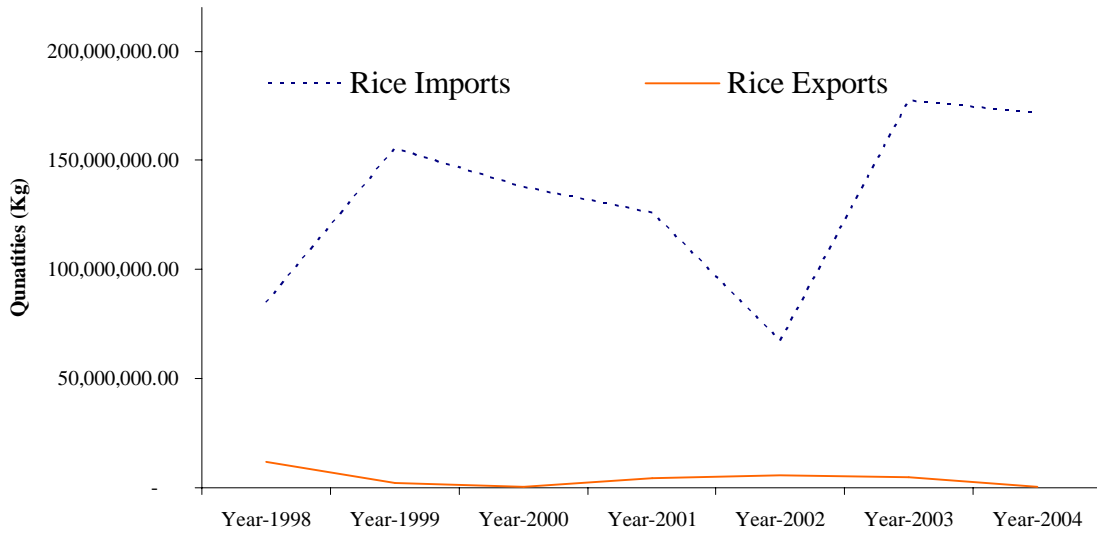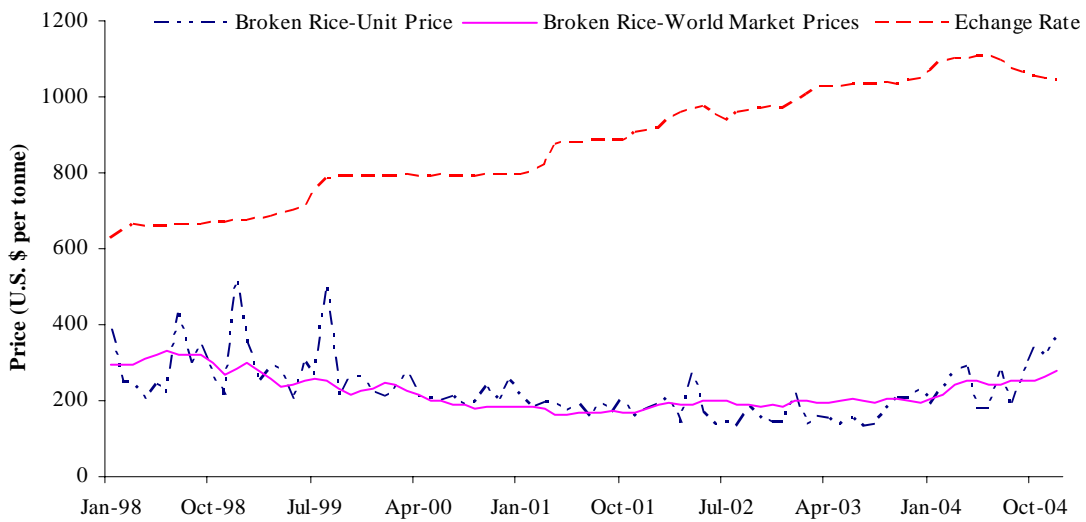| Series | Levels | | | First Differences | | |
|---|---|---|---|---|---|---|
| | Zero Mean | Single Mean | Trend | Zero Mean | Single Mean | Trend |
| $\ln P_t^{sugd}$ | -1.63 | -2.53 | -0.75 | -4.93 | -5.18 | -5.89 |
| | (0.0972) | (0.1106) | (0.9969) | (0.0001) | (0.0001) | (0.0001) |
| $\ln P_t^{sugI}$ | -0.47 | -2.13 | -2.14 | -3.11 | -3.13 | -3.31 |
| | (0.5083) | (0.2317) | (0.5174) | (0.0021) | (0.02775) | (0.0698) |

Note that figures in parenthesis represent $(\Pr < Tau)$.

**Source**: Own Analysis

**Table 3:    Augmented Dickey-Fuller Unit Root Tests (*Tau* Statistics) for Ex-factory Sugar Prices ( $P_t^{sugf}$ )**

| Series | Levels | | | First Differences | | |
|---|---|---|---|---|---|---|
| | Zero Mean | Single Mean | Trend | Zero Mean | Single Mean | Trend |
| $\ln P_t^{sugf}$ | -1.97 | -2.43 | -2.46 | -4.56 | -4.93 | -5.08 |
| | (0.0469) | (0.1362) | (0.3485) | (0.0001) | (0.0001) | (0.0003) |

**Source**: Own Analysis

**Table 4:    Co-integration Rank for FOB Sugar Prices in Tanzania ( $P_t^{sugd}$ ) and World Market Sugar Price ( $P_t^{sugI}$ )**

| Number of cointegrating vector | | Trace | Critical Values |
|---|---|---|---|
| $H_0$ : Rank equals to | $H_a$ : Rank equals to | | |
| 0 | 1 | 99.143 | 19.99 |
| 1 | 2 | 39.96 | 9.13 |

**Source**: Own Analysis

**Table 5:** **Co-integration Rank for Ex-factory ($P_t^{sugf}$) and World Market Sugar Price ($P_t^{sugI}$)**

| Number of Cointegrating vector | | Trace | Critical Values |
|---|---|---|---|
| $H_0$: **Rank equals to** | $H_a$: **Rank equals to** | | |
| 0 | 1 | 96.13 | 12.21 |
| 1 | 2 | 36.13 | 4.14 |

**Source**: Own Analysis

**Table 6:** **Granger Causality Test; Model** $P_t^{sugd} = c_1 + \sum_{i=1}^{2} \alpha_i P_{t-1}^{sugI} + \sum_{i=1}^{2} \beta_i P_{t-1}^{sugd} + \mu_t$

| Test: | Value | d. f | Significance |
|---|---|---|---|
| $H_0: \alpha_1 = \alpha_2 = 0$ | | | |
| $H_A: \alpha_1 \neq \alpha_2 \neq 0$ | | | |
| F-Statistic | 6.25 | (2, 128) | 0.0025 |
| Asymptotic $\chi^2$ | 12.99 | 2 | 0.0015 |

**Source**: Own Analysis

**Table 7:** **Granger Causality Test; Model** $P_t^{sugI} = c_2 + \sum_{i=1}^{2} \varphi_i P_{t-1}^{sugI} + \sum_{i=1}^{2} \xi_i P_{t-1}^{sugd} + u_t$

| Test | Value | d. f | Significance |
|---|---|---|---|
| $H_0: \xi_1 = \xi_2 = 0$ | | | |
| $H_A: \xi_1 \neq \xi_2 \neq 0$ | | | |
| F-Statistic | 0.2814 | (2,131) | 0.7551 |
| Asymptotic $\chi^2$ | 0.5848 | 2 | 0.7464 |

**Source**: Own Analysis

**Table 8:** **Granger Causality Test; Model** $P_t^{sugf} = c_3 + \sum_{i=1}^{2} \phi_i P_{t-1}^{sugI} + \sum_{i=1}^{2} \lambda_i P_{t-1}^{sugf} + \mu_t$

| Test: | Value | d. f | Significance |
|---|---|---|---|
| $H_0: \phi_1 = \phi_2 = 0$ | | | |
| $H_A: \phi_1 \neq \phi_2 \neq 0$ | | | |
| F-Statistic | 4.2599 | (2, 128) | 0.0161 |
| Asymptotic $\chi^2$ | 8.8526 | 2 | 0.0119 |

**Source**: Own Analysis

**Table 9:** **Granger Causality Test; Model** $P_t^{sugI} = c_4 + \sum_{i=1}^{2} \psi_i P_{t-1}^{sugI} + \sum_{i=1}^{2} \zeta_i P_{t-1}^{sugf} + u_t$

| Test | Value | d. f | Significance |
|---|---|---|---|
| $H_0: \xi_1 = \xi_2 = 0$ | | | |
| $H_A: \xi_1 \neq \xi_2 \neq 0$ | | | |
| F-Statistic | 0.7601 | (2,131) | 0.4696 |
| Asymptotic $\chi^2$ | 1.5796 | 2 | 0.4539 |

**Source**: Own Analysis

**Table 10:** **Augmented Dickey-Fuller Unit Root Tests (*Tau* Statistics) for FOB Cotton Prices in Tanzania ($P_t^{cod}$) and World Market Reference Price for Cotton ($P_t^{coI}$)**

| Series | Levels | | | First Differences | | |
|---|---|---|---|---|---|---|
| | Zero Mean | Single Mean | Trend | Zero Mean | Single Mean | Trend |
| $\ln P_t^{cod}$ | -1.02 (0.2749) | -1.57 (0.4967) | -1.93 (0.6353) | -5.28 (0.0001) | -5.43 (0.0001) | -5.54 (0.0001) |
| $\ln P_t^{coI}$ | -0.85 (0.3483) | -1.91 (0.3282) | -2.41 (0.3710) | -2.34 (0.0194) | -2.43 (0.1350) | -2.30 (0.4318) |

**Source**: Own Analysis

**Table 11:** **Co-integration Rank for FOB Cotton Price in Tanzania ($P_t^{cod}$) and World Market Reference Price for Cotton ($P_t^{coI}$)**

| Number of Cointegrating vector | | Trace | Critical Values |
|---|---|---|---|
| $H_0$ : Rank equals to | $H_a$ : Rank equals to | | |
| 0 | 1 | 129 | 12.21 |
| 1 | 2 | 37.21 | 4.14 |

**Source**: Own Analysis

**Table 12: Granger Causality Test; Model** $P_t^{cod} = c_5 + \sum_{i=1}^{2} \alpha_i P_{t-1}^{cod} + \sum_{i=1}^{2} \beta_i P_{t-1}^{coI} + e_t$

| Test: $H_0 : \beta_1 = \beta_2 = 0$ $H_A : \beta_1 \neq \beta_2 \neq 0$ | Value | d. f | Significance |
|---|---|---|---|
| F-Statistic | 7.2522 | (2, 115) | 0.0010 |
| Asymptotic $\chi^2$ | 15.1350 | 2 | 0.0005 |

**Source**: Own Analysis

**Table 13: Granger Causality Test; Model** $P_t^{coI} = c_6 + \sum_{i=1}^{2} \varphi_i P_{t-1}^{cod} + \sum_{i=1}^{2} \gamma_i P_{t-1}^{coI} + z_t$

| Test $H_0 : \varphi_1 = \varphi_2 = 0$ $H_A : \varphi_1 \neq \varphi_2 \neq 0$ | Value | d. f | Significance |
|---|---|---|---|
| F-Statistic | 0.4309 | (2,115) | 0.6509 |
| Asymptotic $\chi^2$ | 0.8993 | 2 | 0.6378 |

**Source**: Own Analysis

**Table 14:** **Augmented Dickey-Fuller Unit Root Tests (*Tau* Statistics) for CIF wheat Price in Tanzania ($P_t^{wheatd}$) and World Market Wheat Reference Price ($P_t^{wheatI}$)**

| Series | Levels | | | First Differences | | |
|---|---|---|---|---|---|---|
| | Zero Mean | Single Mean | Trend | Zero Mean | Single Mean | Trend |
| $\ln P_t^{Wheatd}$ | -1.02 (0.2749) | -1.57 (0.4967) | -1.93 (0.6353) | -5.28 (0.0001) | -5.43 (0.0001) | -5.54 (0.0001) |
| $\ln P_t^{WheatI}$ | -0.83 (0.3572) | -1.91 (0.3282) | -2.41 (0.3710) | -2.34 (0.0194) | -2.43 (0.1350) | -2.30 (0.4318) |

**Source**: Own Analysis

**Table 15:** **Co-integration Rank for CIF wheat Price in Tanzania ($P_t^{wheatd}$) and World Market Wheat Reference Price ($P_t^{wheatI}$)**

| Number of Cointegrating vector | | Trace | Critical Values |
|---|---|---|---|
| $H_0$ : **Rank equals to** | $H_a$ : **Rank equals to** | | |
| 0 | 1 | 100.65 | 12.21 |
| 1 | 2 | 27.15 | 4.14 |

**Source**: Own Analysis

**Table 16:** **Granger Causality Test; Model** $P_t^{wheatd} = c_7 + \sum_{i=1}^{3} \alpha_i P_{t-1}^{wheatd} + \sum_{i=1}^{3} \beta_i P_{t-1}^{wheatI} + \varepsilon_t$

| Test: $H_0 : \beta_1 = \beta_2 = \beta_3 = 0$ $H_A : \beta_1 \neq \beta_2 \neq \beta_3 \neq 0$ | Value | d. f | Significance |
|---|---|---|---|
| F-Statistic | 4.9808 | (2,79) | 0.0091 |
| Asymptotic $\chi^2$ | 10.5922 | 2 | 0.0050 |

**Source**: Own Analysis

**Table 17:** **Granger Causality Test; Model** $P_t^{wheatI} = c_8 + \sum_{i=1}^{3} \phi_i P_{t-1}^{wheatd} + \sum_{i=1}^{3} \zeta_i P_{t-1}^{wheatI} + z_t$

| Test $H_0 : \phi_1 = \phi_2 = 0$ $H_A : \phi_1 \neq \phi_2 \neq 0$ | Value | d. f | Significance |
|---|---|---|---|
| F-Statistic | 0.6608 | (2,79) | 0.5192 |
| Asymptotic $\chi^2$ | 1.4053 | 2 | 0.4952 |

**Source**: Own Analysis

**Table 18:** **Augmented Dickey-Fuller Unit Root Tests (*Tau* Statistics) for CIF Wheat Prices ($P_t^{wheatd}$) and FOB Prices of Wheat Flour ($P_t^{flourE}$)**

| Series | Levels | | | First Differences | | |
|---|---|---|---|---|---|---|
| | Zero Mean | Single Mean | Trend | Zero Mean | Single Mean | Trend |
| $\ln P_t^{Wheatd}$ | -0.71 | -3.15 | -3.43 | -1.96 | -1.97 | -3.68 |
| | (0.4048) | (0.0293) | (0.0595) | (0.0491) | (0.3009) | (0.0334) |
| $\ln P_t^{flourE}$ | 0.81 | -0.35 | -0.24 | -2.78 | -2.86 | -3.28 |
| | (0.8837) | (0.9100) | (0.9903) | (0.0064) | (0.0572) | (0.0812) |

**Source**: Own Analysis

**Table 19:** **Cointegration Test for CIF Wheat Prices ($P_t^{wheatd}$) and FOB Prices of Wheat Flour ($P_t^{flourE}$)**

| Number of Cointegrating vector | | Trace | Critical Values |
|---|---|---|---|
| $H_0$: Rank equals to | $H_a$: Rank equals to | | |
| 0 | 1 | 100.65 | 12.21 |
| 1 | 2 | 27.15 | 4.14 |

**Table 20:** **Granger Causality Test; Model** $P_t^{wheatd} = c_9 + \sum_{i=1}^{3} \alpha_i P_{t-1}^{wheatd} + \sum_{i=1}^{3} \beta_i P_{t-1}^{flourE} + \varepsilon_t$

| Test: | Value | d. f | Significance |
|---|---|---|---|
| $H_0: \beta_1 = \beta_2 = \beta_3 = 0$ | | | |
| $H_A: \beta_1 \neq \beta_2 \neq \beta_3 \neq 0$ | | | |
| F-Statistic | 3.1993 | (2,55) | 0.0479 |
| Asymptotic $\chi^2$ | 6.9409 | 2 | 0.0311 |

**Source**: Own Analysis

**Table 21:** **Granger Causality Test; Model** $P_t^{flourE} = c_{10} + \sum_{i=1}^{3} \phi_i P_{t-1}^{wheatd} + \sum_{i=1}^{3} \zeta_i P_{t-1}^{wheatI} + z_t$

| Test | Value | d. f | Significance |
|---|---|---|---|
| $H_0: \phi_1 = \phi_2 = 0$ | | | |
| $H_A: \phi_1 \neq \phi_2 \neq 0$ | | | |
| F-Statistic | 1.1689 | (2,55) | 0.3177 |
| Asymptotic $\chi^2$ | 2.5359 | 2 | 0.2814 |

**Source**: Own Analysis

**Table 22:** **Augmented Dickey-Fuller Unit Root Tests (*Tau* Statistics) for CIF Rice Price in Tanzania ($P_t^{ricd}$) and World Market Reference Price for Rice ($P_t^{ricI}$)**

| Series | Levels | | | First Differences | | |
|---|---|---|---|---|---|---|
| | Zero Mean | Single Mean | Trend | Zero Mean | Single Mean | Trend |
| $\ln P_t^{ricd\,2}$ | 0.17 (0.7315) | -0.94 (0.7710) | -1.07 (0.9999) | -0.39 (0.5286) | -1.24 (0.6549) | -0.38 (0.9987) |
| $\ln P_t^{ricI}$ | 0.3 (0.7690) | -1.23 (0.6599) | 0.02 (0.9958) | -0.02 (0.6727) | -1.39 (0.5844) | -0.35 (0.9877) |

**Source**: Own Analysis

**Table 23:** **Co-integration Rank for CIF Rice Price in Tanzania ($P_t^{ricd}$) and World Market Reference Price for Rice ($P_t^{ricI}$)**

| Number of Cointegrating vector | | Trace | Critical Values |
|---|---|---|---|
| $H_0$ : Rank equals to | $H_a$ : Rank equals to | | |
| 0 | 1 | 105.18 | 12.21 |
| 1 | 2 | 34.00 | 4.14 |

**Source**: Own Analysis

**Table 24: Granger Causality Test; Model** $P_t^{ricd} = C_{13} + \sum_{i=1}^{2} \phi_i P_{t-1}^{ricd} + \sum_{i=1}^{2} \lambda_i P_{t-1}^{ricI} + \mu_t$

| Test: | Value | d. f | Significance |
|---|---|---|---|
| $H_0 : \lambda_1 = \lambda_2 = 0$ | | | |
| $H_A : \lambda_1 \neq \lambda_2 \neq 0$ | | | |
| F-Statistic | 4.9715 | (2, 79) | 0.0092 |
| Asymptotic $\chi^2$ | 10.5724 | 2 | 0.0050 |

**Source**: Own Analysis

**Table 25: Granger Causality Test; Model** $P_t^{ricI} = c_{14} + \sum_{i=1}^{2} \psi_i P_{t-1}^{ricd} + \sum_{i=1}^{2} \zeta_i P_{t-1}^{ricI} + u_t$

| Test | Value | d. f | Significance |
|---|---|---|---|
| $H_0 : \psi_1 = \psi_2 = 0$ | | | |
| $H_A : \psi_1 \neq \psi_2 \neq 0$ | | | |
| F-Statistic | 2.2217 | (2,79) | 0.1151 |
| Asymptotic $\chi^2$ | 4.7247 | 2 | 0.09441 |

**Source**: Own Analysis