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Market Power and Structural Adjustment
The Case of West African Cocoa Market Liberalization

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Abstract

Liberalization of cocoa market in West Africa, due to structural adjustment reforms, has resulted in the elimination of parastatal marketing boards and initiated the creation of new institutions to replace those agencies in Ivory Coast, Nigeria and Cameroon. Concerns have been raised as to the effects of these reforms on prices of cocoa received by farmers, welfare measures and competitiveness of marketing channels. Of particular importance is backward integration of multinational processing firms, who take over exporting activities from the state and may collect rents previously captured as export taxes. This paper uses a conjectural variations approach to estimate the degree of market power present in the post-liberalized cocoa bean markets of Ivory Coast and Nigeria. Significant evidence of market power is found in the Ivory Coast markets between the farm gate and U.S./EU15 imports. The market power, exercised in part by multinational exporter/processors, must be considered in concert with the Ivorian government who is still collecting export taxes, heavily influenced by the need to finance an ongoing civil war. In contrast, no evidence of market power is found in Nigerian markets or domestic (farmer to trader) markets of Ivory Coast.

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Introduction

Historically, the incomes of West African smallholder cocoa farmers were determined by state-controlled entities. These para-statal marketing agencies set prices and marketing margins, and intervened in input markets, procurement of cocoa and subsequent export. Mandated farmgate prices aimed to protect the farmers from world price volatility while the taxes levied on cocoa exports were an important source of foreign exchange and government revenue. Liberalization of these markets, due to privatization under structural adjustment reforms, has resulted in the elimination of para-statals and created the need for new private institutions and market agents to replace the services of those government agencies (Bloomfield and Lass, 1992; Varangis and Schreiber, 2001). Initially, chaotic markets characterized by entry of many exporters emerged (Gilbert, 1997), but subsequently multinational cocoa bean processors took over exporting as well as processing and are backward integrating into domestic links of the cocoa supply chain.

The main objective of cocoa market liberalization in West Africa was to ensure greater 'pass-through' of the world price to the farmer and to tie the dynamics of the entire chain to world market forces in an effort to improve efficiency (Gilbert and Varangis, 2003). However, if imperfectly competitive agents with market power replace para-statals this may widen (or maintain) the previously large gap between the farmgate price and the price received for exported beans in EU15 and the United States, as agents in a long supply chain reap rents that previously accrued to the government as taxes. This has arguably left farmers at the mercy of both the unstable world market and concentrated multinational corporations, leading to concerns

as to the effects of structural adjustment reforms (Gilbert, 1997; McIntire and Varangis, 1999; Gilbert and Varangis, 2003; Dorin, 2003).

Nigeria and Ivory Coast provide an interesting juxtaposition. As the earliest (1986) and most recent (1999) cocoa market liberalizers, respectively, they provide an opportunity to examine market power issues as they have evolved over time. Institutional differences across these countries suggest the possibility of very different outcomes, as confirmed by our results. The purpose of this paper is to estimate the degree of oligopsony power that may exist in post-liberalized Ivory Coast and Nigeria at various points along the cocoa supply chain.

The paper is organized as follows. Section I provides background related to cocoa market structure. Section II examines literature regarding structural adjustment as it pertains to cocoa market liberalization, emphasizing the role of backward integrating multinationals. Section III reviews the theoretical approach adopted in this study. Section IV describes the model and data used in econometric estimations. Results are explained in Section V and concluding remarks are provided in Section VI.

I. Background on cocoa market structure

Cocoa beans are a perennial tree crop grown in tropical climates, with about 66% typically produced by smallholder farmers in West Africa (ICCO, 2003). Ivory Coast leads all countries with approximately 35 percent of total world production while Ghana, Nigeria and Cameroon accounted for 13%, 12% and 4%, respectively. Cocoa plays an important role in these African economies as a main export good and source of foreign exchange. In addition, smallholder farmers (< 5 hectares) typically grow this cocoa, which generates work opportunities for an estimated 10.5 million Africans (ICCO, 2003). Though some producing countries have

begun to process their own beans, the bulk of production is shipped to processors in Europe and North America who roast beans and grind them into liquor, butter and powder used in the manufacture of chocolate and other products. The vast majority of finished products that contain cocoa are consumed in Europe and North America.

In the past, producers from the main cocoa producing African countries participated in a system where para-statal controlled farmgate prices, input supply and all levels of marketing, research and extension (Dand, 1999; Fold, 2002). The French and English influences from their colonial past led each country to follow either a *Caisse de Stabilisation* or marketing board approach, respectively. The marketing boards in Ghana and Nigeria controlled all aspects of the cocoa marketing chain by setting the f.o.b. price in the pre-season, and by declaring producer prices, buyer's margins, transportation costs and export taxes. The marketing boards also performed all the related tasks including inspections, buying, loading, transportation, quality control, storage and export. The *Caisse*, in Ivory Coast and Cameroon, on the other hand, was not directly involved with the transportation of cocoa from the farmgate (controlled by private traders called *traitants*) and permitted 'private' exporters to operate within a system of quotas (Losch, 2002), and regulated farm gate as well as export prices, while collecting substantial taxes.

Nigeria was the first West African cocoa producer to liberalize (in 1986), with reforms from the producer and input level through the marketing chain to exporting the beans. Currently, Ghana is the last country to retain its marketing board and other portions of its para-statal apparatus, having undergone partial reforms beginning in the 1992/93 season. Cameroon and Ivory Coast began the liberalization process in 1991 and 1999, respectively (ICCO, 2003). The specific impacts of liberalization have been particular to each country, though marketing chain

composition (via concentration) has been affected to some degree without exception. Cameroon has eliminated export taxes and promoted ‘cooperation’ between Cameroonian exporters and multinational firms. Ivory Coast has restructured its taxation regime, eliminated the *Caisse de Stabilisation*, and allowed some backward integration by the market’s new entrants – the multinational firms. Ghana (in principle) has allowed the creation of quasi-private exporting firms coexisting with *Cocobod*, but the marketing board structure remains largely intact. Less is known about Nigeria, the first to liberalize, but there are reports that it has the most competitive cocoa sector since many local exporters are still warehousing and exporting independent of the multinationals that are also present (Dand, 1999).

The use of market power has a long history in cocoa markets, as quotas as well as implicit and explicit tax schemes have been implemented by para-statals (Panagariya and Schiff, 1992). The export tax intervenes between the producer and world price and may be set ‘optimally’ as governments take advantage of their nation’s relatively large world market share. The optimal tax is a function of interactions among and conjectures about the other major producing countries in addition to residual demand and supply elasticities (Yilmaz, 1999). The tax wedge generates revenue to the government which is theoretically redistributed to the population. A goal of structural adjustment has been elimination of these taxes due in part to inefficiencies and corruption in redistribution.

The current structure of the marketing chain in Ivory Coast is diagramed in Figure 1 (adapted from Sanogo, 2002). Markets in other West African countries exhibit small variations. As shown, it provides the cocoa farmer with two basic options: sell their product to *pisteurs* (up-country agents) and *so traitants* (traders) or to cooperatives. According to the Bureau d’Etudes Techniques et de Développement (BNETD), the market share enjoyed by cooperatives decreased

from 32% during the 1998/99 season to 18% in the post-liberalization season of 2000/01, and has varied around that share since, leaving 75 to 80% to be funneled through middlemen (BNTED, 2002). Once the cocoa arrives at the port of Abidjan or San Pedro, it is conditioned for export (*usinage*) and shipped to processors largely by multinational exporters who, in the cases of Archers Daniels Midland (ADM), Cargill and Barry Callebaut, are themselves processors. Therefore the farmgate price is the residual of the 'c.i.f.' (EU15/ U.S.) price less transportation, conditioning, taxes and other associated marketing costs which may include rents to exporters. This is in contrast with pre-liberalization ,where the farmgate price was mandated and rents were collected exclusively by the government.

A survey of reports shows how multinational exporter market share has evolved since liberalization in Ivory Coast (Table 1). Immediately after liberalization was implemented in Ivory Coast, the nation's largest exporter/processor was Sifca-Jag with almost a 20% market share. At that time ADM put a partial takeover of Sifca into motion. Overall, fourteen firms controlled three-quarters of the cocoa that was declared for export in 99/00 (the cocoa season traditionally begins in October and some data include bean equivalents as several exporters process a portion of Ivorian output in-country). These fourteen firms now control upwards of 85% of the export market, with almost 90% during the 2001/02 season. Currently, though there are 59 exporters, the top five firms control roughly half (55%) of total exports. According to the calculated Herfindahl-Hirschman index (Table 1), the equivalent number of symmetric firms ranges from 10.9 in 2000 to 13.28 in 2003.

Unfortunately, these reports only allow one to discern the nominal ownership of cocoa exporters while anecdotal information leads us to believe that several smaller companies are acting on behalf of the larger exporters, and there are allegations of overlapping ownership.

Moreover, the project funding this research (STCP) has worked with cooperatives who are developing partnerships with the multinational exporter/processors, including cooperatives who are acting as their own exports, but contract for services (usage, transportation, warehousing, port handling) from the multinational exporters. This practice allows the multinationals to realize economies of scale beyond what is possible under regulations limiting the market share of exporters, while the cooperatives also bear the price risk of these export transactions. Exporters are also allowed to export processed products in excess of their ten percent market share restriction under Ivorian law.

II. Research Specific to Market Power and Cocoa Market Liberalization

Fold (2002) and Losch (2002) both provide insight into how the market structure of West African cocoa (Ghana and Ivory Coast, respectively) has changed and may further change due to liberalization. Both authors provide anecdotal evidence supporting the possibility that liberalization resulted in backward integration by the multinational processors and subsequent market power exertion.

Currently, the consolidation of exporters across countries is to the point where, cumulatively, multinationals have international market shares that almost rival Ivory Coast itself (Fold, 2002 and Losch, 2002). The ‘oligopolistic’ countries have been replaced by a few multinationals that may be better prepared to use their market power, to achieve different objectives. In the past, major cocoa producers with aims of exercising market power (i.e. Ivory Coast) were thwarted by non-cooperation and limited by in-country storage capacity due to climatic conditions. Coordinated international efforts have also been attempted in the form of four separate international commodity agreements in an effort to stabilize market prices, but

these quotas or stock schemes all failed (Maizels, 1997). In contrast, as the multinational processors backward integrated, they have also made efforts to integrate forward as the primary chocolate manufacturers were restructuring and willingly sold their processing capacity to the processors. Some processors are also entering the chocolate manufacturing business. The take home message is that liberalization opened up the export market to private multinational corporations that have incentives to vertically integrate in an effort to promote cost savings through efficiency gains and possibly to exert market power against smallholder farmers, chocolate manufacturers, and consumers.

Gilbert (1997) examines the possible effects of liberalization on farmgate prices and the resulting farm income. While exchange rate and inflation issues may dampen the usefulness of cross-country comparisons, liberalized markets (at the time Nigeria and Cameroon) resulted in farmers receiving a larger share of the f.o.b. price. Gilbert noted that export taxes may lower after liberalization but are not necessarily eliminated. And the narrower margins could also reflect greater competition along the supply chain.

McIntire and Varangis (1999) analyze the reforms undertaken by Ivory Coast early in the liberalization process. Ivory Coast's pricing policies and marketing strategies were examined in a general equilibrium framework. They concluded that the government did not manage farm price stabilization programs effectively under the *caisse* system and that under the new liberalization scheme farm prices should rise, along with rural incomes, by lowering the export tax. They found that lowering the export tax would have a slight negative effect on national income, but trying to raise the tax to 'optimal' levels may have deleterious effects on Ivory Coast's market share. Improving the efficiency of the marketing chain through competition and raising the

minimum producer price (which had since been eliminated and then reinstituted ineffectively since 2003) should also promote income gains.

Gilbert and Varangis (2003) discuss how liberalization opens the marketing chain to world price volatility and that export taxes will have less of an impact on farmgate prices. This, coupled with the market share enjoyed by countries like Ivory Coast and Ghana, may result in supply shifts that have large country implications on price: lower prices as output expands, so farmers will have a larger share of the lower price. The origin of this result was the ‘adding up’ effect, due to inelastic world demand and relatively more elastic farmer supply. These authors contend that producers will see some welfare gain if export tax revenue is redistributed and foreign consumers will be the only ‘clear winners’ if the world price of cocoa falls.

Dorin (2003) took a value sharing approach to establish how the current move toward liberalization in Ivory Coast has changed the environment in which the producers, governments, processors and manufacturers operate. He notes that export taxes have fluctuated from a pre-liberalization level of 36% of the c.i.f. price in 1996/97 to 19% in 1998/99 and afterwards remained between 25 and 29%. Looking at data from 1992 to 2001 covering all levels of value from farmgate to French chocolate tablet, he concludes that the gains and losses imply bilateral market power exertion by multinational processors.

The common thread has been the increased importance of multinational firms. Fold (2002), Losch (2002) and Dorin (2003) discuss market power within the newly liberalized markets, focusing on the new role of multinationals. Their insights provide a basis upon which we use economic theory and data to uncover evidence, if any, of the exertion of market power in the marketing chain from farm-level cocoa procurement to the exporter selling the beans. The major drawback to this literature is the lack of attention paid to measuring the extent of market

power in the cocoa marketing chain, and its quantitative effects on market outcomes. This paper attempts to resolve this issue on the extent of market power exercised by multinational cocoa exporter/processors after liberalization. New Empirical Industrial Organization type estimations will explicitly test for market power and estimate markup/downs due to those rents.

III. *Estimation of Market Power*

Market power issues in the agricultural sector have received increasing attention as firms in the United States and European Union consolidate throughout the marketing chain (Sexton and Zhang, 2001; McCorriston, 2002). While consolidation itself does not automatically predestine a sector to imperfect competition, it is an often cited characteristic that may increase the incidence of market power within the Structure-Conduct-Performance (SCP) paradigm (Carlton and Perloff, 1994). The demand and supply dimensions of agricultural goods also may lead to imperfect competition. For example, the nature of raw agricultural products (bulky, perishable, limited substitutability, etc.) and their production (economies of scale, exit barriers, etc.) creates opportunities for firms to exert market power on the demand and supply side, respectively (Sexton and Zhang, 2001). Imperfect competition in the trade of agricultural goods is driven by factors such as increasing returns, intra-firm trade and market structure (Helpman and Krugman, 1985).

The vast majority of work in the field of market power and the agricultural sector has focused on estimating the degree of market power in processing, manufacturing and retail (Sexton and Lavoie, 2001). An early contribution by Appelbaum (1982) looks beyond the SCP paradigm and introduces a model framework to estimate market power that developed in co-evolution with the New Empirical Industrial Organization (NEIO) paradigm. NEIO relies on

game theory and econometrics to find evidence of market power by using price and quantity data for individual industries. In contrast, the profit-structure, price-cost margins and accounting data for aggregated industries are commonly used in the SCP literature (Sexton, 2000; Carlton and Perloff, 1994). Within the NEIO framework, the data are used to estimate conjectural elasticities and price influences under *a priori* assumptions about how firms throughout the marketing chain conduct themselves, functional forms for demand, supply and cost as well as the magnitude of elasticities (Sexton and Zhang, 2000; Carlton and Perloff, 1994). Much of this work has been done using a conjectural variations approach that incorporates a firm's belief about how rivals will react to their output choice within a static framework. This conjectural variations approach, as proposed by Appelbaum (1982), will be modified here to also accommodate the oligopsony case following Schroeter (1988) in an effort to examine the behavior of intermediaries.

IV. Description of the Theory, Model and Data

Agents demanding cocoa beans from the farmer will either be traitants (traders), who earn the prevailing *prix entrée usine* (price received prior to conditioning by traitants) less fixed marginal costs and the farmgate price, or exporters who receive the c.i.f. price (unit import value) less export taxes, fixed marginal costs and the farmgate price. Potential agents who could exercise market power are the government via continued export taxes, exporters/processors, and even the local traitants. These are intermediaries along a chain who buy from farmers (or traitants in one variant) and sell to processors in Europe and North America. Farmers in each country are assumed to produce homogenous products. These producers are assumed to behave as competitive agents who simply satisfy demand at prices, which they take as given. The basic model, modified to treat each potential agent, describes the behavior of an intermediary with

potential market power both up and down stream. An exporter is typical, and the agent most likely to exercise market power.

Model

An exporting firm j 's problem is to choose the profit (Π) maximizing amount of cocoa beans q_{ij} in month i to buy/sell given farmer supply, processor/chocolate manufacturer demand, and conjectured responses by rival exporting firms:

$$\text{Max}_{q_{ij}} \Pi_{ij} = P_i(Q_i)q_{ij} - r_i(Q_i)q_{ij} - cq_{ij} - tq_{ij} \quad (1)$$

where P_i is the nominal price at which the beans are sold by firm j in month i and r_i is the farmgate price for beans in month i - both are functions of overall aggregate demand faced by the exporting sector ($\sum_j q_{ij} = Q_i$). The term, c , represents the fixed marginal cost associated with cocoa bean procurement by the exporting firm. These costs may include: conditioning at the port, transportation from farm to port or port-to-port as well as other costs of doing business such as non-export tax fees to the government. The last term, t , represents the specific export taxes levied by the government and paid by the exporting firm.

The first order conditions for profit maximization are:

$$\left[\frac{\partial P_i}{\partial Q_i} \frac{\partial Q_i}{\partial q_{ij}} q_{ij} \right] + P_i - \left[\frac{\partial r_i}{\partial Q_i} \frac{\partial Q_i}{\partial q_{ij}} q_{ij} \right] - r_i - c - t = 0 \quad (2)$$

where $\partial Q_i / \partial q_{ij}$ is the effect of this firm's behavior on industry quantity, Q , based on the conjecture on rival behavior.

As with many other NEIO-esque studies, firm level data is not available so industry level data is used here. Appelbaum considered θ^j to be a benchmark estimate of the oligopolistic power of firm j . This could be used to test the hypotheses that $\theta^j = 0$, the behavior of the firm is described by perfect competition, or $\theta^j = 1$ where the firm behavior is characterized by pure monopoly. Schroeter extends this definition to describe behavior in the factor markets as well and observes that θ^j is the j^{th} firm's perceived rate of change (as an elasticity) of aggregate market output (factor demands) with respect to the firm's output (factor demands) in the monopoly (monopsony) case. In order to implement their theoretical framework at the industry level, these views of θ^j required that marginal cost ($c_j = c$) was constant and shared common values across symmetric firms, and therefore $\theta^j = \Theta$. In other words, all of the firms would act with the same degree of market power, so $\partial Q_i / \partial q_{ij} = \Theta$ for all j .

Equation (2) can now be re-arranged into elasticity form as an aggregate optimality condition under Schroeter's assumptions:

$$P_i \left[1 + \frac{\Theta}{\eta n_k} \right] = r_i \left[1 + \frac{\Theta}{\varepsilon n_k} \right] + c + t \quad (3)$$

where Θ represents the industry level conjectural elasticity, $\eta = \left(\frac{\partial P_i}{\partial Q_i} \frac{Q_i}{P_i} \right)^{-1}$ the own price

elasticity of demand, $\varepsilon = \left(\frac{\partial r_i}{\partial Q_i} \frac{Q_i}{r_i} \right)^{-1}$ the own price elasticity of supply and n_k is the equivalent

number of symmetric firms in a given season k , based on the Herfindahl-Hirschmann Index

calculated from export declarations data (Table 1). The markup and markdown by this intermediary are therefore represented by $\Theta/\eta n_k$ and $\Theta/\varepsilon n_k$, respectively.

Both authors use the estimated Θ to calculate price distortions in the output market (and input market in Schroeter's case) as measured by Lerner's index (and its factor market analog). Here the average markup/down ($\bar{m}$) will be quantified by subtracting off all costs incurred by the firm (average taxes ($\bar{t}$), and estimated fixed marginal ($\hat{c}$) and average input costs ($\bar{r}$)) from the average price received ($\bar{P}$) for exporting beans thus leaving the residual rent. A percent markup/down is then measured as rent relative to the output price average from the sample:

$$\bar{m} = \left(\frac{\bar{P} - \bar{r} - \bar{t} - \hat{c}}{\bar{P}} \right) * 100 \quad (4)$$

The optimality condition (3) includes three unknown parameters, Θ , η and ε , which cannot be identified from linear estimation of that equation.. Schroeter's assumption on the intermediary case implied that the firm's behavior was the same in both the output and factor markets (as implemented above, a result of Leontief cost function restrictions used to resolve indeterminacy of upstream versus downstream behavior). While this assumption is appropriate given the prevailing technology and available data, this limits the ability to attribute any evidence of profit taking to the exporter/processor's relative ability to markup the price against agents upstream versus markdown prices received by farmers or traders depending on which input price is considered. In this case, the indeterminacy could be resolved if there were greater confidence in the constant elasticity assumption used to derive (3) and the specific demand and supply elasticities assumed (or estimated): η and ε , respectively.

A common thread throughout these studies is the use of annual data that is often problematic due to lack of appropriate data, a lack of confidence in its accuracy and the fact that it cannot account for the timeframe within which decisions are actually made. For this research, an attempt was made to use monthly data to estimate the optimality condition (3) in a system of equations that included supply and demand equations. However, successful estimation of these two equations proved impractical to implement so, given the specific goals of this research, estimates from the literature were obtained as discussed below. Estimates of Θ from the single optimality conditions for Ivory Coast and Nigeria were then computed given η and ε . Ideally, short run cocoa supply and demand equations would be developed and estimated simultaneously with (3). Sensitivity analysis, by varying these elasticities, generates proportional changes in estimates of Θ without changing results or significance on tests of market power. Given the difficulty of estimating these supply and demand equations, both by firms and researchers, any markup/downs are a likely to be result of fixed markup/down pricing rules.

Supply and demand elasticities

As a perennial tree crop, estimating a cocoa supply function should take into consideration a farmer's tree planting decisions, the delayed maturation of the tree (most types do not bear fruit for up to 3-5 years), and the farmer's management strategies based on their past experiences as well as expectations for the present and future seasons. These factors imply a low own price elasticity of supply in the short run but do not rule out producer response through production levels due to shifts in management strategies related to fertilizer, pesticide and fungicide applications as well as the requisite clearing of undergrowth. Storage is another factor that should be considered as farmers decide whether to hold or sell cocoa. Given the unfavorable

climate for long term, on-farm storage of a perishable product such as cocoa, storage is considered as a short run decision and results in short run supply variation due to price. However, no storage data is available so, in the case of this study, so such responses are considered using delivery lags as discussed below.

The original work on cocoa supply response in Ghana was done by Bateman (1965). Bateman based aggregate supply response on an iterative model that incorporated the choice of the Ghanaian farmers to plant cocoa (a perennial tree crop) and the ensuing management. Since his ‘technological capacity’ approach was introduced, several researchers have attempted to improve on its basic design and implementation by adding lagged dependent and independent variables, introduction of competing crops to capture the dynamic effects of competing uses of labor, planting decisions and an examination of longer term elasticities (see Akiyama and Trivedi, 1987 for a review).

Maizels, et. al. (1997) provides a framework to estimate cocoa demand using a log linear specification using lags that result in estimates of short and long run cocoa demand elasticities. The ICCO made a similar effort in 1993 but their model specification is unavailable at this time.

Preliminary attempts to use both annual and available monthly, post-liberalization data to estimate the necessary short run supply elasticity, ε , were met with failure, reflecting strong upward trends in supply in Ivory Coast in the face of declining world and farmgate cocoa prices. Lack of appropriate monthly data precluded the same estimation of the short run, own-price elasticity of demand, η . Therefore, the short run supply elasticity ε was set as 0.2, a consensus result from available recent prior estimates (Gilbert and Varangis, 2003; Labys, 1973), and η set at -0.3 based on ICCO estimates of the short run demand for chocolate (ICCO, 2004). Since a

monthly model was being estimated, choosing these parameters reflected a desire to err on the low side, reflecting what is believed to be limited, very short run alternatives available to farmers, traders and even exporters. As noted above, guesses on these elasticities do not affect tests for market power nor estimated markups/downs.

Data

The necessary data to econometrically estimate this model are as follows: average monthly prices paid at the farmgate, the monthly prices received by buyers when they sell to the next level in the chain (represented by the *prix entrée usine* paid at the port), export taxes, and monthly c.i.f. prices received by the exporters. Data for the estimation of market power in the domestic links of Ivory Coast and Nigeria have been collected from a variety of sources.

All analyses for Ivory Coast covered monthly data from October 1999 to June 2005 with data from July through September omitted due to lack of information (these off-season months represent transactions that are comprised of primarily beans stored by the traders and/or exporters so this should not significantly affect the results concerning the farmer's direct interactions with the agents upstream)(Figure 2). Working upstream, world cocoa prices were represented by the monthly Ivory Coast origin-specific futures price on the LIFFE exchange (DataStream, 2005). Since this c.i.f. world price includes the export tax levied on exporters by the government of Ivory Coast, a time series of export taxes was collected from the *Observatoire* (BNETD, various years) and Factiva (2005) and subtracted from the world price to obtain an exporter price (Table 2). The resulting price is used when the aim was to determine whether the Ivory Coast government's actions were actually influencing the results on exporter behavior. The monthly average *prix entrée usine* price was reported by BNETD for the 1999/00 through

2001/02 seasons. For the remaining months, weekly prices were obtained from newspaper articles (Factiva, 2005) for Abidjan and San Pedro, the two main ports, and averaged using a 0.5 weight for each port (reflecting their share in total exports) and the number of days that the price persisted. Farmgate prices are not reported specifically by the government of Ivory Coast but prices paid to farmers at the buying center are reported on a weekly basis. This means that the market power held by up-country agents (pisteurs) cannot be differentiated from that held by traders. There is some debate over whether pisteurs in Ivory Coast can hold any market power as they are typically doing the bidding for the traders that finance their work (Sanogo, 2002). The farmgate prices were collected in the same fashion as the *prix entrée usine* and from the same sources but they were averaged using buying center market share as a weight.¹ For use in the estimation of market power against farmers by traders, prices were left in local currency (FCFA) per kilogram. When used in the exporter's optimality condition, the farmgate price was converted to \$US/mt using monthly exchange conversion rates from DataStream (2005).

Market prices in Ivory Coast followed an upward trend from 1999 to February 2003 (Figure 2). After the 2002 civil war, prices began to decline as record production in several countries and subsequent rising stocks affected world prices. Not surprisingly given a world market share that is usually around 35%, domestic prices in Ivory Coast follow a trend similar to the world price. Export taxes were at their lowest immediately after liberalization. As domestic unrest grew, export taxes began to rise and averaged 27.5% of the prevailing world price for Ivorian cocoa (assumed to be the LIFFE Ivory Coast futures price) between 1999 and 2005. The

¹ The buying center prices are collected and reported by the BCC. Unfortunately, the BCC does not provide access to historical data so newspaper articles that reported the data were used instead. Buying center market shares are reported by Oster Dow Jones Newswires (2005). The buying centers used to calculate the average farmgate prices were Abengourou, Daloa, Divo, Gagnoa, and Soubre. The remaining major buying center, Man, was excluded from the calculation because it has been under rebel rule since September 2002 and prices were only reported sporadically. When information from one buying center was missing, the other weights were adjusted proportionally to maintain consistency.

effect of the war is apparent when one considers that export taxes averaged 24.5% of the world price between October 1999 and June 2002 and 32% between October 2003 and June 2005.

Nigerian data covered September 2002 to June 2005 (Figure 3). Since data in some months suggested zero or negative transactions costs, in order to account for potential exporter profits we needed to consider the effects of parallel foreign exchange markets that have persisted in Nigeria during our estimation period. All months were included in the basic Nigerian data set, but parallel exchange rate data was only available through March 2005 so regressions using the parallel rate did not include April to June 2005. In addition, data on domestic cocoa prices were not available for March and April 2003 as well as May 2004 and omitted from the dataset. Working upstream, the LIFFE price (average of 2nd position) was taken to be the world price for Nigerian cocoa since the majority is destined for the European market (DataStream, 2005). As export taxes in Nigeria are very low (~\$5/mt) and not always collected (Isiaka, 2004) they are not considered in the analysis and reside in the estimated fixed costs. The trader and farmgate price was collected from news reports (Factiva, 2005) where cocoa prices (trader and farmgate) are reported on a semi-weekly basis. Monthly averages were calculated for each of these prices with number of days used as a weight.

Several authors have noted that inflation and limited access to foreign exchange led many cocoa buyers to use the cocoa trade as an intermediary step when trying to acquire foreign exchange to arbitrage and profit on the parallel market (Gilbert, 1997; Uma, 1998; Alaofin, 1999; Dand, 1999 and Varangis and Schreiber, 2001). It is assumed that the farmers do not have access to the parallel exchange markets but all other downstream agent do and may or may not choose to use it. When the parallel rate is used, all prices are denominated in Naira; otherwise prices are

converted to Euros. The parallel exchange rate was constructed by multiplying the monthly average principal rate (Naira to \$) by the monthly average consumer price index divided by 100 (International Financial Statistics, 2005). The use of the parallel markets may allow traders to appear to purchase cocoa at prices that are much higher, as a percentage of the world price, than is often observed in other cocoa producing countries. This practice may also widen the margin between traders and farmers as the trader can sell their cocoa at price that is effectively higher than what they would otherwise receive. All other prices were converted using average monthly conversion rates from International Financial Statistics (2005). As with Ivory Coast, farmer to trader regressions were in local currency (Naira/mt) while exporter to farmer regressions were converted to €/mt.

V. Regression Results

Separate regressions were performed to represent interactions amongst agents at different levels of the domestic cocoa marketing chains in Ivory Coast and Nigeria. The optimality condition (3) included the world and domestic price variables described above and in the result tables. These variables were interchanged as necessary (and as indicated in the tables) to examine transactions between farmers and exporters as well as between traders and exporters, both with and without the export tax wedge imposed by the government (Tables 3-4 for Ivory Coast and Table 6 for Nigeria). The final regressions examined the interaction between farmers and traders (Table 5 for Ivory Coast and 6 for Nigeria). In each case an intermediary with potential market power faced differing upstream and downstream prices, so different supply and demand functions.

T-tests were performed to test the hypothesis that the conjectural elasticity, Θ , was equal to zero. In other words, the t-test provides evidence on whether the conjectural elasticity truly represents perfect competition ($\Theta = 0$) or a departure manifested as oligopoly/oligopsony power exerted by the intermediary in the marketing chain ($\Theta \neq 0$).

As the available data are monthly, time becomes an issue since transactions along the marketing chain can take several weeks to complete, due to transportation and conditioning tasks. As a result, farmgate prices for a batch of cocoa sold in a particular month may be associated with an exporter price for the subsequent month. Therefore, the farmgate price in the current and lagged period are weighted in the optimality condition and these econometrically estimated weights sum to one. This accounts for delivery lags and possible short-term storage by traders and exporters in the empirical implementation of the model. Experimentation with the time lag weights gave expected results, no influence of the lagged price ($w = 0$) for arms-length transactions (farmer to trader) and were not used in those estimations. When the weights proved insignificant in regressions involving other agents, the optimality equation was estimated without the lagged price and associated weight.

The Breusch-Godfrey (autocorrelation) and unit root (stationarity of the data and residuals) tests were performed given the time series nature of the data. Regressions with autoregressive errors were accounted for using the AR(1) correction provided by SAS in the Proc Model routine (SAS, 2005). Subsequent tests confirmed that there was no evidence of autocorrelation or non-stationarity post-correction. When relevant, estimates for the lagged dependent variable are reported in the tables of results.

Ivory Coast

Each case is divided by the agents involved and then within cases by the time period of the data used in the sample. It was suspected that the civil war in Ivory Coast, which began in September 2002, may have had an effect on the ability of exporters to exert market power as the government raised wartime revenue through export taxes and the transactions costs associated with the procurement of cocoa increased due to the increased risks. Therefore, regressions were performed for the whole time period (October 1999 to June 2005), before the war (October 1999 to June 2002), and after the war (October 2003 to June 2005). Regressions with the war eliminated from the dataset (the combination of the before and after war datasets) yielded results very similar to those for the full time period. It should be noted that the post-war estimates take place in an environment that included flare-ups between the government and rebel forces and a fragile peace marred by violence and the persistence of a frontline border that effectively split the country in two. The pre-war period included a coup d'état and regime change but the country remained whole and cocoa continued to flow out of the country. Since the beginning of the war in September 2002, cocoa has continued to be exported but representatives from the multinational exporting firms have had to evacuate on several occasions and all agents involved continue to work under difficult conditions.

The first cases examine whether a combination of the government and exporters exert market power against farmers (Table 3). In the case where all agents are included, perfect competition is rejected (at a 1% significance level) and markup/down (calculated using Equation 4) ranged from 14.1% to 34.7% depending on the time period. Overall the market power against farmers was manifested as a 29.2% markup/down while the ability to markup/down appears to have diminished when comparing the pre-war markup/down (39.0%) to the post-war (14.1%). A

perspective of this case would be that post-war, export taxes are simply an exogenous cost of doing business to multinationals, so are implicitly in *C1*, the fixed marginal cost. Another note is that the estimate of *C1* post-war is \$869/mt, which contains not only export taxes but also the increased costs of doing business in post-war Ivory Coast where the country is divided in half, market risks are high and security roadblocks abound to maintain the precarious peace. These conditions may inhibit the exporter's ability to extract rents from agents upstream.

When the government is removed from the chain, by subtracting export taxes from the exporter to farmer margin, a similar pattern is noted between pre-war (28.2%) and post-war (19.8%) but market power estimates fail to find evidence of market power when the whole time period is used. Structural change in the coefficients, and in the exercise of market power, obviously contribute to this result.

A cross-case comparison of the before and after war results are consistent with a reluctant sharing of market power between the government, who continues to tax exports, and the multinationals. News reports on the “debate between the government and trader organizations” as export taxes are adjusted when world market prices change are consistent with this view of bilateral market power. However, the government's reliance on the export taxes to fund the war may diminish the role of world market conditions when setting export taxes.² Fixed marginal costs are significant at a 1% significance level and margins appear to be 7.6% and 16.2% for the whole and war-less datasets, respectively.

² As of 10/22/05, Ivory Coast had still not announced export tax levels for the 2005/06 season effectively blocking the release of any exports (Aboa, 2005). Concomitantly, observers from the UN accused Ivory Coast of diverting export taxes from the sale of cocoa to fund the civil war that continues as a stalemate up to the present (Remy, 2005).

Anecdotal evidence suggests that beans sold during the midcrop are discounted by buyers due to the prevalence of smaller beans, so we included a mid crop dummy variable. No evidence was found that the midcrop significantly affected the price paid to farmers though the after war regression that included exporters and traders did estimate a premium (\$51.59/mt) accruing to beans during the midcrop time period (roughly April to June).

By varying the agents included in each regression, agent behavior can also be examined. To assess the effects that these factors have on the transactions that occur after cocoa leaves the farmgate, regressions were performed that included the behavior of exporters and traders (Table 4). Exporters and the government still appear to share rents just as was found in the regressions that included farmers. Estimates of the conjectural elasticity are significantly different from zero and result in a markup/down that ranged from 11.1% post-war to 30.4% using the full sample. The marginal fixed costs were significant and appreciably higher during the post-war period. Surprisingly, the delivery lag weight was significant in both cases and for almost every period under investigation. As expected, these estimates were lower than those found in the farmer to exporter regressions given that the transaction between the trader and the exporter takes place at the ports. When compared across cases, the pre-war estimates for the farmer transactions are 39.0% versus 20.5% for the trader transactions. A similar relationship is found post-war (14.1% versus 11.1%) but the opposite is true for the full period.

When the government is eliminated from the margin, the results are ambiguous. Evidence of exporter market power is found using the full and post-war periods – resulting in 13.0% and 11.6% markup/down, respectively – but the before war period results in a conjectural elasticity that is statistically equivalent to zero and an infeasible markup/down. When comparing the

farmer and trader results it is difficult to conclusively discern how the market power exertion is distributed but they are strongly suggestive of market power in the hands of exporters and the government, not traders. The fact that exporters may hold some degree of market power is intriguing given the relationships that are often fostered between the up-country agents and the multinational exporters.

To test if the exertion of market power commences at the first transaction in the marketing chain, the farmer to trader transaction was examined in Table 5. Since this involved two domestic agents and often entails smaller quantities of cocoa than the aggregated amounts that are delivered from the buying centers, all of the prices were in FCFA/kg. Though anecdotal reports have claimed that traders exert market power on farmers, this effect is not captured when one considers the farmgate to trader margin. It appears that there may be a markdown against farmers using the full dataset (4.7%) given the significant fixed marginal costs and average farmgate and trader prices. However, exertion of market power is not suggested by the conjectural elasticity estimates, which are not significantly different from zero. Another explanation may be that it is pisteurs who exert market power over remote, isolated farmers and the market power is not measurable in these farmgate prices that were obtained at, and aggregated over, buying centers. To test this, a weekly time series of 'farmgate' prices by buying station and prix entrée usine for Abidjan and San Pedro was collected for the entire 2003/04-2004/05 seasons and regressions run to determine if the exertion of market power against remote farmers could be detected. No evidence of market power was found and results, such as negative conjectural elasticities, infeasible fixed marginal costs and delivery lag weights, suggest that critical information (size and direction of quantity flows (to attribute prices to buying centers and ports), infrastructure and institutional status, etc.) is missing from the regression. Currently, the

buying station data can give an idea of the relative prices in each region but still represents an aggregation over farmers. Actual farmer level data would therefore be desired for further analysis.

Nigeria

Regression results for Nigeria suggest that market power is not being exercised as none of the conjectural elasticities are significantly different from zero (Table 5). Percent markup/downs are reported but since none of the estimated fixed costs were significant, even at a 10% level, they should be considered zero. Regressions results using parallel and conventional exchange rates did not differ. Interestingly, the use of the LIFFE and farmgate prices reported in the press perform better than unit values and those included in US-FAS reports, respectively. However, the farmgate prices reported in the press suffer from the same aggregation problems as those in Ivory Coast. Prices are reported at a state (provincial) level and do not allow for a more micro-level approach.

These results seem to provide credence to the conventional wisdom that the Nigerian markets are more competitive than the neighboring markets of Cameroon, Ghana (where the State continues to dominate) and Ivory Coast. Newsreports that describe farmers actively negotiating and trying to influence prices paid by traders through loosely collective action is perhaps having some effect. Unfortunately, more information is needed to provide a clearer picture of how the marketing channels actually operate and what the margins are and what type of behavior they reflect.

VI. *Concluding Remarks*

These econometric results strongly suggest that there is exercise of market power along the cocoa supply chain in Ivory Coast. It appears that the government continues to extract rents from its large world market share, but following liberalization, those rents are shared with multinational exporters. The markups that include export taxes range from 14.1 to 39%. These are ominously similar to optimal export taxes estimated by Yilmaz and more importantly to actual export taxes charged by the Ivory Coast government prior to structural adjustment reforms.

While the results which seek to isolate market power of the multinational exporters are strongly suggestive that market power is exerted, how that is shared between the government and local traders is somewhat uncertain, and needs further sorting out. There is little evidence of local traders exercising market power against farmers, although they may be colluding with exporters in some instances, and market power against remote farmers would not be found in this data. Markups by the government as a consequence of export taxes during the war appear to be captured as fixed costs. The need for financing by the government may have forced the government to disregard variations in world market prices it faces in setting ‘sub-optimal’ taxes.

Results for Nigeria are consistent with perfect competition among intermediaries there. These initial attempts to account for foreign exchange issues suggest that future work is needed on the role of black markets for foreign exchange, and the cost of an overvalued currency to farmers. Traders in Nigeria may be primarily in the foreign exchange business, with cocoa as a side enterprise to generate foreign exchange. Hence, there is little incentive to restrict cocoa trade in an effort to lower farmgate prices.

The exercise of market power, whether directly against farmers or upstream by exporters, increases the margin between farmgate prices and prices paid by consumers and chocolate manufacturers. Farm income could be higher if these markets were more competitive. Changes in institutional structures are needed to bring the greater pass-through of chocolate prices to farmers anticipated in structural adjustment reforms. Institutional innovations of antiquated supply chain links may also reduce transactions costs currently contributing to low farm income.

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Figure 1: Stylized Cocoa Marketing Chain and Average Prices around 2002

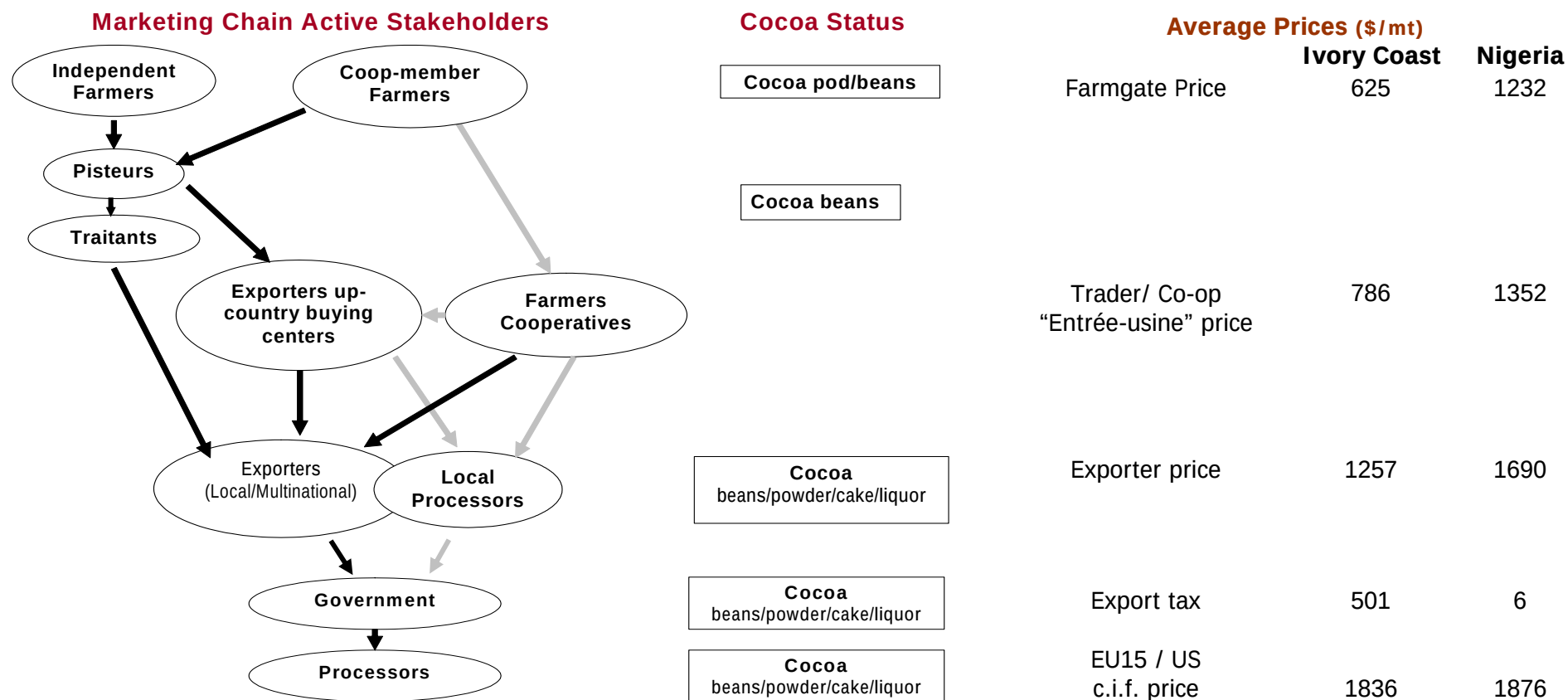


Figure 2. October through June Export Taxes and Farmgate, Prix Entrée Usine, Exporter and World Prices in \$/mt for *Ivory Coast* from 1999 to 2005

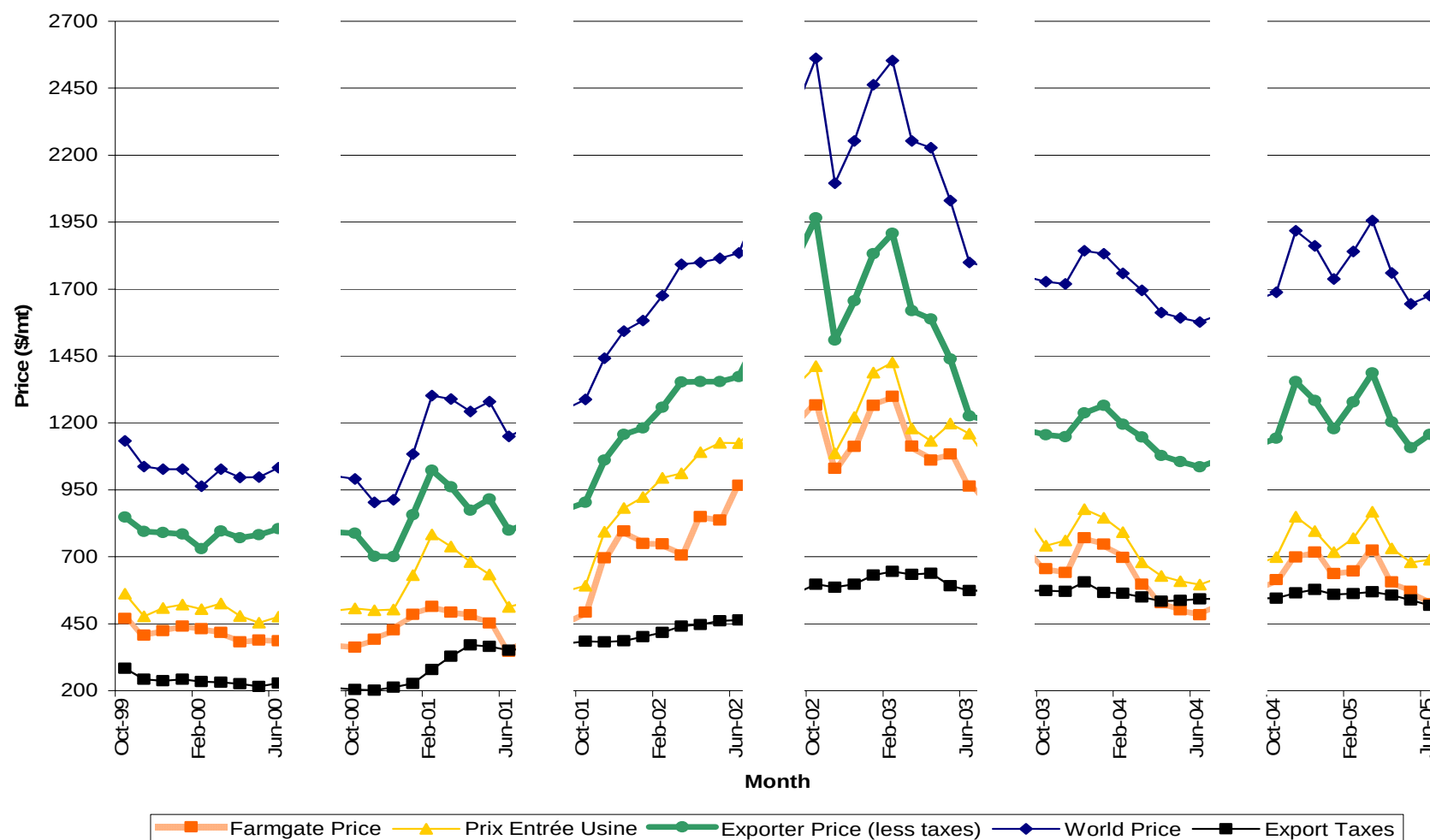


Figure3. Nigerian Exporter, Trader and Farmgate Prices from September 2002 to June 2005

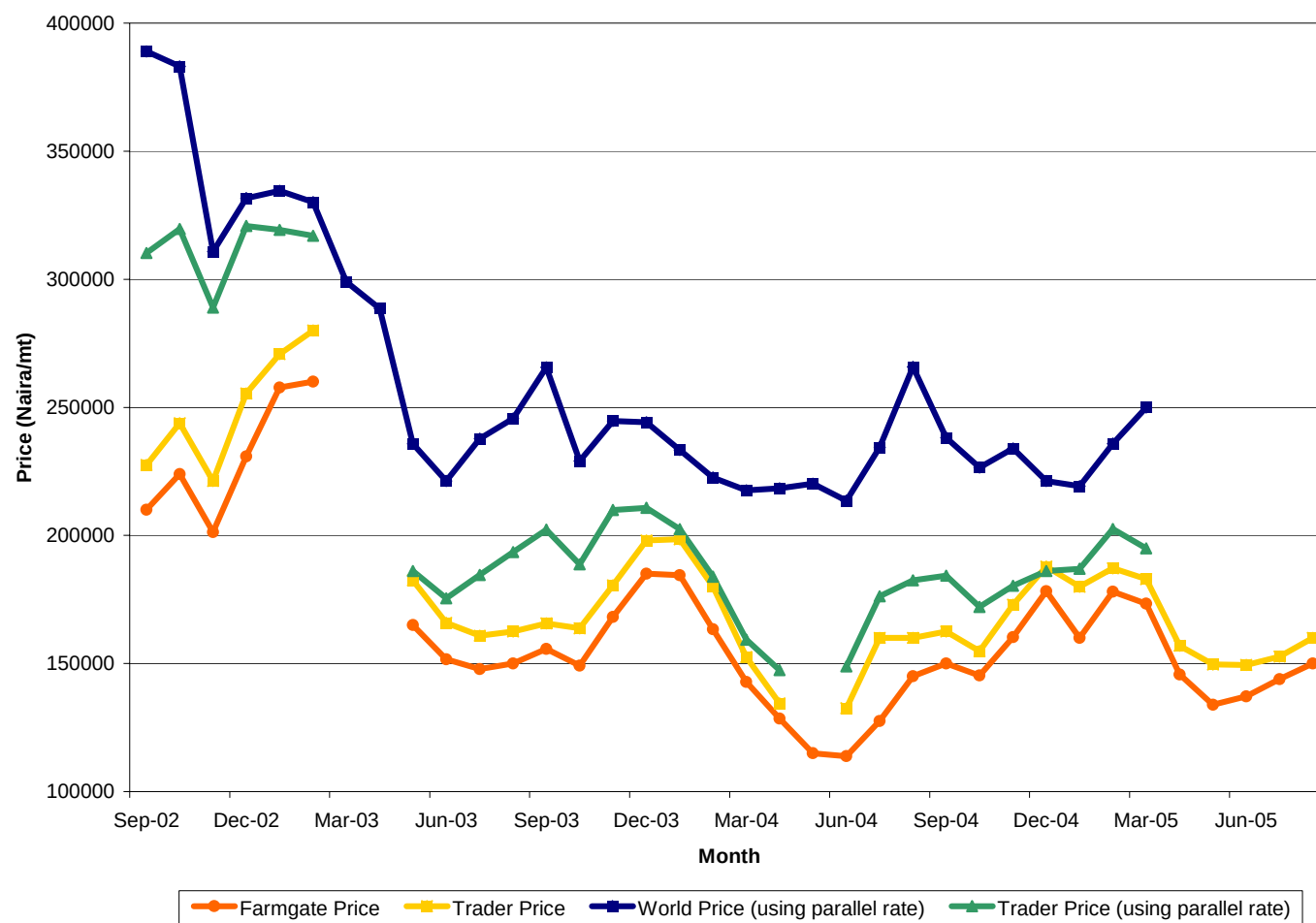


Table 1. Exporter Market Shares, CR5 Concentration, Herfindahl-Hirschmann Index and Equivalent Number of Symmetric Firms for *Ivory Coast* from 1999/00 to 2004/05

Exporter	Parent Company	% of Total Exports for Season*					
		1999/00 ^a	00/01 ^b	01/02 ^c	02/03 ^d	03/04 ^e	04/05 ^f
ADM Cocoa Sifca/Unicaoc	ADM (USA)	-	15.5	10.2	11.9	11.2	12.7
Armajaro	Armajaro Holdings Ltd. (UK)	-	-	-	0.7	3.0	3.2
Barry Callebaut / Saco	Barry Callebaut (FRA)	6.9	6.8	3.9	6.9	7.0	7.7
Cargill West Africa/Micaoc	Cargill (USA)	9.5	15.8	9.8	15.1	15.5	17.4
Cemoui	Cantallou (FRA)	4.0	3.1	0.0	4.2	2.7	2.2
Cipexi	Continaf (NLD)	7.1	6.1	9.4	8.5	6.3	7.8
Cocaf Ivoire	Noble (CHN)	-	-	5.7	3.4	3.7	1.9
Dafci and IFCO	Bollore (FRA)	-	3.7	8.8	5.2	2.2	2.7
Delbau	Touton (FRA)	7.2	8.0	8.5	6.0	4.1	0.6
Outspan Ivoire	Olam (SGP)	2.5	4.4	7.0	3.5	5.5	7.8
Proci	Gepro (FRA)	7.2	7.2	8.2	5.1	5.2	7.4
Sifca-Coop	ANAPROCI (CIV)	19.7	-	-	2.2	3.8	0.9
Tropival	ED&F Man (GBR)	11.5	12.1	10.8	9.6	8.2	9.6
Zamacom	Ecom (SWZ)	-	-	7.0	5.6	3.2	5.4
Percent of total (%) in sample		75.5%	82.7%	89.3%	88.0%	81.6%	87.2%
Number of actual firms in sample		≈ 40	>35	>40	≈ 43	64	59
CR5 – Five Firm Concentration Ratio		55.1%	58.6%	49%	52%	48%	55%
Herfindahl-Hirschman Index		873	920	780	758	671	858
Equivalent Number of Symmetric Firms		11.5	10.9	12.8	13.2	14.9	11.6

* These market shares are calculated from exports of cocoa beans and cocoa products (as bean equivalents) declared by shippers and cocoa processors and represent a firm's share of the total amount declared for that season at that time. Firms are aggregated by parent company; a = Oct 1, 1999 to Sept 30, 2000; b = Oct 1, 2000 to Jan 1, 2001; c = Oct 1 (22), 2001 to Jun 2, 2002; d = October 1, 2002 to September 14, 2003; e = October 1, 2003 to September 30, 2004; f = October 1, 2004 to September 30, 2005. Source: OsterDow Jones Commodity Wire and Reuters, various articles.

Table 2. Cocoa Export Taxes in Ivory Coast from 1999/00 to 2004/05, in FCFA/kg

Item	Season						
	99/00	00/01	01/02	02/03	03/04 mid crop ^p	03/04 main crop	04/05 ^q
Export Tax (<i>Droit Unique de Sortie – DUS</i>)	125	125 ^a 200 ^b 160 ^c	160 ^d 180 ^e 220 ^f	220	220	220	220
Registration Tax (% c.i.f.)	2.3	2.3	2.3	2.3	5	2.3	2.3
Prudential Reserve	0	0	41 ^g 60 ^h	64 ⁱ 15 ^j 10 ^k	10	10	10
Sack, Weighing, Quality Tax	0, 3.5	3.5	3.5	5	5	5	8.5
ARCC Royalty	5	5.3	2.96	2.77	5	5	3.4
BCC Royalty	0	0	6.2, 7.23 ^l	4.9	4.9	4.9	4.67
FDPCC Royalty	0	0, 35	35	55 ^m 50 ⁿ 35 ^o	25	25	10.7
FRC Royalty	0	0	0	3	2.78	2.78	2.66

a = 10/01-3/15/01; b = 3/16/01-7/11/01; c = 7/12/01-9/01; d = 10/01-2/17/02; e = 2/18/02-8/12/02; f = 8/13/02-9/02; g = 10/01-1/10/02; h = 1/11/02-9/02; i = 10/02-4/03; j = 5/03 - 6/03; k = 7/03-9/03; l = 1/11/02-9/02; m = 10/02 - 4/03; n = 5/03 - 6/03; o = 7/03-9/03; p = 10/03-12/03; q = 10/04-10/05

Table 3. Market Power Regression Results for Transactions that Include Exporters, the Government and *Farmers* during the Seasons 1999/00 to 2004/05 in *Ivory Coast*

Item	Exporter, Government, Farmer			Exporter and Farmer		
Time Period	October 1999 to June 2005	Before War ^a	After War ^b	October 1999 to June 2005	Before War ^a	After War ^b
Average Buyer Price (\$/mt)	1590	1266	1747	1146	952	1189
Average Seller Price (\$/mt)	669	537	631	669	537	631
Percent Markup/down (%)	29.2%	39.0%	14.1%	7.6%	28.2%	19.8%
Number of Observations	48	24	18	48	24	18
Conjectural Elasticity (θ)	0.637*** (0.185)	0.837*** (0.227)	0.348*** (0.08)	0.134 (0.155)	0.537*** (0.111)	0.400*** (0.105)
Fixed Marginal Cost (CI)	455.9*** (127.5)	234.5* (131.2)	869.0*** (58.884)	389.6*** (90.452)	147.3** (54.725)	322.16*** (61.613)
Mid Crop ($C2$)	-14.8 (37.02)	3.13 (36.215)	20.26 (18.877)	-27.75 (30.343)	16.73 (21.645)	51.59** (20.946)
Delivery Lag Weight (w)	0.877*** (0.099)	0.591*** (0.126)	N/A	0.960*** (0.099)	0.498*** (0.133)	N/A
Lagged Dependent Variable (ARI)	0.922*** (0.084)	0.644*** (0.198)	N/A	0.791*** (0.122)	N/A	N/A
Adj. r^2	0.93	0.93	0.86	0.93	0.92	0.77

a: October 1999 to June 2002; b: October 2003 to June 2005

*** = Significant at $P < 0.01$; ** = Significant at $P < 0.05$; * = Significant at $P < 0.1$

Table 4. Market Power Regression Results for Transactions between Exporters and *Traders* during the Seasons 1999/00 to 2004/05 in *Ivory Coast*

Item	Exporter and Trader		
	October 1999 to June 2005	Before War ^a	After War ^b
Average Buyer Price (\$/mt)	1146	952	1189
Average Seller Price (\$/mt)	798	687	741
Percent Markup/down (%)	13.0%	-6.3%	11.6%
Number of Observations	48	27	18
Conjectural Elasticity (θ)	0.256** (0.123)	-0.104 (0.088)	0.227** (0.101)
Fixed Marginal Cost (CI)	198.59** (75.857)	325.78*** (50.883)	310.56*** (63.926)
Mid Crop ($C2$)	-12.75 (23.238)	-3.11 (17.07)	12.1 (20.805)
Delivery Lag Weight (w)	0.964*** (0.059)	N/A	N/A
Lagged Dependent Variable (ARI)	1.01*** (0.092)	0.489*** (0.169)	0.447* (0.232)
Adj. r^2	0.96	0.97	0.88

a: October 1999 to June 2002; b: October 2003 to June 2005

*** = Significant at $P < 0.01$; ** = Significant at $P < 0.05$; * = Significant at $P < 0.1$

Table 5. Market Power Regression Results for Transactions between *Traders and Farmers* during the Seasons 1999/00 to 2004/05 in *Ivory Coast*

Item	Trader and Farmer		
	October 1999 to June 2005	Before War ^a	After War ^b
Average Buyer Price (FCFA/kg)	502	491	387
Average Seller Price (FCFA/kg)	418	384	329
Percent Markup/down (%)	4.7%	-5.5	9.2%
Number of Observations	54	27	18
Conjectural Elasticity (θ)	0.005 (0.007)	-0.035 (0.023)	0.01 (0.013)
Fixed Marginal Cost (CI)	60.19** (29.402)	133.78* (0.059)	21.59 (39.271)
Mid Crop ($C2$)	4.02 (10.285)	-19.48 (19.283)	15.14 (8.652)
Lagged Dependent Variable (ARI)	0.737*** (0.095)	0.994*** (0.064)	N/A
Adj. r^2	0.97	0.95	0.90

a: October 1999 to June 2002; b: October 2003 to June 2005

*** = Significant at $P < 0.01$; ** = Significant at $P < 0.05$; * = Significant at $P < 0.1$

Table 6. Market Power Regression Results for Transactions that Include Exporters, Traders and Farmers during the Seasons 2002/03-2004/05 in *Nigeria*

Item	Agents			
	<i>Exporter to Farmer</i>	<i>Exporter to Trader (Parallel Exchange rate)</i>	<i>Trader to Farmer</i>	<i>Trader to Farmer (Parallel Exchange rate)</i>
Average Buyer Price (Naira/mt)	1486 €/mt	259397	181614	211966
Average Seller Price (Naira/mt)	1090 €/mt	181614	165667	165667
Percent Markup/down (%)	11.7%	4.9%	5.0%	2.2%
Number of Observations	33	29	33	28
Conjectural Elasticity (θ)	0.018 (0.013)	0.01 (0.029)	0.005 (0.004)	0.009 (0.018)
Fixed Marginal Cost ($C1$)	222.69 (181.5)	79489.05 (57358.6)	6860.86 (5997.4)	41715.36 (30985.6)
Mid Crop ($C2$)	73.57* (36.878)	3025.57 (12757.8)	671.86 (2180.4)	-10123.3 (7756.5)
Lagged Dependent Variable (ARI)	0.927*** (0.117)	0.718*** (0.16)	N/A	0.873*** (0.119)
Adj. r^2	0.95	0.80	0.98	0.94