The Impact of Market Reform Programmes on Coffee Prices in Tanzania

E. Mkandya, *F.T.M. Kilima, E.A. Lazaro and J.R. Makindara

Sokoine University of Agriculture, Department of Agricultural Economics and Agribusiness
P. O. Box 3007, Morogoro, Tanzania

Abstract

This paper presents an empirical investigation of 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 likelihood that prices paid to domestic producers were higher but more volatile after the reforms. This likelihood 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 Organisation (ICO). Results show that there was a significant decline in coffee prices after the collapse of the ICA and market liberalisation (P<0.05). Results also show that the volatility of coffee price increased significantly after the demise of ICA (P<0.05) but this volatility did not persist over the entire post-liberalisation 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 and; handle and value separately the high-value coffee at the auction to allow fair pricing.

Key words: Market liberalisation; ICO; Producer Prices; ARCH-M model

Introduction

Coffee is one of the important sources of Tanzania's foreign exchange earnings and household's income in coffee growing areas. In 2007 the value of coffee export was US $ 98.1 million and was the most import source of foreign earnings—constituting about 33.8 percent of the earnings (URT, 2007). The coffee sub-sector employs more than 7 percent of the Tanzanians who derive their livelihoods from this crop. Many coffee growers are smallholder farmers with an average of 0.42 hectares per household.

However, the coffee sector in Tanzania like many other agricultural sub-sectors has been intensively intervened. Experience from many 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 (Akiyama *et al.,* 2003; Bauer 1976; Bates 1981; Friedman, 1954; Johnson and Mellor, 1961; Lal, 1985; Todaro and Smith, 2006; World Bank, 1997). In many countries primary export crops (e.g. cocoa, cotton, coffee, tobacco, tea and sugar cane) are considered too important, both politically and economically, to be handled by the private sector.

Tanzania held a strong belief in government controlled markets inherited from her colonial masters (World bank, 1977). In the coffee sector this form of control came in the form of cooperatives and coffee boards, which were involved in many aspects of coffee production, marketing and trade. The institutionalization of coffee marketing replicated earlier endeavours by expatriate coffee growers during the 1920s and thereafter a successful marketing cooperative of native cultivators, which was established in Kilimanjaro in 1932 (Clarence-

Smith, 1995). This belief triggered a national-wide campaign to promote state-owned cooperatives even in areas where this philosophy was new, incompatible with people's way of life or simply not needed. This political interference resulted into abandonment of privately organised and managed cooperatives because were generally viewed as monopolistic or capitalistic institutions. Consequently many of the newly formed cooperatives were mismanaged and they collapsed in the mid-1960s. However, the government-forced cooperative movement continued to expand and since then the coffee sub-sector has been subjected to a shifting power between different levels of state-controlled cooperatives and the Tanzania Coffee Board (TCB) or Coffee Authority of Tanzania (Baffes, 2003).

The perseverance of the Tanzanian government to maintain the control over coffee marketing led to inefficient marketing system because most unions incurred huge losses in the early 1990s but avoided bankruptcy because they received special support from the government for both political and economic reasons. These losses contributed to increase government's spending and became unmanageable in the 1990's when the economy experienced economic hardships and fiscal deficits that required major reforms. Therefore reforms became imperative to restore macroeconomic balance and efficiency to the economy. Thus, another intervention in the coffee sector has been the liberalization of coffee marketing motivated by the global evidence that successful reforms would promote efficiency in resource use and allocation within the agricultural sector, which has the potential to stimulate productivity; reduce the monopoly power held by government marketing agencies and; allow producers to receiving a larger share of export prices. 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 (Kilima *et al.*, 2008; Krueger *et al.,* 1988).

At the international level the intervention has been possible through commodity agreements adapted to stabilize prices of traded commodities. 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 generally described as "race to bottom' competition and it refers to the situation where exporters are eager to increase their market share and revenue from coffee trade and has resulted into a huge increase in supply and depressed coffee prices.

The preceding discussion about interventions in the coffee market has profound ramifications for coffee prices in Tanzania. Before market liberalization coffee farmers 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 instalments. However, the second and third payments were never guaranteed and could be forfeited if the cooperatives incurred losses. Although the 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, 1974).

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. Therefore, these challenges pose an empirical question with respect to effects of reform policies on the 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.

There have been many attempts to assess the evolution of coffee prices in Tanzania after market reforms (Baffes, 2005; Ponte and Daviron, 2003; Ponte, 2002). Some of these studies found that market liberalization intensified competition in buying coffee from Tanzanian farmers but did not affect price competition. There is evidence to suggest that some coffee buyers decided to purchase coffee that was not ready to be marketed (e.g. immature and wet coffee) because the private sector had not yet set a system of buying coffee in grades (Cooksey, 2003; Ponte, 2002). As a result coffee quality deteriorated during this period and it resulted into low prices as well as high price volatilities that affected low-grade producers more than high-quality producers (Ponte, 2002). However, many of the earlier studies adopted non-parametric approaches to assess the evolution of coffee prices in Tanzania. Unlike these previous studies, this study employs a parametric model to test whether coffee prices observed after market reforms are lower and more volatile than before the reforms. Excessive volatility and low coffee prices have the potential to endanger the livelihoods of coffee producers, rural workers involved in coffee plantations and coffee processing factories that depend on coffee as their major source of earnings.

It is important to note 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). Furthermore many farmers in developing countries operate in imperfect markets and they do not realize all the gains from reallocating resources into different risk portfolios (Mosley and Verschoor, 2008). 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.

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. There is a need to assess the differences across the reform periods using descriptive and inferential statistics and to test for statistical differences using a model that allows the variance of price to vary over time. Therefore this study examines whether the levels and volatilities of price before and after the reforms, show any significant differences. Market reforms as used in this context refer to the collapse of the ICA in 1989, which operated through a flexible quota system to maintain desired price indices as well as the liberalization of coffee marketing in Tanzania implemented in 1993.

Material and method
This study adopts an autoregressive conditional heteroskedasticity in mean (ARCH-M) model to test price differences across reform periods. 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 and Varangis, 1990). The purpose of liberalizing coffee marketing in Tanzania can be broadly stated as increasing prices paid to domestic producers through enhanced market efficiency. 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. The research questions being investigated can be stated in two testable hypotheses expressed as:

$$H_0 : \sigma^2_{i1-in} = \sigma^2_{j1-jn} \quad \text{…………………………... (1)};$$

$$H_0 : \mu_i = \mu_j \quad \text{………………………… (2)}$$

where σ^2_{i1-in} and σ^2_{j1-jn} are unconditional variances of coffee prices at farm level before and after the

reforms while μ$_i$ and μ$_j$ are mean prices before and after the reforms, respectively. The subscripts *i* and *j* signify pre- and post-reform periods, respectively. The hypothesis (1) states that price variances before and after markets reforms are not different whereas hypothesis (2) states that mean prices before and after market reforms are not different.

Thus the null (Ho) hypothesis presented in equations (1) can be tested using coefficients of variation which are better measures of variability than standard deviations. Likewise the hypothesis shown in equations (2) is simply a test for the mean difference across the reform periods. In finite samples this test is a conventional Z-score or *t*-test for mean difference.

While these simple statistics are widely used to test for statistical differences in 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 important to distinguish not only between predictable and unpredictable components of prices but also to allow the variance of unpredictable element to be time variant. Thus in this study the coefficients of variation and inferential statistics are only used as bench-mark to identify the differences in levels and volatilities before and after the reforms.

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).

To capture the possible effects of the market reforms, namely the liberalization of coffee markets and the collapse of the ICA on the levels and volatilities of coffee price, an ARCH-in-Mean (ARCH-M) model was specified and estimated. This model has been employed to explore price volatility in finance as well as agricultural markets (Jayne and Myers, 1994; Yang and Brorsen, 1992; Yang *et al.,* 2001). The model is commonly applied to non-perishable (storable) agricultural commodities where inventory

carry-over is possible (Barrett, 1997; Shively, 1996 and 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 coefficients of variation and inferential statistics is that it takes into account the evolution of prices over time, 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 are well-known and are beyond the scope of this study (see Kilima *et al.,* 2008). The ARCH-M model is relevant when the series is observed at least on monthly basis, it is stationary and there are no leverage and interaction effects.

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 model with shock and two indicator variables is specified using the following equation:

$$P_t = \beta_0 + \beta_1 P_{t-1} + \beta_2 REF + \beta_3 QQ_t + \beta_4 RER + \beta_5 BP + \beta_6 ICA + \delta h_t^{1/2} + \varepsilon_t$$

$$h_t = \alpha_0 + \lambda_1 \varepsilon_{t-1}^2 + \lambda_2 P_{t-1} + \lambda_3 REF + \lambda_4 QQ_t + \lambda_5 RER + \lambda_6 BP + \lambda_7 ICA$$ (3)

where P_t, and P_{t-1} are real coffee price (US \$/kg) in time *t*, lagged coffee price and conditional variance respectively; is a constant while and are coefficients. is a conventional random component of the residuals that are 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 reforms. 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 (RER) 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 is estimated in a system framework (with mean and variance equations) using the autoregressive procedure in SAS software package. 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. Thus, the null hypothesis of non-stationarity is rejected at the 10 percent significance level.

The order of the ARCH model is determined through an assessment of the statistical significance generated from the Lagrange multiplier test. Results suggest that an autoregressive order of one is appropriate for the data. 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, we find that 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. In equation (3), the coefficient   tests whether the mean prices before and after the market liberalisation are different, while the coefficient   tests whether the price volatility has changed after liberalisation. Coefficients   and   test whether there are significant differences in mean prices and price volatilities before and after market reforms, respectively.

Price series used in this study are monthly wholesale prices for coffee paid to producers in Tanzania for years 1980–2007. The price data were obtained from the ICO and are presented in Figure 1 (ICO, 2009). 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 and the price series was deflated using appropriate Consumer Price Index (CPI) to arrive at real price.

Results and discussion

Inferential statistics and coefficients of variation show that mean prices decreased and price variances increased after the market reforms (Tables 1 and 2). This analysis shows that mean coffee price fell by almost 64 percent in real terms after the collapse of the ICA and this fall was significant at 5 percent level. Coefficients of variation (CV) shown in Table 1 indicate that the series was less variable when the agreement was in place (CV≈32%) than after its collapse (CV≈50%).

With respect to market liberalization, the analysis show that mean prices paid to producers fell by almost 55 percent in real terms after market liberalisation and the change was statistically significant at 5 percent level (Table 2). Similarly the series became more volatile after market liberalization (CV≈55%) than before (CV≈50%).

Results from the ARCH-M model reveal that all significant variables have correct signs. The negative and significant coefficient at 5 percent level on the indicator variable for market liberalization in the mean equation confirms the preliminary suggestion that mean prices paid to coffee producers declined after market liberalization and thus the null hypothesis specified in equation (2) is rejected (Table 3). However, in contrast to the descriptive analysis the model does not seem to support the argument that liberalisation of coffee marketing in Tanzania has induced substantial volatility in coffee prices for entire post-liberalization period probably because the entry of more multinational companies with capacity
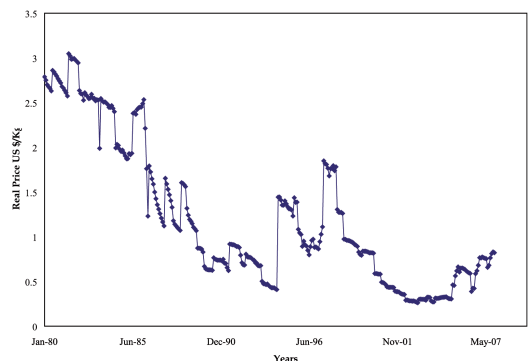

Figure 1: Price paid to producers of arabica coffee in Tanzania

to integrate vertically and invest in coffee processing in the late 1990s contributed to improved coffee quality and reduce price volatility arising from quality discrepancies (Ponte, 2002; Temu, Winter-Nelson and Garcia, 2001).

The positive and significant coefficient at 5 percent level on the indicator variable for ICA in the mean equation implies that coffee prices were higher when the agreement was effective. Likewise, its positive sign on the variance equation suggests that coffee prices were more volatile after the collapse of the ICA.

The model has indicated that lagged price exerts significant influence on mean price at 5 percent level. The implication of this positive sign and its significance at 5 percent level mean that the current mean price at any given period is highly dependent on the price in the previous period. This finding is consistent with the previous findings that most agricultural commodities tend to show high first-order autocorrelation (Dealton and Loraque, 1992). Border parity price and real exchange rate seems to have significant positive effects on producers' price at 5 percent and 10 percent levels, respectively. The demand for coffee grown in Tanzania is in major export markets abroad. Thus, border parity prices are expected to be positively related with coffee prices in Tanzania. Similarly, coffee is widely traded in international markets and its price is expected to be positively related with the real exchange rate that reflects the value of money earned from coffee trade.

Another significant explanatory variable at 5 percent level is the quantity of coffee exported. Since coffee is a major export crop, it reflects that its total supply in local markets is bound to affect local prices negatively as per laws of demand and supply.

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

Statistic	Before (N=120)	After (N=216)	Difference
Mean (US $ per kg)	2.05	0.75	1.31[a]
Standard deviation	0.66	0.38	
Coefficient of variation (%)	32.23	50.49	

[a] means significant at 5 percent level based on t-test for mean difference assuming unequal variances (heteroskedastic)
N means sample size

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

Statistic	Before (N=168)	After (N=168)	Difference
Mean (US $ per kg)	1.67	0.75	0.92[a]
Standard deviation	0.83	0.42	
Coefficient of variation (%)	49.60	55.82	

[a] means significant at 5 percent level based on t-test for mean difference assuming unequal variances (heteroskedastic)
N means sample size

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)[c]	
Lagged price (P_{t-1})	0.83(0.007)[c]	0.00(0.001)
Liberalization Dummy (L)	-0.03(0.006)[c]	0.00(0.001)
Quantity of Arabica (QQt)	-1.45×10^{-10}(0.00)[d]	0.00(0.000)
Border price (BP)	0.09(0.003)[c]	0.00(0.001)
Real Exchange rate (RER)	0.00(0.00)[d]	0.00(0.000)
ICA dummy (ICAD)	0.18(0.01)[c]	0.007(0.002)[c]
ARCH0	0.00(0.00)	
ARCH1	3.49(0.40)[c]	
ARCH2	0.00(0.02)	
Delta (δ)	0.0020(0.022)	
L-likelihood	314.79	
DW statistics	1.99	
R²	0.9727	
N	335	

Note: Values in parentheses are asymptotic standard errors. [c] and [d] denote significance at 5 percent and 10 percent levels, respectively
L-likelihood means log likelihood
DW stands for Durbin Watson

Conclusion

Results from this study 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 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 to quantities of coffee exported. The observed fall in coffee prices after market reforms mean that coffee producers in Tanzania are continuously earning less income from coffee sales. To avert this eminent poverty-trap there is a need to address the following challenges:

Firstly, one of the well-known reasons for sharp decline in coffee prices after market liberalization is quality deterioration (Cooksey, 2003; Ponte, 2002). Therefore improving coffee quality at farm level constitutes a viable strategy to stabilize earnings. This strategy could be achieved through dedicated support to farmers to help them upgrade their production and post-harvest operations (e.g. better access to credit and training on quality aspects and marketing). Achieving this goal demands public and private partnership. It is important to harness the support in training and knowledge transfer provided by certified exporters, the public sector and international co-operation.

Secondly, all coffee with the exception of coffee that meet requirements for direct export, is currently marketed through the coffee auction in Moshi. The mandatory auctioning of coffee at Moshi may serve to under value supreme coffee as criteria for auctioning high value coffee are not yet established and is sold as a regular (uncertified coffee) at a relatively lower price. Ultimately the high-value coffee end up competing with the regular coffee and may affect the levels and volatilities of both high and low value coffee. To allow fair pricing there is a need to handle and value separately the high-value coffee at the auction.

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