

**THE IMPACT OF MARKET REFORM PROGRAMMES ON COFFEE PRICES IN  
TANZANIA**

**BY**

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**ABSTRACT**

The Research investigates the effect of collapse of international coffee agreement (ICA) and liberalization of coffee marketing in Tanzania on coffee prices. The motivation for this analysis is that the ICA regulatory system reduced price volatility by encouraging the build-up of stocks during surplus years and its demise meant allowing coffee prices to vary based on the market forces of supply and demand. Also the purpose of liberalizing coffee marketing in Tanzania was to enhance market efficiency and increase prices paid to domestic producers. Since the liberalization of coffee markets occurred after the collapse of the ICA there is a possibility that prices paid to domestic producers were higher but more volatile after the reform. This hypothesis is tested using descriptive and inferential statistics in conjunction with an ARCH-M model. Data used are time series for producers' prices in Tanzania and were obtained from the International Coffee Organization. Results show that there was a significant decline in coffee prices after the collapse of the ICA and market liberalization. Results also show that the volatility did not persist over the entire post-liberalization period. To mitigate these problems there is a need to: improve coffee quality through harnessing the support in training and knowledge transfer provided by certified exporters, the public sector and international co-operation.

**DECLARATION**

I **Elisha Mkandya** hereby declare to the Senate of Sokoine University of Agriculture that, this dissertation is the result of my own original work and has not been submitted for a higher degree award in any other University.

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Elisha Mkandya  
(MSc. Candidate)

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Date

The above declaration is confirmed by

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Dr. F.T.M. Kilima  
(Supervisor)

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Date

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It is more of a dispensation than a right that I should sign my name to this work, which is the mutual effort of so many. I will not attempt to list all individuals who in one way or another assisted in the accomplishment of this task and make it a reality even though each one of them deserves special mention. It would be unseemly, however, not to list a few names.

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**DEDICATION**

This dissertation is dedicated to my beloved parents the late Martine Timothy and Juliana Paulo who lit the torch of my academic career.

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## CHAPTER ONE

### 1.0 INTRODUCTION

Coffee is an important traditional crop in Tanzania and it contributes significantly to the country's GDP and foreign earnings besides offering employment to many people (Temu, 1994). The share of coffee out of total value of traditional exports in Tanzania ranged between 15% and 28% in 1999-2004 (BOT, 2005). Nevertheless, 95% of this coffee came from smallholder coffee growers with plots of 1-2 hectares who are responsible for determining the quality of coffee at farm level and their practices affect the final grade and quality of coffee (Baffes, 2003).

The coffee price and quality control systems in Tanzania have changed over time as the economy has gone through a transformation from being a command to a market-based system. Prior to liberalization of coffee market the primary cooperative societies were mandated to buy coffee from farmers and delivered the coffee to processing factories located in Moshi (Arabica) and Bukoba (Robusta), which were owned by the cooperatives.

During this period coffee was sold to exporters at the Moshi Auction, operated by the Tanzania Coffee Board, which was the only authority that determined coffee prices on the domestic market and publicized the prices before the start of the buying season (Daviron and Ponte, 2005). The government abolished the primary societies in 1976 and all post-harvest functions were handed over to the villages whose functions were regulated by the Tanzania Coffee Board renamed the Coffee Authority of Tanzania in 1977 (Baffes, 2003).

In 1984, the government authorised the cooperative unions and primary societies to take over again the marketing functions (Daviron and Ponte, 2005). The cooperatives through primary societies paid a fixed advance payment per unit of weight of coffee delivered and

then paid another one or two instalments after delivering the coffee to curing plant or exporting it. Although the multi-payment system reduced the uncertainty for the growers, it introduces a considerable price risk for the cooperative unions. When the first payment to coffee growers was higher than the price realised at the auction, the cooperative unions incurred losses.

Evidence shows that most unions incurred huge losses in the early 1990s but avoided bankruptcy because the cooperatives received special support for both political and economic reasons. Literature shows that many developing countries are known for intervening intensively in their agricultural markets for two main reasons. Firstly, in many countries agriculture is the largest sector of the economy and the main export sector and it is easy to monitor and tax it. Secondly, intervention has also been perceived as an instrument to reduce domestic price volatility with the view of lowering risks to producers who depend on the prices of export crops (Akiyama *et al.* 2003).

The introduction of market demand driven economy has resulted into removal of subsidy for cooperative union and has allowed private traders to purchase coffee directly from growers and process it in their own factories, this change has reduced the monopoly power of cooperative union (Baffes, 2003). Market reforms implemented in developing countries such as Tanzania have sought to present agricultural producers with the right prices to stimulate productivity through promoting efficiency in resource use and allocation within the agricultural sector. Despite this optimistic view concerns have been raised with respect to both the direct and indirect effects of market reforms on the level of prices, their variance and shifts in relative prices (Krueger *et al.* 1988). These price shocks arising from the liberalization of coffee markets in conjunction with the collapse of the international coffee agreement in the 1980's constitutes new challenges to actors in the coffee value

chain. Deaton and Miller (1996) and Collier and Gunning (1999) reveal that the shocks have been shown to affect the economic growth as well as socio-political discontent.

### **1.1 Problem Statement**

The main challenges for the coffee industry in Tanzania relate to tremendous fall in prices and the resulting volatility in the world market after collapse of international coffee agreement in 1980's and liberalization of coffee markets in 1992/93. Statistics show that farm-gate prices declined in absolute term from 1 412 Tshs per kg in 1993 to 750 Tshs per kg in 2003 (BOT, 2003) and continued to fall by almost 6.5% per kg in 2005 (BOT, 2005).

While there are many reasons to justify this fall in coffee prices there is evidence to suggest that the fall is mainly attributable to deterioration in coffee quality. Daviron and Ponte (2005) indicate that the overall quality of Tanzania's green coffee has undoubtedly declined reflecting the decrease in proportion of top-quality coffee sales at the auction. These findings imply that the world market can objectively determine and value coffee quality. This idea has received an overwhelming support in economic theory. Among other theories, the efficient market hypothesis stipulates that prices of traded assets gives "fair" value of the corresponding equities/commodities and reflect all information about their future prospect (Milkiel, 2003; Timmermann and Granger, 2004; Akintoye, 2008).

In summary it is important to note that the fiscal consequences of a sharp commodity price decline in the 1980s and early 1990s came from several sources including; Domestic and external policies and practices, which have direct or indirect effects on commodity markets. These challenges therefore pose an empirical ambiguity with respect to effects of

reform policies on the general direction and magnitude of real coffee price. This study examines the impact of market reforms on coffee prices and its implication at farm-level.

## **1.2 Justification**

Many researchers (e.g. Daviron and Ponte 2005; Baffes 2005; Winter-Nelson and Temu 2005; Ashimogo *et al.* 2007; Winter-Nelson and Temu 2002) have attempted to assess the evolution of coffee prices in Tanzania after market reforms. However, many of these researchers have used non-parametric methods to assess price changes. Unlike these previous studies, this study employs a parametric model to test whether coffee prices observed after market reforms are lower and more volatility than before the reforms. Excessive volatility and sustained decreases in coffee prices has the potential to endanger the livelihoods of about 500 000 families of small-scale farmers employed in coffee sector and other 2 million individuals involved in the sector such as researchers, extensionist, marketing agents, coffee processors and those employed in coffee plantations who depend on coffee as the major source of earnings (TCA, 2006). Findings from this study will provide more credible information regarding the evolution of coffee prices in Tanzania after market reforms and should help planners and policy makers to adopt appropriate price policies.

Although price changes may arise from structural factors linked with the production of coffee itself; the changes could also emanate from developments in commodity exchange markets (e.g. destabilizing speculation), failure of international cooperation to stabilize prices as well as market reforms discussed in section 1.1.

### **1.3 Objective of the Study**

#### **1.3.1 Overall objective**

The main objective of this study is to assess the impact of market reforms on coffee prices and its implication for small holder farmers in Tanzania.

#### **1.3.2 Specific objectives**

- (i) To examine the impact of the market reforms on the levels and volatility of coffee prices, and;
- (ii) To identify factors that influence prices of coffee exported from Tanzania.

### **1.4 Hypotheses**

- (i) The market reforms did not increase the prices paid to producers of Arabica coffee.
- (ii) The market reforms did not increase the volatility of prices paid to producers of Arabica coffee.

### **1.5 Organisation of the study**

This thesis is organized into five chapters. The first chapter provides background information and it presents the problem statement, study objectives, and research Hypotheses. The second chapter gives a review of literature relevant to the study while the third chapter presents the methodology used in this study. The fourth chapter discusses the main findings while conclusion and recommendations are summarized in chapter five.



## CHAPTER TWO

### 2.0 LITERATURE REVIEW

#### 2.1 Introduction

This chapter reviews literature related to coffee sub-sector and its role in the economy. Also this section reviews the economic importance of coffee, domestic trade regulation, interventions at the commodity trade level and implications of market interventions on coffee prices. The section also evaluates alternative approaches that could be adopted in this study.

#### 2.2 Economic Importance of Coffee

Coffee is an important source of foreign exchange and household income for many developing countries. In Tanzania, it is the main export crop and contributes substantially to export earnings. Each year Tanzania is exporting 45 000 to 50 000 tonnes, corresponding to 99% of the total coffee production, equivalent to 0.8% to 0.9% of the world total coffee production (TCA, 2006). In 2003, export earnings from coffee amounted to US\$ 63m, making up around 6% of total merchandise export earnings (Baffes, 2003). The coffee sub-sector employs more than 7% of the total populations in Tanzania who earn substantial income from the coffee sector (Rutihinda, 2004).

However, the coffee sub-sector in Tanzania like many other commodity markets has been intensively intervened. Literature shows that this intervention is attributed to many reasons. Some analysts indicate that the most likely reason is to derive some political or economic benefits, which most developing countries believed was the right philosophy (World Bank, 1997).

Existing literature reveals that government marketing agencies might be inefficient and may use their monopoly power to achieve either price and income stability or food safety objectives without due consideration of consequences of welfare losses and gains (Friedman, 1954; Johnston and Mellor, 1961; Lal, 1985).

Experience from African countries show that the objectives of the control over marketing were to insulate farmers and consumers from market shocks and ensure tax and foreign exchange revenues (Bates, 1981; Todaro and Smith, 2006). In many African countries primary export crops such as cotton, coffee, tobacco and tea are considered too important, both politically and economically, to be handled by the private sector. While many interventions were locally designed there were other interventions that were organized through international commodity agreements. These interventions are briefly discussed in sections 2.3 and 2.4.

### **2.3 Domestic Trade Regulation**

Since the independency in 1961, the Tanzania economy held a strong belief in government controlled markets inherited from her colonial masters (World bank, 1997). In the coffee industry this form of control came in the form of cooperatives and coffee boards, which were involved in most aspects of production, marketing and trade of coffee. The institutionalization of coffee marketing replicated earlier endeavours by expatriate coffee growers during the 1920s<sup>1</sup> and thereafter a successful marketing cooperative of native cultivators, which was established in Kilimanjaro in 1932. This belief triggered a national-wide campaign to promote cooperative movement even in areas where this philosophy was

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<sup>1</sup> During the colonialism cooperatives were viewed an instrument to promote and protect and colonial interests (Clarence-Smith, 1995).

new, incompatible with people's way of life or simply not needed. Despite the fact that many of the newly formed cooperatives were mismanaged and collapsed in the mid-1960s, the government forced-cooperative movement continued to expand and since then the coffee sub-sector has been subjected to a shifting power between cooperatives and coffee board and other players that are described in section 1.0.

#### **2.4 Interventions at the Commodity Trade Level**

Larson *et al.* (1998) reveal that programmes organized through international commodity agreements have been widely adapted to stabilize prices of major commodities traded. In the past interventions at this level took the form of quota or buffer stock. One of the most significant interventions in coffee was the international coffee agreements (ICA) implemented in 1962 to July 1989. This agreement regulated the volumes of coffee exports as it placed ceilings on the amount of coffee exported by producing members. However, since the demise of this agreement in 1989 there has been no effective supply management. The situation that emerged after this demise is described as "race to bottom" competition and it refers to exporters' eagerness to increase revenue from coffee trade, which resulted into a huge increase in supply and depressed earnings.

Another intervention in the coffee section in Tanzania has been the liberalization of coffee marketing motivated by the global evidence that successful reforms<sup>2</sup> would reduce the monopoly power held by government marketing agencies and allow producers to receive a larger share of export prices. The view that reduced government involvement in marketing and production; and increasing participation of the private sector in commodity markets can promote marketing efficiency through reducing price distortions has received an overwhelming support in economic literature (Todaro and Smith, 2006). Evidence shows

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<sup>2</sup> The successful adoption of market-oriented agricultural policies in China and the collapse of the former Soviet Union were cited as contrasting cases in favour of market lead-economy and against the philosophy of state-controlled economy, respectively.

that many marketing aspects have improved after the liberalization of coffee markets in Tanzania. Notable improvements include: Increased participation of private buyers that increased their market share from 6% (prior to 1994) to 67% in the late 1990s; Increased number of coffee processing facilities from 2 in the late 1980s to at least 12 after 1993—though with significant capacity underutilization (Daviron and Ponte, 2005).

However, it is important to realize that successful reforms require strong political commitment in terms of strengthening of a supporting regulatory environment. However, the continued existence of protectionist policies elsewhere in the world—especially among developed countries, may encourage reforming countries to maintain some level of market control even after the reform processes—albeit implicitly. In Tanzania the process of reforming coffee markets has neither been totally successful nor complete and there are many challenges to address: Coffee markets continue to be tightly controlled by Tanzania Coffee Board (TBC); the registration and taxation processes are claimed to be overly complex and tax rates too high; except for grades that qualifies for direct export all coffee other grades must be auctioned through the Moshi Coffee auction, a statutory body managed and run by TCB (Baffes, 2003).

## **2.5 Implications of Market Interventions on Coffee Prices**

The foregone discussion about interventions in the coffee market has had profound ramifications for coffee prices in Tanzania. Before market liberalization coffee farmers in Tanzania experienced an internal pricing and price formation mechanism that paid a minimum or guaranteed advance to farmers upon delivering the coffee to cooperatives and the balance was paid in two installments. However, the second and third payments were never guaranteed and could be forfeited when the cooperatives incurred losses. Although

the International Coffee Agreement (ICA) seemed to offer an opportunity for the relatively less efficient African producers to market their coffee many African exporters were not able to exploit the opportunity because it restricted the volume to be traded (Pearson and Meyer, 1994).

The liberalization of coffee markets in 1993 meant co-existence of the conventional buyer (cooperatives) and private buyers (both individuals and companies). The existence of multiple buyers may have subjected producers to more price risk because intensified competition would make cooperatives less willing to offer guaranteed price or floor to farmers and would induce price volatility even in areas where cooperatives offered more lucrative terms than private buyers. Furthermore market liberalization may raise questions over the possibility that it may result into buyer-driven value chain that exclude small producers and that brand owners and marketers are the most powerful actors within the chain to influence farm gate prices.

In Tanzania there have been concerns over the consequences of the tremendous fall in prices and the resulting volatility after the collapse of international coffee agreement in 1989 and liberalization of coffee markets in 1993. While there are many possible reasons to justify this fall in coffee prices there is evidence to suggest that the fall is mainly attributable to deterioration in coffee quality. However, it has been established in section 1.0 that the fiscal consequences of a sharp commodity price decline in the 1980s and early 1990s came from several sources. Therefore there is a need to investigate the effects of reform policies on the general direction and magnitude of coffee price. This study attempts to examine the impact of market reforms on the level and volatility of coffee prices and its implication for smallholder farmers in Tanzania.

It is crucial to understand changes in mean prices and price volatilities because these changes have direct impacts on the livelihood of actors in the coffee sub-sector. Excessive volatility and sustained decreases in coffee prices have the potential to endanger the livelihoods of millions of rural workers involved in coffee plantations, coffee processing factories who depend on coffee as their major source of earnings. For example, when large scale farmers feel that they cannot break even, the natural response may not be to stop production (a difficult decision with perennial crops) but to exploit labour, which may be achieved through low wages, excessive working hours and use of cheap labour (e.g. children willing to work for less than the going wage) or to engage in poor environmental management such as deforestation if expansion is a cheaper way of increasing yields than is intensification. In other words, low prices may encourage unethical practices to emerge as producers strive to reduce their production costs.

Similarly, high and sustained price volatility can undermine the welfare of poor producers and consumers who have limited access to lucrative diversification options and are more vulnerable to price risk. Unbalanced access to these options and exposure to price risks may lead to a vicious and self-reinforcing system of unequal distribution of resources and income, which can force poor people into persistent poverty that affect household consumption, nutrition, health and education.

It is important to realize that price volatility is not always a bad thing because it can allow entrepreneurs to reallocate resources to high-risk yet more rewarding enterprises when prices are high. However there is evidence suggesting that most African producers are risk averse and tend to avoid risk irrespective of expected returns (Finkelshtain and Chalfant, 1991). Also many farmers in developing countries operate in imperfect markets and they do not realize all the gains from reallocating resources into different risk portfolios (Oi,

1961). When markets are imperfect African farmers, who have no access to hedging markets, might make ill-informed decisions based on price movements that are largely distorted and unrelated to supply and demand.

Other actors in the coffee (e.g. exporters, stockists and related businesses) can realize less profit when prices are more volatile because of limitation in storage capacities and supply response to take advantage of opportunities created by price volatility. Coffee is perennial crop and the supply response is very limited in a short-run period i.e. investment response to price change is quicker but output response to investment is slow.

## **2.6 Modelling**

Literature shows that there are various ways of measuring price instability. The simplest approach involves descriptive analysis of changes in mean and volatility of coffee prices over time. One for example would calculate the mean prices for each reference period and compare the means descriptively or statistically. Price volatility can also be assessed by treating all price movements as indicative of instability and calculating standard deviation of the price index across reference periods (Groebner *et al.* 2005).

The main purpose of this study is to investigate the effect of market reforms on both levels and volatilities of coffee prices paid to producers in Tanzania before and after market reforms. This investigation entails accessing the differences across the reform periods and testing whether the difference is statistically significant. The rationale for this analysis is that the ICA regulatory system reduced price volatility by encouraging the build-up of stocks during surplus years and its demise meant allowing coffee prices to vary based on the market forces of supply and demand (Akiyama *et al.* 2001). The purpose of liberalizing coffee marketing in Tanzania can be broadly stated as increasing prices paid to

domestic producers. Since the liberalization of coffee markets occurred after the collapse of the ICA it is reasonable to hypothesize that prices paid to domestic producers were higher but more volatile after the reforms. In a statistical sense the research questions being investigated can be stated as testable hypotheses expressed as:

$$\begin{array}{ll}
 H_0 : \sigma_{i1-in}^2 = \sigma_{j1-jn}^2 & \dots\dots\dots(1) \quad \text{and} \quad H_0 : \mu_i = \mu_j \\
 H_1 : \sigma_{i1-in}^2 \neq \sigma_{j1-jn}^2 & \dots\dots\dots(2) \quad \text{and} \quad H_1 : \mu_i \neq \mu_j
 \end{array}$$

where  $\sigma_{i1-in}^2$  and  $\sigma_{j1-jn}^2$  are unconditional variances of coffee prices at farm level before and after the reforms, respectively;  $\mu_i$  and  $\mu_j$  are mean prices before and after the reforms, respectively. The subscripts  $i$  and  $j$  signify pre- and post-reform periods, respectively.

Thus the null ( $H_0$ ) and alternative ( $H_1$ ) hypotheses summarized in equations (1) could be tested using the ratio of variances as follows:

$$F^{Obs} = \frac{\sigma_{i1-in}^2}{\sigma_{ij-jn}^2} \approx F(n_1, n_2) \dots\dots\dots$$

(3)

However, use of variance or standard deviation as a measure of variation is criticised as it does not take into account the trade-off between levels and variability of variables



considered. Coefficients of variations are always accepted as better measures of variability than standard deviations as adopted to correct for this oversight (Groebner *et al.* 2005).

Likewise the hypothesis shown in equations (2) is simply a test for the mean difference across the reform periods. In finite sample this test is the conventional Z or an independent *t*-test for mean difference. While these simple statistics are widely used to assess variability of data sets they can not account for predictable components like trends in the price evolution process and may overstate the levels and volatilities of variables. Furthermore, it is always advisable to distinguish not only between predictable and unpredictable components of prices but also to allow the variance of unpredictable element to be time variant.

A more robust approach for testing change in levels and volatility of coffee prices before and after the market reforms is to generate a statistical model that allows the conditional variance to vary over time. Such time varying conditional variances has been widely modelled as an Autoregressive Conditional Heteroscedasticity (ARCH) model and GARCH framework (Engle, 1982; Bollerslev, 1986). However there are several variants of this model and the choice of an appropriate model should be based on relative advantages of each specification. An Autoregressive Conditional Heteroscedasticity in mean (ARCH-M) would be appropriate for the problem at hand as described below:

First, many storable commodity prices are perceived to have an Autoregressive Conditional Heteroskedasticity (ARCH) process because current price volatility transmits itself into future periods by creating volatility in inventory carryover (Beck, 2001 cited by Kilima *et al.* 2008). The model is commonly applied to non-perishable (storable) agricultural commodities where inventory carry-over is possible (Barrett, 1997; Shively, 2001). The

basic assumption underlying this model is that there is a non-linear fashion in temporal behaviour of the price series that induces volatility. The preference for this model over descriptive and simple statistical tests is that it takes into account the evolution of price levels, and the mean and volatility equations are both estimated in a simultaneous framework. The advantages of this model over other possible GARCH specifications when data is well-behaved<sup>3</sup> are well-known and beyond the scope of this study (Kilima *et al.*, 2008). The conceptual model adopted follows Kilima *et al.* (2008) and is specified as:

$$\begin{aligned}
 Y_{it} &= \alpha_0 + \sum_h \alpha_h X_{hit} + \delta h_{it}^{1/2} + \sum_j \xi_j D_{ji} + \varepsilon_{it}, \\
 \varepsilon_{it} | \psi_{t-1} &\sim iidN(0, h_{it}), \dots\dots\dots(4) \\
 h_{it} &= \beta_0 + \sum_k \beta_k \varepsilon_{it-k}^2 + \sum_l \gamma_l Z_{it} + \sum_m \eta_m D_{mi}.
 \end{aligned}$$

$Y$  is a dependent variable generated by an autoregressive process, and  $X$  and  $Z$  are vectors of exogenous variables.  $D$  is a vector of region-specific attributes that account for differences in price volatility across regions. Error term  $\varepsilon$  is assumed to be independently, identically, and normally distributed, conditional on the information set  $\psi_{t-1}$  with mean zero and variance  $h$ .  $\varepsilon_{t-1}, \dots, \varepsilon_{t-k}$  are lagged disturbances where  $k$  is the order of the autoregressive process appropriate for the ARCH-M model.  $\alpha$ 's,  $\beta$ 's,  $\gamma$ 's,  $\delta$  and  $\eta$ 's are parameters of mean and variance equations.

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<sup>3</sup> The ARCH-M model can be adopted when the series is observed at least on monthly basis, it is stationary and there are no leverage and interaction effects.

## CHAPTER THREE

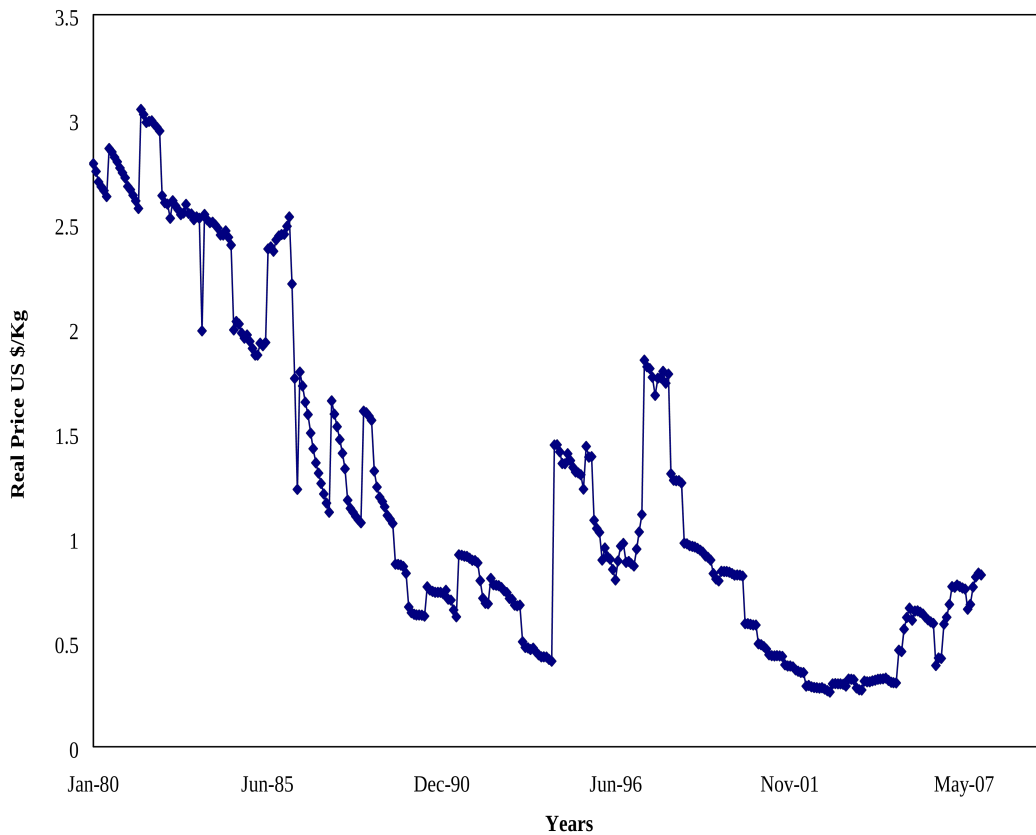
### 3.0 METHODOLOGY

#### 3.1 OVERVIEW

This chapter presents the methodology used in the study. It gives detailed information regarding data types and sources as well as analytical tools adopted for analysis. The analytical tools that are adopted are evaluated, compared and specified.

#### 3.2 Data types and Source

This study utilizes monthly wholesale prices of mild arabica coffee paid to producers in Tanzania for years 1980–2007 (Figure 1). The price data were obtained from the International Coffee Organization (ICO) website ([www.ico.org/prices/pr](http://www.ico.org/prices/pr)). Additional data was obtained from the Bank of Tanzania (BoT) and Tanzania Revenue Authority (TRA). The series are aggregated on a monthly basis with 336 observations. Since the dependent variable was quoted in USD per kg it was necessary to eliminate the effect of inflation, which can make prices look integrated (Alderman and Paxson, 1992) and the price series was deflated using appropriate Consumer Price Index (CPI) to arrive at real price.



**Figure 1 Price Paid to Producers of Arabica Coffee in Tanzania**

### 3.3 Data Analysis

In this study the descriptive and inferential statistics were used as bench-mark to identify the differences in levels and volatilities before and after the coffee market reforms. The null hypothesis stated in equation (1) is tested descriptively and statistically. The descriptive analysis involves the use of coefficients of variation of prices observed before and after market reforms. The coefficients of variation are simply the ratios of standard deviations to means of prices observed before and after market reforms. The null hypothesis is rejected if the coefficients are different.

The null hypothesis specified in equation (2) is tested using Z-scores, which is formally defined as:

$$Z = \frac{(\bar{p}_i - \bar{p}_j) - (\mu_i - \mu_j)}{\sqrt{\frac{S_i^2}{n_i} + \frac{S_j^2}{n_j}}} \dots\dots\dots$$

(5)

where  $\bar{p}_i$  and  $\bar{p}_j$  are the sample mean prices before and after reforms while  $\mu_i$  and  $\mu_j$  are their corresponding population values, respectively.  $S_i^2$  and  $S_j^2$  are variances of observed prices for these periods, respectively. Inferences regarding statistical significance of mean prices are based on the comparison of the computed Z-score and tabulated values. The null is rejected when computed values are larger than tabulated values.

An alternative way to assess variability of the series over the reform periods is to measure

the standard deviation of  $\ln\left(\frac{p_t}{p_{t-1}}\right)$  over a period, where  $p_t$  is price in period 't'

and  $p_{t-1}$  is its lagged value. This standard deviation is analogously interpreted as the standard deviation of the growth rates. Therefore, monthly growth rates in real prices for each of the reforms are calculated for each consecutive months and intra-year variability is calculated as the standard deviation of the 12 monthly growth rates in a year. Then the

overall averages for periods before and after reforms are calculated as the average of annual intra-year variability of all the years in that period (Sekhar, 2003).

Realistically to capture the possible effect of the market reforms, namely the collapse of ICA in 1989 and liberalization of coffee marketing in Tanzania, an ARCH-M(p) with shock and two indicator variables is specified using the following equation

$$\begin{aligned} P_t &= \beta_0 + \beta_1 P_{t-1} + \beta_2 REF + \beta_3 QQ_t + \beta_4 RER + \beta_5 PB + \beta_6 ICA + \delta h_t^{1/2} + \varepsilon_t \dots\dots\dots(6) \\ h_t &= \alpha_0 + \lambda_1 \varepsilon_{t-1}^2 + \lambda_2 P_{t-1} + \lambda_3 REF + \lambda_4 QQ_t + \lambda_5 RER + \lambda_6 BP + \lambda_7 ICA \end{aligned}$$

where  $P_t$ ,  $P_{t-1}$  and  $h_t$  are real coffee price (US \$/kg) in time  $t$ , lagged coffee price

and conditional variance respectively;  $\alpha_0$  is a constant while  $\beta_s$  and  $\lambda_s$  are

coefficients.  $\varepsilon_t$  is a conventional error term that is normally, independently and

identically distributed (*iid*, normal). The indicator variable *REF* is defined to coincide with

the liberalization of coffee markets; it takes 1 for period extending from January 1993-

December 2007 and zero elsewhere. A positive coefficient on *REF* in both the mean and

variance equations is taken to indicate higher mean price and price volatility during the

reform. Another dummy variable, the *ICA*, is defined to account for period when the *ICA*

agreement was in place and it takes a value of 1 for period ranging from January 1980-

December 1989 and zero otherwise. Other variables included in the model include the

quantity of Arabica coffee exported from Tanzania in time  $t$  ( $QQ_t$ ) measured in kg, the

real exchange rate as an index (1980=100) and is calculated as the ratio of the Tanzanian

shilling to the US dollar and is deflated by Consumer Price Index, *BP* is the boarder parity

price for coffee exported from Tanzania also measured in US \$ per kg.

The model was estimated in a system framework (with mean and variance equations) using the autoregressive procedure using SAS (SAS Institute Inc., Cary, NC 27513, USA). Prior to the estimation, the coffee price, the dependent variable, was tested for stationarity. The Augmented Dickey–Fuller (ADF) test provided test statistics well below the ADF critical values, which leads us to reject the null hypothesis of non-stationarity at the 10% significance level (Appendix 1).

The order of the ARCH model was determined through an assessment of the statistical significance generated from the Lagrange multiplier test. Results suggest that an autoregressive order of one was appropriate for the data (Appendix 2).

Misspecification of the variance equation could lead to inconsistent estimates of parameters in the mean equation. Thus, attempts are made to model for alternative functional forms such as exponential and square root. However, the results are not sensitive to the functional forms. The leverage effects are analysed by testing whether the lagged values of standardised residuals influenced the standardised variance. Results indicate that the standardised variance is uncorrelated with the level of standardised residual, suggesting that there are no leverage effects in the specified model (Appendix 3). In equation (3), the

coefficient  $\beta_2$  tests whether the mean prices before and after the market liberalisation are different, while the coefficient  $\lambda_3$  tests whether the price volatility has changed after liberalisation. Coefficients  $\beta_6$  and  $\lambda_7$  test whether there are significant differences in mean prices and price volatilities before and after market reforms, respectively.

## CHAPTER FOUR

### 4.0 RESULTS AND DISCUSSION

#### 4.1 Descriptive and Statistical Analysis

Descriptive statistics for Arabica coffee prices paid to Tanzania producers before and after the collapse of ICA are presented in Table 1 while similar statistics for market liberalization are presented in Table 2. These statistics show that there was a significant decline in coffee prices after the collapse of the ICA and market liberalisation. Results also show that the volatility of coffee price increased after the reforms.

**Table 1: Summary of descriptive statistics for coffee prices before and after the collapse of ICA**

<b>Statistic</b>	<b>Before (N=120)</b>	<b>After (N=216)</b>	<b>Difference</b>
Mean (US \$ per kg)	2.05	0.75	1.31**
Standard deviation	0.66	0.38	
Coefficient of variation (%)	32.23	50.49	

\*\* means significant at 5% level based on *t*-test for mean difference assuming unequal variances (heteroskedastic)

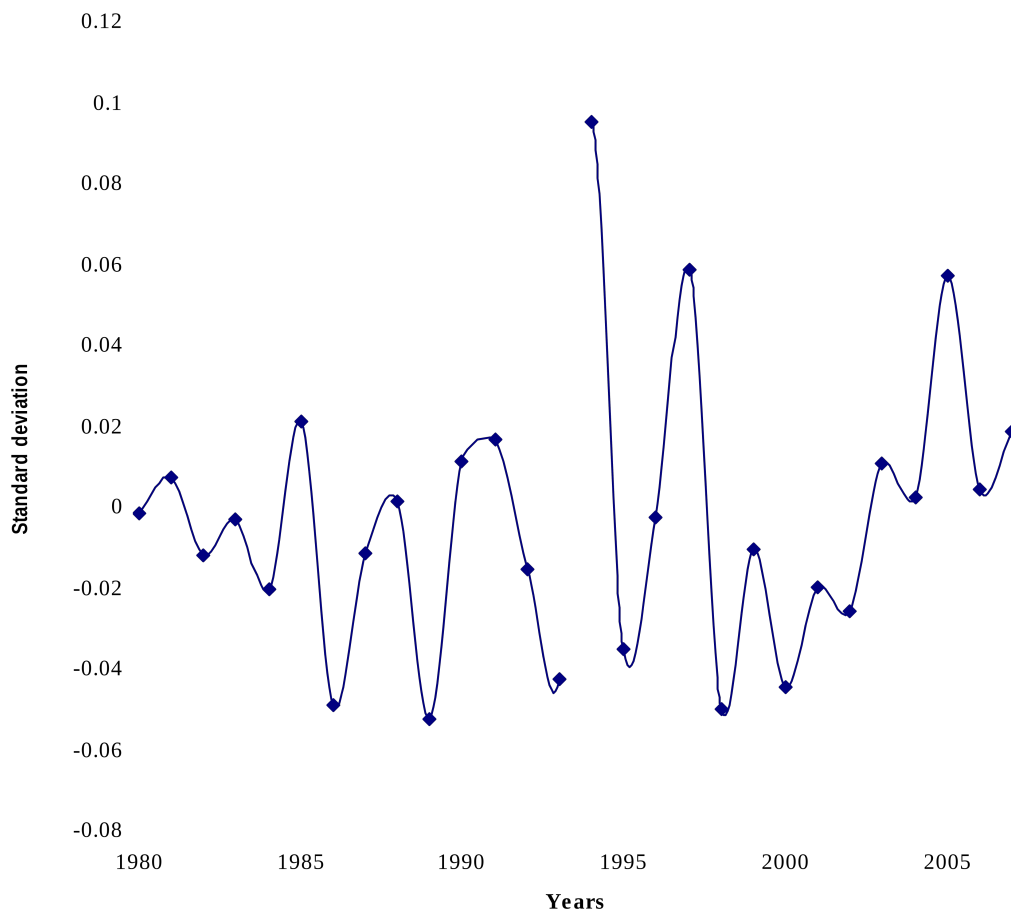
**Table 2: Summary of descriptive statistics for coffee prices before and after market liberalization**

<b>Statistic</b>	<b>Before (N=168)</b>	<b>After (N=168)</b>	<b>Difference</b>
Mean (US \$ per kg)	1.67	0.75	0.92**
Standard deviation	0.83	0.42	
Coefficient of variation (%)	49.60	55.82	

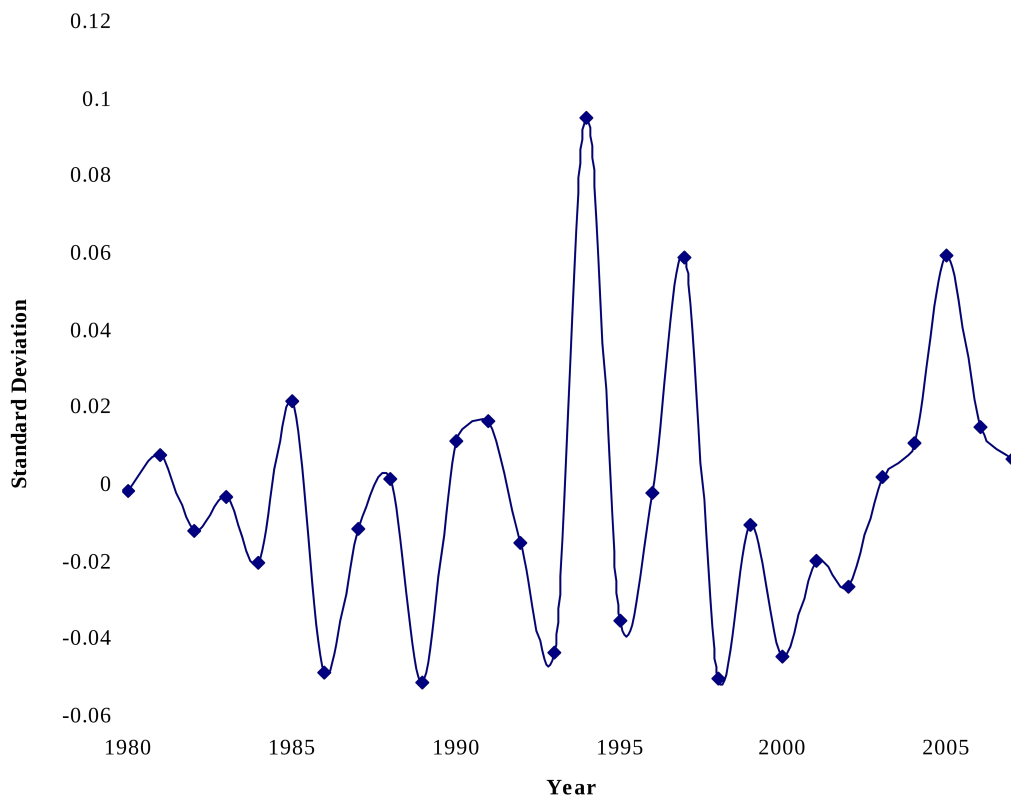
\*\* means significant at 5% level based on *t*-test for mean difference assuming unequal variances (heteroskedastic)

The intra-year standard deviations presented in Fig. 2 and 3 shows that coffee prices were volatile and the volatility seem to be higher after reforms. The standard deviations were 0.02 when the ICA was in place and 0.04 after its collapse. With respect to market liberalisation the standard deviation was 0.02 before and 0.04 after the liberalisation.





**Figure 2: Standard deviation of growth rates for real coffee prices paid to producers of Arabica coffee in Tanzania before and after the collapse of ICA**



**Figure 3: Standard deviation of growth rates for real coffee prices paid to producers of Arabica coffee in Tanzania before and after market liberalisation**

The observed changes in price volatility are consistent with Struthers and Gemech (2007) who observed that prices for primary commodity are notoriously unstable particularly for tropical beverage crops such as cocoa, tea and coffee. This frequent fluctuation in prices induces earning instability and uncertainty for country that derive substantial earnings from agricultural sector.

#### **4.2 Econometric Analysis**

To test whether market reforms increased both trend and level of volatility of coffee price in Tanzania a number of explanatory variables were included in the ARCH-M model to identify factors determining the level of mean and factors influencing the conditional

variance of real producer price of coffee. The estimated results for ARCH-M model are summarized in Table 3.

**Table 3: ARCH-M estimates of coffee farm gate real prices: Dependent variable: real farm gate price (USD/kg)**

Independent variable	Mean equation	Variance equation
Constant	-0.04(0.005)**	
Lagged price( $P_{t-1}$ )	0.83( 0.007)**	0.00(0.001)
Liberalization Dummy(L)	-0.03( 0.006)**	0.00( 0.001)
Quantity of Arabica(QQt)	$-1.45 \times 10^{-10}$ ( 0.00)*	0.00( 0.000)
Border price (BP)	0.09( 0.003)**	0.00(0.001 )
Real Exchange rate(RER)	0.00( 0.00)*	0.00(0.000)
ICA dummy (ICAD)	0.18( 0.01)**	0.007(0.002)**
ARCH0	0.00(0.00)	
ARCH1	3.49(0.40)**	
ARCH2	0.00(0.02)	
Delta ( $\delta$ )	0.0020(0.022)	
L-likelihood	314.79	
DW statistics	1.99	
R <sup>2</sup>	0.9727	
N	335	

Note: Values in parentheses are asymptotic standard errors. \*\* and \* denote significance at 5% and 10% levels, respectively.

The log-likelihood ratio test indicates that the amount of variation explained by the model is significantly different from zero at less than 5% significant level (chi-square probability = 0.0001) and the model was well fitted with R-square of 0.97

Results from this study show that there was a significant decline in coffee prices after the collapse of the ICA and market liberalisation. Thus the null hypothesis specified in equation (2) is rejected. Results also show that the volatility of coffee price increased significantly after the demise of ICA but this volatility did not persist over the entire post-liberalisation period. The analysis has also indicated that current price is positively related to lagged price, border parity price and real exchange rate but is negatively related with quantities of coffee exported.

The estimated coefficient for lagged price ( $P_{t-1}$ ) was positive and significant at 5% level. This coefficient indicates that the current mean price at any one given period is dependent on the price in the previous period. The sales volume coefficient has a significant effect on the coffee price determination. The result shows that coffee sales volumes, and by inference production levels, are likely to influence producer prices.

The variable real exchange rate estimate was positive and significant for the price of coffee. It shows that the coffee producer price was significantly affected by the movement in the real exchange rate meaning that the higher the exchange the more domestic currency is accrued to the farmer and vice versa.

The inclusion of border parity price (BP) and commodity price agreement such as international coffee agreement(ICA) in the model was based on the theoretical believe that, the export commodity such as coffee prices are influenced by the international market factors apart from domestic factors. A dummy variable ICA for the period the international coffee agreement was in operation was positive and significant, indicating that coffee growers also benefited as their earnings were 18% higher during this period.

The producer coffee prices were also closely correlated to the New York coffee futures prices as shown by the border price (BP) coefficient estimate. Estimated coefficient of border parity price was positive and statistically different from zero at 5% level; this coefficient implies that the mean coffee price paid to producers increased by 9% for every unit increase in border parity price. The correlation between international market prices and producer price could have arisen as a result of distortions in the exchange rate during the period of pre-reform.

## **CHAPTER FIVE**

### **5.0 CONCLUSIONS AND POLICY IMPLICATION**

#### **5.1 Conclusions**

The result from this study shows that, ending control of coffee price in 1980s and the adoption of liberalized market in 1990s did not always create the necessary conditions to enhance the level of real coffee price.

The effect of market reforms on coffee prices that were shown by the intervention or dummy variable was observed to be negative and suggest that currently average mild

Arabica coffee price have declined. This observation provide evidence that farm-gate price has declined since liberalization of coffee sub-sector.

Coffee price volatility were observed to have a link with the market reform, a phenomenon that can reduce the welfare of smallholder coffee farmer who are price-taker and have limited price risk management choices.

It is concluded that the collapse of ICA has contributed to increase coffee price volatility. The market reform policy implementation have shown to increase Arabica coffee price volatility and decrease of price during the reform as compared to pre-reform period a phenomenon that reduce the welfare of poor producers who have limited price(income). In general the result shows that farmgate prices were declining after the termination of the ICA and high price volatility was observed after market liberalization.

## **5.2 Policy implication**

In view of the finding of the study and the above conclusion the following recommendations are made in order to promote coffee prices at farm level hence improve production as well being of coffee farmers.

- i. Government should stimulate the domestic market by investing more on coffee value additions and local consumption of coffee, these can increase the demand of coffee and raise the price of coffee at the local market rather than depending on external markets.
- ii. There is a need to formalize farmer groups or associations. This could be achieved through sensitization of farmers to formulate association or marketing groups with the aim of accessing the market directly. Training on entrepreneurship and financial management as well as leadership are also needed.

- iii. Improve the road infrastructure that can enable coffee farmers reduce cost of transport  
the government should allocate more budget for rehabilitation for rural roads.

### **5.3 Limitations of the study and suggestions for further research**

#### **5.3.1 Limitations of the study**

This study has investigated the impact of the market reforms on prices paid to producers' of Arabica coffee. However some of the coffee is exported directly to consumers in importing countries and pricing mechanisms differ significantly across coffee growing areas based on the concentration of traders and other aspects of marketing. Thus the recommendations made should be adopted cautiously.

#### **5.3.2 Areas for future research**

Based on the limitations of this study future research work should concentrate on the aspects that are not fully addressed by this study, which include:

- (i) the impact of market reforms on prices paid to exporters
- (ii) the spartial effects of these reforms to producers of both arabica and robusta coffee.

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## APPENDICES

### Appendix 1. Augmented Dickey-Fuller Unit Root Tests

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	10	-2.6619	0.2622	-2.00	0.0433		
Single Mean	10	-5.1890	0.4153	-2.06	0.2621	2.67	0.3863
Trend	10	-9.8899	0.4392	-1.96	0.6221	2.62	0.6520

### Appendix 2. Test for number of lags

Variable	df	Parameter estimate	Standard error	t-value	Pr> t
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intercept	1	0.01528	0.01319	1.16	0.2476
L1	1	0.94993	0.05544	17.13	<.0001
L2	1	0.02623	0.07649	0.34	0.7319
L3	1	-0.02432	0.07649	-0.32	0.7507
L4	1	-0.00326	0.07649	-0.04	0.9661
L5	1	0.03348	0.05520	0.16	0.5445

### Appendix 3. Test for leverage effect

Variable	df	Parameter estimate	Standard error	t-value	Pr> t
Intercept	1	0.99262	0.13782	7.20	0.0001
St1	1	0.02849	0.13615	0.21	0.8344
St2	1	-0.11002	0.13652	-0.81	0.4209
St3	1	0.04083	0.13670	0.30	0.7654
St4	1	-0.04239	0.13666	-0.31	0.7566
St5	1	-0.12250	0.13704	-0.89	0.3721