Development Policy Review, 2001, 19 (2): 205-222

Market Liberalisation, Vertical Integration and Price Behaviour in Tanzania's Coffee Auction

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Whether market liberalisation can promote agricultural development in Africa depends on how well existing institutions can facilitate trade by private agents. This article assesses the performance of the Tanzania coffee marketing system after liberalisation and the emergence of private, vertically integrated exporters (VIEs). Increasing producer prices, declining marketing margins, and the continued provision of a useful auction for coffee that is delivered by traders who are not VIEs all suggest a degree of success for liberalisation. The presence of VIEs seems to have provided investment to reduce marketing costs, whilst a sufficient number of competing firms has limited non-competitive behaviour in the market for coffee that is traded at the auction by non-VIEs.

The wave of liberalisation and privatisation programmes that swept through Africa in the 1980s and 1990s was based in part on a vast body of research that demonstrated the failings of state intervention in commodity markets (Bauer, 1971; Bates, 1981; World Bank, 1981, 1989). Whilst the negative impacts of state-controlled markets on efficiency and equity have been well documented, the risks of liberalisation, including the entry of monopolistic traders, the under-provision of public goods, the costs to food consumers and the inability of farmers to respond to incentives, have also been well articulated (Cornia et al., 1992; Stewart et al., 1992).

A general concern in recently liberalised commodity markets is that participants must rely on institutions and organisations that developed to facilitate trade during the period of state control. Empirical analyses of cereals markets in Africa suggest that these institutions may often be unable to adjust to the new market environment (Barrett, 1997, 1998; Masters, 1993). After reviewing numerous studies on maize in Southern and Eastern Africa, Jayne et al. (1998: 239) conclude: 'So far, liberalisation and privatisation appear to have replaced often unreliable, high-cost, and centralised forms of state marketing with private markets that are competitive but often lacking in information and infrastructure and poorly integrated with other key activities.'

Whilst the practical and political significance of food crops motivates attention to cereals markets, it is also important to assess how policy reforms have affected the domestic marketing of export crops, which provide a large share of Africa's foreign exchange and income. *A priori*, one could expect liberalised export crop markets to attract more capitalised and sophisticated firms than food crops. However, greater capital and management requirements could also create barriers to entry into these

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Published by Blackwell Publishers, Oxford OX4 1JF, UK and 350 Main Street, Malden, MA 02148, USA.

markets, as could an inappropriate mix of liberalisation and continued state control of specific functions. Even in countries that have pursued economic policy reforms aggressively (such as Uganda), there is evidence that improvements in export agriculture were restricted by inappropriate institutional arrangements in agricultural markets (Ssemogerere, 1990; Belshaw et al., 1999). Referring to traditional export crops in Uganda, Belshaw and his colleagues conclude (688): 'The failure to engage in effective institutional reform simultaneously or shortly following liberalization has led to a recovery far less rapid than needed to alleviate widespread poverty and achieve sustainable economic growth.'

This article uses an extensive data set from the Tanzanian coffee auction to assess how well that market is functioning in the newly liberalised environment. An assessment of the performance of the exchange, along with an understanding of how the market structure has changed, should indicate the effects of liberalisation. The ultimate purpose of market reform is the supply response by farmers. This article does not address the supply response directly, because of the limited potential for short-run output response in coffee and also because of a desire to measure the impact of reform on market performance as a precursor to supply response.

Coffee in Tanzania

Coffee is a leading export crop in Tanzania, accounting for a third of the country's foreign-exchange earnings in the 1990s (Bank of Tanzania, 1999; World Bank 1994). Smallholder farmers produce more than 90% of Tanzania's coffee. Hence, changes in the production, marketing and trading of coffee can have a profound impact on the national economy and on the small-scale producers who depend on the crop for their livelihood. In this respect, Tanzania is like many African states where the market for a single export crop is critical to the welfare of countless smallholders and to the country's foreign-exchange position.

From the 1960s to the mid-1990s state organisations handled all the marketing and processing of smallholder coffee up to the Tanzania Coffee Board (TCB) auction, where private exporters purchased the commodity. Beginning in the 1994/5 crop year, private agents were allowed to engage in internal marketing and processing in competition with government-supported co-operative unions, though legislation continued to require that all exported coffee be channelled to exporters through the TCB auction. In response to this policy change and the inability of the co-operative system to deliver the desired quantities of coffee, private exporters expanded their operations to include domestic marketing.

Before delivery to the export auction, fresh coffee 'cherries' must be pulped to remove their fleshy cover, fermented, washed, and dried into 'parchment'. In most cases farmers deliver parchment to either a private trader or a primary co-operative society. (In some cases cherry is delivered to a co-operative pulper.) Parchment is then 'cured' by milling to reveal the 'clean' coffee bean, which is graded by size using international standards (AA, A, B, C, or PB). Its salient quality characteristics can only be determined after curing.[1] Both private firms and the co-operative unions have curing

1. Roasting, brewing and tasting coffee reveals quality variation within grades. However, most buyers at the auction do not taste-test samples from lots before bidding.

facilities and provide services to private traders on a fee basis. All private curing factories are owned by vertically integrated exporters (VIEs).

By 1997 there were five fully vertically integrated exporters that engaged in domestic trade, owned processing factories, and exported coffee. These firms had usually operated as exporters prior to liberalisation, and are subsidiaries or agents of multinational coffee companies. In the 1997/8 market-year, they accounted for 45% of deliveries to the auction. Another 27 private coffee buyers who do not own processing facilities were also licensed by 1997, and accounted for 22% of auction deliveries that year (Table 1). Some of these traders engage in domestic marketing only; others purchase coffee from producers, outsource processing, and then export the coffee. In total, the private traders accounted for 67% of auction deliveries in 1997/8, with 53% of total deliveries coming from traders who were also licensed exporters (VIEs).

Coffee lots that are brought to the auction by exporters are referred to as 'captive' or 'private' supply because they are in an exporter's possession prior to the auction. These captive supplies are usually bought at the auction by the same firm that bought them from the producer and delivered them to the auction. As shown in Table 1, captive supply grew from 11% of the auction volume in 1994 to 72% in 1996, and then fell to 53% in 1997.

Table 1: Market shares in coffee in Northern Tanzania, 1993/4–7/8

	Share of coffee marketed (%)				
	1993/4	**1994/5**	**1995/6**	**1996/7**	**1997/8**
VIEs with processing capacity[a]	0	12	33	57	45
Other private buyers[b]	0	1	8	12	22
Co-operative system	75	58	44	22	26
Estates	6	8	4	6	7
Other governmental organisations	19	21	11	2	1
Captive supply[c]	0	11	42	72	53

a) Represents the 5 firms that are licensed for domestic marketing and export and own processing facilities.
b) Includes exporters who outsource processing and traders who do not export.
c) Represents the share of supply to the auction brought by a licensed exporter.

Over the period 1995-7, the five VIEs with processing capacity accounted for 45% of auction deliveries on average and over 60% of purchases, making them large in the market and large net purchasers (Table 2). At the firm level, these VIEs consistently bid on their own deliveries and are rarely out-bid at auction. VIEs that outsource processing also tend to repossess their auction deliveries, and buy additional lots delivered by traders who do not export. In short, the combination of domestic market liberalisation, vertical integration, and continued use of the TCB auction to channel exports has resulted in a coffee auction in which over half the deliveries are 'purchased' by the same firm which supplies them to the auction.

Table 2: VIEs in the Tanzanian coffee auction, 1995/6-7/8 (%)

	1995/6	1996/7	1997/8
VIE deliveries as share of auction supply	33	57	45
VIE deliveries as share of VIE exports	53	85	73
VIE auction purchases as share of supply	62	67	62

Note: VIE includes only exporters who are licensed for domestic marketing and own processing facilities. Other sources of captive supply exist.
Source: Auction catalogues and own calculations.

Table 3: Producer prices and marketing margins for Tanzanian coffee 1992/3 – 7/8 (current prices)

	1992/3	1993/4	1994/5[a]	1995/6	1996/7	1997/8
Export price						
(US$/kg clean coffee)	1.38	1.25	2.80	1.90	2.80	3.00
(US$/kg parchment coffee[b)]	1.10	1.00	2.24	1.52	2.24	2.40
Producer price						
(US$/kg parchment coffee[c)])	0.51	0.50	2.00	1.36	2.00	2.26
Marketing margin						
(US$/kg parchment coffee)	0.59	0.50	0.24	0.16	0.24[d]	0.14
Producer price as % of export price	0.46	0.50	0.89	0.90	0.89	0.94

a) Year markets were liberalised. b) Conversion factor of 0.80 was used to convert clean coffee into parchment. c) Converted from Tanzania Shillings at: 450Tsh/$ for 1992/3, 500 for 1993/4, 550 for 1994/5 and 1995/6, 600 for 1996/7, and 620 for 1997/8. d) High marketing costs in this season are attributable to widespread flooding and mudslides caused by El Niño rains.
Source: Based on MDB (1997).

Liberalisation in the Tanzanian coffee market has been followed by a drop in marketing margins of over 50% and increases in producer prices both in absolute terms and as a share of the world price (Table 3). Much of the decline in marketing costs can be attributed to the establishment between 1995 and 1997 of five new curing factories in Moshi and Arusha. The new, privately owned factories proved to be considerably more efficient than the factory owned by the co-operative unions, which used its original 1935 technology. Temu (1999) documents that the newer factories offer lower operating costs per unit, higher rates of output per unit input, higher quality of output, and faster throughput. Falling marketing margins plus rising world prices resulted in increases in producer prices from US$0.50 per kilogram to US$ 2.25 between 1993 and

1998.[2] Despite these encouraging results, considerable anxiety remains concerning the role of the private sector and in particular the potential for large VIEs to drive out competitors (including the co-operatives) and then engage in monopsonistic or oligopsonistic practices. Casual observation of the bidding behaviour of the VIEs at the TCB auction has heightened concern that the VIEs may be colluding to depress auction prices.

Ideally, a functioning auction would offer producers an alternative outlet to the potentially oligopsonistic VIEs and a source of reliable information about the value of their crop and the premiums available for improved quality. Since captive coffee is exchanged in a spot market prior to the auction and usually does not change hands again, its auction price may have a limited relationship to the producer price or the cost to exporters.[3] In particular, an auction price for captive coffee that deviates from the marginal cost to that point need not imply that producers are under- or over-paid or that exporters reap super-normal profits. However, welfare losses would follow if the presence of 'captive' supply in the auction was distorting the prices of coffee brought by non-vertically integrated private traders, farmers, and co-operatives (non-captive supply). If captive supplies are distorting the auction prices for non-captive coffee, the auction is not a viable alternative outlet or a source of reliable price information.

The next section describes the auction market, providing descriptive statistics on the auction for captive and non-captive supplies. The following section offers a theoretical explanation as to why exporters rarely contest for captive coffee. Finally, theoretical and empirical analysis of the factors affecting the price of non-captive coffee are used to assess whether the TCB auction provides meaningful price information and serves as an alternative outlet for producers and non-integrated traders and exporters.

Tanzania's coffee auction

Coffee auctions are held twice a month, provided at least 20,000 kg of clean coffee have been submitted for auction. Before the auction, the Tanzania Coffee Board (TCB) distributes auction catalogues, indicating the supplier, grade, warehouse and volume of each lot of coffee. The TCB also roasts and brews samples from each lot for taste tests.

Prior to the auction the TCB sets reserve prices, which the final bid in the auction must exceed if the transaction is to be finalised immediately. Although the reserve prices are not announced, the TCB appears to set the reserve for C-grade lots at 80-85% of the 3-months forward New York futures price for C-grade arabica coffee. Reserve prices for other grades are derived from the C-grade price by penalising lower quality beans and rewarding the higher quality beans in an *ad hoc* manner.

Auction participants assemble in one room, taking their assigned seats. There were 24 licensed exporters in 1998, ten or more of which were usually present at any given auction. Bids for each lot are presented orally until the highest bidder is found. The auctioneer declares a lot sold to the highest bidder only if the bid exceeds the reserve

2. In Tanzanian shillings, the producer price rose from Tsh 230/kg in 1992/3 to Tsh1100/kg in 1994/5 and Tsh 1400/kg in 1997/8. Deflating using the consumer price index (1995=100) suggests a change in real prices from Tsh 400/kg in 1992/3 to Tsh 900/kg in 1997/8.
3. The auction price affects the exporters' costs because it is the basis for a 2% levy on coffee exports, which covers some of the TCB costs. Other taxes, levies and licensing fees are paid to engage in domestic trade.

price by at least US$0.10 per 50 kg bag. If the highest bid is below this threshold, it is recorded as a 'noted price', which is later used by the TCB to set an administered price.

When the bids do not exceed the reserve price, the TCB establishes an administered price based on a comparison of noted prices with the corresponding reserve prices, and the prices of directly sold lots of similar grade and quality. About 80% of the time prices are administered, the final price is equal to the highest bid (the noted price). In the remaining cases, mark-ups average about US$8 per 50 kg bag. Larger mark-ups from the noted price are more common for captive than for non-captive lots and are usually justified based on low contestation during bidding. The TCB then offers an administered price to the highest bidder who can accept the offer or allows the lot to be withdrawn until the next auction.

Since liberalisation, there has been a marked increase in both the share of coffee that is sold at an administered price rather than through a pure bidding process, and the share that is supplied by an exporter (Table 4). In the three years prior to liberalisation, on average 58% of coffee lots in the auction were exchanged at administered prices compared with 81% in the four years following liberalisation (column 1, Table 4). Meanwhile, the share of coffee that was captive rose from zero, prior to liberalisation, to 72% in 1996/7, then falling to 53% in 1997/8 (column 2, Table 4).

Table 4: Distribution of coffee sales at TCB auction by source and pricing method (%)

Pricing:	Administered	All	Administered		Competitive bid	
Source:	All	Captive	Captive	Non-captive	Captive	Non-captive
Year						
1991/2	60	00	00	60	00	40
1992/3	47	00	00	47	00	53
1993/4	67	00	00	67	00	33
1994/5[a]	80	11	9	71	2	18
1995/6	88	42	39	49	3	9
1996/7	88	72	68	20	4	8
1997/8	76	53	45	31	8	16

a) First season after liberalisation.
Source: TCB, *Auction Catalogue* (various issues).

The frequency with which price is determined administratively is higher for captive than for non-captive coffee, but administered prices became more frequent for non-captive supplies following liberalisation. From 1994/5 to 1997/8 the proportion of captive supply with an administratively-determined price ranged from 81% to 94%, whilst that of non-captive supply ranged from 66% to 85%. Although captive coffee is usually sold at an administered price, these supplies have expanded their share of the competitively bid coffee from 5% in 1993/4 to 33% in 1996/7 and 1997/8.

Auction prices and coffee ownership

The equilibrium price for coffee lots should vary over time and by quality, but should not be affected by the status of its owner as an exporter or not. Liberalisation has brought new classes of owners and a rise in administered pricing. If prices vary by owner in a way that is not consistent with changes in market conditions over time or differences in quality, there is evidence that the auction is not performing well in the liberalised market environment.

Table 5 reveals that administered prices are consistently lower than prices that follow from an unhampered bidding process. These low administered prices could reflect external market conditions that cause the competitively bid price to be less than the set reserve price. Since the administered prices are usually set at the highest bid, the administered price is usually a competitively bid price that fell below some target (the reserve price). The finding that administered prices are lower on average than other prices does not necessarily mean that they misrepresent the actual value of the product.

The mechanics of the reserve price system imply that coffee lots that have a lower market value and generate lower bids in the auction will tend to have administered prices. Whereas the use of administered prices is expected to correlate with lower value coffee, the status of the supplier as an exporter or not should not affect the value. Nonetheless, administered prices for captive supplies tend to be lower than those for non-captive lots (Table 6). These differences were found to be statistically significant using non-parametric and parametric tests and were consistent across grades of coffee.

Whereas the administered prices for captive coffee were consistently lower than those for non-captive coffee, there was usually no statistically significant difference in the competitively bid prices between the two categories. The tendency for the price difference to be greater among captive than non-captive lots may be caused by especially low noted prices for coffee supplied by VIEs or some unmeasurable aspect of the mechanism for deriving administered prices. Whatever the cause, differences in prices by type of supplier suggest that either the captive or the non-captive or both categories of coffee are inconsistently priced at the auction.

The finding that prices differ by ownership of the lots suggests that, by ushering in vertically integrated exporters and captive supply, liberalisation may have altered the relationship between the auction prices and the world market prices, possibly distorting the information content of auction prices. Critics of the new system have expressed concern that the auction under-prices captive supply and that the presence of the mis-priced captive lots has distorted the price of the non-captive supply. We consider the prices of each category of coffee in the following sections.

Table 5: Competitively bid prices less administered prices for non-captive and captive coffee lots at TCB auction (US$ per 50kg)

Grade	1992/3	1993/4	1994/5		1995/6		1996/7		1997/8	
	Non-captive	Non-captive	Non-captive	Captive	Non-captive	Captive	Non-captive	Captive	Non-captive	Captive
AA	24.34	10.06	1.13	25.78	6.41	9.96	10.66	29.84	16.31	24.23
	(6.73)	(2.64)	(0.36)	(3.93)	(3.43)	(3.39)	(1.32)	(3.94)	(2.16)	(3.83)
A	9.54	37.87	13.84	20.34	5.33	6.81	34.80	27.32	11.78	37.38
	(5.62)	(12.89)	(4.65)	(2.43)	(2.80)	(1.76)	(4.43)	(3.47)	(1.41)	(6.77)
B	0.61	25.15	11.10	15.93	7.51	12.33	42.65	1.74	7.64	28.33
	(0.71)	(7.87)	(3.81)	(1.86)	(4.90)	(3.45)	(6.35)	(3.29)	(0.98)	(4.82)
PB	7.56	7.45	16.94	2.97	0.69	7.45	6.91	7.27	16.07	28.68
	(4.46)	(1.91)	(2.65)	(0.32)	(0.26)	(2.11)	(0.48)	(1.17)	(1.21)	(3.66)
C	2.81	12.80	16.99		13.87	21.68	26.95	25.63	12.93	10.43
	(3.06)	(3.22)	(3.25)		(4.18)	(3.24)	(1.82)	(3.49)	(1.67)	(2.09)
Average	8.61	28.80	9.66	21.89	6.91	11.45	26.00	16.86	11.98	22.84
	(9.82)	(16.49)	(5.74)	(4.99)	(7.04)	(6.29)	(6.34)	(5.33)	(2.29)	(6.21)
No. of competitively bid lots	853	703	258	66	236	93	206	190	193	237
No. of lots priced administratively	2,506	1,431	1,090	335	1,380	1,379	301	1,687	226	711

Note: t-statistics in parentheses are for tests of significant differences in prices (competitive bid price minus administered price). The data used cover all lots sold in the period indicated.

Source: TCB, *Auction Catalogue* (various issues).

Table 6: Administered prices for captive coffee lots less administered prices for non-captive lots (US$/50kg)

Grade	1994/5	1995/6	1996/7	1997/8
AA	-14.13	-3.13	-17.90	-16.50
	(-4.53)	(-2.80)	(-17.90)	(-3.84)
A	-8.96	-3.77	-2.50	-19.20
	(-2.69)	(-3.55)	(-0.49)	(-2.78)
B	-9.38	-5.99	3.80	-22.30
	(-3.47)	(-6.45)	(0.87)	(-4.05)
PB	0.95	-5.93	-31.97	-22.42
	(0.26)	(-2.88)	(-3.21)	(-1.96)
C	-27.73	-4.77	-2.60	4.24
	(-4.75)	(-2.54)	(-0.24)	(0.71)
Average	-14.14	-5.07	-7.89	-18.44
	(-8.36)	(-8.35)	(-3.05)	(-4.78)
No. of captive lots	335	1,379	1,687	711
No. of non-captive lots	1,090	1,380	301	226

Note: t-statistics in parentheses are for tests of significant difference in prices (captive coffee price minus non-captive price). The data used cover all lots sold in the period indicated.
Source: Ibid.

Auction prices and captive coffee

Because captive supplies rarely change hands at the auction, the behaviour of auction prices for captive supplies may be of limited relevance to the market's performance. However, the tendency for captive supplies to receive auction prices that are consistently lower than those for non-captive coffee raises questions as to why the coffee is not actually exchanged at a higher price. Low auction prices and lack of contestation for captive supply have been taken as indication of collusion among exporters. In fact, there is little scope for captive coffee lots to be profitably exchanged.

A vertically integrated coffee exporter (VIE) has the option to buy coffee from the auction or a village buying centre. In principle, a VIE could purchase more coffee at the village level than needed to meet its own export contracts and opportunities. In such a case the VIE could sell 'captive' coffee to another exporter at the auction. In reality, VIEs export more than they purchase as domestic traders (Table 2) and exchange of captive coffee has been rare.

If an exporter supplying coffee to the auction and any competing bidders face the same international market, then other bidders may not find it profitable to buy away coffee from the supplier/exporter. For the exporter who has supplied coffee to the auction, relinquishing coffee implies gains in the auction price and losses in: (i)

transactions costs of exchange at auction, which are avoided if coffee does not change hands; (ii) potential loss of reputation if the VIE is unable to meet contracts with importers; and (iii) loss of revenues from the world price. Only if the competing bidder offers a sufficient margin above the supplier's export price to cover the costs of exchange and potential reputation loss will a competing bidder buy away captive coffee.

Recognising that VIEs usually have the same international market options as other traders, few exporters bid on captive supply. The most likely impact of bidding against a VIE which attempts to buy its own coffee is to raise the price the VIE ultimately pays itself. Since exporters pay a 2% levy on the auction price, such counter-bidding could be perceived as malicious and result in retaliation through similar market activities. Bidding against a VIE for its captive supply is only likely to occur if a counter-bidding firm is at risk of a larger reputation loss than the supplying exporter or has access to an exceptionally high price on the world market.

The actual absence of contestation at the TCB auction is probably a reflection of the futility of bidding against a supplier who has no intention to sell. With little counter-bidding for captive supply, the auction price rarely reaches the reserve price and the final price is administered, usually at a noted price that is equal or close to the opening bid of the exporter who supplied the lot. The failure of this price to follow the price for non-captive supply does not necessarily imply that the prices at the point of exchange with producers are distorted. Indeed, the trends in producer prices and marketing margins (Table 3) suggest improved conditions for producers over the period when captive supplies rose.

Since captive supply is not exchanged at the auction, the auction price for that coffee may be of accounting significance only. In contrast, the ability of the auction to generate meaningful prices for non-captive supplies is critical to the coffee system. If non-captive prices fail to follow the world market, there is evidence that the auction does not provide farmers with a real alternative to selling to VIEs that may have local oligopsony power. The following section analyses whether price discovery for non-captive coffee has been adversely affected by the emergence of captive supply and whether supply of captive coffee adversely affects the price of non-captive supply.

We derive a price transmission elasticity between the New York futures price and the price of non-captive supply as well as a price elasticity for non-captive coffee with respect to the supply of captive coffee. A transmission elasticity of close to one will confirm that price discovery at the auction is effective in determining non-captive prices, regardless of whether they are competitively bid or administered. The impact of captive supply on non-captive price will indicate the degree to which village-level sourcing by VIEs has depressed auction prices.

Price behaviour for non-captive coffee

The effect of backward vertical integration by buyers on the price received by independent producers has attracted some attention from price analysts in developed countries (Perry, 1978; Schroeder et al., 1993; Azzam, 1998). Schroeder et al. use an econometric model to measure the impact of captive supplies on spot prices for non-captive sales in a livestock market. Although they identify an inverse relationship between non-captive prices and captive supply, Azzam (1998) demonstrates that the elasticities obtained from the reduced form equations may suggest only that products

from the two sources of supply are substitutes; they do not necessarily indicate non-competitive behaviour.

The analysis in this section uses a model similar to that of Schroeder and his colleagues to reveal whether non-captive prices are moving in a manner that is consistent with variation in world market prices and indicate the degree to which the presence of captive supply has depressed the price of other coffee. As Azzam's work demonstrates, such a negative price impact could reflect a shift in demand for non-captive coffee, or an exercise of market power by the integrated exporter, or both. Meanwhile, one-to-one correspondence with changes in world market prices will indicate that auction prices provide reliable information.

Theoretical considerations

An empirical model to investigate the impact of vertically integrated traders on auction market prices can be derived from a profit-maximising objective function. The representative exporter can be assumed to maximise short-run profits at each auction date. The short-run supply of non-captive coffee is highly inelastic because cured coffee must be marketed quickly to avoid loss of quality and the costs of holding capital. Given the fixed supply of captive and non-captive coffee in the short run, price is determined by export demand. Profits are maximised by selecting the optimal level of non-captive coffee (q_{nc}) to purchase, given the predetermined level of captive coffee (q_{cc}), and can be expressed as,

$$\text{Max } \prod = P_w^E q_E - (P_f + C_m + \gamma_e)q_{cc} - (P_{nc} + \gamma_e)q_{nc} \qquad (1)$$

subject to

$$q_d = q_{cc} + q_{nc},$$

and

$$q_E = f_1(\psi\, q_d).$$

P_w^E is the f.o.b. price of mild arabica coffee in the world market, q_E is quantity exported; P_f is the farmers' price (at a village buying centre), C_m is the domestic marketing costs; γ_e is the unit export tax; q_{cc} is a quantity of captive coffee repossessed at the auction; P_{nc} is the auction price of the non-captive coffee; q_{nc} is the quantity of non-captive coffee purchased at the auction; ψ is a quality attribute of the coffee; and q_d is the quantity of coffee demanded by exporters.

The first-order condition for profit maximisation is:

$$\partial\prod/\partial q_{nc} = P_w^E \psi f'(q_{nc}) - P_{nc} - \gamma_e = 0. \qquad (2)$$

Demand for non-captive coffee is conditional on the quantity already secured at the farm level by an integrated exporter:

$$q_{nc} = f_2(P_{nc}, P_w^E, \psi, \gamma_e \mid q_{cc}). \qquad (3)$$

Assuming each exporter faces the same expectations regarding world prices and costs, individual exporters' demands can be aggregated to a market-level demand function.[4] Thus market demand for non-captive coffee (Q_{nc}), given the market supply of captive coffee (Q_{cc}), is the sum of i=1 to n individual exporter's demands:

$$Q_{nc} = \Sigma_i q_{nc,i} = f_3(P_{nc}, P_w^E, \psi, \gamma_e \mid Q_{cc}). \quad (4)$$

At equilibrium, aggregate demand and supply must be equal for both captive and non-captive coffee. Substituting the equilibrium market clearing conditions, Q^*_{nc} and Q^*_{cc}, yields:

$$P_{nc} = f_3(Q^*_{nc}, P_w^E, \psi, \gamma_e \mid Q^*_{cc}). \quad (5)$$

Equation 5 provides a model to assess the impact of captive supplies on the auction price of non-captive coffee. Given that the quantity of non-captive coffee is fixed in the short run, equation 5 is a price-dependent demand for non-captive coffee which is a function of the quantity of non-captive coffee, expected world prices, coffee quality, marketing levies, and the volume of captive coffee.

Empirical model

Data were collected from the TCB *Auction Catalogues* for 1994/5 to 1997/8. The catalogue identifies coffee lots that have been sold, specifying their grade, weight, month auctioned, supplier and warehouse/curing factory, noted price, final price, and buyer. 10,188 lots of Tanzania's northern arabica coffee were sold at the auction from 1994/5 to 1997/8. To allow us to identify the effect on price of the volume of captive supply relative to total supply, these data were aggregated into average monthly prices by grade. The dependent variable in the model (P_{nc}) is the monthly average price for all non-captive lots of a given grade sold at the auction.

Grades AA, A, B, PB, and C were selected for this analysis. Together, these grades account for 92% of the coffee auctioned, with 80% coming from the top three grades (AA, A, and B). The quantity of non-captive supply by grade and month (Q_{nc}) is measured in 50 kg bags and is expected to have a negative coefficient, reflecting a downward sloping demand curve. The expected price is taken as the New York futures price for C-grade arabica three months forward to delivery, measured in US dollars per 50 kg. Its coefficient is expected to be near unity if the auction is functioning well.

Quality is captured by dummy variables for grades AA, A, B, and PB, with C omitted. All quality variables should have positive coefficients, with larger values on higher grades. The share of supply by grade that is captive (Q_{cc}) is expected to have a negative coefficient, if captive and non-captive supplies are substitutes. Marketing levies were not included in the estimation due to low variability.

Yearly dummy variables were included in the empirical model to capture both the impact of changing marketing costs and shifts in demand. Declining internal marketing

4. We are assuming here that integrated and non-integrated exporters have the same cost structure for post-auction activities. Data for testing this assumption were not available. Dummy variables are included to reflect change in costs over time.

costs following liberalisation may have made captive coffee more economical, reducing the willingness to pay for non-captive lots over time. However, the fact that world prices for coffee were rising over the period suggests shifts in demand to raise the willingness to pay. Hence, the expected signs on the annual dummy variables are ambiguous.

Aggregating the auction data by month and grade produced a panel of 206 observations representing auction prices for each of 5 grades over 8 to 12 months per year for 4 years. Because no auctions are held when the volume of deliveries is low, some years had fewer observations than others. To estimate the regression parameters using Generalised Least Squares (GLS) the panels must be balanced. Therefore, random samples of 7 auctions were taken for each year, resulting in a sample of 140 observations consisting of the average monthly prices for 5 grades of coffee over 7 months per year for 4 years.

Previous studies show that OLS estimation may produce inconsistent or meaningless estimates of parameters in panel data due to heterogeneity (Kmenta, 1971; Hsiao, 1986; Judge et al., 1985). Missing market sessions create discontinuity in the auction data, which implies that the residuals cannot be efficiently estimated using OLS. The possible GLS procedures suggest different estimations of the generalised regression model. Park's model, which allows differences in variances and autocorrelation, is not attractive because of the structure of the data and the sampling undertaken to obtain balanced panels. Because adjacent markets may be more than one month apart, the autocorrelation correction used in Park's methods can produce spurious results. The Fuller and Bettese model was chosen for the analysis because it assumes that for each cross-sectional unit the correlation of the disturbances over time remains unchanged no matter how far apart in time the disturbances are. Time-series-cross-sectional regression (TSCSREG) procedure in the SAS system software was used to estimate the GLS model.

Results

Parameter estimates from the Fuller and Bettese estimation are shown in Table 7 with results from the OLS model reported for comparative purposes. The comparisons between the estimated parameters for different models reveal that the coefficients of the GLS model are slightly larger than those obtained using the OLS model. The estimated t-values are more or less the same for all variables, apart from the coefficients associated with the quantity of non-captive coffee and the proportion of captive coffee variables, which are significant in the GLS model only. Results from the Fuller and Bettese procedure are used for interpretations.

The results are consistent with a functioning auction market. The premiums for quality are as expected, with the higher grades receiving greater premiums. The coefficients associated with both the quantity of non-captive coffee and the captive supply are negative and significant, as would be expected if the two were substitutes on the auction floor. Positive coefficients on the annual dummy variables indicate that the demand for non-captive coffee has been shifting upwards every season since liberalisation, leading to price increases of US$40 and US$64 per bag for 1996/7 and 1997/8 respectively.

Table 7: Factors affecting auction prices for non-captive coffee

Variable	Fuller and Battese estimates	OLS estimates
P_{nc}	Dependent variable	Dependent variable
Intercept	-42.52	-32.95
	(-1.87)	(-1.78)
Grade AA (0,1)	48.51	45.01
	(6.54)	(5.59)
Grade A (0,1)	46.99	43.63
	(6.37)	(5.44)
Grade B (0,1)	40.28	35.27
	(5.10)	(4.06)
Grade PB (0,1)	17.74	19.67
	(2.46)	(2.52)
Q_{nc} (kg)	-0.003	-0.001
	(-2.06)	(-0.63)
$Q_{cc}/(Q_{nc}+Q_{cc})$	-38.66	-23.90
	(-2.79)	(-1.60)
P^{E}_{W} (US$)	1.06	0.99
	(9.52)	(10.86)
1995 (0,1)	14.80	5.59
	(1.03)	(0.57)
1996 (0,1)	40.07	32.15
	(2.72)	(2.82)
1997 (0,1)	63.58	59.42
	(4.79)	(6.44)
Adjusted R^2	0.60	0.70
Df	129.00	129.00
Sample size	140.00	140.00
	Cross section var: 7.16	SSE: 105,512.00
	Time series var: 367.47	MSE: 817.93
	Error var: 496.23	RMSE: 28.60

Note: t-statistics in parentheses.

The price of non-captive coffee is sensitive to the New York futures prices. The estimated coefficient on the futures price (1.06) is near one and is significant at the1% level. The estimated price transmission elasticity between the auction price and the New York futures price is 1.02; a near unitary elasticity implies that, on average, prices of non-captive coffee are sensitive to changes in the world market even after liberalisation.[5] The price of non-captive coffee is inversely related to the proportion of captive coffee. This suggests that vertical integration has had a negative impact on the auction price of non-captive coffee. The price flexibility with respect to the proportion of captive coffee is –0.0998. The share of captive supply increased from zero in 1993/4 to 53% in 1997/8. Thus, *ceteris paribus*, the auction prices for non-captive coffee decreased by about 5.3% between 1993/4 and 1996/7 due to the increasing share of captive coffee.

These results suggest that non-captive coffee suppliers receive better prices when VIEs fail to meet their contracts using captive coffee. The magnitude of this price effect could plausibly be attributed to a downward shift in demand for non-captive coffee as exporters source their supplies from the producers, but may reflect some limited market power. The declining marketing margins (Table 3) suggest a competitive situation, with VIEs engaging in domestic trade at relatively low cost, thereby reducing demand for coffee delivered by other traders.

The flexibility associated with the quantity of non-captive coffee (own-price flexibility) is -0.036, suggesting an elastic demand function. High own price elasticity of demand is due to high substitutability between the non-captive supply and both captive coffees and foreign coffee. Taken together, these results confirm that the price discovery for non-captive coffee functioned well. Therefore the auction of non-captive coffee provided reliable price information even after the vertically integrated traders emerged.

Conclusion

The success of domestic market liberalisation in delivering agricultural recovery in Africa depends on the ability of institutions to evolve and perform as market structures change. There is some evidence from African economies that the institutions and organisations that arose during the period of state-dominated marketing have been slow to adjust to the new environment. In the case of the Tanzanian coffee market, liberalisation brought changes in the market structure, but no change in the formal processes of the TCB auction that governs the transfer of coffee from domestic traders to exporters. The success of the liberalisation exercise depends in part on the ability of the Tanzanian coffee auction to function in the new market environment.

A functioning auction market facilitates price discovery, market co-ordination, and sound industry management. Tanzania's coffee auction could allow farmers to: gauge the value of improved quality; provide them with information they may require when they negotiate contracts with parchment buyers; and ensure an alternative market outlet

5. This price transmission measure is a simple price-on-price elasticity, based on the data in Table 7. More sophisticated analysis might exploit the time series aspects of the price relationships through tests of cointegration, as in Lloyd et al. (1999). Such analysis was not possible in this case because of discontinuities in the data resulting from the absence of auctions in certain months each year.

to vertically integrated exporters. The results confirm that the auction market performs well for non-captive coffee. Therefore, information from the auction of non-captive coffee can be used when producers consider marketing contracts and other management decisions.

In contrast, the auction cannot be used for price discovery for captive coffee because such coffee is not exchanged at the auction. The Tanzania Coffee Board uses the auction of captive coffee to collect levies, but requiring captive supply to be auctioned also implies increased transaction costs for exporters who have already secured their coffee. Whether the volumes of non-captive coffee alone could support an auction and whether the benefits of such an auction justify the costs is beyond the scope of this article. Major benefits of auctioning non-captive coffee are (i) fostering competitiveness at the farm gate, as farmers can switch from exchanging at the farm-gate to the auction, and (ii) providing information on the value of quality, which cannot be known if coffee is exchanged in its parchment form.

There is evidence that the liberalisation of cereals markets in Africa has brought in competitive traders who operate at high cost, due to lack of access to information and facilitating services such as insurance and finance. One concern for export-crop markets is that liberalisation could result in dominance of the market by a few oligopolistic traders with access to these facilitating services. In the case of Tanzanian coffee, large firms with better access to international finance have emerged as forces in the market, but their presence does not appear to have been detrimental. Declining marketing margins and the continued provision of a useful auction suggest a degree of success for the liberalisation of the coffee market. In this case, the presence of international firms with an interest in the commodity translated into sufficient investment to provide reduced costs, whilst a sufficient number of competing firms, including the co-operative unions, seems to have limited the emergence of non-competitive behaviour.

The impact of marketing reform on production is not readily discernible. Coffee production rose after liberalisation from 43,500 MT in 1994/5 to 54,000 MT in 1995/6. With poor growing conditions related to El Niño weather patterns, production declined to 38,000 MT in 1997/8 and then rebounded to 49,000 MT in 1999/2000. A better measure of farmers' intended response could be the dramatic increase in coffee plantings (from 500,000 plants in 1996 to 13 million in 1999) and the recurrent shortages of planting material in the country.

That demand for planting material has outstripped supply reveals both an enthusiasm on the part of producers and the potential for physical constraints to hamper supply response to reform. In Tanzania, inefficiencies in related markets could also deter coffee plantings. For example, costly and unreliable food markets are likely to discourage self-provisioning farmers from shifting resources out of food production and into coffee. Tanzania seems to have achieved a balance of liberalisation and regulation in the coffee market that has encouraged a reduction in marketing costs and the provision of a range of market functions. However, the impact of the improvement of any single commodity market will be muted unless related markets are also functioning and technical constraints are removed.

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